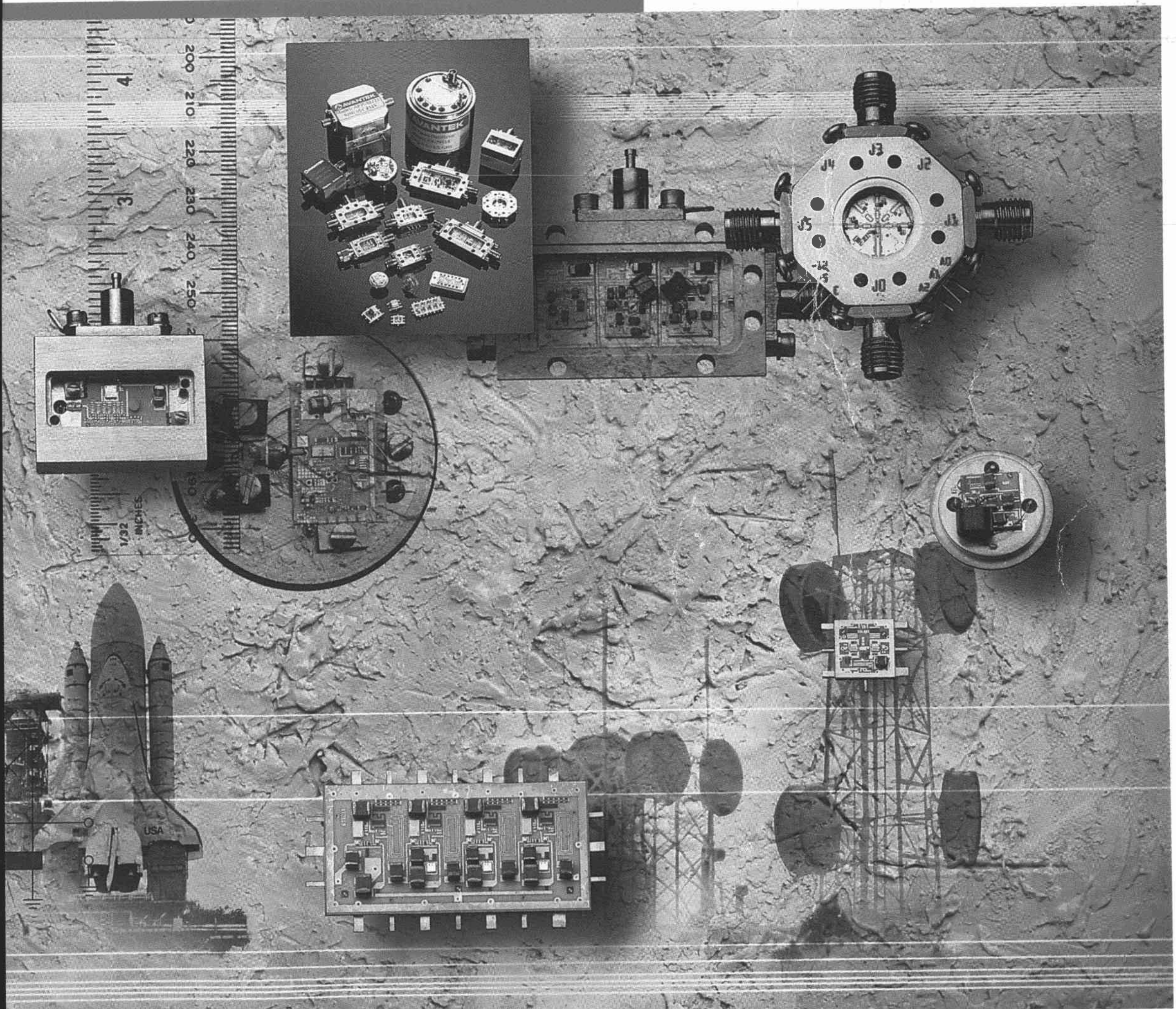
AVANTEK
A Subsidiary of Hewlett-Packard

Modular and Oscillator Components



Data Book
second edition

KARIE MCNAMARA

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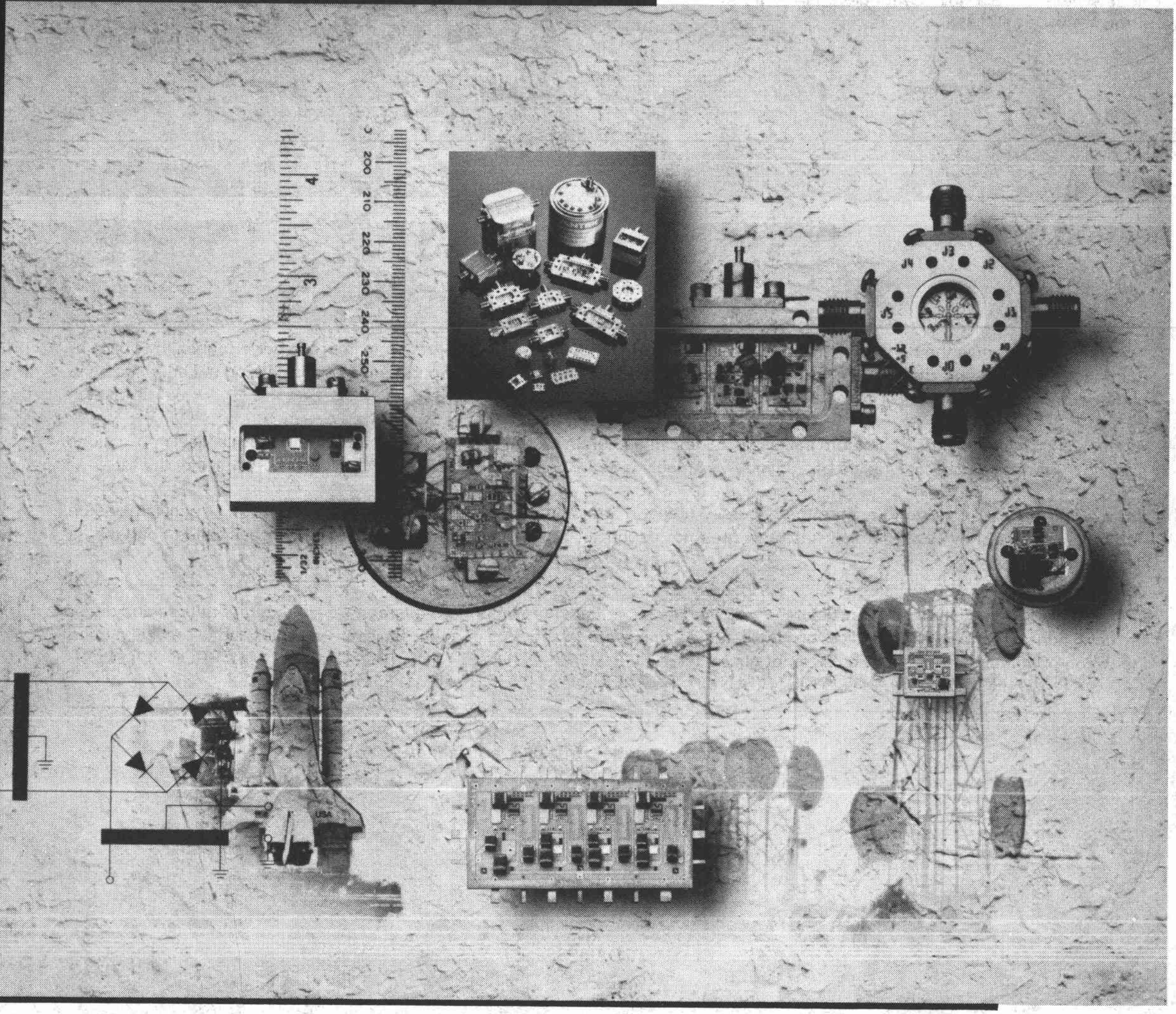
AVANTEK

Modular and Oscillator Components



Data Book
second edition

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About The Cover

The modular and oscillator product line in this Data Book ranges from low-cost, TO-12 packaged amplifier modules for commercial applications to military- and space- qualified amplifiers, signal sources and signal-processing components. Shown (clockwise from lower left): Double-balanced mixer schematic, dielectric-resonator and YIG-tuned oscillator circuits, typical products and packages, Avanpak™ flatpack amplifier, PIN-diode switch, TO-8 amplifier module, PlanarPak™ surface-mount amplifier.

Unless otherwise indicated, all specifications indicated as minimum or maximum are guaranteed at the temperatures and under the conditions described. All specifications indicated as typical are tested on a periodic basis and are intended to provide a good indication of actual performance, but are not guaranteed. FOR MORE DETAILED INFORMATION ON ANY PRODUCT, CONTACT ANY AUTHORIZED AVANTEK DISTRIBUTOR, REPRESENTATIVE OR THE FACTORY.

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Alphanumeric Index

BOLD .... New Products

SOME INFORMATION ABOUT THIS DATA BOOK

Standard Modular and Oscillator Components

Avantek's *Modular and Oscillator Components Data Book* contains detailed information on our full line of standard modular and oscillator products. This book includes all Avantek products in TO-8, TO-39 and TO-12 metal cans, in the *PlanarPak* surface mount package, the *Avanpak* miniature microwave flatpack, and the Avantek RF dual-inline package, as well as functional cascades (UTC Series) in aluminum cases with connectors, and all YIG-tuned oscillator and YIG filter packages.

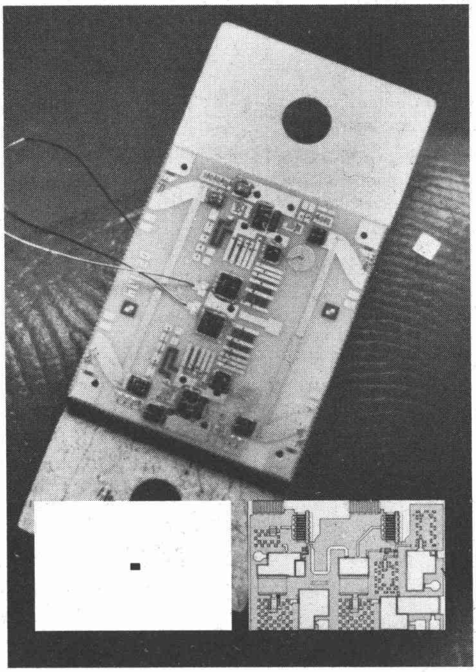
This Data Book is divided into sections, based on the following definitions of product functions:

1. **IF Products**—all amplifiers, variable attenuators, detectors and related components.
2. **Mixer Products**—all thin-film and soft-substrate mixers, mixer preamplifiers and frequency multipliers.
3. **Control Device Products**—reflective and non-reflective switches and limiters
4. **Oscillator Products**—voltage-controlled oscillators, dielectric resonator oscillators, YIG-tuned oscillators, YIG-tuned oscillators with drivers, YIG-tuned filters and YIG filter-driver assemblies.

Available Through Distribution

All products in this data book which operate at frequencies up to 26 GHz are available through Avantek's network of authorized distributors. For pricing information or to place an order, please contact any Avantek field sales office, sales representative or distributor listed at the back of this book.

AVANTEK VERTICAL INTEGRATION

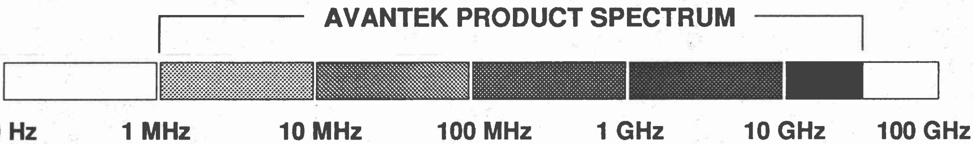


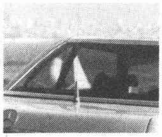
The tiny GaAs monolithic microwave integrated circuit performs the same basic function as the similar hybrid circuit in 1/25th the area and eliminates most circuit adjustment.s Insets: The same MMIC shown actual size and enlarged 35 times.

From Transistors and MMICs to Advanced Integrated Subassemblies

1. **Space-Age Technology:**
   - Silicon and GaAs transistors
   - Silicon and GaAs Monolithic Microwave Integrated Circuits (MMICs)
   - Thin-film hybrid Microwave Integrated Circuits (MICs)
   - Mixers and RF switches
   - Advanced fabrication technology
   - Proprietary packaging
2. **Premium Product Performance:**
   - GaAs FETs operating beyond 60 GHz
   - GaAs MMICs through 20 GHz
   - Widest oscillator and amplifier bandwidths
     — Only available 2-18, 18-40 GHz transistor amplifiers
     — Only available 18-26, 26-40 and 33-50 GHz transistor YTOs
   - Lowest amplifier noise figures

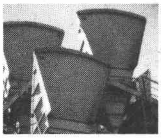
Frequency Spectrum Chart





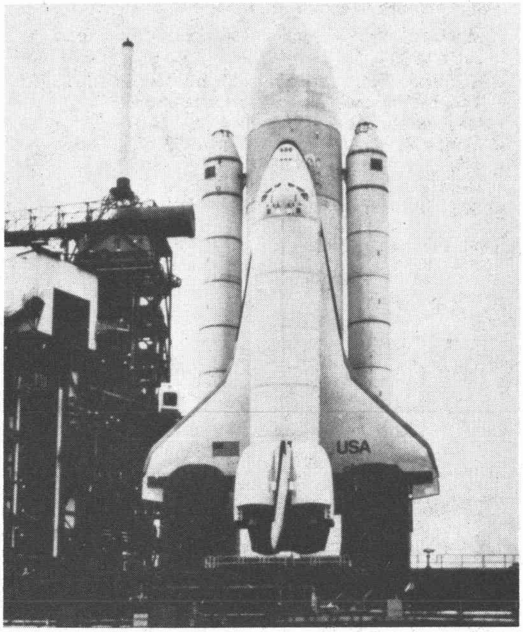
RADIO COMMUNICATIONS

SATELLITE COMMUNICATIONS



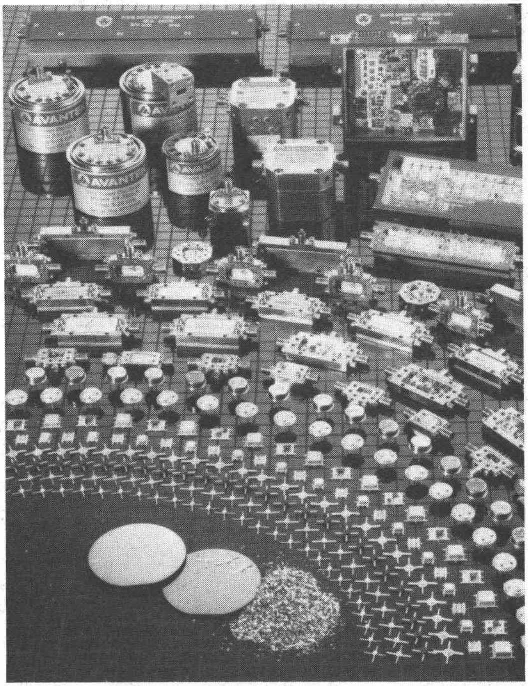
MICROWAVE RELAY

ELECTRONIC DEFENSE



3. High Quality/Reliability

- Supplier to virtually all airborne electronic warfare systems
- Space-qualified products
- Integrated QA/QC system
- High-reliability screening



4. Vertical Integration

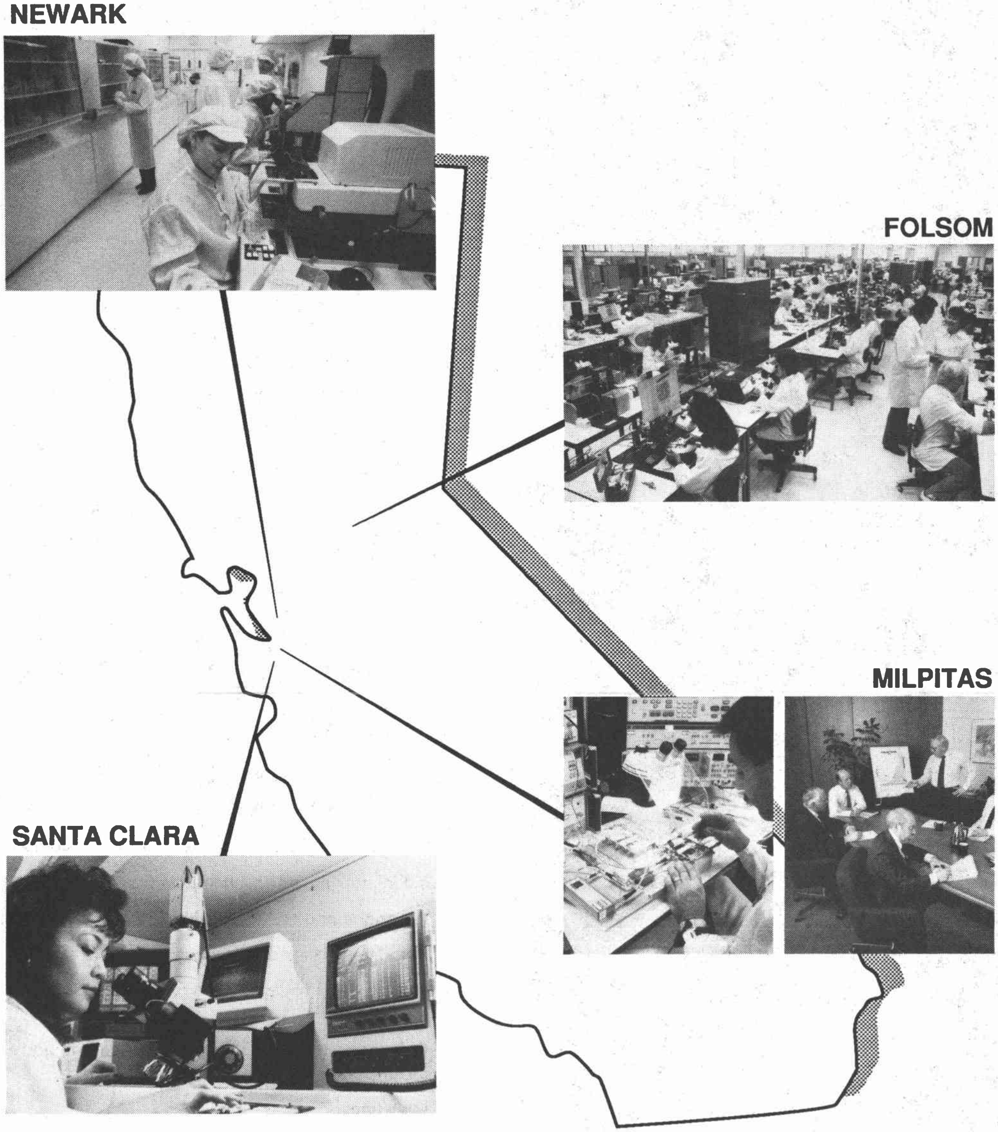
- Microwave transistors
- Silicon and GaAs MMICs
- Modular amplifiers and signal-processing components
- Modular signal control components
- Wideband and communications/radar-band amplifiers
- Variable- and fixed-frequency oscillators
- Digitally- and voltage-tuned oscillator and filter assemblies
- Downconverters, amplifier-downconverters and mixer-preamps
- Multifunction subassemblies
- Over 700 standard products

5. Volume Manufacturing Capability

- Four U.S. manufacturing facilities
- 600,000 sq. ft.
- Over 2600 employees
- Industry's most advanced microwave semiconductor facility
- Three million product units shipped in five years (excluding semiconductors)

6. Over 20 Years of Experience

- Manufacturing solid-state microwave components since 1965
- Semiconductors and thin-film hybrids since 1968
- Tunable microwave oscillators since 1969
- Microwave mixers since 1980
- Monolithic Microwave ICs since 1982
- Thin-film mixers since 1986
- HEMTs and MSI MMICs since 1987
- 60 GHz amplifiers since 1988



Avantek, Inc. was founded in late 1965 to meet the electronic industry's need for high performance solid state VHF, UHF and microwave transistor amplifiers.

By December, 1965, the company had developed and introduced a family of low-noise solid state preamplifiers covering the 30 to 1000 MHz frequency range. Less than six months later, Avantek added solid state microwave amplifiers with octave band coverage through 2300 MHz as well as narrowband amplifiers for specific communications bands in that frequency range. This early family of highly reliable Avantek transistor amplifiers played a significant part in the microwave industry's decision to replace tube-type amplifiers with solid state.

Advances in solid state amplifier technology were hampered in these early years by the limited and sporadic availability of microwave transistors. Device suppliers simply were not able to keep pace with the progress made by Avantek circuit designers.

Consequently, in the spring of 1968, Avantek added the staff and facilities to design, develop and manufacture its own gold-metalized planar epitaxial microwave transistors. The capability to design and produce high performance microwave transistors in-house is one of the important factors leading to Avantek's present success. Today, virtually every microwave transistor used in an Avantek product is an Avantek transistor. In 1968, Avantek also established a facility for the production of hybrid thin-film microwave integrated circuits (MICs).

In February, 1970, Avantek was granted a patent on the techniques of producing unconditionally-stable, cascadable wideband amplifier modules. This concept resulted in a wide variety of modular "gain blocks" tiny thin-film modules in TO-8 and TO-12 transistor packages.

To meet the needs of both the commercial and military user Avantek introduced thin-film fundamental YIG-tuned transistor oscillators in 1969. In 1973, varactor-tuned transistor oscillators were added to the growing component line. Some more-recent Avantek developments include:

1981

- 5-watt communications/radar-band GaAs FET amplifiers.
- Dielectrically-stabilized microwave oscillators.
- Avanpak flatpack amplifiers through 18 GHz.
- YIG filters.
- 1 Watt, 4–8 GHz GaAs FET amplifier.

1982

- Industry's first 40+ GHz GaAs FET.

1983

- Silicon monolithic microwave ICs into production
- Industry's first 26.5–40 GHz GaAs FET amplifier
- 10 watt 6 GHz amplifiers.
- 45 watt, 900 MHz amplifiers.
- Industry's first 26.5–40 GHz GaAs FET YIG-tuned oscillator.

1984

- GaAs monolithic amplifiers introduced
- Industry's first 18–40 GHz GaAs FET amplifiers
- PlanarPak surface mount package

1985

- Industry's first 2 watt, 20 GHz GaAs FET.
- Industry's first 55 watt bipolar transistor @ 900 MHz

1986

- Tunable dielectric-resonator oscillators
- Low-cost, plastic-packaged MMIC amplifiers
- Industry's first 33–50 GHz YIG-tuned GaAs FET oscillator
- Industry's first 45 GHz GaAs FET amplifier

1987

- Patented fast-switching multi-resonator DRO design
- 6–18 GHz, 1-watt power amplifier.
- 2–20 GHz, quarter-watt MMIC.

1988

- HEMT device with 0.5 dB noise figure at 12 GHz
- 35 GHz HEMT with 12 dB gain.
- Industry's first medium-scale integration (MSI) silicon MMICs.
- 60 GHz integrated amplifier/downconverter

1989

- Very-low-cost 1" dia., 1.8 oz. YTOs
- µAVPAK microstrip package
- 5.5 GHz divide-by-4 Si MMIC
- 6 GHz active mixer Si MMIC
- 35.5 GHz 0.5 watt power amplifier
- 100 watt 900 MHz amplifiers
- 80+ GHz pseudomorphic HEMT

Today, Avantek is the world's leading manufacturer of microwave products. During the past two decades Avantek has produced more Monolithic Microwave Integrated Circuits (MMICs), wideband solid state microwave and millimeter-wave amplifiers, YIG-tuned oscillators and low-noise communications/radar amplifiers than all other U.S. manufacturers combined. Over the past five years Avantek has shipped nearly three million product units (excluding all semiconductor devices) to over 3000 customers.

Today the Avantek microwave product line includes:

- Microwave Semiconductors
- Silicon Transistors
- Gallium Arsenide Field Effect Transistors
- GaAs and Silicon Monolithic Microwave Integrated Circuits
- High Frequency Silicon ICs
- Fiber-optics ICs
- Internally-Matched GaAs FETs
- Avanpak Miniature Flatpack Products
- PlanarPak Surface-Mount Products
- µAVPAK Microstrip Products
- Control Components:
  - —Mixers
  - —Switches
  - —Limiters
  - —Attenuators
  - —Filters
- YIG-tuned Oscillators and Filters
- Varactor-Tuned Oscillators
- Dielectric Resonator Oscillators
- Wideband Microwave Amplifiers
- Low-Noise Communications Amplifiers
- Power Amplifiers
- Modular Amplifiers
- Special-Purpose Amplifiers
- Multifunction Integrated Assemblies

Avantek products cover frequencies from DC to 60 GHz for use in electronic defense and radar; missiles and satellites; test equipment and instrumentation; and communications equipment for the military, commercial, industrial and consumer markets, both domestic and international.

Avantek Employees and Facilities: Today there are over 2600 employees in the Avantek family supported by some of the industry's most modern equipment and facilities. Manufacturing, engineering and administrative facilities, all located in California, include 255,000 sq. ft. in Santa Clara, 180,000 sq. ft. in Milpitas, 88,000 sq. ft. in Folsom and 90,000 sq. ft. in Newark. Avantek also has a facility in Farnborough, UK to support European requirements. This staff and floorspace supports Avantek's fundamental vertical integration strategy: to manufacture high-performance microwave semiconductors, to build these into amplifiers and other functional "building blocks," to integrate these functions into multifunction assemblies—and to support all products with research, engineering, quality control and customer support.

OTHER COMPANY PRODUCTS

SEMICONDUCTORS

Avantek's line of advanced microwave semiconductors is fully described in the Avantek *Semiconductor Data Book*. Products include:

SILICON BIPOLAR TRANSISTORS

Avantek's line of silicon bipolar transistors offers high gain, low noise figure and moderate power output for amplifier applications up to 6 GHz and oscillator applications through 12 GHz. The devices are available in a variety of package styles suitable for commercial through military applications.

SILICON MONOLITHIC MICROWAVE INTEGRATED CIRCUITS

Avantek has over 55 different models in its steadily-increasing line of MODAMP MSA-series monolithic amplifiers and MSF-series frequency converters. These silicon MMICs are designed for use in narrow- and broad-bandwidth applications from DC to 6 GHz. They are offered in package styles for military, industrial and high-volume commercial designs. The same MMIC designs are also offered in unpackaged chip form for incorporation in thin- or thick-film hybrid MIC applications.

Avantek also offers a series of advanced MagIC™ silicon monolithic circuits using its ISOSAT process for high-performance and medium-scale integration devices. Products include active mixers operating through 8 GHz; low-noise amplifiers, AGC amplifiers and frequency dividers operating through 6 GHz, and a series of functional units designed for fiber-optic communications applications.

GALLIUM ARSENIDE FIELD EFFECT TRANSISTORS (GaAs FETs)

Avantek's range of GaAs FETs includes low-noise, high-gain devices operating through 18 GHz, and medium-power devices operating to 15 GHz. Suitable for use in military, industrial and commercial applications, all transistors are designed and tested to provide extremely uniform performance for the most severe and critical microwave applications.

GALLIUM ARSENIDE MONOLITHIC MICROWAVE INTEGRATED CIRCUITS

Avantek now offers an extremely versatile, cost-effective 2 to 6 GHz GaAs MMIC gain block suitable for commercial applications.

IMFET™ INTERNALLY-MATCHED GaAs FETs

Avantek's line of *IMFET* internally-matched GaAs FETs provides output power of up to 6 watts, optimized for specific frequency bands between 2.9 and 8.4 GHz. These power FET assemblies contain all the necessary matching circuitry to allow them to be used in 50-ohm applications without external tuning.

MICROWAVE and MILLIMETER-WAVE AMPLIFIERS

Avantek produces microwave/millimeter-wave amplifiers operating at frequencies through 60 GHz. Its products include low-noise, wideband amplifiers; GaAs FET thin-film limiting amplifiers, Temperature-compensated GaAs FET amplifiers; Wideband, medium-power amplifiers, Solid-state TWT replacement amplifiers and communications and radar-band amplifiers for low-noise preamplification, medium-power driver and high-power output applications. Standard amplifier products are listed in the Avantek *Microwave and Millimeter-Wave Amplifier Data Book*.

MOC DIVISION

Avantek's Modular and Oscillator Components Division offers a wide range of RF and microwave components to meet our customers' needs for cost-effective, high-performance products. Drawing on Avantek's state-of-the-art silicon and gallium arsenide semiconductor capabilities, the Modular and Oscillator Components Division maintains expert staffs of design, manufacturing, test and quality personnel whose goal is to provide our customers with an ever-increasing range of high performance RF and microwave components. Our people are supported with the best equipment available throughout the entire development/manufacturing/test process. Computer-aided design, engineering, drafting and manufacturing play a significant and ever-increasing role in the production of our products, and our high volume, automated production and test capabilities are constantly being upgraded.

MOC products offer the system designer a cost-effective "building block" approach which usually saves both time and money, and yields improved system performance. Consider some of the MOC benefits:

- Design cost savings
- Greatly reduced system development time
- State-of-the-art, off-the-shelf system building blocks
- Simplified system troubleshooting and repair
- Full-time, ongoing product development and support from the Avantek MOC Team

MOC FUNCTIONS

Avantek MOC products cover frequency ranges from DC to millimeter wave, and are designed to operate in conventional 50 ohm systems as stand-alone functions or in combination with other functions.

Modular products include Amplifiers, AGC Amplifiers, Limiting Amplifiers, Mixers, Mixer-Preamplifiers, Switches, Attenuators, Limiters, Detectors, Oscillators, and Filters. The Selection Guides throughout this catalog are provided to offer the user a convenient overview for each product category. Each Selection Guide provides technical information about Avantek products to aid in proper selection and location of the relevant data page.

MOC PACKAGE OPTIONS

In addition to the wide range of performance offered by the MOC Products Family, a variety of package options is also available to meet size, weight and design requirements. Package options available are:

- TO-8, TO-39, and TO-12 Metal Cans
- PlanarPak Surface Mount
- Avanpak Connectored or Connectorless UTC Cascade
- Dual-in-Line
- YIG Oscillator and Filter Packages

The TO and PlanarPak packages offer the smallest size with the TO being suitable for through-hole softboard applications and the PlanarPak providing state-of-the-art component technology for either softboard or ceramic substrate surface-mount applications. The Avanpak package is ideal for either connectored or connectorless applications where premium performance and small size are essential. The UTC Cascade offers one to four of the TO modular products in a connectored, sealed aluminum case.

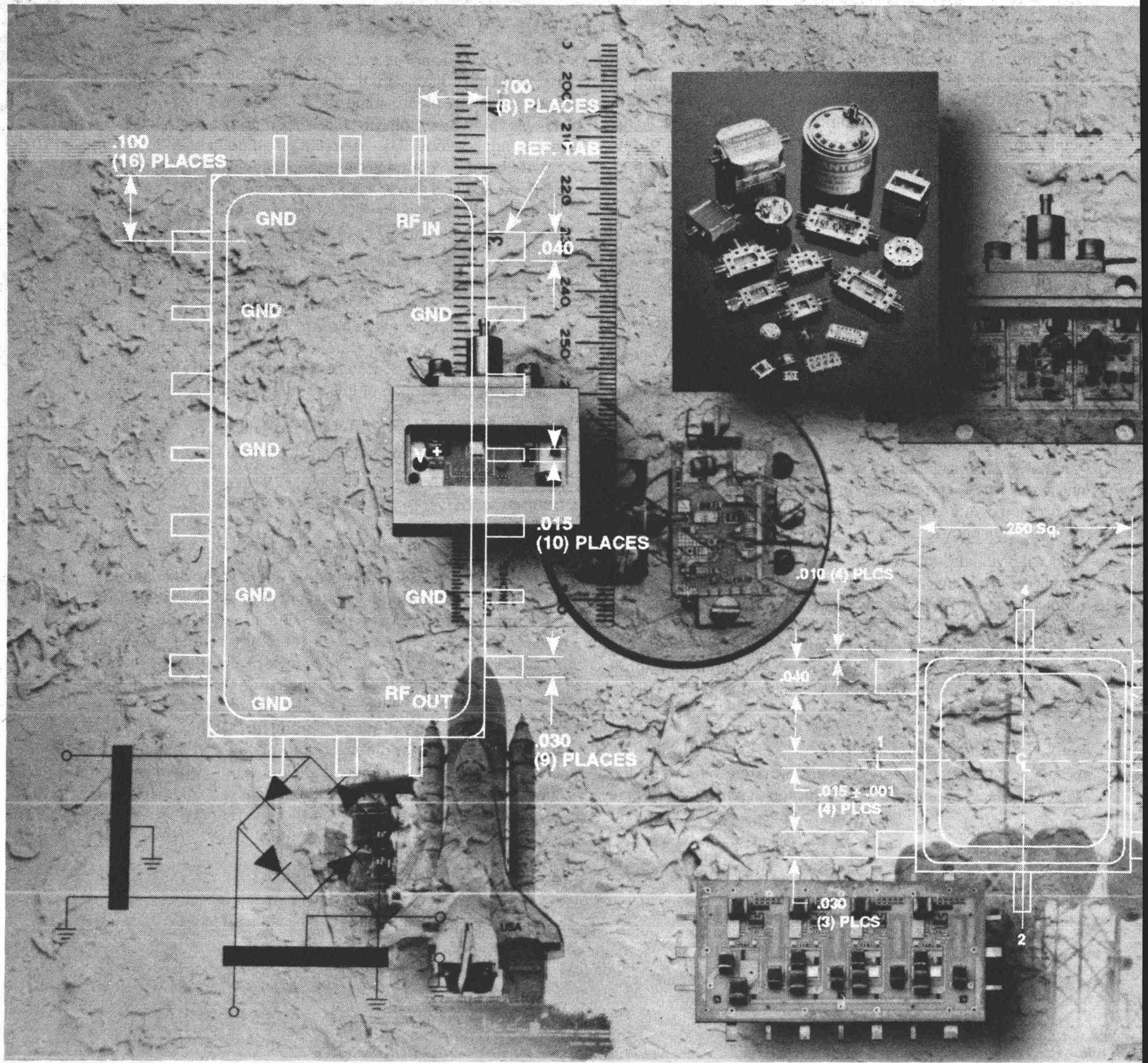
Where possible, throughout this catalog, products which are available in different package options are listed as a series on the same catalog page. The different packages in which the particular product is available are indicated by the relevant case drawings on each data sheet. Detailed dimensional drawings of all Avantek modular packages can be found in the Case Drawings section of this catalog.

HOW TO USE THE DATABOOK SERIES

The Avantek Databook set consists of the following items:

1. Product Guide
2. Modular and Oscillator Components Data Book
3. Semiconductor Data Book
4. Microwave and Millimeter Wave Amplifier Data Book

Item 1, the Product Guide, gives summary specifications for all of Avantek's standard products at time of publication. Custom and special products are described. It is suggested that this Product Guide be used as the first reference to locate products of possible use. When potentially useful products have been identified, the user should refer to items 2 through 4, the data books, which provide complete, detailed data sheets on all standard Avantek products in that category plus applications notes and other appropriate information. Some products, such as modular amplifiers, may appear in more than one databook for user convenience.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GND
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GND
GND
GND
RF_{OUT}
.030
(9) PLACES
.250 Sq.
.010 (4) PLCS
.040
1
.015 ± .001
(4) PLCS
.030
(3) PLCS
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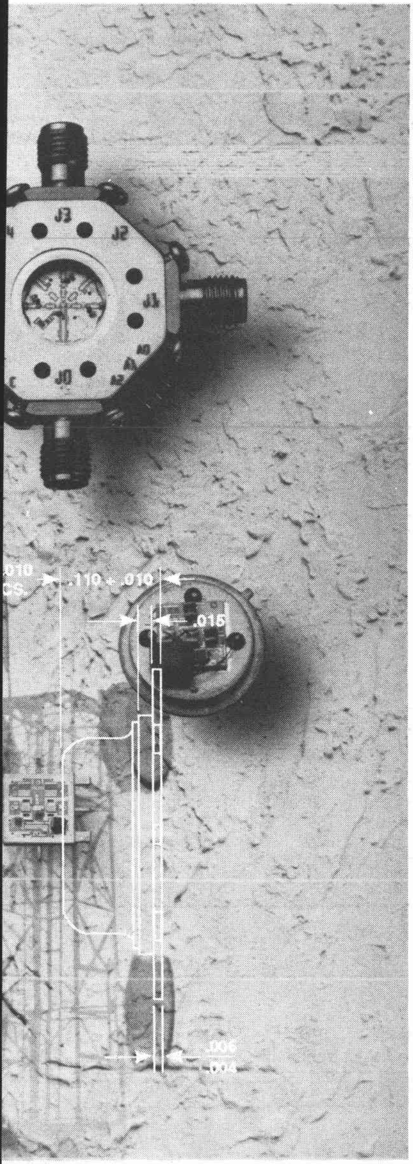
USA

SURFACE MOUNT PRODUCTS

PLANARPAK SERIES



PRODUCT DESCRIPTION

Avantek supplies a wide selection of high performance thin-film hybrid products in the PlanarPak surface mount package covering the frequency of DC to 18 GHz. A surface mount component solution reduces board area and weight by 40–60% in comparison to conventional TO-8 through lead "drop-in" package assembly alternatives, ultimately resulting in significantly enhanced system performance. In addition to amplifier, the PlanarPak product line includes a selection of switches, mixers, attenuators, detectors, filters, and other passive components and functions packaged in three standard sizes, 1/4"X1/4", 3/8"X3/8" and 0.4"X0.8"... with performance guaranteed up to 18 GHz... allowing a complete surface mount component solution. Refer to the appropriate product section for detailed specifications for these products.

Application Note "Using PlanarPak Surface Mount Components" on page 14–38 covers methods of assembly and printed circuit board selection to maximize performance from these devices. Test fixtures for these products are covered on page 15–7.

AMPLIFIERS

Guaranteed Specifications at 0° to 50°C Case Temperature

	Model	Frequency Range (GHz) Minimum	Gain (dB) Minimum	Noise Figure (dB) Maximum	Power Output at 1 dB Gain Compression (dBm) Minimum	3rd Order Intercept Point (dBm) Typ./Min.	Power Requirements Voltage (VDC)	Power Requirements Current (mA) Nominal	Case Drawing	Page Number
	PPA-210	.010-.2	8.0	2.0	+11	+29	+15	15	PP-38	3–16
	PPA-211	.010-.2	7.5	2.7	+17	+28	+15	30	PP-38	3–18
	PPA-253	.005-.2	29.0	4.0	0	+14	+5	30	PP-25	2–4
	PPA-441	.020-.4	13.5	4.5	+15	+32	+15	32	PP-38	3–32
	PPA-543	.010-.5	10.0	2.5	+6	+22	+15	25	PP-38	3–84
	PPA-517	.005-.5	22.0	2.5	+5	+15	+15	22	PP-38	3–66
	PPA-544	.010-.5	10.0	3.0	+12	+28	+15	36	PP-38	3–86
	PPA-520	.005-.5	14.0	4.5	+12	+22	+5	33	PP-38	3–72
	PPA-519	.005-.5	13.0	5.5	+18	+29	+15	70	PP-38	3–70
	PPA-509	.005-.5	13.0	5.5	+20	+35/30	+15	90	PP-38	3–50
	PPA-557	.010-.5	12.0	6.0	+18.5	+25	+5	105	PP-38	2–6
	PPA-1043	.010-1.0	10.0	4.0	+6	+19	+15	25	PP-38	3–132
	PPA-1044	.010-1.0	10.0	4.5	+12	+28/+22	+15	35	PP-38	3–134
New	PPA-1021	.005-1.0	22.0	4.5	+12	+27	+15	85	PP-38	3–124
	PPA-1007	.005-1.0	12.5	5.0	+11	+21	+5	33	PP-38	3–116
	PPA-1006	.005-1.0	11.0	6.0	+17	+27	+15	70	PP-38	3–114
	PPA-1005	.005-1.0	11.0	6.0	+20	+35	+15	90	PP-38	3–112
	PPA-2012	.5-2.0	9.0	4.0	+12	+23	+15	50	PP-38	3–160
	PPA-2013	.5-2.0	9.0	5.5	+19	+33	+15	100	PP-38	3–162
	PPA-2023	.010-2.0	8.0	8.5	+14	+25	+15	50	PP-38	3–168
	PPA-2123	1-2	31.0	2.2	+11.0	+23	+12-+15	80	PP-48	2–8
New	PPA-4213	2-4	27.5	1.7	+14	+22	+8	85	PP-38	2–12
	PPA-4132	1-4	20.0	6.0	+17	+27	+8	150	PP-38	2–10
	PPA-6213	2-6	21.0	3.0	+9.5	+22	+8	80	PP-38	2–14
	PPA-6232	2-6	18.0	5.5	+17	+27	+8	150	PP-38	2–16
	PPA-18632	6-18	12.0	6.5	+13	+25	+9	50	PP-25	2–22
New	PPA-18222	2–18	11.0	8.5	+8.5	+22	+9	75	PP-25	2–18
	PPA-18232	2-18	9.0	9.5	+11	+24	+8	155	PP-25	2–20

ANALOG LEVEL DETECTORS

Typical Specifications at 25°C Case Temperature

Model	Frequency Range (MHz)	VSWR (50Ω) Maximum	Sensitivity (V/mW) Typical	Input Flatness (dB) Maximum	Video B/W (kHz) Typical	Power (VDC) Nominal	Case Type	Page Number
PPD-2001	20-2000	1.8	1.0	±.3	150	±15	PP-25DA	5–6

DIGITAL THRESHOLD DETECTOR: TTL OUTPUT,VOLTAGE OR RESISTANCE CONTROL

Typical Specifications at 25°C Case Temperature

Model	Frequency Range (MHz)	Input Flatness[1] (dB), Max.	Operating Range (dBm), Typ.	Input VSWR Max.	Control Level Typ.	Voltage Range Min./Max.	Current @15 VDC (mA), Typ.	Case Type	Page Number
PPD-6002	100-6000	±1.0	–10 to +10	2.0	0-1 Volts	+11 to +16	12	PP-25D	5–7

ATTENUATOR: PIN DIODE

Guaranteed Specifications at 0° to 50°C Case Temperature

Model	Frequency Range (MHz)	Insertion Loss (dB) Maximum	Attenuation (dB) Minimum	VSWR (50Ω) Maximum	Switching Speed (µsec) Typical	Control Voltage (V)	Case Type	Page Number
PPF-030	100-500	2.5	40	2.0	.5	0 to +15	PP-25F	4–7
	500-1000	3.0	35	2.0	.5			
	1000-2000	3.5	25	2.0	.5			

LIMITING AMPLIFIER: 4 STAGE EMITTER COUPLED

Guaranteed Specifications at 0° to 50°C Case Temperature

Model	Frequency Range (MHz)	Input Power Limiting Range (dBm) Minimum	Saturated Output Power (dBm) Minimum	Output Power Flatness (dB) Maximum	Noise Figure (dB) Maximum	Operating Bias (VDC)	Case Type	Page Number
PPL-504	10-1000	–25 to +10	–4.0	±0.8	10.0	+15	PP-48	3–215

MIXER: TRIPLE BALANCED

Typical Specifications at 25°C Case Temperature

Model	Frequency Range RF & LO (GHz)	Frequency Range IF (GHz)	Conversion Loss (dB)	Isolation LO to RF (dB)	Isolation LO to IF (dB)	VSWR RF Port	VSWR LO Port	Case Type	Page Number
PPM-2515M	.05-2.5	.001-1.5	7.6	35	35	1.5:1	2.5:1	PP-38M	7–55

SWITCH: PIN DIODE, SPDT, NON-REFLECTIVE

Guaranteed Specifications at 25°C Case Temperature

Model	Frequency Range (MHz)	Insertion Loss (dB) Maximum	Isolation (dB) Minimum	VSWR (50Ω) Maximum	Switching Speed (µsec) Maximum	Control Voltage (VDC)	Case Type	Page Number
PPS-010	10-200	1.5	40	1.7	5.0	±15	PP-25S	8–12
	200-500	1.5	30					
	500-2000	2.5	20					

THIN-FILM PASSIVES: LOW PASS FILTERS

Guaranteed Specifications at 0° to 55°C Case Temperature

Model	Passband Frequency Range (Minimum) (GHz)	Stopband Frequency Range (Maximum) (GHz)	Passband Insertion Loss (Maximum) (dB)	Stopband Insertion Loss (Minimum) (dB)	Passband VSWR Input (Maximum)	Case Type	Page Number
PLP-105	DC-1	2.3–5.5	1.2	35	1.5:1	PLP	6–6
PLP-207	DC-2	3.5–7.5	1.5	35	1.5:1	PLP	6–8
PLP-407	DC-4	7.5–15	1.5	30	2.0:1	PLP	6–10

New

AVANTEK

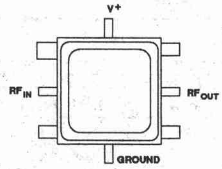
PPA-253
Surface Mount Cascadable Amplifier
5 to 200 MHz

FEATURES

- Frequency Range: 5 to 200 MHz
- High Gain: 32 dB (Typ)
- 5 Volt Supply
- Surface Mount
- Low Noise Figure: 3 dB (Typ)
- Small Size

APPLICATIONS

- High Gain Single Stage Gain Block
- Portable or Compact RF/IF Signal Processing



PP-25, p. 16–34

DESCRIPTION

The PPA-253 high-gain, low bias voltage, two-stage bipolar RF amplifier is mounted in the Avantek PlanarPak surface mount package. Internal blocking capacitors couple the RF signal through the amplifier. Decoupling on the bias voltage input provides increased immunity to bias variations.

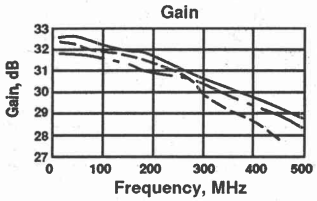
ELECTRICAL SPECIFICATIONS[1] (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted)

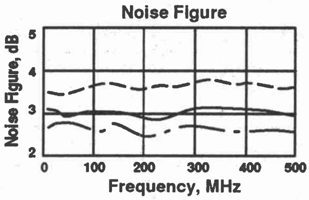
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	5-200	5-200	5-200	MHz
GP	Small Signal Gain (Min.)	32.0	29.0	28.0	dB
—	Gain Flatness (Max.)	±0.5	±.05	±1.0	dB
NF	Noise Figure (Max.)	3.0	4.0	4.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+3.0	0.0	–2.0	dBm
—	Input VSWR (Max.)	1.2:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+14.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+23.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+29.0	—	—	dBm
I_D	DC Current	30	—	—	mA

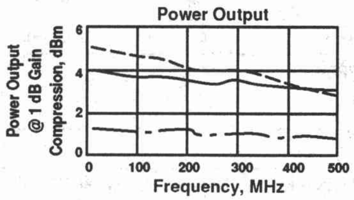
[1]The PPA-253 is based on the GPD-252.

TYPICAL PERFORMANCE OVER TEMPERATURE (@ +5 VDC unless otherwise noted)

KEY: +25°C ———— (solid)
+85°C – – – – (dashed)
–55°C —- - — (dash-dot)







MAXIMUM RATINGS

DC Voltage	+12 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

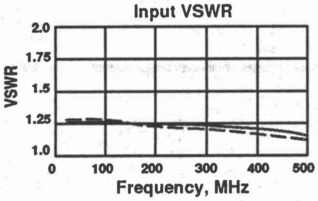
THERMAL CHARACTERISTICS*

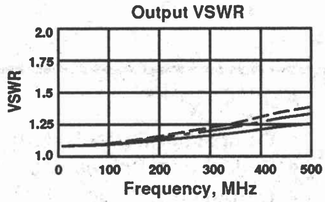
θ_{JC}	160/160°C/W
Active Transistor Power Dissipation	24/43 mW
Junction Temperature Above Case Temperature	4/7°C

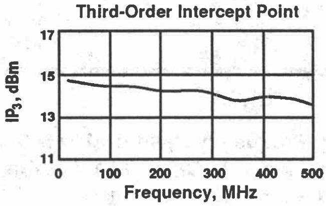
*For further information, see High Reliability section, p. 17–2.

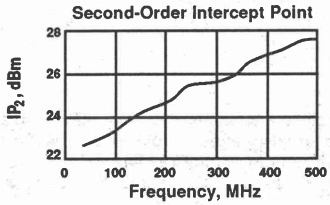
WEIGHT: (typical) — 0.25 grams

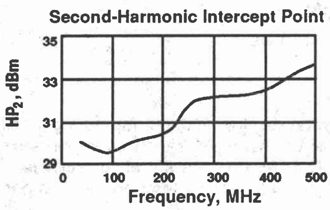
TYPICAL PERFORMANCE OVER TEMPERATURE (continued)











AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS — **BIAS = 5.00 VOLTS**

FREQ MHz	VSWR IN	GAIN dB	DEV LIN 0 DEG	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.12	31.9	–.3	.587	1.42	46.8
150.0	1.17	31.5	.6	.630	1.43	46.7
200.0	1.22	31.4	–.3	.609	1.45	47.0
250.0	1.25	30.9		.547	1.46	47.0
300.0	1.30	30.5		.577	1.46	46.2
350.0	1.38	30.1		.577	1.45	46.4
400.0	1.44	29.6		.535	1.44	46.2
450.0	1.51	29.1		.528	1.41	45.7
500.0	1.59	28.4		.504	1.38	45.6
600.0	1.73	27.1		.452	1.32	45.2
700.0	1.88	25.8		.401	1.25	44.2
800.0	1.98	24.6		.364	1.10	44.0
900.0	2.07	23.2		.334	1.12	43.2
1000.0	2.12	22.0		.323	1.07	42.6

BIAS = 5.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.059	–97.38	31.90	–23.9	–47.41	12.6	.176	–176.65
150.00	.079	–116.83	31.50	–34.5	–46.66	11.6	.178	–176.65
200.00	.099	–121.21	31.34	–46.6	–46.60	15.4	.183	–179.22
250.00	.112	–121.56	30.95	–56.4	–46.73	12.2	.186	178.94
300.00	.132	–119.26	30.53	–66.3	–46.39	16.6	.186	176.02
350.00	.158	–117.84	30.08	–77.1	–46.31	17.3	.184	173.85
400.00	.181	–118.71	29.62	–87.0	–46.21	21.0	.179	170.67
450.00	.203	–119.38	29.10	–96.3	–45.74	23.3	.170	167.98
500.00	.228	–122.53	28.45	–106.0	–45.64	26.4	.161	164.76
600.00	.267	–129.70	27.09	–123.6	–45.20	31.0	.137	160.38
700.00	.305	–136.94	25.76	–138.6	–44.15	34.6	.111	158.09
800.00	.329	–145.50	24.50	–152.4	–43.93	37.2	.081	160.06
900.00	.349	–154.13	23.22	–164.8	–43.18	38.4	.056	166.92
1000.00	.362	–162.31	22.04	–176.4	–42.69	37.1	.035	–173.10

![AVANTEK]

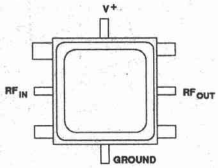
PPA-557
Surface Mount Cascadable Amplifier 10 to 500 MHz

FEATURES

- Frequency Range: 10 to 500 MHz
- Moderate Gain: 13.1 dB (Typ)
- High Power Output: +20 dBm (Typ)
- +5V Power Supply
- Surface Mount Package

APPLICATIONS

- Compact or Portable IF Amplifier
- RF/IF Signal Processing
- Output Gain Stage



PP-38, p. 16–35

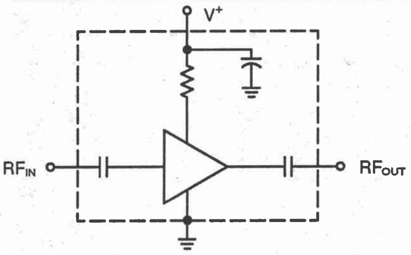
DESCRIPTION

The PPA-557 is a high power, low-voltage, medium gain RF amplifier containing discrete Avantek® transistors mounted on a thin-film substrate. The design consists of resistive feedback and active bias circuitry to provide temperature compensation and increased immunity to bias voltage variations. Internal input/output blocking capacitors couple the RF signal through the amplifier. The PPA-557 is available in a hermetically sealed .375 in. x .375 in. surface mount package.

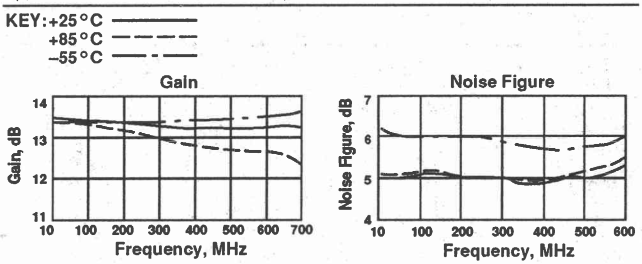
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	10-500	10-500	10-500	MHz
GP	Small Signal Gain (Min.)	13.1	12	11	dB
—	Gain Flatness (Max.)	±0.2	±0.7	±1.0	dB
NF	Noise Figure (Max.)	4.9	6.0	7.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+20	18.5	18.0	dBm
—	Input VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.3:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+25.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+23.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+28.0	—	—	dBm
V_D	DC Voltage (1% Reg.)	5			Volts
I_D	DC Current (Max.)	105	115	115	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +5 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	+7 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

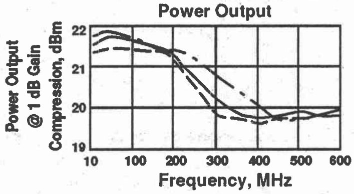
θ_{JC}	92/92C/W
Active Transistor Power Dissipation	210/210 mW
Junction Temperature Above Case Temperature	19/19°C

*For further information, see High Reliability section, p. 17–2.

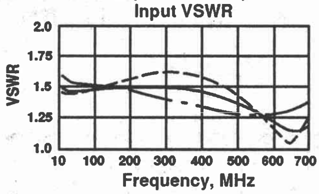
WEIGHT: (typical) 0.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

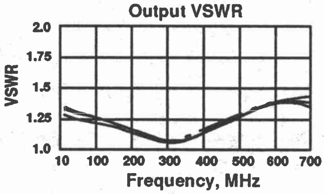
Power Output



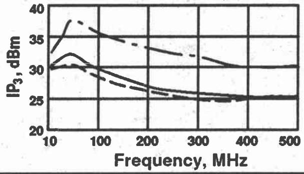
Input VSWR



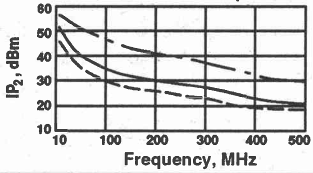
Output VSWR



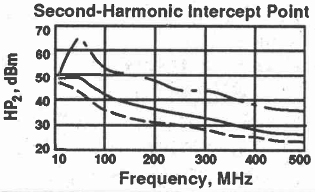
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

NUMERICAL READINGS

BIAS = 5.00 VOLTS

FREQ GHz	GPDEL (ns)	PHASE (DEG)	FREQ GHz	GPDEL (ns)	PHASE (DEG)	FREQ GHz	GPDEL (ns)	PHASE (DEG)
.010	1.66	5.23	.180	.66	–.58	.350	.66	.25
.020	1.66	1.71	.190	.67	–.55	.360	.67	.26
.030	.97	.61	.200	.66	–.50	.370	.68	.27
.040	.84	.08	.210	.66	–.44	.380	.66	.31
.050	.76	–.25	.220	.66	–.38	.390	.67	.34
.060	.73	–.46	.230	.66	–.31	.400	.68	.33
.070	.71	–.55	.240	.66	–.27	.410	.67	.33
.080	.70	–.63	.250	.65	–.16	.420	.69	.30
.090	.70	–.72	.260	.66	–.13	.430	.69	.29
.100	.68	–.72	.270	.67	–.10	.440	.68	.27
.110	.69	–.74	.280	.66	–.05	.450	.69	.23
.120	.68	–.76	.290	.66	.01	.460	.68	.25
.130	.67	–.72	.300	.66	.08	.470	.70	.12
.140.	.67	–.72	.310	.67	.11	.480	.69	.08
.150	.67	–.69	.320	.66	.15	.490	.70	–.02
.160	.67	–.66	.330	.66	.20	.500	.70	–.10
.170	.67	–.61	.340	.67	.20	.510	.70	–.19

LINEARIZATION RANGE: .010 to .510 GHz

S-PARAMETERS

BIAS = 5 VOLTS
CURRENT = 105 mA

FREQ GHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang	K
.001	.46	–76.3	10.8	–126.2	–20.9	60.4	.47	–154.65	1.35
.005	.23	–136.8	13.2	–167.1	–18.2	14.7	.18	151.48	1.13
.010	.19	–158.4	13.3	–177.0	–18.1	4.5	.14	161.89	1.14
.030	.18	–174.4	13.3	170.8	–18.2	–6.7	.13	161.63	1.15
.050	.19	–179.5	13.3	162.2	–18.2	–13.8	.13	154.83	1.15
.070	.19	177.2	13.3	154.1	–18.2	–20.4	.12	147.14	1.15
.090	.19	174.4	13.2	146.2	–18.2	–26.9	.12	139.04	1.15
.110	.19	171.8	13.2	138.3	–18.3	–33.1	.11	130.67	1.15
.130	.19	169.1	13.2	130.6	–18.3	–39.5	.11	121.92	1.15
.150	.19	166.4	13.2	122.8	–18.3	–45.6	.10	112.96	1.15
.170	.19	163.9	13.2	115.1	–18.3	–51.8	.09	103.47	1.16
.190	.19	161.3	13.2	107.4	–18.3	–58.0	.08	93.07	1.16
.210	.19	158.5	13.1	99.7	–18.3	–64.1	.07	81.95	1.16
.230	.19	155.7	13.1	92.1	–18.4	–70.3	.06	69.19	1.16
.250	.19	152.9	13.1	84.4	–18.4	–76.5	.05	54.89	1.16
.270	.19	149.9	13.1	76.7	–18.4	–82.6	.04	37.78	1.16
.290	.19	147.0	13.1	69.1	–18.4	–88.8	.04	16.33	1.17
.310	.19	144.1	13.1	61.3	–18.4	–95.0	.03	–10.11	1.17
.330	.19	141.1	13.1	53.7	–18.4	–101.2	.03	–39.48	1.17
.350	.19	138.2	13.0	45.9	–18.4	–107.5	.04	–65.79	1.17
.370	.19	135.2	13.0	38.2	–18.5	–113.8	.05	–86.75	1.17
.390	.18	132.1	13.0	30.4	–18.5	–120.0	.06	–103.14	1.17
.410	.18	128.9	13.0	22.6	–18.5	–126.3	.07	–117.07	1.18
.430	.17	125.8	13.0	14.8	–18.5	–132.7	.08	–129.14	1.18
.450	.17	122.7	13.0	7.0	–18.5	–139.1	.09	–140.41	1.18
.470	.16	119.9	13.0	–.9	–18.5	–145.5	.10	–151.11	1.18
.490	.16	117.1	13.0	–8.9	–18.6	–152.0	.11	–161.16	1.18
.590	.10	110.0	13.1	–49.6	–18.7	–174.8	.16	151.27	1.20
.630	.07	119.3	13.1	–66.5	–18.8	161.1	.16	132.14	1.21
.670	.06	151.0	13.1	–84.0	–18.9	147.0	.16	112.07	1.22
.790	.24	179.6	12.8	–140.1	–19.7	102.5	.12	42.58	1.26
.830	.33	169.8	12.5	–160.1	–20.2	87.3	.09	11.76	1.28
.870	.43	157.8	12.0	179.5	–20.8	72.1	.07	–29.02	1.31
.990	.68	117.4	9.5	119.1	–23.4	30.8	.07	–168.03	1.46
1.100	.81	82.9	6.0	69.4	–25.8	.2	.08	145.72	1.77
1.300	.89	31.1	–.8	–4.7	–29.0	–51.8	.17	145.41	3.27
1.500	.91	–12.3	–7.2	–65.8	–32.2	–106.4	.39	93.83	7.08

AVANTEK

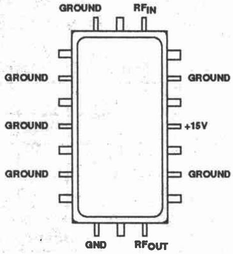
PPA-2123
Surface Mount Cascadable Amplifier
1 to 2 GHz

FEATURES

- Frequency Range: 1 to 2 GHz
- Small Surface Mount Package: .4 in. x .8 in.
- Ultra Low Noise Figure: 1.5 dB (Typ)
- High Gain: 34 dB (Typ)
- Flat Response: ±0.6 dB (Typ)
- Moderate Power Out: 13 dBm (Typ)
- Internally Regulated

APPLICATIONS

- GPS Receiver
- IF Amplifier
- Receiver Front End
- IF Front End



PP-48S, p. 16–36

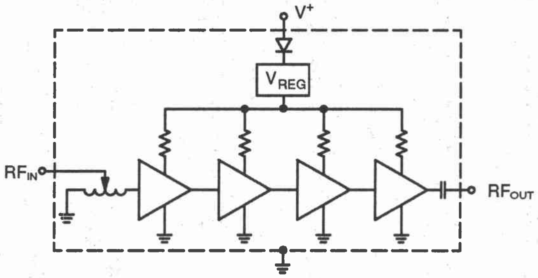
DESCRIPTION

The PPA-2123 is a multistage, low-noise, high-gain amplifier utilizing discrete GaAs FETs on a thin-film substrate. The low input/output VSWR is maintained by reactive circuits. The RF signal is transformer-coupled at the input (at DC ground) and capacitively-coupled at the output. The PPA-2123 is available in a hermetically sealed PP-48 (.4 in. x .8 in.) surface mount package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +12 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	1000-2000	1000-2000	1000-2000	MHz
GP	Small Signal Gain (Min.)	34.0	31.0	30.0	dB
—	Gain Flatness (Max.)	±0.6	±1.0	±1.0	dB
NF	Noise Figure (Max.)	1.5	2.2	2.3	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+13.0	11.0	9.0	dBm
—	Input VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+23	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+37	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+43	—	—	dBm
—	DC Voltage (1% Reg.)	+12 to +15	—	—	V
I_D	DC Current (Max.)	80	90	90	mA

SCHEMATIC



MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +15 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

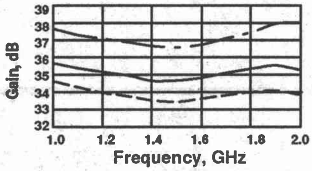
THERMAL CHARACTERISTICS

θ_{JC} .... 100°C/W, 120°C/W
Active Transistor Power Dissipation .... 84 mW, 160 mW
Junction Temperature Above Case Temperature   8.4°C/19.2°C

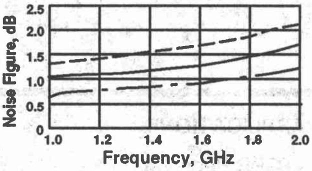
WEIGHT: 1.1 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (@ +12 VDC unless otherwise noted)

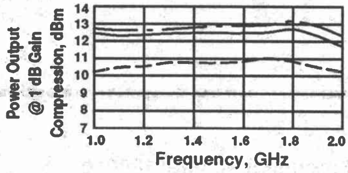
Gain



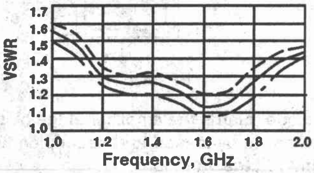
Noise Figure



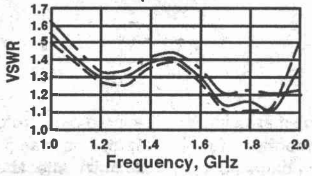
Power Output



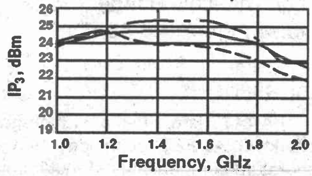
Input VSWR



Output VSWR

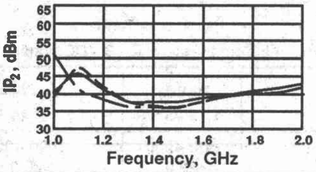


Third-Order Intercept Point

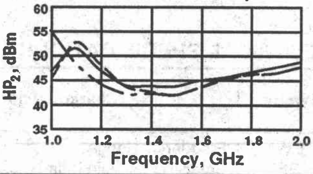


KEY: +25°C ———
+85°C — — —
–55°C — · —

Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

BIAS = 12 VOLTS
CURRENT = 79 mA

FREQ GHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang	GPDEL nS	PHASE DEG
.100	.85	135.5	–22.71	–48.3	–61.9	53.6	.77	–161.72	2.34	
.200	.83	89.4	9.21	–92.0	–63.8	–31.2	.79	163.17	2.56	
.250	.81	64.9	17.71	–135.2	–63.1	–71.3	.72	153.40	2.94	
.300	.76	40.0	23.51	–175.7	–70.5	–153.1	.65	145.10	2.84	
.400	.61	–8.4	30.30	111.5	–68.3	–104.6	.55	135.90	2.52	
.500	.46	–55.3	33.56	50.8	–56.3	158.3	.47	133.45	2.17	
.550	.40	–78.0	34.44	24.6	–60.9	74.7	.44	133.26	2.03	
.600	.36	–96.8	35.06	.8	–68.3	12.0	.40	132.61	1.92	
.650	.34	–112.6	35.49	–21.3	–64.5	11.2	.37	131.46	1.82	
.700	.31	–124.8	35.77	–42.2	–66.2	171.1	.34	128.67	1.76	
.750	.28	–136.1	35.92	–61.6	–71.6	47.8	.31	125.72	1.68	
.800	.25	–147.5	35.97	–80.1	–64.7	–17.6	.29	123.51	1.61	
.850	.23	–159.9	35.93	–97.6	–61.8	165.2	.27	122.96	1.57	
.900	.22	–171.2	35.83	–114.2	–64.0	–174.4	.26	124.66	1.52	
.950	.22	–178.7	35.72	–129.6	–63.0	–110.5	.24	130.33	1.47	
1.000	.22	176.5	35.59	–144.4	–63.3	141.6	.22	137.20	1.42	.49
1.050	.21	173.3	35.47	–158.8	–58.1	146.6	.20	146.11	1.39	–1.26
1.100	.19	171.0	35.32	–172.8	–65.0	–12.1	.17	153.81	1.36	–2.41
1.150	.16	168.3	35.22	173.5	–70.1	–156.5	.15	159.19	1.32	–2.99
1.200	.13	160.4	35.08	160.2	–62.9	–30.8	.13	160.06	1.29	–2.93
1.250	.11	146.8	34.98	147.1	–60.9	30.7	.12	156.82	1.27	–2.65
1.300	.11	134.5	34.86	134.3	–73.0	–106.1	.13	153.12	1.26	–1.98
1.350	.12	124.8	34.73	121.8	–60.3	81.3	.14	149.07	1.24	–1.11
1.400	.12	120.1	34.64	109.9	–58.0	76.2	.16	151.70	1.22	.17
1.450	.11	120.9	34.61	97.9	–63.4	–40.1	.17	155.00	1.23	1.39
1.500	.10	118.2	34.62	85.8	–70.6	–71.8	.17	159.95	1.23	2.53
1.550	.07	117.6	34.68	73.8	–63.2	–126.9	.16	163.96	1.22	3.76
1.600	.06	101.4	34.80	61.5	–60.9	63.7	.13	166.10	1.24	4.78
1.650	.06	80.1	34.93	48.8	–59.5	–97.8	.10	159.78	1.24	5.66
1.700	.07	71.8	35.05	35.7	–63.7	–68.0	.06	139.27	1.27	6.07
1.750	.10	65.2	35.18	22.2	–59.4	–5.9	.06	97.49	1.31	5.73
1.800	.12	70.2	35.29	8.4	–61.5	–162.8	.07	74.42	1.35	4.76
1.850	.14	74.5	35.41	–5.9	–73.5	44.9	.06	53.29	1.41	2.71
1.900	.16	76.4	35.53	–21.0	–56.1	–109.9	.05	14.65	1.49	–.79
1.950	.17	74.7	35.54	–37.3	–61.8	75.7	.07	–53.24	1.68	–7.80
2.000	.18	63.1	35.34	–54.2	–61.0	–101.5	.15	–72.58	1.65	–14.13
2.100	.21	34.0	34.49	–87.6	–63.5	179.7	.33	–90.96	1.61	
2.150	.24	24.9	33.89	–103.5	–57.6	144.7	.38	–97.77	1.58	
2.200	.27	19.3	33.10	–119.1	–64.8	26.6	.41	–108.28	1.56	
2.300	.27	14.1	31.41	–149.1	–64.9	107.9	.47	–133.70	1.35	
2.400	.22	.4	29.26	–176.8	–66.7	17.9	.57	–151.89	1.28	
2.500	.22	–22.6	27.13	160.3	–68.4	50.3	.66	–157.48	1.21	

AVANTEK

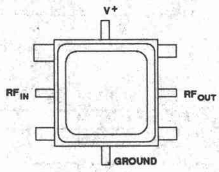
PPA-4132
Surface Mount Cascadable Amplifier
1000 to 4000 MHz

FEATURES

- Frequency Range: 1000 to 4000 MHz
- High Dynamic Range
- Noise Figure: 4.5 dB (Typ)

APPLICATIONS

- GPS Receiver
- IF Amplification



PP-38, p. 16–35

DESCRIPTION

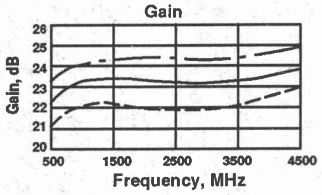
The PPA-4132 is a two-stage, high-gain RF amplifier using Avantek® GaAs FET technology, and resistive feedback for temperature compensation. Input/output blocking capacitors couple the RF signal through the amplifier, and a built-in reverse bias protection diode guards the amplifier at the bias input. The bias input voltage is bypassed and decoupled to minimize effects of supply voltage variations.

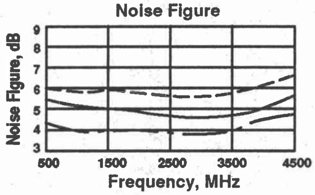
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +8 VDC nominal unless otherwise noted)

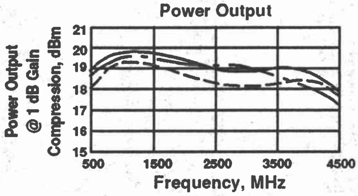
Symbol	Characteristic	Typical $T_c = 25°C$	Guaranteed Specifications $T_c = 0°$ to $50°C$	$T_c = -55°$ to $+85°C$	Unit
BW	Frequency Range	500-4500	1000-4000	1000-4000	MHz
GP	Small Signal Gain (Min.)	22.0	20.0	19.0	dB
—	Gain Flatness (Max.)	±0.3	±1.0	±1.0	dB
NF	Noise Figure (Max.)	4.5	6.0	7.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+18.5	+17.0	+16.0	dBm
—	Input VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+27.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+50.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+55.0	—	—	dBm
I_D	DC Current	150	—	—	mA

TYPICAL PERFORMANCE OVER TEMPERATURE (@ +8 VDC unless otherwise noted)

KEY: +25°C ————
+85°C — — — —
–55°C —— - ——







MAXIMUM RATINGS

DC Voltage .... +9 Volts
Continuous RF Input Power .... +15 dBm
Operating Case Temperature .... –55°C to +115°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +115°C

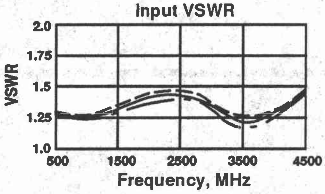
THERMAL CHARACTERISTICS*

θ_{JC}[1] .... 100/100°C/W
Active Transistor Power Dissipation[1] .... 290/370 mW
Junction Temperature Above Case Temperature[1] .... 29/37°C
NOTE 1: Values refer to 1st and 2nd stage transistors respectively.
*For further information, see High Reliability section, p. 17–2.

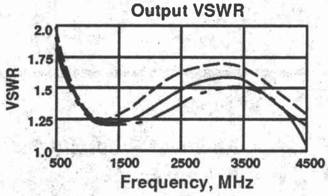
WEIGHT: (typical) 0.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

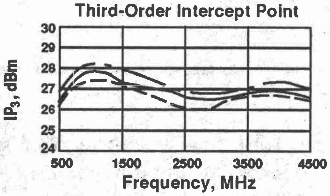
Input VSWR



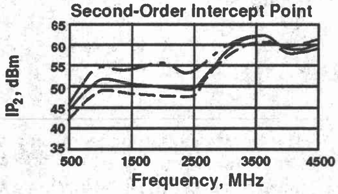
Output VSWR



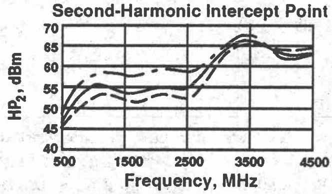
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

S-PARAMETERS BIAS = 8.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
250.00	.206	–67.84	14.61	139.6	–56.28	122.0	.746	147.67
500.00	.127	–106.00	21.79	63.0	–49.55	67.0	.320	117.88
750.00	.107	–110.26	22.69	32.5	–49.17	51.5	.179	117.57
1000.00	.110	–112.30	22.92	14.4	–49.34	46.6	.123	116.64
1250.00	.122	–114.72	22.99	2.4	–49.67	44.1	.096	104.64
1500.00	.136	–118.14	23.04	–8.8	–50.28	43.7	.089	82.24
1750.00	.149	–122.94	23.02	–17.1	–50.80	46.8	.103	60.68
2000.00	.168	–133.90	22.95	–23.8	–51.71	48.3	.136	50.43
2250.00	.179	–141.20	22.86	–32.4	–52.95	51.7	.161	41.42
2500.00	.179	–150.18	22.82	–38.7	–53.62	55.9	.186	35.98
2750.00	.168	–162.98	22.78	–45.4	–55.10	58.4	.206	34.01
3000.00	.148	–177.69	22.84	–51.8	–56.20	65.4	.218	30.06
3250.00	.119	158.39	22.89	–58.2	–58.16	68.0	.224	29.01
3500.00	.093	121.10	22.92	–65.4	–60.44	74.5	.212	25.76
3750.00	.099	71.51	23.12	–72.8	–63.34	108.9	.192	22.39
4000.00	.132	32.72	23.23	–81.7	–63.47	141.3	.155	14.34
4250.00	.172	5.85	23.51	–91.3	–58.54	171.6	.100	–8.84
4500.00	.195	–14.86	23.57	–102.0	–55.23	175.1	.080	–89.70
4750.00	.197	–29.30	23.39	–116.0	–52.15	178.4	.196	–141.42
5000.00	.187	–43.04	22.94	–131.3	–49.93	172.2	.346	–163.59
5250.00	.164	–53.74	21.80	–144.9	–49.32	166.1	.463	–179.60
5500.00	.132	–68.07	20.24	–158.0	–47.41	175.6	.519	170.55
5750.00	.085	–71.21	18.73	–168.3	–46.22	161.3	.537	161.89
6000.00	.065	–62.02	17.13	–175.8	–47.79	150.2	.490	155.84
6250.00	.053	–54.35	15.22	176.7	–51.34	–179.7	.408	156.12
6500.00	.054	–42.47	13.59	172.0	–50.22	–138.2	.333	158.13
6750.00	.081	–33.45	12.53	168.3	–44.31	–152.3	.297	153.72
7000.00	.115	–46.64	11.26	161.4	–43.32	–161.1	.200	139.48
7250.00	.138	–59.35	9.93	156.0	–45.20	–167.6	.122	109.06
7500.00	.163	–70.47	8.55	148.3	–47.16	–155.3	.131	53.87
7750.00	.186	–78.25	7.32	142.5	–47.74	–140.9	.207	33.56
8000.00	.205	–86.12	5.70	134.4	–48.95	–132.8	.304	26.50

LINEARIZATION RANGE: 1000 to 4000 MHz

AVANTEK

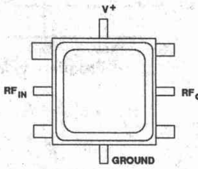
PPA-4213
Ultra-Low Noise Surface Mount Amplifier 2000 to 4000 MHz

FEATURES

- Ultra-Low Noise: 1.2 dB (Typ)
- Low Current (or High Efficiency)
- Frequency Range: 2000 to 4000 MHz
- High Gain: +30.0 dB (Typ)
- Surface Mount Package

APPLICATIONS

- Receiver Frontend Gain Block
- IF Gain Block
- Satellite Communications
- Telemetry Tracking
- EW Systems



PP-38, p. 16–35

DESCRIPTION

The PPA-4213 is a low current, high gain, ultra-low noise RF amplifier using Avantek® GaAs FET technology and lossless feedback to achieve excellent noise figure performance. Input and output blocking capacitors couple the RF signal through the amplifier. The bias input voltage is bypassed and decoupled to minimize the effects of supply voltage variations.

The surface mount configuration provides the user with excellent performance density in a 3/8" PlanarPak case. Inherent advantages of PlanarPaks include significant size and weight reductions over conventional packaging, increased reliability, and they are ideal for automated manufacturing environments. These advantages ultimately equate to lower system costs and increased functional capability.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +8 VDC nominal unless otherwise noted)

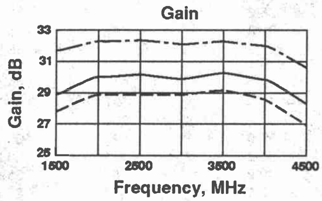
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			$T_C = 0°$ to $52°C$	$T_C = -55°$ to $+85°C$	
	Frequency Range	2000-4000	2000-4000	2000-4000	MHz
BW	Small Signal Gain (Min.)	30.0	27.5	26.5	db
—	Gain Flatness (Max.)	±0.5	±1.0	±1.25	dB
NF	Noise Figure (Max.)	1.2	1.7	2.1	dB
P_{1dB}	Power Output @ +1 dB compression (Min.)	15.0	14.0	13.0	dBm
—	Input VSWR (Max.)	1.8:1	2.0:1	2.2:0	
—	Output VSWR (Max.)	1.8:1	2.0:1	2.2:0	
IP_3	Two Tone 3rd Order Intercept Point	22.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	25.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	32.0	—	—	dBm
I	DC Current	85	—	—	mA

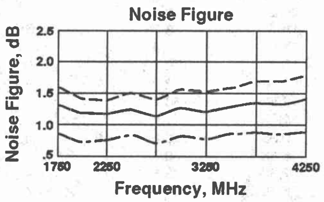
TYPICAL PERFORMANCE OVER TEMPERATURE (@ +8 VDC unless otherwise noted)

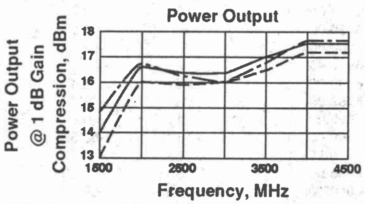
KEY: +25°C ————

+85°C — — — —

–55°C —— - ——







MAXIMUM RATINGS

DC Voltage .... +12 Volts
Contunuous RF Power (CW or Pulse) .... +17 dBm
Operating Case Temperature Rage .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

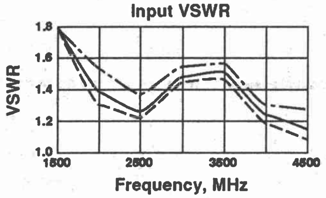
THERMAL CHARACTERISTICS

θ_{JC} .... 160°C/W
Active Translator Power Dissapation .... 160 mW
Junction Temperature Above Case Temperature .... 25°C

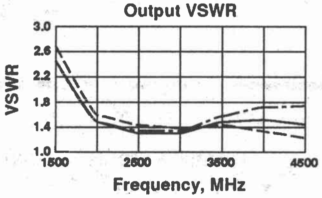
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

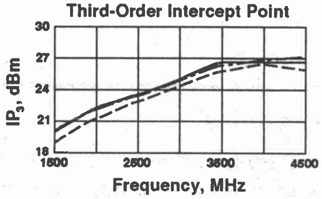
Input VSWR



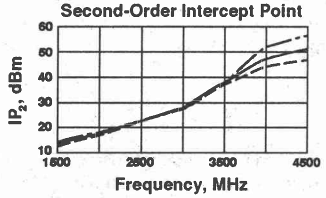
Output VSWR



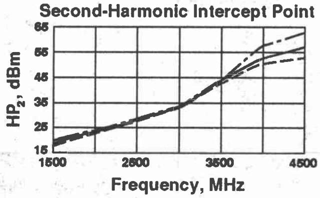
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

S-PARAMETERS AND NUMERICAL READINGS

BIAS = 8.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}		GPDEL	PHASE
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	ns	DEV
250.0	–.01	–22.59	–46.98	67.76	–73.52	115.98	–.31	–82.67	.49	—
500.0	–.10	–46.16	–23.88	–79.15	–71.98	110.80	–.63	–144.54	1.89	—
750.0	–.29	–75.25	10.27	–169.66	–72.51	54.32	–1.13	165.55	1.89	—
1000.0	–1.43	–121.00	15.76	128.48	–75.38	–12.06	–2.44	116.01	1.11	—
1250.0	–12.66	164.43	27.72	11.30	–71.32	–47.83	–5.19	68.31	1.26	—
1500.0	–14.05	–83.87	29.71	–82.27	–71.88	–141.86	–9.16	25.07	.88	—
1750.0	–12.62	–123.44	30.06	–145.16	–68.10	178.35	–13.04	–10.94	.65	—
2000.0	–15.46	–163.28	30.14	165.47	–64.56	172.44	–15.87	–42.64	.52	7.75
2250.0	–19.39	–137.51	30.18	122.27	–63.35	152.19	–16.99	–67.36	.47	–2.93
2500.0	–19.06	73.27	30.23	91.18	–66.21	125.96	–17.03	–80.55	.45	–1.82
2750.0	–16.44	24.29	30.15	56.54	–59.39	144.56	–16.19	–92.34	.40	–3.68
3000.0	–14.47	–.40	30.34	24.12	–58.10	142.07	–14.91	–104.74	.36	–2.83
3250.0	–13.55	–20.89	30.55	–8.21	–55.30	120.66	–13.03	–120.38	.36	–.98
3500.0	–13.83	–36.23	30.68	–41.37	–50.88	113.98	–11.37	–140.40	.36	.36
3750.0	–14.89	–47.89	30.53	–75.23	–50.16	101.10	–10.28	–163.74	.37	1.43
4000.0	–15.82	–48.82	29.95	–108.03	–49.23	82.55	–9.91	171.02	.36	2.71
4250.0	–15.80	–47.82	29.07	–139.11	–48.19	65.43	–10.10	146.16	.35	—
4500.0	–15.86	–52.36	28.05	–167.24	–47.57	53.51	–10.72	121.99	.33	—
4250.0	–16.72	–62.74	27.16	166.23	–47.81	44.03	–11.51	97.84	.30	—
5000.0	–18.75	–76.28	26.42	140.64	–46.98	31.85	–12.10	72.35	.29	—
5250.0	–23.91	–92.99	25.71	116.26	–46.36	18.08	–12.52	47.48	.30	—
5500.0	–31.94	121.66	25.29	90.09	–46.17	4.26	–12.45	24.91	.30	—
5750.0	–19.51	72.63	24.80	63.03	–45.83	–14.30	–12.52	5.25	.34	—
6000.0	–13.53	55.97	24.16	34.30	–45.75	–29.77	–13.02	–8.97	.36	—
6250.0	–10.33	42.48	23.20	3.50	–47.11	–45.10	–13.65	–15.36	.35	—
6500.0	–8.17	31.73	21.70	–28.55	–47.92	–55.32	–13.62	–15.53	.33	—
6750.0	–6.50	23.12	19.33	–59.84	–49.38	–61.26	–12.46	–18.12	.29	—
7000.0	–4.95	16.09	16.29	–84.72	–51.08	–65.27	–11.39	–25.20	.13	—
7250.0	–3.74	9.09	12.96	–101.68	–50.71	–81.91	–11.11	–32.03	.19	—
7500.0	–2.81	.50	9.55	–114.48	–50.82	–84.61	–11.59	–36.93	.16	—
7750.0	–2.23	–7.19	6.93	–122.75	–51.77	–88.78	–12.37	–36.74	.12	—
8000.0	–1.83	–14.24	5.08	–128.36	–54.10	–102.97	–12.94	–32.38	.12	—
8500.0	–1.40	–27.69	2.82	–143.27	–55.48	–140.59	–12.58	–19.56	.11	—
9000.0	–1.17	–38.35	1.59	–161.35	–56.23	178.25	–11.73	–9.79	.11	—
9500.0	–1.12	–49.15	1.11	178.66	–52.98	144.35	–11.27	–6.94	.11	—
10000.0	–1.13	–62.22	.94	155.11	–49.44	109.25	–11.40	–9.52	.16	—
10500.0	–1.31	–78.26	1.42	127.81	–46.56	78.31	–11.48	–10.62	.17	—
11000.0	–1.53	–100.72	2.00	95.64	–43.76	52.06	–12.18	–9.04	.26	—
11500.0	–2.02	–126.32	2.17	59.41	–40.44	27.73	–14.06	–7.88	.05	—
12000.0	–2.65	–151.70	2.33	19.42	–36.89	2.85	–15.95	1.47	.24	—

LINEARIZATION RANGE: 2000.0 to 4000.0 MHz

AVANTEK

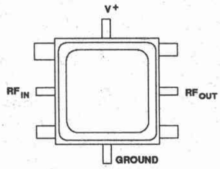
PPA-6213
Low Noise Surface Mount Amplifier
2000 to 6000 MHz

FEATURES

- Ultra-Low Noise: 2.0 dB (Typ)
- Low Current (or High Efficiency)
- Frequency Range: 2000 to 6000 MHz
- High Gain: 23 dB (Typ)
- Surface Mount Package

APPLICATIONS

- Receiver Frontend Gain Block
- IF Gain Block
- Satellite Communications
- Telemetry Tracking
- IJ Band First IF Stage



PP-38, p. 16–35

DESCRIPTION

The PPA-6213 is a low current high-gain, low noise RF amplifier using Avantek® GaAs FET technology and lossless feedback to achieve excellent noise figure performance. Input and output blocking capacitors couple the RF signal through the amplifier. The bias input voltage is bypassed and decoupled to minimize the effects of supply voltage variations.

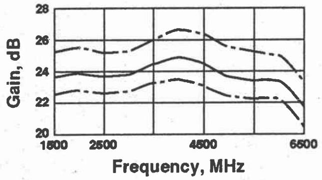
The surface mount configuration provides the user with excellent performance density in a 3/8" PlanarPak case. Inherent advantages of PlanarPaks include significant size and weight reductions over conventional packaging, increased reliability, and they are ideal for automated manufacturing environments. These advantages ultimately equate to lower system costs and increased functional capability.

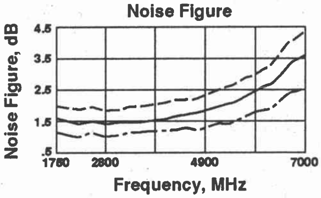
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +8 VDC nominal unless otherwise noted)

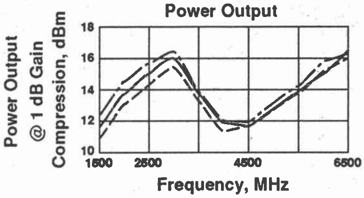
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	2000-6000	2000-6000	2000-6000	MHz
GP	Small Signal Gain (Min.)	23.0	21.0	20.0	dB
—	Gain Flatness (Max.)	±0.8	±1.25	±1.5	dB
NF	Noise Figure (Max.)	2.0	3.0	3.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+12.0	+9.5	+8.5	dBm
—	Input VSWR (Max.)	1.8:1	2.0:1	2.2:1	—
—	Output VSWR (Max.)	1.8:1	2.0:1	2.2:1	—
IP_3	Two Tone 3rd Order Intercept Point	+22.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+25.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+32.0	—	—	dBm
I	DC Current	80	—	—	mA

TYPICAL PERFORMANCE OVER TEMPERATURE (@ +8 VDC unless otherwise noted)

KEY: +25°C ————
+85°C — — — —
–55°C —·—







MAXIMUM RATINGS

DC Voltage .... +12 Volts
Continuous RF Input Power .... +18 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

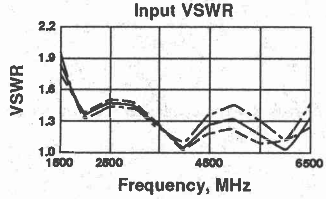
THERMAL CHARACTERISTICS

θ_{JC} .... 160°C/W
Active Translator Power Dissipation .... 160 mW
Junction Temperature Above Case Temperature .... 25°C

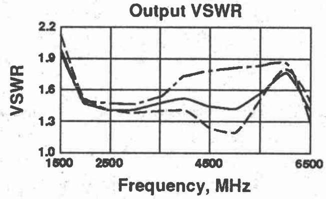
WEIGHT: (typical) 0.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

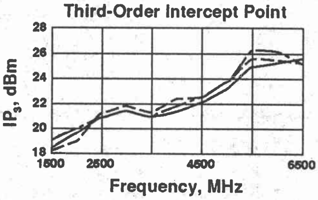
Input VSWR



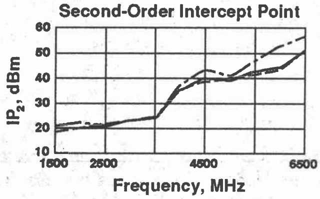
Output VSWR



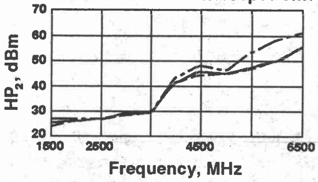
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

S-PARAMETERS AND NUMERICAL READINGS

BIAS = 8.00 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang	GPDEL ns	PHASE DEV
250.0	–.11	–21.29	–55.87	159.06	–54.55	–77.98	–.29	–82.54	5.62	—
500.0	–.20	–44.03	–26.43	–113.78	–51.75	–171.91	–.61	–146.12	1.15	—
750.0	–.34	–69.94	–13.66	159.29	–64.40	108.88	–1.20	161.09	1.68	—
1000.0	–.93	–103.80	8.30	102.97	–53.95	64.40	–2.77	107.99	.95	—
1250.0	–3.20	–151.02	19.24	13.28	–53.25	–144.34	–5.82	57.11	1.03	—
1500.0	–10.58	148.02	23.65	–74.76	–57.89	–167.99	–9.60	12.02	.89	—
1750.0	–19.97	44.26	24.27	–141.29	–59.07	169.11	–12.64	–25.86	.65	—
2000.0	–16.57	–30.11	23.93	169.59	–61.63	26.75	–14.45	–57.85	.51	12.91
2250.0	–14.45	–58.09	23.76	130.08	–50.63	131.49	–15.04	–84.12	.41	1.34
2500.0	–14.10	–70.73	23.63	102.28	–51.69	177.92	–15.41	–98.20	.35	1.45
2750.0	–14.03	–84.47	23.66	70.85	–51.68	107.60	–15.67	–112.78	.35	–2.07
3000.0	–14.69	–102.00	23.77	42.39	–49.41	121.02	–15.45	–125.60	.32	–2.59
3250.0	–16.19	–118.00	24.03	14.25	–53.18	160.02	–15.13	–133.10	.30	–2.76
3500.0	–18.80	–135.95	24.38	–14.16	–47.60	117.19	–14.48	–144.66	.31	–3.10
3750.0	–24.03	–160.45	24.70	–42.94	–46.26	84.01	–14.09	–159.48	.32	–3.62
4000.0	–33.45	82.73	24.83	–72.21	–47.45	43.35	–13.74	–176.98	.32	–4.48
4250.0	–23.20	7.08	24.71	–100.96	–46.81	36.46	–13.99	162.84	.32	–4.85
4500.0	–18.47	–18.58	24.41	–129.15	–48.22	55.12	–14.96	136.50	.30	–4.79
4750.0	–17.21	–36.60	24.04	–155.74	–50.72	26.35	–15.23	106.58	.29	–3.47
5000.0	–17.24	–56.48	23.70	179.14	–48.94	10.81	–15.33	72.89	.29	–.68
5250.0	–19.21	–75.73	23.39	154.73	–49.14	.42	–14.71	35.22	.27	2.81
5500.0	–22.07	–97.18	23.42	128.85	–61.58	–14.32	–13.16	1.11	.29	4.67
5750.0	–27.06	–102.75	23.43	102.11	–54.15	30.49	–11.46	29.76	.33	5.60
6000.0	–39.73	–139.51	23.37	72.43	–49.95	49.15	–10.92	–60.04	.34	3.62
6250.0	–23.49	89.01	22.81	40.66	–52.05	66.31	–12.52	–87.65	.36	—
6500.0	–16.75	75.32	21.75	7.74	–49.79	16.78	–15.98	–110.07	.36	—
6750.0	–11.95	62.65	19.92	–23.91	–42.11	.54	–25.03	–111.88	.34	—
7000.0	–8.88	51.39	17.65	–50.17	–43.92	–6.52	–26.64	–31.09	.18	—
7250.0	–6.61	39.40	15.17	–71.76	–42.53	–16.85	–20.54	–17.41	.25	—
7500.0	–5.02	26.12	12.34	–92.28	–41.55	–21.90	–18.06	–17.95	.20	—
7750.0	–4.20	16.39	9.53	–108.80	–38.59	–48.12	–18.35	–13.41	.18	—
8000.0	–3.33	8.11	7.10	–121.35	–41.15	–85.50	–17.10	–.28	.13	—
8500.0	–2.28	–9.68	3.37	–142.62	–50.79	43.92	–14.26	4.04	.11	—
9000.0	–1.91	–23.16	.84	–161.15	–51.11	–165.93	–12.52	7.20	.10	—
9500.0	–1.73	–33.83	–.44	–179.65	–57.40	115.59	–11.28	10.37	.10	—
10000.0	–1.87	–49.30	–.87	156.15	–48.30	–29.56	–10.71	9.36	.15	—
10500.0	–2.53	–68.07	–1.05	123.70	–49.82	82.88	–10.17	7.91	.22	—
11000.0	–3.21	–80.64	–5.27	84.32	–42.05	62.02	–10.47	7.49	.03	—
11500.0	–2.41	–112.00	–4.40	85.04	–37.97	–9.25	–11.26	6.26	.18	—
12000.0	–3.00	–147.25	–3.00	51.44	–36.08	–5.35	–11.96	5.62	.18	—

LINEARIZATION RANGE: 2000.0 to 6000.0 MHz

AVANTEK

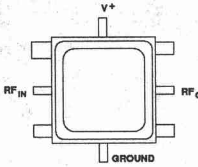
PPA-6232
Surface Mount Cascadable Amplifier
2000 to 6000 MHz

FEATURES

- Frequency Range: 2000 to 6000 MHz
- High Dynamic Range
- Noise Figure: 4.3 dB (Typ)
- Surface Mount Package

APPLICATIONS

- Wideband Receiver Gain Block
- IF Gain Block



PP-38, p. 16–35

DESCRIPTION

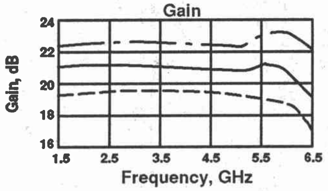
The PPA-6232 is a two-stage high-gain RF amplifier using Avantek® GaAs FET technology and resistive feedback for temperature compensation. Input/output blocking capacitors couple the RF signal through the amplifier, and a built-in reverse bias protection diode guards the amplifier at the bias input. The bias input voltage is bypassed and decoupled to minimize effects of supply voltage variations.

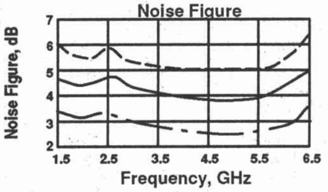
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +8 VDC nominal unless otherwise noted)

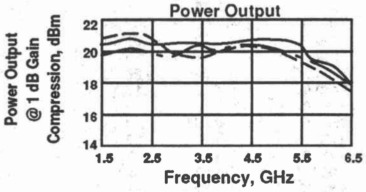
Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	1500-6000	2000-6000	2000-6000	MHz
GP	Small Signal Gain (Min.)	20.0	18.0	17.0	dB
—	Gain Flatness (Max.)	±0.3	±1.0	±1.5	dB
NF	Noise Figure (Max.)	4.3	5.5	7.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+19.0	+17.0	+16.0	dBm
—	Input VSWR (Max.)	1.6:1	2.0:1	2.0:1.	—
—	Output VSWR (Max.)	1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+27.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+45.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+51.0	—	—	dBm
I	DC Current	150	—	—	mA

TYPICAL PERFORMANCE OVER TEMPERATURE (@ +8 VDC unless otherwise noted)

KEY: +25°C ————
+85°C — — — —
–55°C —— - ——







MAXIMUM RATINGS

DC Voltage	+9 Volts
Continuous RF Input Power	+15 dBm
Operating Case Temperature	–55°C to +100°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+100°C

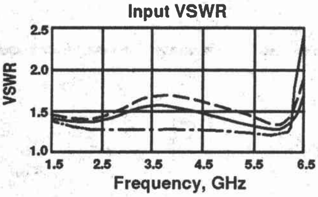
THERMAL CHARACTERISTICS*

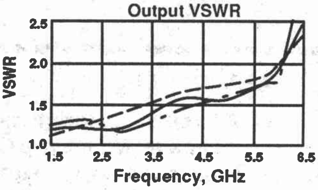
θ_{JC}	100°C/W
Active Transistor Power Dissipation	420 mW
Junction Temperature Above Case Temperature	42°C

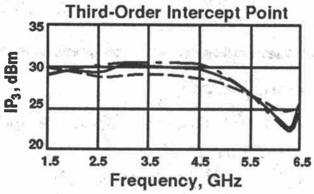
*For further information, see High Reliability section, p. 17–2.

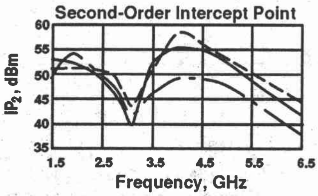
WEIGHT: (typical) 0.5 grams

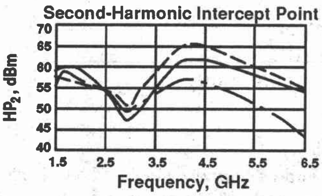
TYPICAL PERFORMANCE OVER TEMPERATURE (continued)











AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

S-PARAMETERS

BIAS = 8.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
250.00	.77	–45.0	–4.7	–132.9	–38.5	–44.1	.95	–38.43
500.00	.50	–70.3	11.8	149.3	–49.1	–70.5	.90	–86.06
750.00	.35	–82.1	18.5	78.7	–46.9	43.6	.54	–139.31
1000.00	.28	–90.3	20.2	26.2	–40.5	19.8	.19	–170.41
1250.00	.22	–98.3	20.5	–10.3	–38.6	.5	.06	–142.41
1500.00	.17	–101.7	20.7	–39.1	–37.4	–16.2	.07	–102.95
1750.00	.13	–97.2	20.8	–64.1	–36.9	–31.9	.08	–109.88
2000.00	.12	–85.4	20.9	–87.3	–36.6	–47.0	.08	–118.82
2250.00	.13	–75.8	20.9	–109.3	–36.6	61.1	.07	–122.55
2500.00	.16	–76.9	20.9	–130.2	–36.3	–75.5	.05	–121.01
2750.00	.19	–83.3	20.9	–150.6	–36.5	–88.9	.05	–95.67
3000.00	.21	–94.2	20.9	–170.5	–36.7	–102.4	.07	–68.22
3250.00	.22	–107.3	20.8	170.1	–36.9	–116.9	.10	–58.24
3500.00	.23	–122.6	20.7	150.8	–37.3	–131.4	.14	–57.24
3750.00	.23	–140.3	20.6	131.8	–37.4	–145.5	.18	–58.46
4000.00	.22	–159.8	20.5	113.2	–37.8	–158.1	.19	–59.87
4250.00	.20	178.6	20.4	94.9	–37.8	–170.4	.22	–64.49
4500.00	.18	153.7	20.4	76.1	–38.2	177.2	.23	–72.62
4750.00	.17	125.5	20.4	57.4	–38.6	166.1	.22	–82.89
5000.00	.16	96.5	20.5	37.6	–38.4	155.4	.21	–102.41
5250.00	.17	70.0	20.5	17.3	–38.7	145.6	.17	–122.94
5500.00	.18	43.5	20.5	–2.5	–38.3	149.1	.15	–146.99
5750.00	.15	17.0	21.0	–25.4	–36.7	131.0	.20	175.83
6000.00	.08	17.3	20.9	–53.0	–36.3	109.4	.24	129.48
6250.00	.09	87.8	20.5	–81.6	–36.0	92.9	.32	96.82
6500.00	.29	83.6	18.9	–115.0	–36.9	62.6	.44	65.64
6750.00	.46	59.2	16.1	–142.2	–39.6	37.3	.50	39.13
7000.00	.56	40.5	12.9	–161.5	–43.9	12.7	.54	23.00
7250.00	.62	26.8	10.1	–175.0	–48.3	–22.4	.55	13.05
7500.00	.67	16.4	7.7	174.6	–47.9	–74.9	.57	4.00
7750.00	.69	8.3	5.7	166.4	–44.6	–110.6	.59	–.75
8000.00	.71	1.7	4.2	158.7	–39.8	–123.1	.59	–4.25
8250.00	.72	–4.1	2.9	150.8	–35.5	–132.0	.59	–9.46
8500.00	.73	–9.4	1.9	143.1	–30.9	–138.9	.59	–12.13
8750.00	.73	–14.3	1.0	135.1	–26.0	–149.0	.58	–14.03
9000.00	.72	–18.7	.3	126.3	–20.7	–163.6	.55	–19.42

AVANTEK

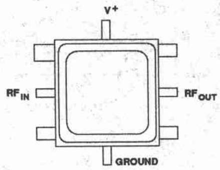
PPA-18222
Surface Mount Cascadable Amplifier
2 to 18 GHz

FEATURES

- Small Surface Mount Package: .25 in. x .25 in.
- Very High Gain Density: 13 dB (Typ) per 1/4 in. square
- Very Wide Bandwidth: 2 to 18 GHz
- Low Power Consumption: 75 mA @ 9 VDC
- GaAs MMIC Technology

APPLICATIONS

- RF Amplifiers for Highly Integrated Microwave Receivers
- Broadband ECM Systems
- Satellite Communications
- Space Critical Systems



PP-25, p. 16–34

DESCRIPTION

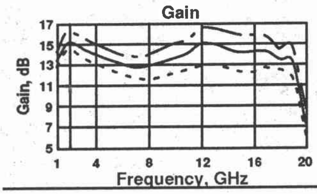
The PPA-18222 is an extremely wideband two stage MMIC amplifier incorporating blocking capacitors, DC bypass capacitors, RF chokes, and thin-film circuitry. It is packaged in a very small surface mount case providing a self-contained, low power consumption, high gain density amplifier module with a bandwidth of 2 to 18 GHz.

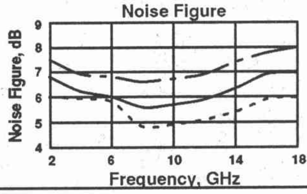
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +9 VDC nominal unless otherwise noted)

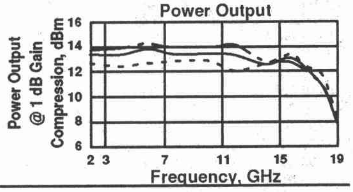
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			$T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	
BW	Frequency Range	2-18	2-18	2-18	GHz
GP	Small Signal Gain (Min.)	13.0	11.0	10.0	dB
—	Gain Flatness (Max.)	±1.5	±2.0	±2.25	dB
NF	Noise Figure	6.5	8.5	9.5	dB
$P_{1\,dB}$	Power Output @ + 1 dB Compression	+11.0	+8.5	+7.5	dBm
—	Input VSWR	1.8:1	2.2:1	2.2:1	—
—	Output VSWR	1.8:1	2.2.1	2.2:1	—
IP_3	Two Tone 3rd Order Intercept Point	+22.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+36.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+42.0	—	—	dBm
—	DC Voltage (1% Reg.)	9	—	—	Volts
I_D	DC Current	75	—	—	mA

TYPICAL PERFORMANCE OVER TEMPERATURE (@ +9 VDC unless otherwise noted)

KEY: +25°C ————
+85°C — — — —
–55°C —— - ——







MAXIMUM RATINGS

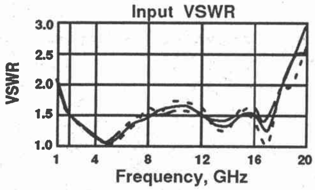
DC Voltage .... +12 Volts
Continuous RF Input Power .... +15 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

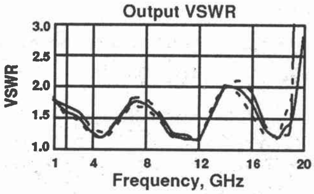
THERMAL CHARACTERISTICS

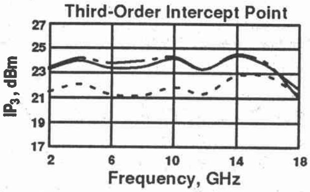
θ_{JC} .... 40°C/W
Active Transistor Power Dissipation .... 300 mW
Junction Temperature Above Case Temperature .... 12°C

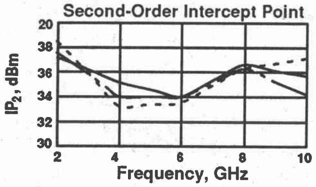
WEIGHT: (typ.) 0.21 grams

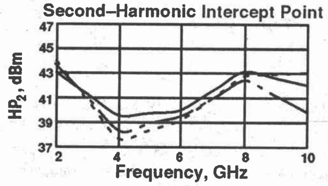
KEY: +25°C
+85°C
–55°C











AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

BIAS = 9 Volts
CURRENT = 72.2 mA

Freq MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang	GPDEL ns	Phase Deg
.50	–3.56	–97.08	–3.98	–155.59	–49.07	–114.84	–3.10	–122.40	.12	0.00
1.00	–8.68	–162.57	13.15	56.86	–54.98	–43.28	–10.88	93.39	1.07	0.00
1.50	–12.16	149.07	15.43	–78.23	–54.99	–37.51	–15.83	–167.49	.62	0.00
2.00	–14.02	105.49	15.20	–170.73	–57.87	–161.74	–12.66	115.46	.47	13.30
2.50	–15.37	66.20	14.88	115.39	–57.68	–133.14	–12.84	56.80	.37	2.73
3.00	–17.28	25.12	14.60	43.35	–56.99	–130.89	–13.97	1.14	.39	–6.27
3.50	–19.81	–12.99	14.32	–24.51	–50.70	169.69	–16.05	–53.75	.37	–11.00
4.00	–23.60	–48.91	14.01	–90.32	–53.82	114.02	–19.25	–114.08	.36	–13.54
4.50	–30.47	–64.05	13.79	–154.83	–46.28	87.19	–22.56	167.13	.36	–14.76
5.00	–31.76	–10.79	13.57	141.92	–52.53	41.95	–21.09	73.76	.35	–15.03
5.50	–24.21	–24.65	13.31	79.12	–57.78	–.30	–17.24	7.36	.35	–14.57
6.00	–20.49	–52.27	13.03	17.75	–46.74	4.50	–14.85	–37.84	.34	–12.68
6.50	–18.00	–84.32	12.80	–42.54	–45.71	–72.26	–12.88	–81.03	.33	–9.76
7.00	–15.96	–115.33	12.78	–101.85	–41.48	–111.82	–11.43	–121.90	.33	–5.75
7.50	–15.08	–147.57	12.77	–156.67	–46.13	173.86	–11.22	–160.22	.34	2.64
8.00	–14.66	–175.55	12.85	144.08	–53.24	100.64	–11.49	161.77	.33	6.40
8.50	–14.12	160.48	13.01	84.04	–49.00	112.50	–12.33	125.72	.33	9.61
9.00	–13.26	133.23	13.27	22.71	–49.23	81.62	–13.57	84.84	.34	11.23
9.50	–12.79	106.76	13.41	–38.80	–56.51	107.32	–16.29	42.29	.34	12.91
10.00	–12.44	79.87	13.63	–100.49	–51.68	77.10	–20.74	–9.70	.34	14.57
10.50	–12.30	50.19	13.84	–162.44	–43.78	–28.40	–22.99	–92.00	.34	15.75
11.00	–12.36	18.01	14.09	135.02	–46.28	–65.88	–22.11	–175.19	.35	16.42
11.50	–13.16	–17.58	14.42	72.12	–50.60	–40.72	–20.68	127.08	.35	16.85
12.00	–13.76	–55.15	15.02	7.84	–46.36	–124.59	–23.25	95.04	.37	15.58
12.50	–14.95	–105.08	15.27	–60.29	–43.13	–157.55	–19.32	129.08	.38	10.70
13.00	–16.53	–165.58	14.93	–127.58	–46.72	–177.59	–13.02	86.23	.38	6.76
13.50	–17.91	124.14	14.68	167.52	–42.04	123.06	–10.65	40.38	.36	5.28
14.00	–16.90	57.10	14.53	108.23	–44.10	61.61	–9.53	–.72	.35	9.00
14.50	–15.16	–8.52	14.27	42.73	–41.69	2.78	–9.07	–46.12	.36	6.47
15.00	–13.95	–69.42	14.18	–22.37	–44.72	–26.89	–9.81	–93.10	.36	4.23
15.50	–13.16	–124.49	14.16	–88.71	–44.58	–106.72	–10.48	–139.73	.37	.61
16.00	–13.73	178.63	14.12	–156.80	–47.13	–64.22	–11.48	163.21	.37	–3.74
16.50	–15.30	130.19	14.25	137.11	–43.32	–115.99	–13.97	117.72	.40	–6.84
17.00	–19.84	42.30	14.33	65.70	–49.89	172.99	–17.17	56.14	.40	–13.99
17.50	–15.87	–84.77	14.01	–6.52	–46.90	143.34	–20.14	–16.70	.39	–22.85
18.00	–10.27	–152.33	13.53	–77.81	–44.09	68.25	–21.22	–90.85	.38	–30.25
18.50	–7.53	155.88	13.24	–148.87	–38.95	–33.10	–22.11	–127.86	.39	0.00
19.00	–7.65	101.05	13.48	135.80	–33.23	–99.34	–14.24	–112.14	.44	0.00
19.50	–21.85	93.30	12.34	42.02	–28.65	148.81	–4.26	–166.51	.56	0.00
20.00	–6.15	121.37	6.68	–32.21	–26.53	45.57	–1.94	130.41	.33	0.00
20.50	–4.57	79.82	3.47	–73.67	–35.96	–48.43	–2.02	88.96	.21	0.00
21.00	–2.73	45.17	3.41	–123.49	–31.47	–44.36	–1.53	53.04	.25	0.00
21.50	–3.31	5.59	3.95	178.60	–27.58	–96.16	–2.01	16.64	.33	0.00
22.00	–6.10	–26.26	7.54	116.96	–26.48	–144.95	–4.41	–15.88	.50	0.00
22.50	–5.19	—18.83	10.31	12.24	–24.52	151.12	–3.83	–16.65	.59	0.00
23.00	–3.56	–67.02	7.80	–87.27	–31.50	84.45	–2.30	–58.62	.48	0.00
24.00	–8.30	–134.06	1.53	83.98	–30.09	13.99	–4.18	–116.36	.53	0.00
25.00	–8.80	171.58	–8.83	–94.97	–24.56	–114.50	–6.01	169.07	.47	0.00
26.00	–5.88	97.72	–21.15	143.44	–31.64	147.26	–3.97	85.47	.16	0.00

GAIN FLATNESS = ±1.25

AVANTEK

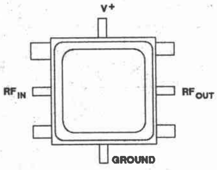
PPA-18232
Surface Mount Cascadable Amplifier
2 to 18 GHz

FEATURES

- Frequency Range: 2 to 18 GHz
- GaAs MMIC Technology
- High Density Wideband Gain Block
- Surface Mount Package

APPLICATIONS

- Space Program — Wideband Receiver
- Portable or Compact Radar Systems
- ECM Systems Amplifier



PP-25, p. 16–34

DESCRIPTION

The PPA-18232 wideband amplifier uses two GaAs MMIC distributed amplifiers to provide 11 dB gain and +13 dBm power output over the complete 2 to 18 GHz range. Packaged in a 1/4 x 1/4 in. surface mount package, it provides users with a very high gain per volume and is compatible with surface-mount assembly technology. Internal bias supply decoupling and bypassing provide increased immunity to bias voltage variations.

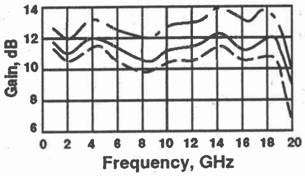
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +8 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	2-18	2-18	2-18	GHz
GP	Small Signal Gain (Min.)	11.0	9.0	8.0	dB
—	Gain Flatness (Max.)	±1.0	±2.0	±2.0	dB
NF	Noise Figure (Max.)	7.5	9.5	11.0	dB
$P_{1 dB}$	Power Output @ +1 dB Compression (Min.)	+13.0	+11.0	+9.0	dBm
—	Input VSWR (Max.)	1.8:1	2.0:1	2.2:1.	—
—	Output VSWR (Max.)	1.8:1	2.0:1	2.2:1	—
IP_3	Two Tone 3rd Order Intercept Point	+24.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+30.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+36.0	—	—	dBm
I_D	DC Current	155	—	—	mA

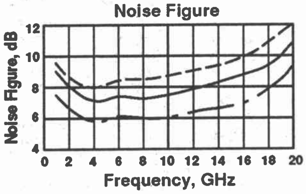
TYPICAL PERFORMANCE OVER TEMPERATURE (@ +8 VDC unless otherwise noted)

KEY: +25°C ————
+85°C — — — —
–55°C —— - ——

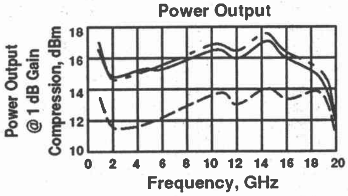
Gain



Noise Figure



Power Output



MAXIMUM RATINGS

DC Voltage .... +9 Volts
Continuous RF Input Power .... +15 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

THERMAL CHARACTERISTICS*

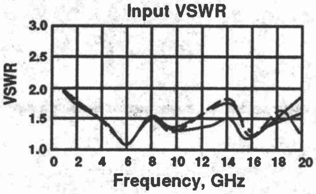
θ_{JC} .... 40°C/W
Active Transistor Power Dissipation .... 410 mW
Junction Temperature Above Case Temperature .... 16°C

*For further information, see High Reliability section, p. 17–2.

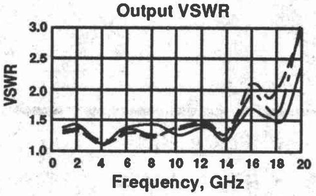
WEIGHT: (typical) 0.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

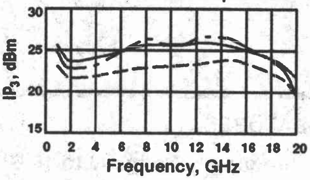
Input VSWR



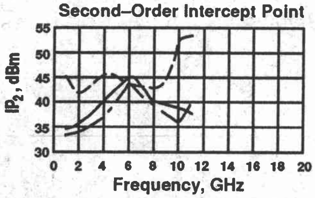
Output VSWR



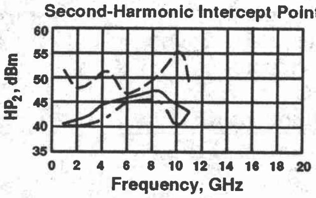
Third–Order Intercept Point



Second–Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

S-PARAMETERS

BIAS = 8.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
.500	.42	–63.8	–9.4	–56.3	–84.7	91.3	.74	–147.04
1.000	.31	–69.7	11.1	112.8	–75.3	89.6	.13	–8.77
1.500	.28	–80.7	10.7	26.4	–62.3	135.4	.17	–84.42
2.000	.26	–90.0	10.5	–21.3	–59.7	80.4	.15	–116.19
2.500	.24	–98.3	10.6	–58.1	–57.8	45.6	.13	–130.05
3.000	.23	–105.4	10.8	–90.7	–63.3	4.9	.09	–126.20
3.500	.20	–113.6	11.2	–122.1	–68.1	136.1	.05	–95.84
4.000	.17	–119.6	11.3	–152.4	–55.1	67.3	.05	–14.54
4.500	.14	–127.3	11.4	177.8	–53.5	30.6	.08	7.66
5.000	.10	–146.0	11.2	148.6	–57.2	–17.5	.10	20.34
5.500	.06	–176.2	10.9	121.5	–60.4	1.4	.13	18.93
6.000	.05	120.1	10.7	95.4	–61.3	–12.1	.14	13.47
6.500	.09	84.1	10.4	70.1	–65.0	–2.9	.16	6.14
7.000	.13	70.4	10.2	45.8	–60.4	51.9	.16	.50
7.500	.17	61.8	10.1	22.4	–57.4	14.8	.16	–5.52
8.000	.19	56.0	10.1	–1.4	–55.7	–9.3	.16	–13.46
8.500	.20	52.0	10.2	–25.5	–61.2	–22.9	.14	–21.39
9.000	.19	48.8	10.3	–49.7	–59.3	–1.2	.11	–34.02
9.500	.16	44.1	10.6	–74.8	–60.1	–8.7	.08	–68.00
10.000	.12	35.6	10.7	–100.7	–60.1	34.4	.11	–109.12
11.000	.08	–21.6	10.8	–152.4	–57.4	27.5	.19	–116.23
12.000	.15	–58.8	11.0	155.0	–48.2	–1.1	.14	–97.74
13.000	.18	–47.5	11.6	100.8	–46.3	–57.2	.12	–79.50
14.000	.19	–31.4	11.7	40.9	–46.8	–88.8	.06	–94.45
15.000	.14	–32.5	11.4	–19.1	–43.9	–108.0	.09	113.27
16.000	.07	–126.6	10.8	–80.1	–41.4	–170.1	.24	142.87
17.000	.14	–154.5	10.7	–138.3	–39.5	119.9	.16	166.74
18.000	.19	–141.7	11.5	154.2	–33.3	50.5	.18	–177.08
19.000	.22	–170.2	10.7	74.6	–31.7	–13.0	.38	128.69
20.000	.28	139.0	8.6	–2.8	–29.4	–71.1	.40	95.74
21.000	.44	131.7	4.7	–80.5	–26.9	–133.8	.54	129.62
22.000	.67	158.1	3.2	–165.8	–32.8	–148.8	.56	137.46
23.000	.59	149.5	–3.2	122.5	–24.8	137.6	.19	153.61
24.000	.47	–179.5	–7.6	88.1	–29.7	41.2	.39	–143.92
25.000	.54	–160.4	–12.9	4.7	–35.1	44.9	.57	–144.68

AVANTEK

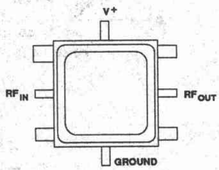
PPA-18632
Surface Mount Cascadable Amplifier
6 to 18 GHz

FEATURES

- Frequency Range: 6 to 18 GHz
- Surface Mount Package — Less Board Area Required
- Very High Gain Density — 14 dB (Typ) per 1/4-in. Square
- Low Power Consumption: 50mA @ 9 VDC
- Low Noise Figure: 5.5 dB (Typ)

APPLICATIONS

- RF Amplifiers
- Broadband ECM Systems
- Satellite Communications
- Size-Critical Systems



PP-25, p. 16–34

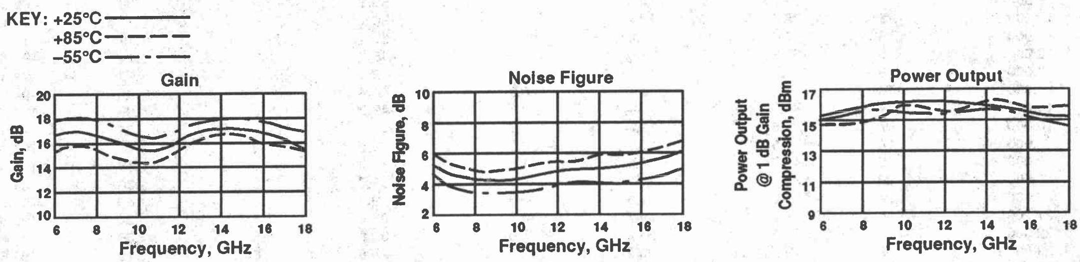
DESCRIPTION

The PPA-18632 is a two-stage GaAs FET RF amplifier in a 1/4 in. square package. Internal blocking capacitors couple the RF signal through the amplifier. The bias voltage input is capacitor bypassed and choke decoupled for RF.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +9 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	6-18	6-18	6-18	GHz
GP	Small Signal Gain (Min.)	14	12	11	dB
—	Gain Flatness (Max.)	±0.75	±1.50	±2.00	dB
NF	Noise Figure (Max.)	5.5	6.5	7.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+15	+13	+12	dBm
—	Input VSWR (Max.)	<1.8:1	2.0:1	2.2:1	—
—	Output VSWR (Max.)	<1.8:1	2.0:1.	2.2:1	—
IP_3	Two Tone 3rd Order Intercept Point	+25.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+32.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+38.0	—	—	dBm
V_D	DC Voltage (1% Reg)	9	—	—	Volts
I_D	DC Current	50	—	—	mA

TYPICAL PERFORMANCE OVER TEMPERATURE (@ +9 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	12 Volts
Continuous RF Input Power	+15 dBm
Operating Case Temperature	−55°C to +125°C
Storage Temperature	−62°C to +150°C
"R" Series Burn-In Temperature	+125°C

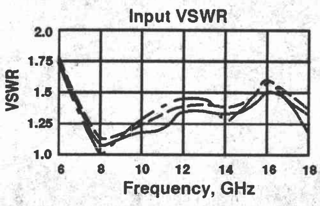
THERMAL CHARACTERISTICS*

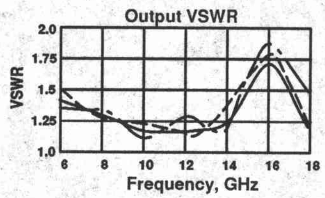
θ_{JC}	212°C/W
Active Transistor Power Dissipation	115 mW
Junction Temperature Above Case Temperature	24°C

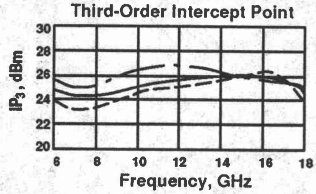
*For further information, see High Reliability section, p. 17–2.

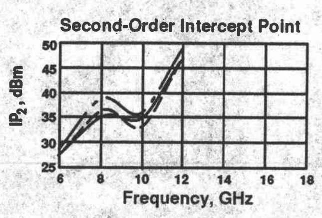
WEIGHT: (typical) 0.21 grams

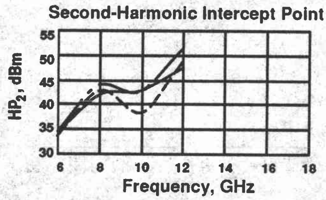
TYPICAL PERFORMANCE OVER TEMPERATURE (continued)











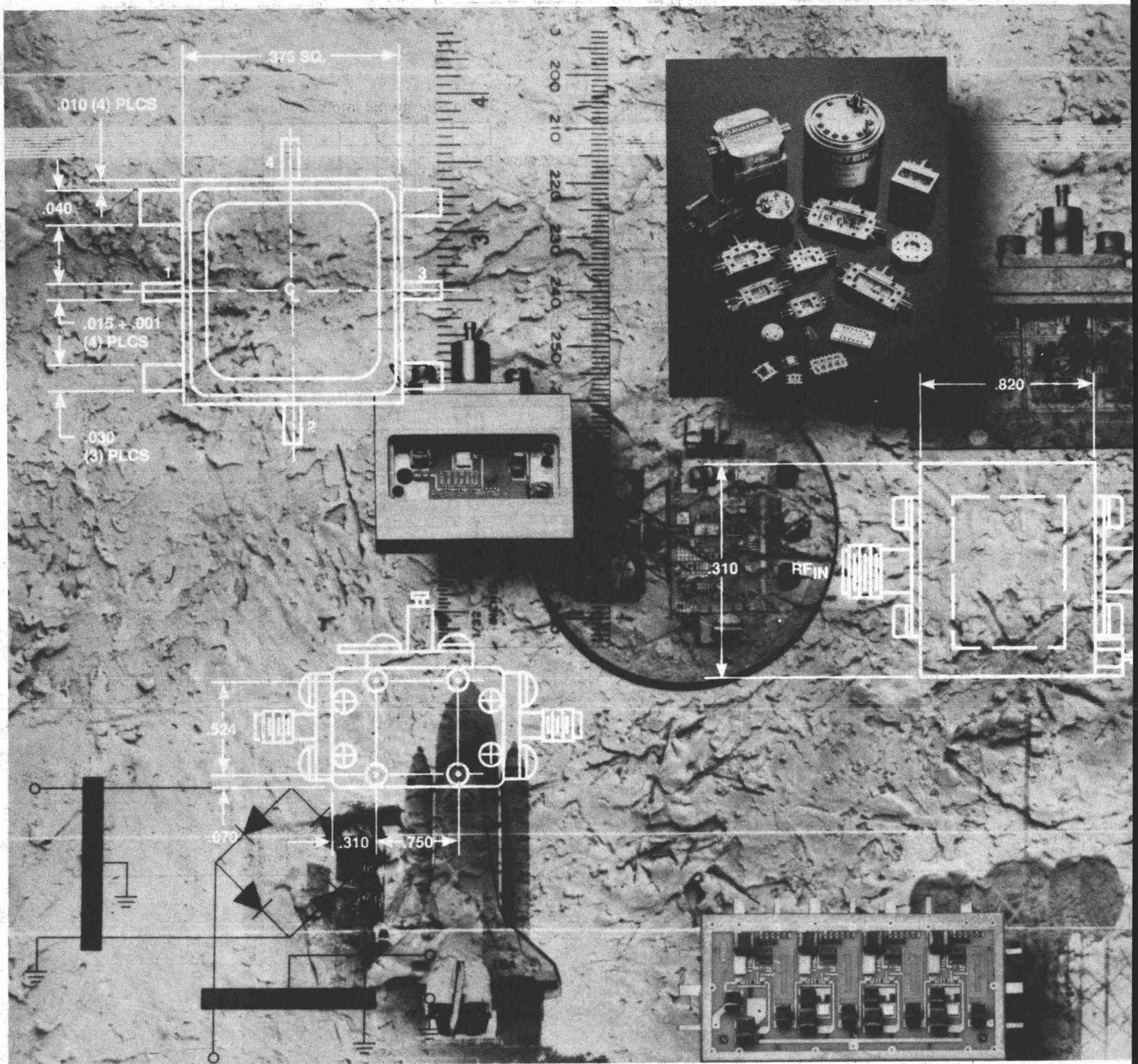
AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

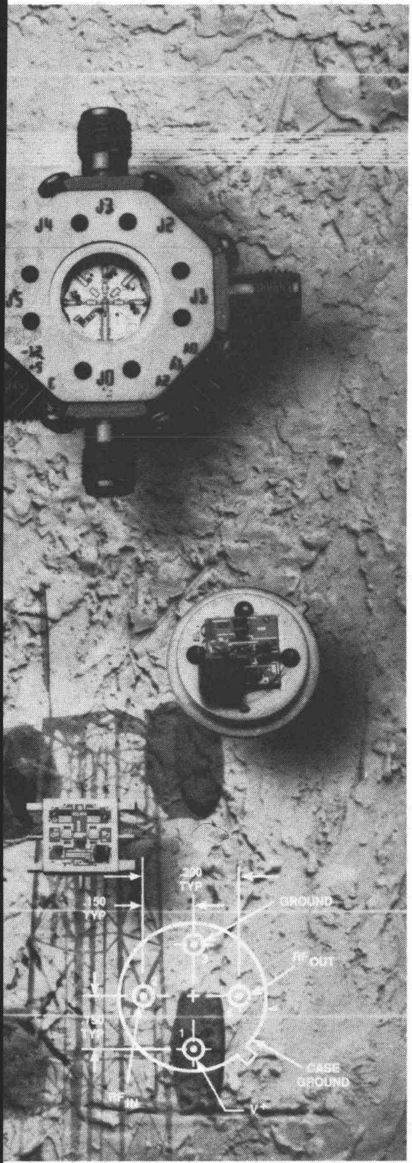
BIAS = 9.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}		GPDEL	PHASE
GHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	ns	DEG
4.0	0.382	121.11	8.60	–174.15	–59.35	101.50	0.238	115.42	.34	0.00
4.5	0.313	32.46	11.61	122.54	–56.35	57.57	0.192	22.23	.34	0.0
5.0	0.291	–37.29	11.11	77.86	–52.60	–122.66	0.180	–39.03	.15	0.00
5.5	0.267	–91.71	13.25	54.67	–50.33	–105.70	0.189	–82.54	.16	0.00
6.0	0.259	–131.40	15.54	12.65	–42.00	–149.51	0.153	–118.69	.23	25.93
6.5	0.259	173.84	15.76	–27.67	–43.67	–163.55	0.135	–155.73	.20	8.21
7.0	0.191	110.39	15.54	–56.34	–41.77	156.03	0.073	177.76	.07	2.13
7.5	0.075	25.00	15.57	–84.63	–42.56	143.38	0.080	–156.68	.15	–3.56
8.0	0.077	–110.64	15.55	–111.66	–45.45	114.46	0.119	174.52	.14	–7.98
8.5	0.107	179.88	15.21	–139.00	–43.81	104.17	0.112	139.37	.12	–12.73
9.0	0.136	150.66	14.87	–159.95	–53.76	43.68	0.107	120.50	.12	–11.08
9.5	0.127	126.88	14.79	178.36	–51.83	65.18	0.099	89.83	.13	–10.17
10.0	0.148	110.54	14.51	156.78	–46.64	100.30	0.071	61.90	.10	–9.15
10.5	0.183	82.72	14.44	136.65	–47.41	119.02	0.066	35.50	.10	–6.68
11.0	0.199	44.62	14.54	117.05	–58.84	39.93	0.022	31.77	.12	–3.68
11.5	0.179	–119.47	14.67	98.19	–46.51	–95.20	0.015	83.02	.11	.05
12.0	0.123	–42.60	15.00	78.69	–43.88	110.16	0.031	99.17	.11	3.16
12.5	0.085	–103.40	15.42	56.93	–47.00	–41.11	0.056	82.30	.12	3.99
13.0	0.082	166.66	15.67	33.80	–42.63	–53.36	0.076	73.55	.14	3.47
13.5	0.131	89.27	15.95	12.48	–39.68	–62.71	0.118	53.88	.11	4.74
14.0	0.199	38.50	15.97	–8.57	–39.26	–71.61	0.157	22.94	.14	6.29
14.5	0.228	–9.86	15.78	–32.41	–38.11	–90.29	0.201	–13.66	.12	5.05
15.0	0.248	–60.76	15.64	–53.72	–41.31	–121.61	0.222	–54.53	.07	6.33
15.5	0.223	–111.23	16.05	–78.06	–40.11	–156.89	0.238	–95.58	.12	4.59
16.0	0.187	–146.49	15.65	–108.05	–41.24	–176.21	0.228	–137.91	.17	–2.80
16.5	0.139	–167.87	14.41	–131.26	–38.56	122.13	0.211	–174.27	.15	–3.41
17.0	0.140	176.43	14.50	–147.51	–37.20	108.21	0.223	140.88	.08	2.94
17.5	0.152	154.26	14.89	–175.37	–35.86	93.81	0.201	87.30	.17	–2.33
18.0	0.162	124.28	14.59	161.04	–32.25	73.43	0.138	31.78	.09	–3.31

GAIN FLATNESS = ±.82


.375 SQ.
.010 (4) PLCS
.040
.015 + .001
(4) PLCS
.030
(3) PLCS
.820
.310
RF IN
.524
.070
.310
.750

IF/RF AMPLIFIERS



PRODUCT DESCRIPTION

Avantek UTO/UTC/PPA cascadable amplifiers is offered in TO-8 packages, TC-1 connectorized cases, and surface-mount PlanarPak packages, respectively. Available with Avantek *R Series* screening, these amplifiers are cascadable modules designed for the best possible performance under difficult operating conditions. They offer unconditional stability and guaranteed performance over the specified frequency response range and temperature extremes. Voltage requirements vary from +5 VDC to +24 VDC, depending on the model. Internally, these units contain various combinations of Si or GaAs MMICs and discrete components on alumina substrates, with thin-film gold interconnect and resistors. Since these units are cascadable modules, both input and output circuits of each device is optimized for the best 50-ohm impedance match. These amplifiers are ideal for pulse amplification, radar and avionic military systems, and high-speed fiber optic systems. Higher-frequency surface mount amplifiers, up to 18 GHz, can be found in the PPA section, beginning on page 2–4.

IF/RF AMPLIFIERS

Guaranteed Specifications at 0° to 50°C Case Temperature

Model	Frequency Response (MHz) Minimum	Gain (dB) Minimum	Noise Figure (dB) Maximum	Power Output for 1 dB Gain Compression (dBm) Minimum	Gain Flatness (±dB) Maximum	3rd-Order Intercept Point (dBm) Typical	Input Power (±1% Reg.) Voltage (VDC)	Input Power (±1% Reg.) Current (mA) Typical	Case Type	Page Number
10 to 150 MHz (Listed in Order of Increasing Noise Figure)										
New UTO/UTC 111	10–100	10.5	1.7	+15.5	0.3	+28[7]	+15	14	TO-8T	3–14
UTO/UTC 103	10–100	25.5	2.1	+9.5	1.0	+22	+5	15	TO-8T	3–10
UTO/UTC 101	10–100	26.5	2.2	+14.5	1.0	+26	+15	20	TO-8T	3–6
UTO/UTC 104	10–150	24.0	2.3	+9	1.0	+22	+5	20	TO-8T	3–12
UTO/UTC 102	20–150	23.5	3.2	+18	1.0	+32	+15	31	TO-8T	3–8
10 to 200 MHz (Listed in Order of Increasing Noise Figure)										
UTO/UTC 514	30–200	15	2.0	−3	0.75	+7	+15	8	TO-8U	3–60
UTO/UTC/PPA 210	10–200	8.0	2.0	+11	1.0	+29	+15	15	TO-8T	3–16
UTO/UTC 221	10–200	27	2.5	+13.5	0.7	+23	+15	29	TO-8T	3–20
UTO/UTC/PPA 211	10–200	7.5	2.7	+17	1.0	+28	+15	30	TO-8T	3–18
UTO/UTC 222	20–200	28	3.6	+18	0.7	+28	+15	47	TO-8T	3–22
UTO/UTC 250	5–200	30	4.0	−3	1.0	+14	+5	13	TO-8U	3–24
5 to 400 MHz (Listed in Order of Increasing Noise Figure)										
UTO/UTC 443[3]	10–400	12.5	4.5	+4.5	0.7	+19	+5	10	TO-8T	3–36
UTO/UTC 440[3]	10–400	12.5	4.5	+8	0.7	+23	+15	15	TO-8T	3–30
UTO/UTC/PPA 441[3]	20–400	13.5	4.5	+15	0.7	+32	+15	32	TO-8T	3–32
UTO/UTC 444[3]	10–400	12.5	5.0	+8.0	0.7	+22	+5	15	TO-8T	3–38
UTO/UTC 421	5–400	27	5.5	+6	1.0	+18	+15	38	TO-8U	3–28
UTO/UTC 416	5–400	14	5.5	+10	1.0	+23	+15	35	TO-8U	3–26
UTO/UTC 442[3]	20–400	13	5.5	+20	0.7	+33	+15	62	TO-8T	3–34
2 to 500 MHz (Listed in Order of Increasing Noise Figure)										
UTO/UTC 511	5–500	15	2.5	−2	1.0	+12	+15	10	TO-8U	3–54
UTO/UTC/PPA 517	5–500	22	2.5	+5	1.0	+15	+15	22	TO-8T	3–66
UTO/UTC/PPA 543[1]	10–500	10	2.5	+6	1.0	+22	+15	25	TO-8T	3–84
UTO/UTC 510	5–500	15	3.0	−2	1.0	+12	+15	10	TO-8U	3–52
UTO/UTC 512	5–500	20	3.0	+7	1.0	+20	+15	23	TO-8U	3–56
UTO/UTC 554	5–500	28.0	3.0	9.0	0.7	+21	+5	40	TO-8T	3–96
UTO/UTC/PPA 544[1]	10–500	10	3.0	+12	1.0	+28	+15	36	TO-8T	3–86
UTO/UTC 547	10–500	11.5	3.5	+18	0.7	+31	+15	55	TO-8T	3–92
UTO/UTC 558	5–500	28	3.2	13.5	0.7	+23	+5	70	TO-8T	3–98
UTO/UTC 572[4]	50–500	18	3.5	+11	0.5	+24	+15	32	TO-8T	3–104
UTO/UTC 501	5–500	14	4.0	−2	1.0	+12	+15	10	TO-8U	3–40
UTO/UTC 521	5–500	27	4.0	+6	1.0	+18	+15	38	TO-8U	3–74
New UTO/UTC 526	5–500	26.5	4.0	+19	0.7	+28[7]	+15	93	TO-8T	3–80
UTO/UTC 552	5–500	13.5	4.0	+6.5	0.7	+21	+5	18	TO-8T	3–94
UTO/UTC 502	5–500	14	4.0	+7	1.0	+21	+15	23	TO-8U	3–42
UTO/UTC 571[4]	50–500	14.5	4.0	+10	0.5	+27	+15	32	TO-8T	3–102
UTO/UTC 524	5–500	30	4.0	+14	1.0	+27	+15	70	TO-8T	3–78
New UTO/UTC 573	10–500	13	4.3	+11	0.5	+23	+15	33	TO-8U	3–106
UTO/UTC 516	5–500	14	4.5	+10	1.0	+23	+15	35	TO-8U	3–64
UTO/UTC/PPA 520	5–500	14	4.5	+12	0.7	+22	+5	33	TO-8T	3–72
UTO/UTC 533	5–500	16	5.0	+14	0.7	+30	+15	53	TO-8T	3–82
UTO/UTC 545	10–500	10	5.0	+17	0.5	+36	+15	60	TO-8T	3–88
UTO/UTC/PPA 519	5–500	13	5.5	+18	0.7	+29	+15	70	TO-8T	3–70
UTO/UTC/PPA 509	5–500	13	5.5	+20	0.7	+35	+15	90	TO-8T	3–50

NOTE: See notes on page 3–4.

IF/RF AMPLIFIERS (continued)

Guaranteed Specifications at 0° to 50°C Case Temperature

Model	Frequency Response (MHz) Minimum	Gain (dB) Minimum	Noise Figure (dB) Maximum	Power Output for 1 dB Gain Compression (dBm) Mininimum	Gain Flatness (±dB) Maximum	3rd-Order Intercept Point (dBm) Typical	Input Power (±1% Reg.) Voltage (VDC)	Input Power (±1% Reg.) Current (mA) Typical	Case Type	Page Number
2 to 500 MHz (Listed in Order of Increasing Noise Figure)										
UTO/UTC 513	5–500	16	6.0	+14	1.0	+29	+24	50	TO-8U	3–58
UTO/UTC 518	5–500	13	6.0	+23	0.7	+35	+15	130	TO-8T	3–68
UTO/UTC 523	5–500	23	7.0	+12	1.0	+25	+15	80	TO-8U	3–76
UTO/UTC 503	5–500	9	7.0	+13	1.0	+29	+24	50	TO-8U	3–44
UTO/UTC 515	2–500	12	7.0	+14	0.5	+24	+15	65	TO-8U	3–62
UTO/UTC 505	10–500	9	7.0	+18	1.0	+29	+15	100	TO-8T	3–48
UTO/UTC 546[3]	20–500	10	8.0	+23	0.5	+38	+15	110	TO-8T	3–90
UTO/UTC 561[2]	10–500	11	9.0	+26	0.7	+39	+15	190	TO-8T	3–100
UTO/UTC 504	5–500	6	11.0	+17	1.0	+34	+24	100	TO-8U	3–46
2 to 1000 MHz (Listed in Order of Increasing Noise Figure)										
UTO/UTC 1011	2–1000	14	3.5	–5	0.7	+10	+15	8	TO-8U	3–118
UTO/UTC 1012	5–1000	15	4.0	+4	1.0	+17	+15	18	TO-8U	3–120
UTO/UTC/PPA 1043[1]	10–1000	10	4.0	+6	1.0	+19	+15	25	TO-8T	3–132
UTO/UTC 1002	5–1000	14	4.0	+7	1.0	+21	+15	23	TO-8U	3–110
UTO/UTC 1054	5–1000	23.5	4.0	+9.5	0.7	+21	+5	40	TO-8T	3–140
UTO/UTC 1058	5–1000	23.5	4.2	+13	0.7	+22	+5	70	TO-8T	3–146
UTO/UTC 1013	5–1000	15	4.5	+9	1.0	+20	+15	29	TO-8U	3–122
UTO/UTC/PPA 1044[1]	10–1000	10	4.5	+12	1.0	+28	+15	35	TO-8T	3–134
UTO/UTC/PPA 1021	5–1000	22	4.5	+12	1.0	+27	+15	85	TO-8U	3–124
UTO/UTC 1001	5–1000	14	5.0	–2	1.0	+12	+15	10	TO-8U	3–108
UTO/UTC 1052	5–1000	13	5.0	+6	0.7	+18	+5	18	TO-8T	3–136
UTO/UTC/PPA 1007	5–1000	12.5	5.0	+11	0.7	+21	+5	33	TO-8T	3–116
UTO/UTC 1076	10–1000	11.5	5.5	+10	0.5	+22	+15	34	TO-8U	3–148 New
UTO/UTC/PPA 1006	5–1000	11	6.0	+17	1.0	+27	+15	70	TO-8T	3–114
UTO/UTC/PPA 1005	5–1000	11	6.0	+20	1.0	+35	+15	90	TO-8T	3–112
UTM-1056	10–1000	25.5	6.5	+12	0.7	+26	+15	135	TO-8T	3–142
UTM-1057	10–1000	26	6.5	+14	0.7	+29	+15	170	TO-8T	3–144
UTO/UTC 1033	5–1000	10	6.5	+14	1.0	+28	+15	48	TO-8T	3–130
UTO/UTC 1024	10–1000	12	6.5	+22[5]	1.0	+35	+15	155	TO-8T	3–128
UTO/UTC 1023	10–1000	12	8.5	+24.5[6]	1.0	+36	+15	205	TO-8T	3–126
UTM-1053	5–1000	27	9.0	+5	2.0	+21	+15	90	TO-8T	3–138
1 to 1500 MHz (Listed in Order of Increasing Noise Figure)										
UTO/UTC 1524	10–1500	21	4.5	+7	1.5	+19	+15	60	TO-8U	3–158
UTO/UTC 1511	5–1500	10	4.5	–9	0.5	+1	+15	7	TO-8U	3–154
UTO/UTC 1522	5–1500	18	5.5	+11	1.5	+23	+15	85	TO-8U	3–156
UTO/UTC 1501	5–1500	9	5.5	–3	0.5	+10	+15	10	TO-8U	3–150
UTO/UTC 1502	5–1500	9	7.5	+6	0.5	+19	+15	23	TO-8U	3–152
1 to 2000 MHz (Listed in Order of Increasing Noise Figure)										
UTO/UTC 2031	1–2000	9	5.5	+2	1.0	+14	+15	16	TO-8U	3–178
UTO/UTC 2032	1–2000	9	6.0	+7	1.0	+17	+15	25	TO-8U	3–180
UTO/UTC 2033	1–2000	8	8.5	+14	1.0	+30	+15	50	TO-8T	3–182
5 to 2000 MHz (Listed in Order of Increasing Noise Figure)										
UTO/UTC/PPA 2012[2]	500–2000	9	4.0	+12	1.0	+23	+15	50	TO-8U	3–160
UTO/UTC 2021	10–2000	9	4.5	+2	1.0	+14	+15	16	TO-8U	3–164
UTO/UTC 2025	100–2000	9.5	4.5	+25	1.0	+37	+15	175	TO-8T	3–172
UTO/UTC 2052	5–2000	9	5.0	+5.5	0.7	+16	+5	18	TO-8T	3–184
UTO/UTC 2024	5–2000	15	5.5	+5	1.0	+18	+15	38	TO-8U	3–170
UTO/UTC/PPA 2013[2]	500–2000	9	5.5	+19	1.0	+33	+15	100	TO-8U	3–162
UTO/UTC 2022	5–2000	9	6.0	+7	1.0	+17	+15	25	TO-8U	3–166
UTO/UTC 2055	10–2000	8.5	6.0	+10	0.7	+22	+5	32	TO-8T	3–186
UTO/UTC 2026	10–2000	13.5	7.0	+19	1.0	+31	+15	155	TO-8T	3–174
UTO/UTC 2027	10–2000	13.5	7.0	+16	1.0	+30	+15	108	TO-8T	3–176
UTO/UTC/PPA 2023	10–2000	8	8.5	+14	1.0	+25	+15	50	TO-8T	3–168

NOTE: See notes on page 3–4.

IF/RF AMPLIFIERS (continued)

Guaranteed Specifications at 0° to 50°C Case Temperature

Model	Frequency Response (MHz) Minimum	Gain (dB) Minimum	Noise Figure (dB) Maximum	Power Output @ 1 dB Gain Compression (dBm) Minimum	Gain Flatness (±dB) Maximum	3rd-Order Intercept Point (dBm) Typical	Input Power (±1% Reg.) Voltage (VDC)	Input Power (±1% Reg.) Current (mA) Typical	Case Type	Page Number
1700 to 2300 MHz (Listed in Order of Increasing Noise Figure)										
UTO/UTC 2311	1700–2300	8	5.0	–3	0.5	+10	+15	15	TO-8U	3–192
UTO/UTC 2302	1700–2300	8	6.5	+3	0.5	+13	+15	18	TO-8U	3–188
UTO/UTC 2303	1700–2300	8	8.0	+10	0.5	+20	+15	30	TO-8U	3–190
UTO/UTC 2321	1700–2300	14	8.0	+10	1.0	+20	+15	70	TO-8U	3–194

NOTES:
1. Both RF input and RF output pins are at DC ground—no blocking capacitor.
2. RF input pin is at DC ground—no input blocking capacitor.
3. A portion of any DC voltage applied to the RF input pin will appear at the RF output pin (i.e. , a resistive DC path exists between pins). There is no input or output blocking capacitor.
4. High reverse isolation, Typ. S_{12} = –48 dB at 500 MHz.
5. From 10-500 MHz, Power Output for 1 dB Comp = +24.5 dBm.
6. From 10-500 MHz, Power Output for 1 dB Comp = +26 dBm.
7. Guaranteed at 0° to 50°C min.

UTC SERIES FACTORY-ASSEMBLED THIN-FILM AMPLIFIERS

Guaranteed Specifications at 0° to 50°C Case Temperature, V = +15 VDC

Model	Frequency Range (MHz)	Gain (dB) Typ./Min.	Noise Figure (dB) Maximum	Power Output @ 1 dB Gain Compression (dBm) Minimum	Gain Flatness (±dB) Maximum	Intercept Point For IM Products (dBm) Typical	VSWR 50 ohms In/Out :1 Maximum	Input Bias Current (mA) Typical	Case Type
10 to 500 MHz									
UTC5-200	10-500	26.5/25	2.7	+6	1.5	+22	2.0	35	TC-2
UTC5-201	10-500	37/35	2.7	+7	1.5	+20	2.0	33	TC-2
UTC5-202	10-500	51.5/48	2.7	+6	1.5	+18	2.0	60	TC-2
UTC5-203	10-500	64.5/62	2.7	+6	2.0	+18	2.0	70	TC-4
UTC5-210	10-500	27.5/26	3.0	+14	1.5	+30	2.0	78	TC-2
UTC5-211	10-500	38/36	3.5	+14	1.5	+30	2.0	76	TC-2
UTC5-212	10-500	47/45	2.7	+14	1.5	+27	2.0	80	TC-2
UTC5-213	10-500	54/52	2.7	+14	2.0	+27	2.0	92	TC-2
UTC5-214	10-500	67/65	2.7	+14	2.0	+27	2.0	103	TC-4
UTC5-220	10-500	24.5/23	3.5	+23	1.5	+35	2.0	165	TC-2
UTC5-221	10-500	35/33	3.0	+23	2.0	+35	2.0	190	TC-4
UTC5-222	10-500	46/44	3.0	+23	2.0	+35	2.0	193	TC-4
UTC5-223	10-500	60.5/58	3.0	+23	2.0	+35	2.0	210	TC-4
10 to 1000 MHz									
UTC10-210	10-1000	21.5/20	4.5	+11	2.0	+28	2.0	60	TC-2
UTC10-211	10-1000	31/29	3.7	+9	1.5	+20	2.0	37	TC-2
UTC10-212	10-1000	41/39	3.7	+9	2.0	+20	2.0	62	TC-4
UTC10-213	10-1000	52/50	3.7	+12	2.0	+27	2.0	101	TC-4
UTC10-220	10-1000	22.5/21	5.0	+20	1.5	+35	2.0	125	TC-2
UTC10-221	10-1000	33/31	4.5	+20	2.0	+35	2.0	150	TC-4
UTC10-222	10-1000	42/40	3.7	+20	2.0	+35	2.0	127	TC-4
UTC10-223	10-1000	49/47	3.7	+20	2.0	+35	2.0	163	TC-4
10 to 2000 MHz									
UTC20-210	10-2000	19.5/18	5.0	+7	1.5	+17	2.2	41	TC-2
UTC20-211	10-2000	28/26	5.0	+14	2.0	+29	2.2	91	TC-4
UTC20-212	10-2000	34/32	6.0	+14	2.0	+29	2.2	104	TC-4
UTC20-213	10-2000	40/38	6.0	+12	2.0	+29	2.2	126	TC-4

Connector options for TC-2 and TC-4 cases are as follows:

–1	SMA	Female on both
–2	N	Female on both
–3	BNC	Female on both
–4	TNC	Female on both
–5	SMA	Male on both
–6	SMA	Male on input/Female on output
–7	SMA	Female on input/Male on output

AVANTEK

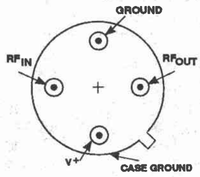
UTO/UTC 101 Series
Thin-Film Cascadable Amplifier
10 to 100 MHz

FEATURES

- Frequency Range: 10 to 100 MHz
- Low Power Consumption: 20 mA @ 15 VDC
- Low Noise Figure: 1.7 dB (Typ)
- High Gain: 27.5 dB (Typ)
- High Output Power: +16 dBm (Typ)
- Wide Dynamic Range
- Temperature Compensated

APPLICATIONS

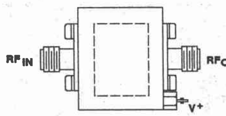
- Receiver IF Gain Stages
- Medical Instruments: Ultra-Sound, Magnetic Resonance



UTO—TO-8T, p. 16–48

DESCRIPTION

The 101 Series is a wideband, single-stage, high-gain silicon bipolar amplifier that incorporates thin-film technology. The low noise figure and high efficiency are the result of an output transformer coupling design. This also provides the unit with a high dynamic range. Resistive feedback and active bias provide temperature compensation and increased immunity to supply voltage variations. The 101 Series is available in either the TO-8 hermetic package or the connectored TC-1 package.

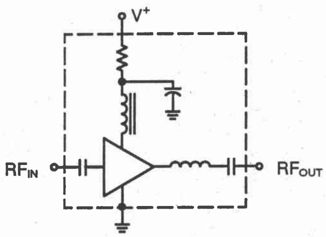


UTC—TC-1, p. 16–42

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal)

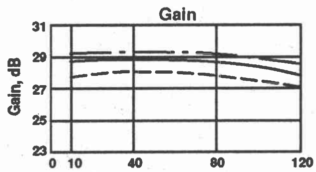
Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	5-120	10-100	10-100	MHz
GP	Small Signal Gain (Min.)	27.5	26.5	25.5	dB
—	Gain Flatness (Max.)	±0.3	±1.0	±1.0	dB
NF	Noise Figure (Max.)	1.7	2.2	2.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+16.0	+14.5	+14.0	dBm
—	Input VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.3:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+26.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+33.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+40.0	—	—	dBm
I_D	DC Current	20	—	—	mA

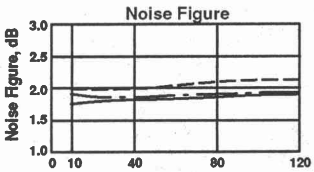
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
–55°C —·—





MAXIMUM RATINGS

DC Voltage .... 17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

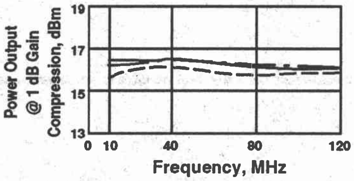
THERMAL CHARACTERISTICS*

θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 162 mW
Junction Temperature Above Case Temperature .... 17°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 653,900 Hrs.
*For further information, see High Reliability section, p. 17–2.

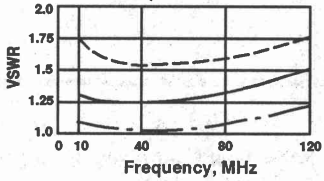
WEIGHT: (typical) UTO—1.7 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

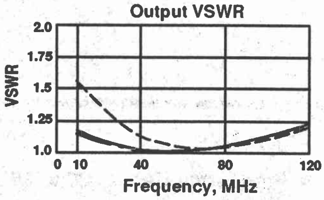
Power Output



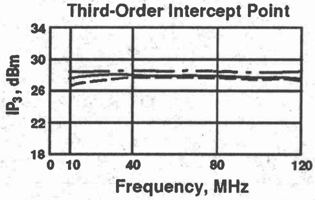
Input VSWR



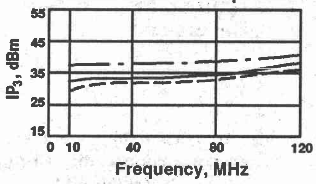
Output VSWR



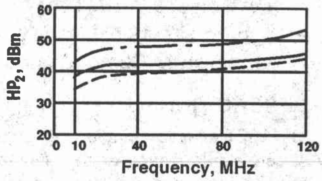
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

BIAS = 15 VOLTS
CURRENT = 19.5 mA

FREQ	S_{11}		S_{21}		S_{12}		S_{22}		GPDEL	PHASE
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	ns	DEG
5	.17	–45.2	28.2	–166.2	–32.8	16.3	.14	126.71	5.96	
10	.13	–28.2	28.2	–176.9	–32.5	8.9	.07	112.23	5.96	2.82
20	.12	–17.6	28.2	174.4	–32.5	5.5	.03	102.68	2.43	–.45
30	.12	–15.1	28.2	168.3	–32.4	4.3	.02	90.30	1.69	–1.10
40	.13	–15.1	28.2	162.8	–32.3	3.7	.00	35.77	1.53	–1.16
50	.13	–16.5	28.1	157.5	–32.3	3.7	.01	–52.02	1.46	–.96
60	.14	–18.6	28.1	152.4	–32.3	3.8	.02	–67.47	1.42	–.63
70	.15	–21.5	28.0	147.3	–32.3	4.1	.03	–74.83	1.41	–.23
80	.16	–24.8	27.9	142.3	–32.3	4.3	.04	–79.82	1.41	.16
90	.17	–28.8	27.8	137.2	–32.2	4.4	.05	–84.82	1.40	.56
100	.18	–32.7	27.7	132.2	–32.2	5.0	.07	–89.41	1.39	.99
110	.19	–37.1	27.5	127.2	–32.1	5.5	.08	–94.15	1.39	
120	.20	–41.3	27.3	122.2	–32.1	5.7	.09	–98.73	1.38	
130	.21	–45.9	27.1	117.3	–32.0	6.2	.11	–103.38	1.36	
140	.22	–50.3	26.9	112.4	–32.0	6.7	.12	–108.20	1.36	
150	.23	–54.5	26.7	107.7	–31.8	7.1	.13	–112.95	1.33	
160	.24	–58.8	26.4	103.0	–31.7	7.5	.14	–117.56	1.31	
170	.25	–63.1	26.2	98.4	–31.6	7.8	.16	–122.23	1.28	
180	.25	–67.0	25.9	93.9	–31.5	8.4	.17	–126.85	1.24	
190	.26	–70.9	25.6	89.6	–31.3	8.4	.18	–131.37	1.21	
200	.27	–74.7	25.3	85.3	–31.2	8.4	.19	–135.77	1.17	
210	.27	–78.0	24.9	81.2	–30.9	8.7	.21	–140.11	1.14	
220	.27	–81.3	24.6	77.2	–30.8	8.1	.22	–144.30	1.11	
230	.28	–84.5	24.2	73.4	–30.7	8.0	.23	–148.37	1.07	
240	.28	–87.4	23.9	69.6	–30.5	7.6	.24	–152.27	1.03	
250	.28	–90.2	23.6	66.0	–30.3	7.4	.25	–156.15	1.01	
260	.28	–92.7	23.2	62.5	–30.2	6.8	.26	–159.84	.97	
270	.28	–95.1	22.9	59.1	–30.0	5.9	.27	–163.43	.94	
280	.28	–97.3	22.5	55.8	–29.9	5.2	.28	–166.99	.93	
290	.28	–99.2	22.2	52.5	–29.8	4.7	.29	–170.42	.89	
300	.28	–101.0	21.8	49.4	–29.6	3.9	.30	–173.80	.88	
310	.28	–102.7	21.5	46.3	–29.5	3.0	.30	–177.10	.86	
320	.28	–104.2	21.2	43.3	–29.4	2.0	.31	179.76	.84	
330	.28	–105.5	20.8	40.3	–29.3	1.1	.32	176.53	.82	
340	.28	–106.6	20.5	37.4	–29.2	.1	.33	173.39	.82	
350	.28	–107.7	20.2	34.5	–29.0	–1.0	.34	170.33	.80	
360	.28	–108.4	19.9	31.6	–29.0	–2.2	.35	167.32	.79	
370	.28	–109.1	19.5	28.8	–28.9	–3.6	.36	164.36	.77	
380	.28	–109.6	19.2	26.1	–28.9	–4.7	.37	161.46	.77	
390	.28	–110.1	18.9	23.3	–28.8	–5.7	.38	158.57	.76	
400	.28	–110.3	18.6	20.6	–28.8	–7.2	.38	155.69	.75	
410	.28	–110.5	18.3	17.9	–28.8	–8.6	.39	152.92	.75	
420	.28	–110.5	18.0	15.2	–28.7	–9.7	.40	150.10	.74	
430	.28	–110.5	17.7	12.6	–28.7	–11.2	.41	147.35	.74	
440	.28	–110.5	17.3	10.0	–28.7	–12.4	.42	144.58	.73	
450	.29	–110.3	17.0	7.4	–28.7	–14.1	.43	141.84	.72	
460	.29	–110.1	16.7	4.7	–28.8	–15.4	.44	139.10	.74	
470	.29	–109.8	16.4	2.1	–28.8	–16.7	.45	136.39	.73	
480	.30	–109.5	16.1	–.4	–28.8	–18.1	.46	133.73	.71	
490	.30	–109.3	15.8	–3.0	–28.9	–19.5	.46	131.00	.72	
500	.31	–109.1	15.5	–5.6	–29.0	–20.6	.47	128.37	.72	

LINEARIZATION RANGE: 10.0 to 100.0 MHz

AVANTEK

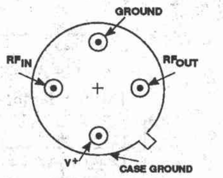
UTO/UTC 102 Series
Thin-Film Cascadable Amplifier
20 to 150 MHz

FEATURES

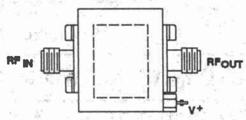
- Frequency Range: 20 to 150 MHz
- High Gain: 24.5 dB
- Low Noise: 2.7 dB (Typ)
- High Power: 19.5 dBm (Typ)
- Temperature Compensated

APPLICATIONS

- Low Frequency IF Stages
- Medical Instruments: Ultra-Sound, Magnetic Resonance



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

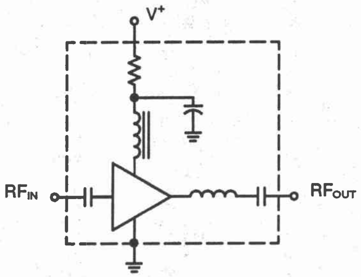
DESCRIPTION

The 102 Series is a single-stage, high-gain silicon bipolar amplifier that incorporates thin-film technology. A low noise figure and high efficiency are the result of an output transformer coupling design. Resistive feedback and active bias provide temperature compensation and increased immunity to bias voltage variations. Blocking capacitors couple the RF through the amplifier while a low VSWR is maintained through inductive tuning. The 102 Series is available in either the TO-8 hermetic package or the connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal)

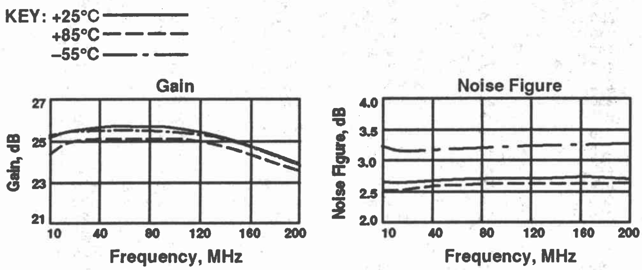
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	20-150	20-150	20-150	MHz
GP	Small Signal Gain (Min.)	24.5	23.5	22.5	dB
—	Gain Flatness (Max.)	±0.3	±1.0	±1.0	dB
NF	Noise Figure (Max.)	2.7	3.2	3.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+19.5	+18.0	+17.5	dBm
—	Input VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+32.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+43.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+50.0	—	—	dBm
I_D	DC Current	31	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage .... 17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... −55°C to +125°C
Storage Temperature .... −62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

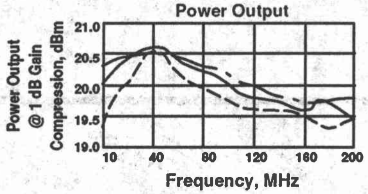
THERMAL CHARACTERISTICS*

θ_{JC} .... 87°C/W
Active Transistor Power Dissipation .... 266 mW
Junction Temperature Above Case Temperature .... 23°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 564,100 Hrs.
*For further information, see High Reliability section, p. 17–2.

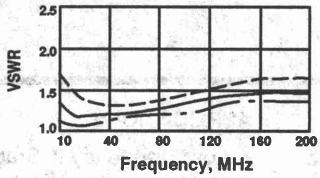
WEIGHT: (typical) UTO—1.7 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

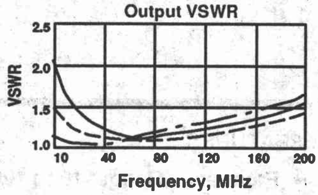
Power Output



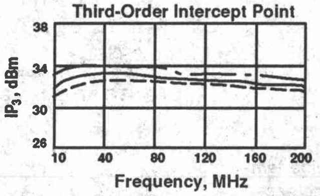
Input VSWR



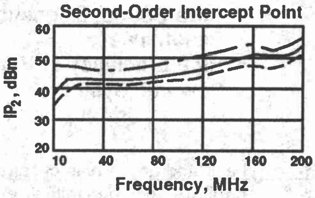
Output VSWR



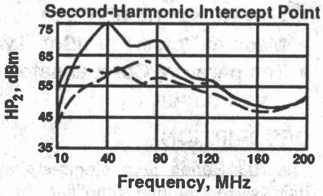
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

BIAS = 15 VOLTS
CURRENT = 30.8 mA

FREQ	S_{11}		S_{21}		S_{12}		S_{22}		GPDEL	PHASE
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	ns	DEG
10	.18	−61.6	24.9	−166.0	−29.6	17.9	.22	117.60	3.53	
20	.09	−46.3	25.0	−178.6	−29.3	9.7	.11	108.39	3.53	1.92
30	.07	−23.4	25.1	174.7	−29.3	7.0	.07	106.92	1.87	−.10
40	.07	−3.7	25.1	169.4	−29.2	5.7	.04	108.26	1.47	−.67
50	.08	7.9	25.1	164.6	−29.3	4.9	.03	114.61	1.33	−.76
60	.09	13.0	25.1	160.0	−29.2	4.9	.01	139.73	1.28	−.63
70	.10	14.4	25.2	155.5	−29.2	4.8	.01	−149.97	1.25	−.43
80	.12	14.0	25.2	151.0	−29.2	5.0	.02	−122.85	1.25	−.21
90	.13	11.7	25.2	146.5	−29.2	4.9	.04	−117.87	1.26	−.06
100	.14	8.5	25.1	141.9	−29.2	5.7	.05	−117.48	1.27	.09
110	.16	4.7	25.1	137.3	−29.2	5.9	.06	−119.65	1.29	.15
120	.17	.3	25.0	132.7	−29.1	6.6	.08	−122.64	1.29	.21
130	.17	−4.3	25.0	127.9	−29.1	7.0	.09	−126.49	1.31	.20
140	.18	−9.3	24.8	123.2	−29.0	7.5	.11	−130.72	1.32	.16
150	.19	−14.5	24.7	118.5	−28.9	8.0	.12	−135.32	1.31	.14
160	.19	−20.0	24.5	113.8	−28.7	8.8	.14	−140.04	1.31	
170	.19	−25.5	24.3	109.1	−28.6	9.4	.16	−144.87	1.29	
180	.20	−30.8	24.1	104.5	−28.4	9.6	.17	−149.88	1.28	
190	.19	−36.5	23.9	100.0	−28.3	10.1	.18	−154.91	1.25	
200	.19	−41.9	23.6	95.6	−28.1	10.4	.20	−159.84	1.22	
210	.19	−47.5	23.3	91.3	−27.9	10.4	.21	−164.78	1.18	
220	.19	−52.8	23.0	87.2	−27.7	10.3	.22	−169.65	1.15	
230	.18	−58.4	22.7	83.2	−27.5	10.2	.23	−174.41	1.12	
240	.18	−63.8	22.4	79.3	−27.3	10.0	.25	−179.07	1.07	
250	.17	−69.0	22.0	75.6	−27.1	9.5	.26	176.47	1.03	
260	.16	−74.6	21.7	72.0	−26.9	9.3	.27	172.04	1.00	
270	.16	−79.9	21.3	68.6	−26.7	8.3	.27	167.70	.95	
280	.15	−85.2	21.0	65.2	−26.5	7.8	.28	163.57	.92	
290	.14	−90.8	20.6	62.0	−26.4	7.1	.29	159.51	.90	
300	.14	−96.5	20.3	58.9	−26.2	6.3	.30	155.49	.87	
310	.13	−102.1	19.9	55.9	−26.0	5.5	.31	151.64	.83	
320	.12	−107.8	19.6	53.0	−25.9	4.5	.31	147.88	.81	
330	.12	−113.8	19.2	50.2	−25.7	3.6	.32	144.17	.78	
340	.11	−120.1	18.9	47.5	−25.6	2.5	.33	140.60	.77	
350	.11	−126.3	18.5	44.8	−25.5	1.7	.33	137.08	.73	
360	.10	−132.7	18.2	42.2	−25.3	.5	.34	133.67	.72	
370	.10	−139.6	17.8	39.7	−25.3	−.5	.35	130.25	.70	
380	.09	−146.4	17.5	37.3	−25.2	−1.6	.35	126.96	.69	
390	.09	−153.3	17.1	34.9	−25.1	−2.7	.36	123.74	.66	
400	.09	−160.5	16.8	32.6	−24.9	−3.9	.36	120.56	.64	
410	.09	−167.6	16.5	30.2	−24.8	−4.8	.37	117.41	.65	
420	.09	−174.6	16.1	28.0	−24.8	−6.1	.38	114.37	.62	
430	.09	178.3	15.8	25.8	−24.7	−7.1	.38	111.36	.61	
440	.09	170.9	15.5	23.6	−24.6	−8.5	.39	108.40	.60	
450	.09	164.2	15.2	21.5	−24.5	−9.5	.39	105.49	.58	
460	.09	158.0	14.9	19.5	−24.5	−10.8	.40	102.64	.58	
470	.09	151.3	14.6	17.4	−24.5	−12.1	.40	99.78	.58	
480	.09	145.8	14.3	15.4	−24.4	−13.4	.41	97.02	.56	
490	.10	140.3	14.0	13.4	−24.3	−14.6	.41	94.29	.55	
500	.10	134.8	13.7	11.4	−24.3	−15.7	.42	91.58	.55	

LINEARIZATION RANGE: 20.0 to 150.0 MHz

![AVANTEK]

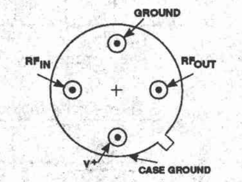
UTO/UTC 103 Series
Thin-Film Cascadable Amplifier
10 to 100 MHz

FEATURES

- Frequency Range: 10 to 100 MHz
- High Gain: 27 dB (Typ)
- Low Noise: 1.6 dB (Typ)
- Medium Power: 11 dBm (Typ)
- Temperature Compensated
- 5 Volt Supply

APPLICATIONS

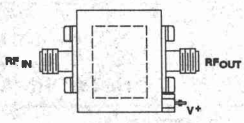
- Low Frequency IF Stages
- Medical Instruments: Ultra-Sound, Magnetic Resonance
- High Efficiency or Battery Powered Systems



UTO—TO-8T, p. 16–48

DESCRIPTION

The 103 Series is a single-stage, high-gain silicon bipolar amplifier that incorporates thin-film technology. Low noise figure and high efficiency are the result of an output transformer coupling design and low supply voltage. Resistive feedback and active bias circuits provide temperature compensation and increased immunity to bias voltage variations. The 103 Series is available in either the TO-8 hermetic package or the connectored TC-1 package.

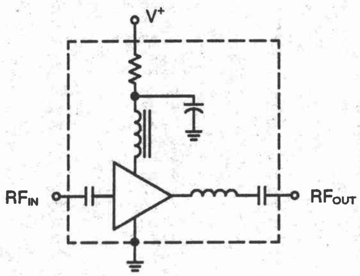


UTC—TC-1, p. 16–42

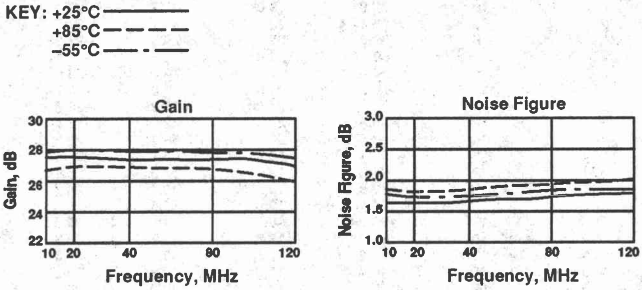
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			$T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	
BW	Frequency Range	5-120	10-100	10-100	MHz
GP	Small Signal Gain (Min.)	27.0	25.5	24.5	dB
—	Gain Flatness (Max.)	±0.2	±1.0	±1.0	dB
NF	Noise Figure (Max.)	1.6	2.1	2.4	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+11.0	+9.5	+9.0	dBm
—	Input VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.3:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+22.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+33.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+38.0	—	—	dBm
I_D	DC Current	15	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +5 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage .... 10 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

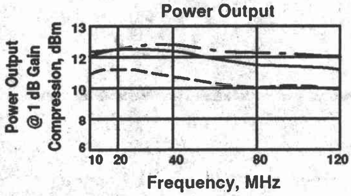
THERMAL CHARACTERISTICS*

θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 47 mW
Junction Temperature Above Case Temperature .... 5°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 892,100 Hrs.
*For further information, see High Reliability section, p. 17–2.

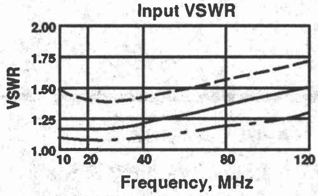
WEIGHT: (typical) UTO — 1.7 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

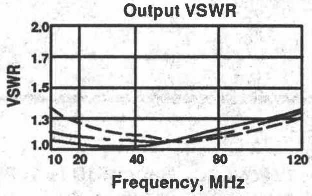
Power Output



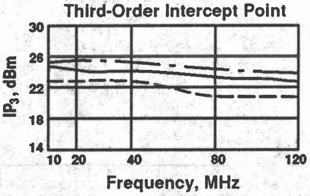
Input VSWR



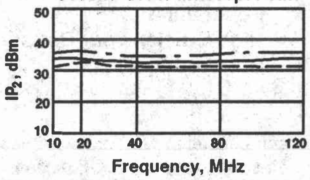
Output VSWR



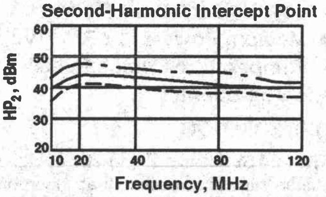
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

BIAS = 5 VOLTS
CURRENT = 15.1 mA

FREQ	S_{11}		S_{21}		S_{12}		S_{22}		GPDEL	PHASE
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	ns	DEG
5	.09	−39.4	27.1	−171.5	−31.4	10.6	.06	155.97	4.27	
10	.07	−16.9	27.1	−179.2	−31.2	5.8	.03	151.84	4.27	1.48
20	.08	.5	27.1	173.6	−31.2	3.5	.02	154.30	2.00	−.50
30	.09	7.2	27.1	168.2	−31.2	2.8	.02	157.83	1.51	−.71
40	.10	9.1	27.1	163.1	−31.2	2.7	.01	175.83	1.41	−.58
50	.11	8.2	27.1	158.1	−31.3	3.4	.01	−97.58	1.38	−.31
60	.13	5.2	27.1	153.1	−31.3	3.9	.02	−71.26	1.39	−.07
70	.14	.9	27.1	148.1	−31.3	4.4	.03	−70.16	1.40	.12
80	.16	−3.9	27.0	142.9	−31.3	4.9	.04	−72.65	1.43	.19
90	.17	−9.7	26.9	137.7	−31.3	6.1	.06	−77.50	1.45	.20
100	.18	−15.5	26.8	132.5	−31.4	7.2	.08	−83.15	1.46	.18
110	.19	−22.1	26.7	127.2	−31.3	8.6	.09	−89.07	1.47	
120	.20	−28.6	26.5	121.9	−31.3	10.2	.11	−95.21	1.46	
130	.21	−35.1	26.2	116.8	−31.1	11.3	.13	−101.44	1.43	
140	.22	−41.5	26.0	111.7	−31.0	12.7	.15	−107.58	1.42	
150	.22	−47.5	25.7	106.7	−30.8	14.4	.16	−113.73	1.36	
160	.23	−53.8	25.4	102.0	−30.6	15.4	.18	−119.67	1.33	
170	.23	−59.7	25.0	97.4	−30.4	16.2	.19	−125.46	1.27	
180	.23	−65.2	24.7	93.0	−30.1	16.7	.21	−130.99	1.21	
190	.23	−70.6	24.3	88.8	−29.8	17.5	.22	−136.31	1.16	
200	.23	−75.9	23.9	84.8	−29.5	17.6	.23	−141.40	1.11	
210	.22	−80.6	23.5	81.1	−29.3	17.7	.24	−146.36	1.05	
220	.22	−85.3	23.1	77.4	−29.0	17.4	.25	−150.94	1.01	
230	.22	−89.6	22.8	74.0	−28.7	17.2	.26	−155.41	.96	
240	.21	−93.8	22.4	70.7	−28.4	16.7	.27	−159.63	.92	
250	.21	−97.8	22.0	67.6	−28.2	16.6	.27	−163.73	.87	
260	.20	−101.6	21.6	64.6	−28.0	15.8	.28	−167.65	.84	
270	.20	−105.0	21.2	61.7	−27.7	15.2	.29	−171.42	.80	
280	.20	−108.4	20.9	58.9	−27.5	14.3	.29	−175.08	.78	
290	.19	−111.7	20.5	56.2	−27.3	13.6	.30	−178.60	.75	
300	.19	−114.8	20.2	53.5	−27.1	12.8	.31	178.00	.74	
310	.18	−117.6	19.8	51.0	−26.9	11.9	.31	174.64	.71	
320	.18	−120.5	19.5	48.5	−26.8	10.6	.32	171.45	.69	
330	.17	−123.1	19.2	46.0	−26.6	9.7	.32	168.25	.67	
340	.17	−125.7	18.8	43.6	−26.4	8.7	.33	165.17	.68	
350	.16	−128.1	18.5	41.3	−26.2	7.6	.34	162.18	.65	
360	.15	−130.2	18.2	39.0	−26.1	6.5	.34	159.25	.64	
370	.15	−132.5	17.9	36.7	−25.9	5.2	.35	156.37	.63	
380	.14	−134.5	17.6	34.5	−25.8	4.1	.35	153.60	.62	
390	.14	−136.3	17.3	32.3	−25.7	3.2	.36	150.86	.61	
400	.13	−138.0	17.0	30.1	−25.6	1.7	.36	148.12	.60	
410	.13	−139.5	16.8	28.0	−25.5	.4	.37	145.49	.60	
420	.12	−140.9	16.5	25.8	−25.4	−.8	.37	142.84	.59	
430	.12	−142.1	16.2	23.7	−25.3	−2.1	.38	140.27	.59	
440	.11	−143.2	15.9	21.6	−25.2	−3.4	.38	137.71	.58	
450	.10	−144.0	15.7	19.6	−25.1	−4.7	.39	135.20	.56	
460	.10	−144.2	15.4	17.5	−25.0	−6.1	.39	132.71	.57	
470	.09	−144.9	15.1	15.4	−25.0	−7.3	.40	130.24	.58	
480	.09	−144.4	14.9	13.4	−24.9	−8.8	.40	127.84	.56	
490	.08	−144.3	14.6	11.4	−24.8	−10.0	.41	125.43	.56	
500	.08	−143.0	14.4	9.4	−24.7	−11.3	.41	123.06	.55	

LINEARIZATION RANGE: 10.0 to 100.0 MHz

AVANTEK

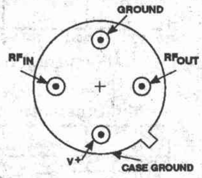
UTO/UTC 104 Series
Thin-Film Cascadable Amplifier
10 to 150 MHz

FEATURES

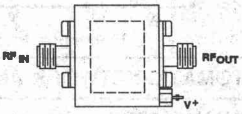
- **Frequency Range: 10 to 150 MHz**
- **High Gain: 25 dB (Typ)**
- **Low Noise: 1.9 dB (Typ)**
- **Medium Power: 11 dBm (Typ)**
- **Temperature Compensated**
- **5 Volt Supply**

APPLICATIONS

- **Low Frequency IF Stages**
- **Medical Instruments: Ultra-Sound, Magnetic Resonance**
- **High Efficiency or Battery Powered Systems**



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

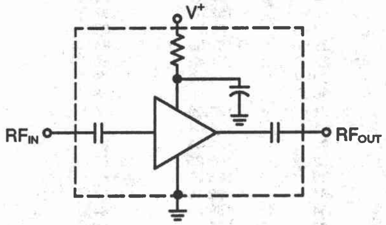
DESCRIPTION

The 104 Series is a single-stage, high-gain silicon bipolar amplifier that incorporates thin-film technology. Low noise figure and high efficiency are the result of an output transformer coupling design and lower supply voltage. Resistive feedback and active bias circuits provide temperature compensation and increased immunity to bias voltage variations. Blocking capacitors couple the RF through the amplifier, while a low VSWR is maintained through inductive tuning. The 104 Series is available in either the TO-8 hermetic package or the connectored TC-1 package.

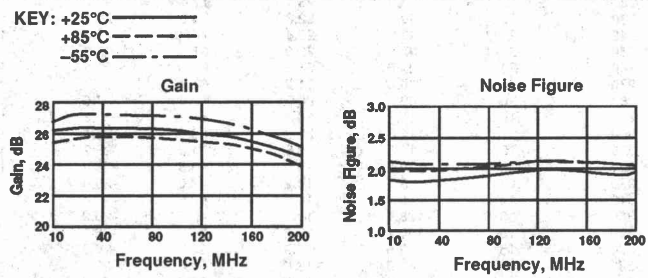
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-150	10-150	10-150	MHz
GP	Small Signal Gain (Min.)	25.0	24.0	23.0	dB
—	Gain Flatness (Max.)	±0.3	±1.0	±1.0	dB
NF	Noise Figure (Max.)	1.9	2.3	2.6	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+10.5	+9.0	+8.0	dBm
—	Input VSWR (Max.)	1.4:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.4:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+22.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+29.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+35.0	—	—	dBm
I_D	DC Current	20	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +5 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	10 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

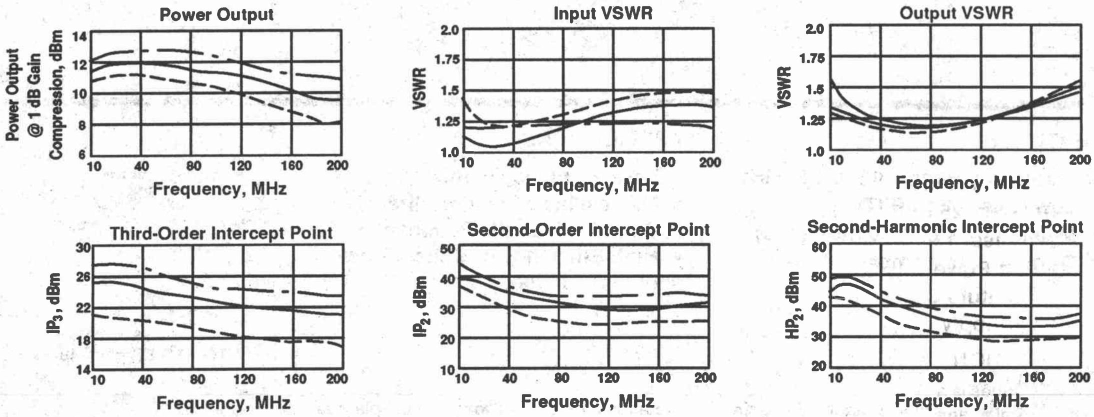
THERMAL CHARACTERISTICS*

θ_{JC}	105°C/W
Active Transistor Power Dissipation	47 mW
Junction Temperature Above Case Temperature	5°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	848,400 Hrs.

*For further information, see High Reliability section, p. 17–2.

WEIGHT: (typical) UTO — 1.7 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

BIAS = 5 VOLTS
CURRENT = 20.1 mA

FREQ	S_{11}		S_{21}		S_{12}		S_{22}		GPDEL	PHASE
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	ns	DEG
5	.17	–79.1	25.7	–162.9	–30.5	18.6	.22	151.01	6.51	
10	.07	–81.4	25.8	–174.4	–30.1	9.7	.15	152.04	6.51	
20	.02	–64.3	25.8	177.1	–30.0	5.8	.12	158.36	2.41	.44
30	.02	23.2	25.9	171.6	–29.9	4.6	.11	161.11	1.53	–.34
40	.03	46.0	25.9	166.8	–29.9	4.5	.10	162.81	1.33	–.47
50	.05	46.3	25.9	162.3	–29.8	4.6	.09	164.29	1.26	–.32
60	.07	42.9	25.9	157.8	–29.8	4.8	.09	166.32	1.24	–.10
70	.08	38.1	25.9	153.4	–29.8	5.2	.08	169.32	1.24	.12
80	.09	32.8	25.9	148.9	–29.8	5.6	.08	173.39	1.25	.27
90	.11	26.5	25.9	144.3	–29.8	6.2	.08	178.63	1.28	.33
100	.12	20.3	25.9	139.6	–29.7	6.8	.08	–175.23	1.29	.34
110	.13	13.6	25.8	134.9	–29.7	7.4	.08	–169.11	1.32	.27
120	.14	7.0	25.7	130.1	–29.6	7.8	.09	–164.00	1.34	.13
130	.14	.3	25.6	125.2	–29.6	8.9	.10	–160.48	1.34	–.02
140	.15	–6.5	25.5	120.4	–29.5	9.6	.11	–158.56	1.35	–.24
150	.15	–13.7	25.3	115.5	–29.4	10.4	.12	–158.13	1.34	–.39
160	.16	–20.7	25.1	110.7	–29.3	11.1	.14	–158.77	1.33	
170	.16	–27.6	24.9	106.0	–29.1	11.8	.15	–160.39	1.31	
180	.16	–34.5	24.6	101.4	–28.9	12.4	.17	–162.71	1.28	
190	.16	–41.3	24.3	96.9	–28.7	13.3	.18	–165.66	1.26	
200	.16	–48.2	24.0	92.5	–28.6	13.5	.20	–168.78	1.21	
210	.15	–55.1	23.7	88.3	–28.3	13.7	.21	–172.22	1.16	
220	.15	–61.7	23.3	84.2	–28.1	13.9	.23	–175.66	1.12	
230	.15	–68.5	22.9	80.4	–27.9	13.7	.24	–179.32	1.08	
240	.14	–75.0	22.6	76.6	–27.7	13.7	.25	177.14	1.04	
250	.14	–81.8	22.2	73.1	–27.5	13.6	.26	173.54	.99	
260	.13	–88.4	21.8	69.6	–27.3	12.8	.28	169.97	.95	
270	.13	–95.1	21.4	66.4	–27.1	12.5	.29	166.40	.91	
280	.12	–102.0	21.1	63.2	–26.9	12.0	.30	162.92	.88	
290	.12	–109.0	20.7	60.1	–26.7	11.3	.31	159.51	.84	
300	.12	–115.8	20.3	57.2	–26.5	10.7	.32	156.10	.82	
310	.11	–123.0	19.9	54.4	–26.3	9.9	.33	152.80	.78	
320	.11	–130.3	19.5	51.7	–26.2	8.9	.33	149.57	.76	
330	.11	–137.5	19.2	49.0	–26.0	8.0	.34	146.36	.73	
340	.10	–144.8	18.8	46.4	–25.8	7.2	.35	143.23	.72	
350	.10	–151.8	18.4	43.9	–25.7	6.2	.36	140.16	.70	
360	.10	–158.9	18.1	41.5	–25.6	5.2	.37	137.16	.67	
370	.10	–166.1	17.7	39.2	–25.4	4.0	.38	134.21	.65	
380	.10	–173.2	17.4	36.9	–25.3	3.2	.38	131.32	.65	
390	.10	–179.7	17.0	34.6	–25.2	2.1	.39	128.46	.62	
400	.10	174.0	16.7	32.4	–25.1	1.0	.40	125.66	.61	
410	.11	167.8	16.3	30.2	–25.0	–.2	.40	122.93	.60	
420	.11	161.9	16.0	28.1	–24.9	–1.4	.41	120.19	.59	
430	.11	156.3	15.7	26.0	–24.8	–2.5	.42	117.49	.58	
440	.11	150.9	15.3	24.0	–24.7	–3.6	.43	114.85	.57	
450	.12	145.9	15.0	22.0	–24.7	–5.0	.43	112.24	.54	
460	.12	141.1	14.7	20.0	–24.6	–6.2	.44	109.65	.55	
470	.12	136.3	14.3	18.1	–24.6	–7.4	.45	107.08	.55	
480	.13	132.1	14.0	16.2	–24.5	–8.5	.45	104.61	.53	
490	.13	127.7	13.7	14.3	–24.5	–9.8	.46	102.12	.53	
500	.14	123.9	13.4	12.4	–24.4	–11.1	.46	99.69	.51	

LINEARIZATION RANGE: 10.0 to 150.0 MHz

AVANTEK

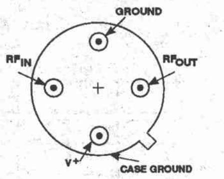
UTO/UTC 111
Thin-Film Cascadable Amplifier
10 to 100 MHz

FEATURES

- Frequency Range: 10 to 100 MHz
- Low Noise: 1.4 dB (Typ)
- Medium Power: 16.8 dBm (Typ)
- Temperature Compensated

APPLICATIONS

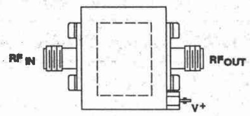
- Low Frequency IF Stages
- Medical Instruments: Ultra-Sound, Magnetic Resonance
- High Efficiency or Battery Powered Systems



UTO—TO-8T, p. 16–48

DESCRIPTION

The 111 Series is a single-stage, high-gain silicon bipolar amplifier that incorporates thin-film technology. Low noise figure and high efficiency are the result of an output transformer coupling design. Active bias circuits provide temperature compensation and increased immunity to bias voltage variations. Blocking capacitors couple the RF through the amplifier, while a low VSWR is maintained through unique transformer designs. The 111 Series is available in either the TO-8 hermetic package or the connectored TC-1 package.

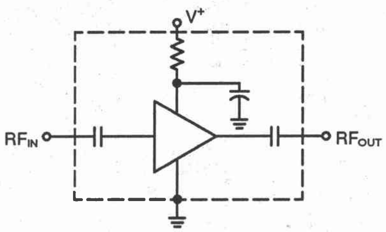


UTC—TC-1, p. 16–42

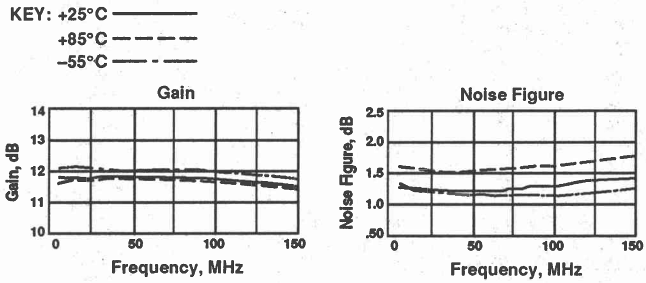
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	10-100	10-100	10-100	MHz
GP	Small Signal Gain (Min.)	11.5	10.5	10.0	dB
—	Gain Flatness (Max.)	±0.1	±0.3	±0.5	dB
NF	Noise Figure (Max.)	1.4	1.7	2.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+16.8	+15.5	+15.5	dBm
—	Input VSWR (Max.)	1.4:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.3:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+33.0	+28.0	+28.0	dBm
IP_2	Two Tone 2nd Order Intercept Point	+47.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+53.0	—	—	dBm
I_D	DC Current	14	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

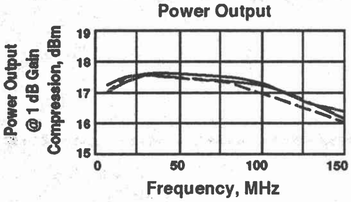
THERMAL CHARACTERISTICS*

θ_{JC}	105°C/W
Active Transistor Power Dissipation	110 mW
Junction Temperature Above Case Temperature	12°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	848,400 Hrs.

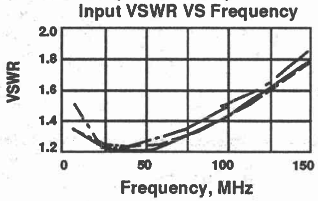
WEIGHT: (typical) UTO — 1.7 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

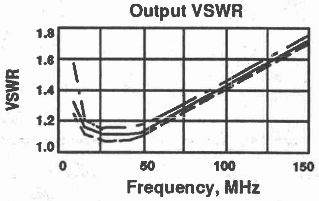
Power Output



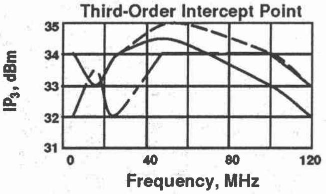
Input VSWR VS Frequency



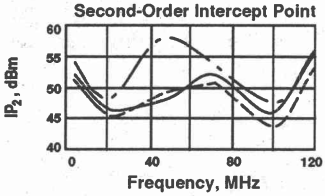
Output VSWR



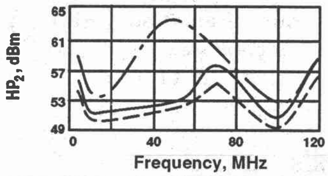
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
10.0	1.35	11.8	15.8	6.90	3.63	1.35	14.5
20.0	1.25	11.8	2.7	–1.12	3.63	1.15	14.6
30.0	1.20	11.8	–4.2	–2.93	1.91	1.13	14.6
40.0	1.22	11.9	–8.9	–2.57	1.31	1.13	14.6
50.0	1.22	11.9	–13.6	–2.20	1.31	1.17	14.6
60.0	1.27	11.9	–18.0	–1.53	1.21	1.22	14.6
70.0	1.30	11.9	–22.1	–.65	1.16	1.25	14.6
80.0	1.35	11.8	–26.2	.30	1.14	1.30	14.6
90.0	1.41	11.8	–30.2	1.35	1.12	1.35	14.7
100.0	1.47	11.8	–34.2	2.47	1.09	1.41	14.8
110.0	1.53	11.7	–38.1		1.09	1.47	14.8
120.0	1.56	11.7	–42.0		1.07	1.53	14.9
130.0	1.63	11.6	–45.8		1.07	1.60	15.0
140.0	1.70	11.6	–49.7		1.06	1.67	15.1
150.0	1.78	11.5	–53.5		1.07	1.74	15.2
160.0	1.86	11.4	–57.3		1.06	1.82	15.4
170.0	1.94	11.3	–61.1		1.05	1.90	15.5
180.0	2.03	11.2	–64.9		1.06	1.94	15.6
190.0	2.13	11.2	–68.7		1.06	2.03	15.8
200.0	2.17	11.1	–72.5		1.06	2.13	15.9
210.0	2.28	11.0	–76.4		1.06	2.23	16.1
220.0	2.39	10.9	–80.2		1.07	2.28	16.2
230.0	2.45	10.7	–84.1		1.07	2.39	16.4
240.0	2.57	10.6	–88.0		1.08	2.51	16.6
250.0	2.70	10.5	–91.9		1.09	2.57	16.8

LINEARIZATION RANGE: 10.0 to 100.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
10.0	.15	136.7	11.8	15.8	–14.5	15.9	.15	83.80
20.0	.11	160.1	11.8	2.7	–14.6	2.7	.07	49.21
30.0	.09	172.5	11.8	–4.2	–14.6	–4.2	.06	11.44
40.0	.10	–170.6	11.9	–8.9	–14.6	–8.9	.06	–29.34
50.0	.10	–160.7	11.9	–13.6	–14.6	–13.5	.08	–51.48
60.0	.12	–153.5	11.9	–18.0	–14.6	–17.8	.10	–67.04
70.0	.13	–149.0	11.9	–22.1	–14.6	–22.0	.11	–78.78
80.0	.15	–146.5	11.8	–26.2	–14.6	–26.0	.13	–88.38
90.0	.17	–145.3	11.8	–30.2	–14.7	–29.9	.15	–96.66
100.0	.19	–145.2	11.8	–34.2	–14.8	–33.8	.17	–104.03
110.0	.21	–146.0	11.7	–38.1	–14.8	–37.7	.19	–110.73
120.0	.22	–147.1	11.7	–42.0	–14.9	–41.5	.21	–116.99
130.0	.24	–148.7	11.6	–45.8	–15.0	–45.2	.23	–122.91
140.0	.26	–150.7	11.6	–49.7	–15.1	–49.0	.25	–128.48
150.0	.28	–152.8	11.5	–53.5	–15.2	–52.7	.27	–133.87
160.0	.30	–155.2	11.4	–57.3	–15.4	–56.4	.29	–139.02
170.0	.32	–157.7	11.3	–61.1	–15.5	–60.2	.31	–144.01
180.0	.34	–160.4	11.2	–64.9	–15.6	–63.8	.32	–148.89
190.0	.36	–163.2	11.2	–68.7	–15.8	–67.5	.34	–153.58
200.0	.37	–166.1	11.1	–72.5	–15.9	–71.2	.36	–158.18
210.0	.39	–169.1	11.0	–76.4	–16.1	–74.9	.38	–162.61
220.0	.41	–172.1	10.9	–80.2	–16.2	–78.6	.39	–167.07
230.0	.42	–175.3	10.7	–84.[illegible]	–16.4	–82.3	.41	–171.36
240.0	.44	–178.5	10.6	–88.0	–16.6	–86.0	.43	–175.65
250.0	.46	178.3	10.5	–91.9	–16.8	–89.7	.44	–179.76

AVANTEK

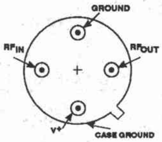
UTO/UTC/PPA 210 Series
Thin-Film Cascadable Amplifier
10 to 200 MHz

FEATURES

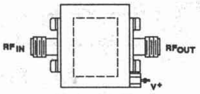
- Frequency Range: 10 to 200 MHz
- Ultra Low Noise: 1.5 dB (Typ)
- Low Current Drain: 15 mA (Typ)
- Temperature Compensated
- Surface Mount Option
- High Efficiency

APPLICATIONS

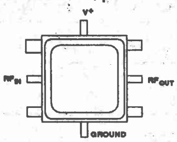
- RF Front Ends
- IF Medical Systems
- Surface Mount Assembly



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42



PPA—PP-38, p. 16–35

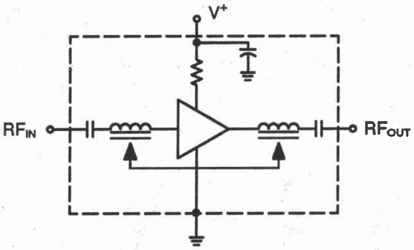
DESCRIPTION

The 210 Series is a thin-film bipolar, medium-gain, low–noise, RF amplifier suitable for front end design. It utilizes lossless feedback circuitry for low power consumption and high dynamic range. Resistive feedback and active bias provide temperature compensation and increased immunity to bias voltage variations. The 210 Series amplifiers are available in three packages: the surface mount PlanarPak PP-38 (.375 in. x .375 in.) case, the TO-8 hermetic case and the connectorized TC-1 case.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

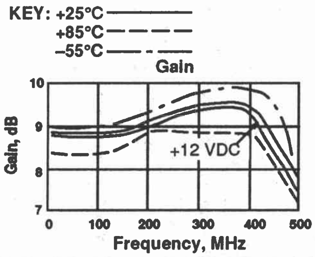
Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	T_C = –55° to +85°C	Unit
BW	Frequency Range	10-200	10-200	10-200	MHz
GP	Small Signal Gain (Min.)	9.0	8.0	7.5	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	1.5	2.0	2.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+13	+11.0	+11.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+29.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+40.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+45.0	—	—	dBm
I_D	DC Current	15	—	—	mA

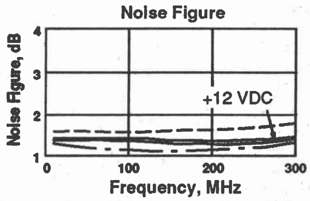
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)





MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

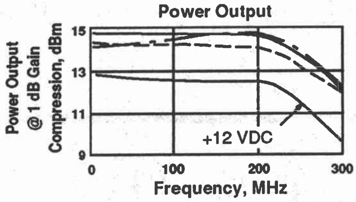
THERMAL CHARACTERISTICS*

θ_{JC} .... 120°C/W
Active Transistor Power Dissipation .... 77 mW
Junction Temperature Above Case Temperature .... 9°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C .... 1,375,000 Hrs.
*For further information, see High Reliability section, p. 17–2.

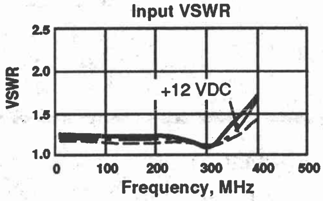
WEIGHT: (typical) PPA—0.5 grams; UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

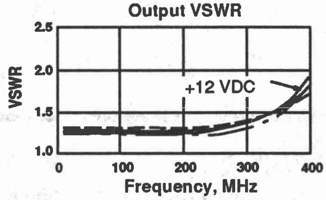
Power Output



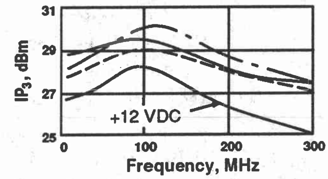
Input VSWR



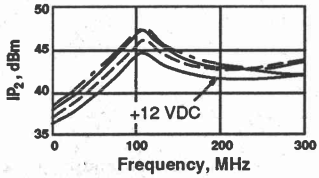
Output VSWR



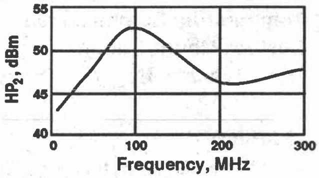
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.17	8.80	−18.96	−1.14	.00	1.16	11.24
120.0	1.19	8.85	−22.60	−.53	.53	1.17	11.44
140.0	1.21	8.89	−26.53	−.22	.55	1.17	11.43
160.0	1.22	8.94	−30.50	.04	.50	1.18	11.55
180.0	1.23	9.00	−33.77	1.02	.52	1.18	11.64
200.0	1.22	9.08	−37.96	1.09	.60	1.18	11.81
220.0	1.21	9.15	−42.38	.91	.61	1.17	11.90
240.0	1.18	9.22	−46.70	.83	.63	1.17	12.11
260.0	1.14	9.29	−51.51	.26	.69	1.17	12.28
280.0	1.09	9.39	−56.59	−.57	.73	1.18	12.49
300.0	1.04	9.46	−61.96	−1.70	.81	1.21	12.73
400.0	1.62	9.55	−94.33		.99	1.77	14.61
500.0	3.60	7.93	−131.04		.95	3.41	18.63
600.0	7.61	4.61	−159.21		.66	5.84	24.82
700.0	13.19	.90	−179.04		.47	7.85	29.91
800.0	18.54	−2.13	165.58		.36	9.00	30.40
900.0	24.65	−4.88	153.02		.34	9.29	27.45
1000.0	27.86	−7.37	143.66		.00	9.25	24.15

LINEARIZATION RANGE: 100.0 to 200.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.077	38.4	8.779	−18.9	−11.284	−17.0	.075	128.5
120.00	.087	36.8	8.852	−22.7	−11.336	−21.1	.077	120.9
140.00	.096	36.6	8.890	−26.6	−11.389	−24.8	.080	114.7
160.00	.100	34.5	8.948	−30.5	−11.544	−28.3	.083	111.4
180.00	.102	31.1	9.019	−34.0	−11.665	−31.7	.084	108.1
200.00	.100	27.7	9.093	−38.2	−11.779	−35.5	.083	105.6
220.00	.094	22.1	9.153	−42.4	−11.942	−39.2	.083	106.7
240.00	.083	16.3	9.233	−46.9	−12.118	−43.3	.081	110.4
260.00	.066	8.2	9.300	−51.6	−12.318	−47.9	.085	117.0
280.00	.046	−2.2	9.385	−56.7	−12.449	−52.4	.091	125.9
300.00	.019	−24.4	9.472	−62.1	−12.751	−56.8	.102	133.6
400.00	.237	152.1	9.566	−94.5	−14.552	−85.2	.282	139.5
500.00	.564	112.2	7.924	−131.1	−18.699	−115.4	.548	110.4
600.00	.769	79.1	4.608	−159.0	−24.810	−140.5	.706	79.6
700.00	.860	56.1	.914	−179.1	−29.931	−161.1	.774	56.3
800.00	.904	39.1	−2.128	165.5	−30.400	172.9	.797	38.7
900.00	.924	25.5	−4.839	153.3	−27.485	154.0	.806	25.3
1000.00	.930	12.4	−7.371	143.6	−24.167	139.2	.805	13.2

AVANTEK

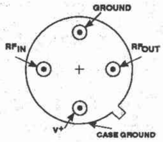
UTO/UTC/PPA 211 Series
Thin-Film Cascadable Amplifier Module
10 to 200 MHz

FEATURES

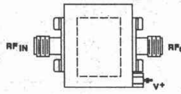
- Frequency Range: 10 to 200 MHz
- Low Noise: 2.0 dB (Typ)
- Low Current Drain: 30 mA (Typ)
- Temperature Compensated
- Surface Mount Option
- High Dynamic Range

APPLICATIONS

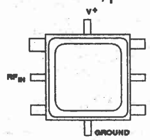
- RF Front Ends
- IF Medical Systems
- Surface Mount Assembly



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42



PPA—PP-38, p. 16–35

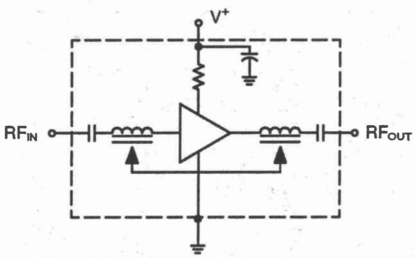
DESCRIPTION

The 211 Series is a thin-film bipolar, medium-gain, low-noise, RF amplifier suitable for front end design. It utilizes lossless feedback circuitry for low power consumption and high dynamic range. Resistive feedback and active bias provide temperature compensation and increased immunity to bias voltage variations. The 211 Series is available in three packages: the surface mount PlanarPak PP-38 (.375 in. x .375 in.) case, the TO-8 hermetic case and the connectorized TC-1 case.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

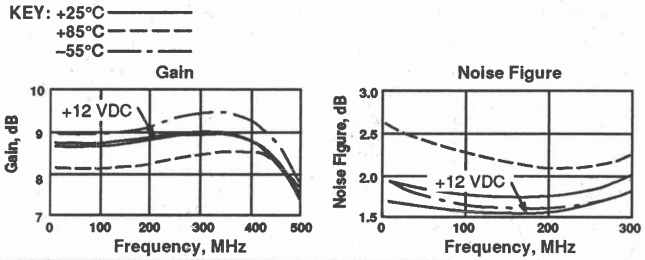
Symbol	Characteristic	Typical T_c = 25°C	Guaranteed Specifications T_c = 0° to 50°C	Guaranteed Specifications T_c = –55° to +85°C	Unit
BW	Frequency Range	10-200	10-200	10-200	MHz
GP	Small Signal Gain (Min.)	8.5	7.5	7.5	dB
—	Gain Flatness (Max.)	+0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	2.0	2.7	3.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+20.0	17.0	+16.0	dBm
—	Input VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+31.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+45.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+51.0	—	—	dBm
I_D	DC Current	30	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+17 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

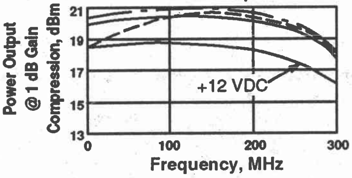
θ_{JC}	120°C/W
Active Transistor Power Dissipation	250 mW
Junction Temperature Above Case Temperature	30°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	604,000 Hrs.

*For further information, see High Reliability section, p. 17–2.

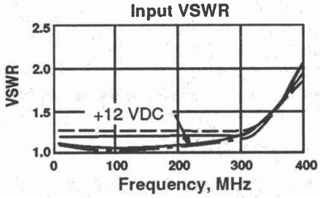
WEIGHT: (typical) PPA—0.5 grams; UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

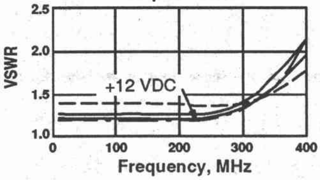
Power Output



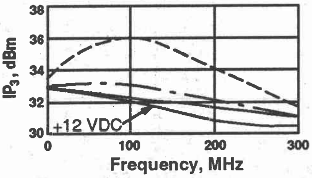
Input VSWR



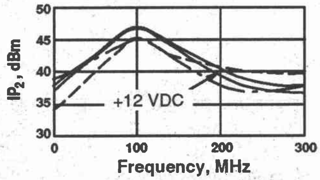
Output VSWR



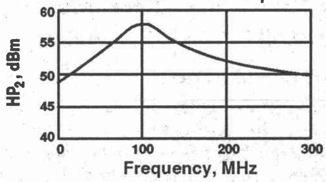
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.11	8.58	–17.31	–.89	.00	1.25	11.43
120.0	1.11	8.63	–20.98	–.42	.52	1.24	11.48
140.0	1.11	8.65	–24.84	–.14	.55	1.24	11.61
160.0	1.11	8.68	–28.96	–.12	.50	1.24	11.71
180.0	1.10	8.72	–32.09	.87	.50	1.24	11.77
200.0	1.09	8.75	–36.20	.89	.58	1.23	11.94
220.0	1.08	8.81	–40.52	.70	.58	1.23	11.99
240.0	1.07	8.85	–44.62	.73	.61	1.24	12.21
260.0	1.08	8.89	–49.23	.25	.66	1.25	12.40
280.0	1.12	8.94	–54.14	–.52	.69	1.26	12.63
300.0	1.18	8.96	–59.11	–1.35	.75	1.30	12.89
400.0	1.94	8.87	–88.75		.89	1.82	14.80
500.0	4.24	7.32	–121.94		.88	3.25	19.03
600.0	9.41	4.25	–148.67		.63	5.57	26.37
700.0	18.23	.59	–167.70		.45	7.59	35.31
800.0	28.35	–2.64	178.14		.33	8.80	42.12
900.0	42.46	–5.62	166.62		.31	9.68	44.61
1000.0	54.08	–8.68	157.69		.00	9.86	35.60

LINEARIZATION RANGE: 100.0 to 200.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.050	76.5	8.598	–17.3	–11.351	–15.1	.106	135.2
120.00	.053	71.3	8.661	–21.1	–11.420	–18.9	.106	131.4
140.00	.053	69.4	8.671	–24.9	–11.506	–22.5	.107	128.7
160.00	.051	68.6	8.720	–28.8	–11.658	–26.1	.107	125.6
180.00	.047	70.4	8.767	–32.2	–11.753	–29.9	.106	123.2
200.00	.043	75.3	8.819	–36.3	–11.884	–33.5	.104	123.0
220.00	.036	84.0	8.839	–40.5	–12.030	–37.6	.103	124.2
240.00	.031	106.8	8.882	–44.8	–12.203	–41.3	.105	127.6
260.00	.038	138.1	8.922	–49.3	–12.355	–45.6	.111	131.6
280.00	.055	154.5	8.975	–54.1	–12.578	–50.2	.119	137.1
300.00	.083	160.4	9.008	–59.2	–12.859	–54.5	.133	141.7
400.00	.324	145.0	8.899	–88.9	–14.795	–80.8	.295	144.8
500.00	.621	112.8	7.324	–121.8	–19.034	–107.2	.534	120.3
600.00	.813	81.9	4.218	–148.3	–26.501	–124.8	.700	92.5
700.00	.900	59.2	.594	–167.3	–35.447	–117.1	.775	69.6
800.00	.942	41.9	–2.592	178.4	–41.899	–101.8	.799	52.6
900.00	.959	27.8	–5.632	167.1	–44.633	–166.4	.812	39.2
1000.00	.965	14.2	–8.691	158.3	–35.760	149.7	.815	28.0

AVANTEK

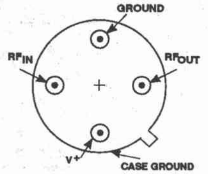
UTO/UTC 221 Series
Thin-Film Cascadable Amplifier Module
10 to 200 MHz

FEATURES

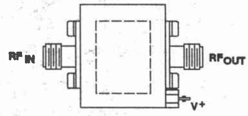
- Frequency Range: 10 to 200 MHz
- High Gain: 28.5 dB (Typ)
- Low Noise: 2.0 dB (Typ)
- High Dynamic Range
- Temperature Compensated
- High Efficiency

APPLICATIONS

- High Gain IF Stages
- Front End Amplifier



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

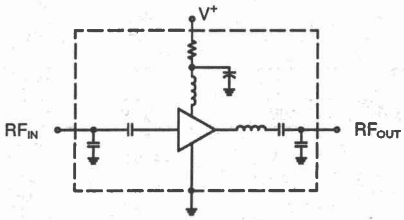
DESCRIPTION

The 221 Series is a thin-film high-gain, low-noise, RF cascode amplifier suitable for a variety of signal processing applications. Output transformer coupling provides high efficiency at low currents. Blocking capacitors couple the RF through the amplifier. The 221 is available in either the TO-8 hermetic case or connectored TC-1 package.

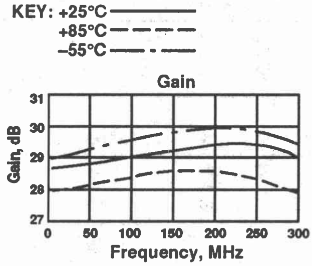
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

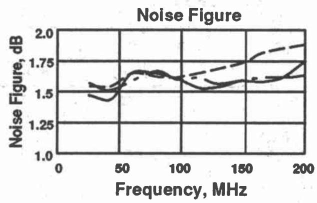
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	10-200	10-200	10-200	MHz
GP	Small Signal Gain (Min.)	28.5	27.0	26.0	dB
—	Gain Flatness (Max.)	±0.3	±0.7	±1.0	dB
NF	Noise Figure (Max.)	2.0	2.5	3.0	dB
$P_{1 dB}$	Power Output @ +1 dB Compression (Min.)	+15.5	+13.5	+13.0	dBm
—	Input VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.4:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+23.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+28.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+37.0	—	—	dBm
I_D	DC Current	29	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)





MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

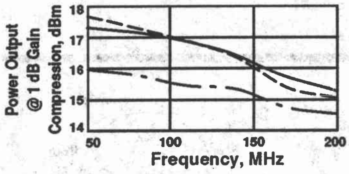
θ_{JC}	105/105°C/W
Active Transistor Power Dissipation	69/230 mW
Junction Temperature Above Case Temperature	7/24°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	689,800 Hrs.

*For further information, see High Reliability section, p. 17–2.

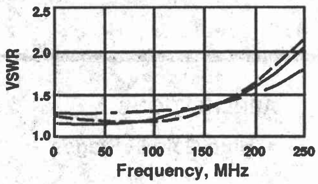
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

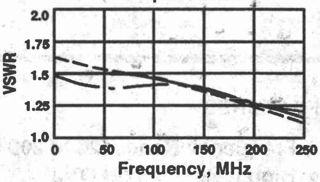
Power Output



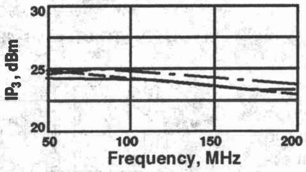
Input VSWR



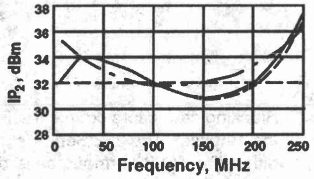
Output VSWR



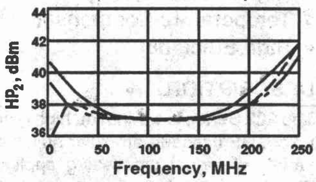
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.19	28.63	155.64	–.46	.00	1.40	33.60
200.0	1.59	29.04	125.98	–.34	.91	1.24	33.65
300.0	2.56	28.84	89.26		1.12	1.25	35.19

S-PARAMETERS

BIAS = 15.00 VOLTS
CURRENT = 28.60 mA

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.090	83.2	28.565	155.6	–33.309	–10.2	.173	152.4
200.00	.226	21.1	28.970	125.6	–33.321	–22.3	.111	144.3
300.00	.450	–24.3	28.762	89.4	–34.917	–40.8	.115	–179.8
400.00	.595	–67.3	26.847	49.6	–37.789	–39.1	.273	163.5
500.00	.638	–97.9	23.130	19.2	–38.848	–37.3	.375	131.7
600.00	.632	–114.5	18.891	–3.0	–37.272	–39.3	.452	104.1
700.00	.657	–125.5	14.894	–3.1	–38.161	–41.3	.437	71.0
800.00	.615	–134.3	13.678	–17.8	–36.656	–48.0	.399	57.2
900.00	.576	–141.3	11.210	–31.3	–36.566	–55.8	.417	41.4
1000.00	.560	–146.7	8.679	–42.9	–36.094	–64.1	.415	25.5
1100.00	.550	–150.9	6.362	–52.6	–35.862	–71.9	.424	10.6
1200.00	.546	–152.2	4.307	–61.2	–36.379	–81.2	.420	–3.1
1300.00	.535	–153.5	2.254	–69.1	–36.077	–89.5	.418	–15.4
1400.00	.523	–154.2	.082	–78.8	–36.625	–96.0	.415	–28.2
1500.00	.513	–155.2	–1.910	–88.2	–37.139	–100.0	.404	–39.2

![AVANTEK]

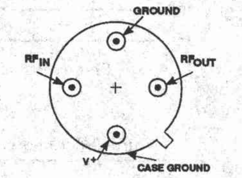
UTO/UTC 222 Series
Thin-Film Cascadable Amplifier Module
20 to 200 MHz

FEATURES

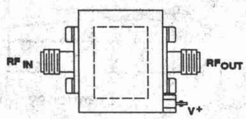
- Frequency Range: 20 to 200 MHz
- High Gain: 29.5 dB (Typ)
- Low Noise: 2.9 dB (Typ)
- High Dynamic Range
- Temperature Compensated
- High Efficiency

APPLICATIONS

- High Gain IF Stages



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

DESCRIPTION

The 222 Series is a thin-film, high gain, low-noise, RF cascode amplifier suitable for a variety of signal processing applications. Output transformer coupling substrate provides high efficiency at low currents.

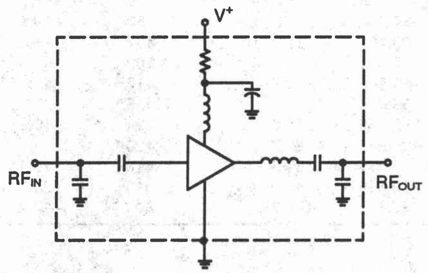
Blocking capacitors couple the RF through the amplifier. The 222 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			$T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	
BW	Frequency Range	20-200	20-200	20-200	MHz
GP	Small Signal Gain (Min.)	29.5	28.0	27.0	dB
—	Gain Flatness (Max.)	±0.3	±0.7	±1.0	dB
NF	Noise Figure (Max.)	2.9	3.6	4.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+21.0	+18.0[1]	+17.0[2]	dBm
—	Input VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.8:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+28.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+40.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+45.0	—	—	dBm
I_D	DC Current	47	—	—	mA

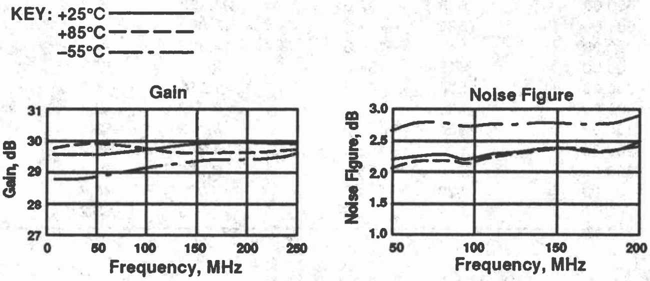
NOTES: 1. Power Out 20 to 100 MHz = +20.0
2. Power Out 20 to 100 MHz = +19.0

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +115°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+115°C

THERMAL CHARACTERISTICS*

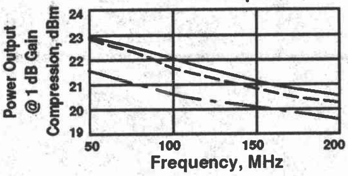
θ_{JC}	87/87°C/W
Active Transistor Power Dissipation	123/410 mW
Junction Temperature Above Case Temperature	11/36°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	568,100 Hrs.

*For further information, see High Reliability section, p. 17–2.

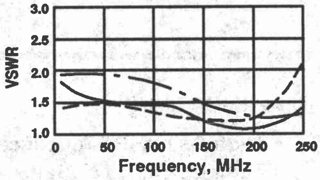
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

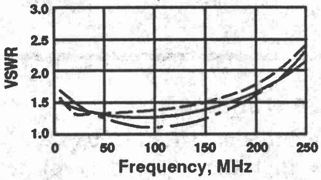
Power Output



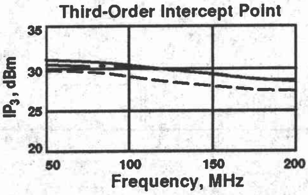
Input VSWR



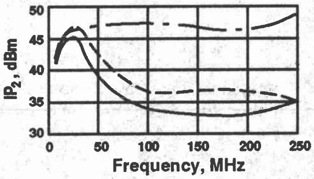
Output VSWR



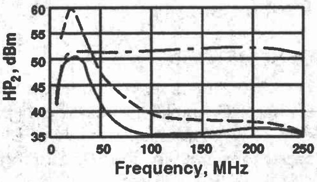
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.44	29.47	152.06	.00	.00	1.23	–29.47
200.0	1.03	29.84	116.24	.00	1.07	1.56	–29.84
300.0	1.80	28.89	74.68		1.09	2.97	–28.89

S-PARAMETERS

BIAS = 15.00 VOLTS
CURRENT = 47.00 MA

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.178	160.7	29.553	151.9	–34.660	–21.5	.114	96.6
200.00	.015	3.7	29.832	116.0	–34.933	–41.3	.221	22.2
300.00	.292	–78.7	28.874	74.6	–36.727	–73.4	.494	–87.3
400.00	.493	–109.3	26.267	38.0	–39.855	–97.8	.667	–133.1
500.00	.579	–128.4	22.825	10.2	–45.535	–114.5	.722	–167.1
600.00	.612	–139.7	19.592	–13.4	–53.626	–122.6	.716	163.4
700.00	.662	–148.2	15.363	–27.5	–54.137	100.0	.584	132.7
800.00	.622	–156.0	14.581	–38.6	–44.844	–1.9	.512	122.9
900.00	.595	–159.0	12.450	–58.9	–43.508	–35.6	.491	96.1
1000.00	.580	–160.2	9.873	–78.5	–42.982	–51.0	.451	65.2
1100.00	.572	–160.7	7.187	–95.9	–42.690	–81.0	.414	32.6
1200.00	.568	–159.0	4.041	–110.8	–40.950	–99.6	.408	–1.1
1300.00	.595	–157.6	.257	–123.5	–40.114	–120.8	.432	–31.6
1400.00	.619	–156.7	–4.008	–131.5	–39.620	–138.1	.467	–55.6
1500.00	.657	–156.2	–8.115	–127.7	–39.040	–153.8	.509	–76.8

AVANTEK

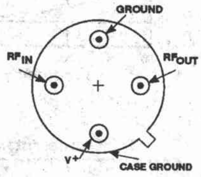
UTO/UTC 250 Series
Thin-Film Cascadable Amplifier
5 to 200 MHz

FEATURES

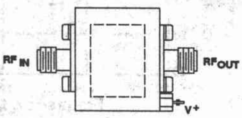
- Frequency Range: 5 to 200 MHz
- High Gain: 33.0 dB (Typ)
- Low Current Drain: 13 mA (Typ)
- Temperature Compensated
- 5-Volt Supply

APPLICATIONS

- High Gain IF/RF Amplification
- High Efficiency or Battery Powered Systems



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

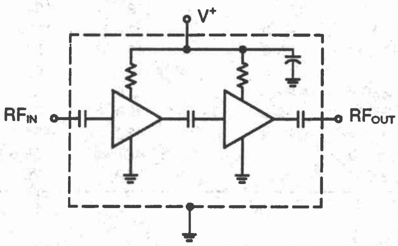
DESCRIPTION

The 250 Series is a two-stage thin-film bipolar RF amplifier providing high gain and low power consumption. Blocking capacitors couple the RF through the amplifier. The 250 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

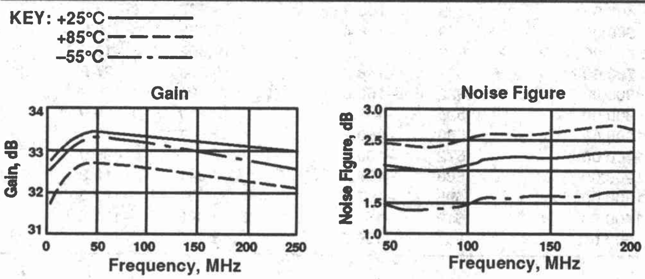
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted))

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-200	5-200	5-200	MHz
GP	Small Signal Gain (Min.)	33.0	30.0	29.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	2.5	4.0	5.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	–1.4	–3.0	–4.0	dBm
—	Input VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+14	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+25	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+30	—	—	dBm
I_D	DC Current	13	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +5 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	+12 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

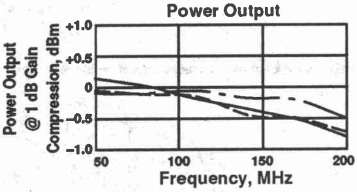
θ_{JC}	90/90°C/W
Active Transistor Power Dissipation	13/18 mW
Junction Temperature Above Case Temperature	1/2°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	974,800 Hrs.

*For further information, see High Reliability section, p. 17–2.

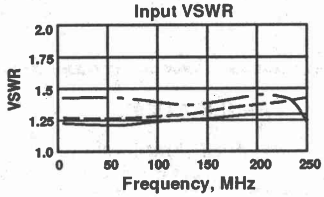
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

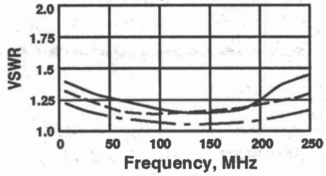
Power Output



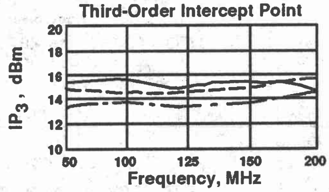
Input VSWR



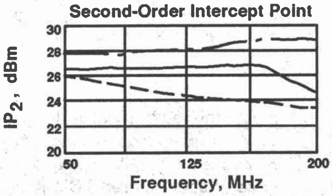
Output VSWR



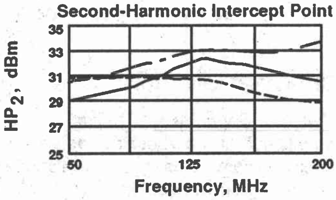
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 5.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.13	33.33	–31.08	–.63	.00	1.20	40.25
120.0	1.13	33.20	–35.74	1.12	.89	1.12	36.00
140.0	1.16	33.25	–43.90	–.61	.97	1.10	45.26
160.0	1.18	33.27	–49.65	.05	.84	1.13	43.12
180.0	1.26	33.16	–55.97	.15	.91	1.14	33.54
200.0	1.25	33.18	–62.70	–.14	.89	1.21	40.96
220.0	1.21	32.99	–68.84	.13	.87	1.24	42.47
240.0	1.23	32.87	–75.25	.14	.92	1.31	45.19
260.0	1.27	32.87	–82.04	–.21	.94	1.38	44.02
280.0	1.31	32.72	–88.86		.94	1.44	36.08
300.0	1.30	32.71	–95.62		.99	1.55	42.24
400.0	1.52	31.92	–132.74		1.06	2.32	45.41
500.0	1.81	29.98	–172.16		1.00	3.37	45.20
600.0	1.93	26.34	155.52		.74	3.43	47.63
700.0	1.88	22.49	134.35		.53	2.99	41.25
800.0	1.82	19.62	117.69		.00	2.60	38.98

LINEARIZATION RANGE: 100.0 to 200.0 MHz

S-PARAMETERS

BIAS = 5.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.108	147.9	33.146	–31.0	–46.374	135.9	.039	–142.6
150.00	.085	126.4	33.095	–46.9	–38.261	48.6	.059	–118.1
200.00	.128	103.8	32.990	–61.9	–37.389	47.9	.097	–172.4
250.00	.116	70.4	32.736	–78.1	–41.684	23.8	.141	170.4
300.00	.138	45.2	32.584	–95.6	–45.391	–31.3	.217	146.8
400.00	.232	–8.0	31.862	–132.7	–45.308	42.4	.396	106.0
500.00	.315	–62.8	29.920	–172.5	–43.993	–37.3	.546	64.1
600.00	.337	–105.1	26.304	155.3	–69.103	140.9	.551	28.7
700.00	.316	–132.3	22.407	134.2	–44.944	109.1	.501	5.6
800.00	.302	–143.8	19.569	117.6	–38.947	103.9	.451	–6.6
900.00	.326	–149.4	17.191	100.2	–37.571	81.9	.438	–10.8
1000.00	.409	–158.5	14.732	79.3	–36.765	76.6	.475	–16.0
1100.00	.465	–176.0	11.304	56.6	–41.182	80.0	.519	–23.8
1200.00	.510	167.8	7.386	39.5	–44.597	75.6	.531	–32.2
1300.00	.519	153.4	2.577	29.7	–41.102	114.3	.532	–39.7
1400.00	.516	139.5	–2.830	26.3	–40.331	110.9	.532	–45.6
1500.00	.500	127.9	–8.145	34.7	–37.673	126.1	.536	–50.0

AVANTEK

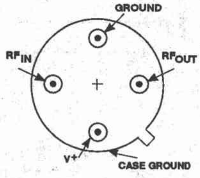
UTO/UTC 416 Series
Thin-Film Cascadable Amplifier
5 to 400 MHz

FEATURES

- **Frequency Range: 5 to 400 MHz**
- **Medium Gain: 14.5 dB (Typ)**
- **Medium Power Output: +12.5 dBm (Typ)**
- **Temperature Compensated**

APPLICATIONS

- **IF/RF Amplification**



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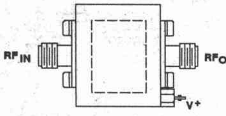


UTC—TC-1, p. 16–42

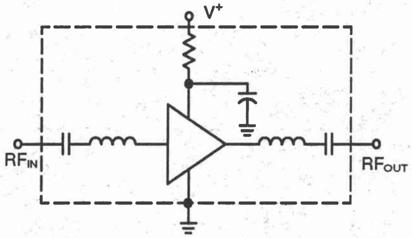
DESCRIPTION

The 416 Series is a thin-film, bipolar RF amplifier that incorporates resistive feedback and active bias to provide a stable and reliable gain stage. Inductively-coupled input and output networks provide good VSWR under all conditions. The 416 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

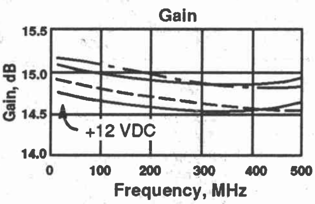
Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	5-400	5-400	5-400	MHz
GP	Small Signal Gain (Min.)	14.5	14.0	13.5	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	4.0	5.5	5.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+12.5	+10.0	+9.5	dBm
—	Input VSWR (Max.)	<1.4:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.2:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+23.0	—	—	dBm
I_D	DC Current	35	—	—	mA

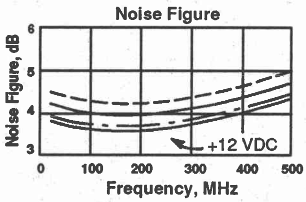
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ————
+85°C — — — —
–55°C —- - —-





MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

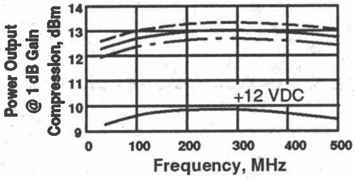
THERMAL CHARACTERISTICS*

θ_{JC} .... 85°C/W
Active Transistor Power Dissipation .... 180 mW
Junction Temperature Above Case Temperature .... 15°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 1,257,000 Hrs.
*For further information, see High Reliability section, p. 17–2.

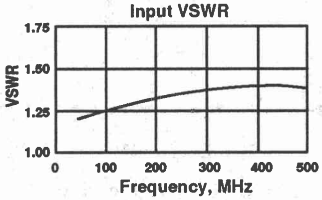
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

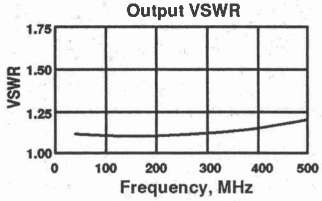
Power Output



Input VSWR



Output VSWR



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.28	15.18	153.37	–.99	1.03	1.05	21.18
150.0	1.35	15.11	140.76	–.73	.69	1.07	21.29
200.0	1.41	14.87	128.36	–.27	.68	1.09	21.44
250.0	1.46	14.81	116.28	.50	.67	1.09	21.50
300.0	1.46	14.74	104.19	1.27	.68	1.09	21.62
350.0	1.43	14.66	91.64	1.58	.72	1.10	21.69
400.0	1.36	14.69	78.41	1.22	.76	1.10	21.81
450.0	1.23	14.81	64.34	.01	.82	1.13	21.88
500.0	1.09	14.97	48.89	–2.57	.92	1.18	21.95
550.0	1.26	15.07	31.40		1.03	1.27	21.99
600.0	1.78	14.88	11.85		1.16	1.38	22.10

LINEARIZATION RANGE: 100.0 to 400.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.098	–77.5	15.000	152.8	–21.11	–11.5	.024	63.3
200.00	.155	–110.0	14.726	130.3	–21.41	–24.3	.043	39.2
300.00	.173	–130.4	14.653	105.1	–21.51	–37.0	.048	10.5
400.00	.140	–152.4	14.656	78.9	–22.05	–49.4	.045	–37.6
500.00	.023	135.4	14.844	50.3	–22.27	–63.5	.068	–105.6
600.00	.270	–15.7	14.641	13.3	–22.38	–78.4	.144	–152.8
700.00	.648	–58.7	12.526	–29.8	–23.35	–97.6	.232	166.7
800.00	.837	–92.4	8.018	–62.9	–25.35	–116.4	.284	138.9
900.00	.906	–114.6	3.329	–84.7	–27.54	–130.8	.314	121.7
1000.00	.919	–127.5	–0.772	–98.1	–29.90	–138.8	.338	109.5

AVANTEK

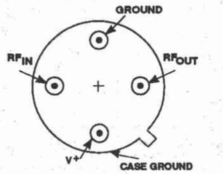
UTO/UTC 421 Series
Thin-Film Cascadable Amplifier
5 to 400 MHz

FEATURES

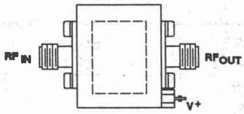
- Frequency Range: 5 to 400 MHz
- High Gain: 29.5 dB (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

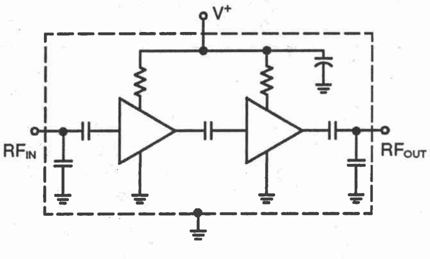
DESCRIPTION

The 421 Series is a two-stage thin-film bipolar RF amplifier providing high gain up to 400 MHz. Blocking capacitors couple the RF through the amplifier. The 421 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

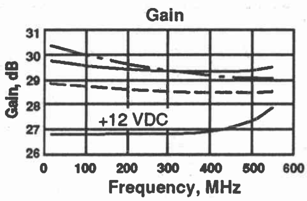
Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	5-400	5-400	5-400	MHz
GP	Small Signal Gain (Min.)	29.5	27.0	27.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	4.5	5.5	5.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+6.0	+6.0	+5.5	dBm
—	Input VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.4:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+18.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+25.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+32.0	—	—	dBm
I_D	DC Current	38	—	—	mA

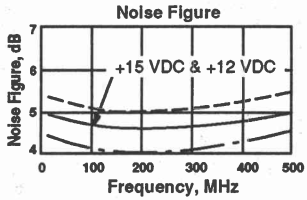
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
–55°C —- · —





MAXIMUM RATINGS

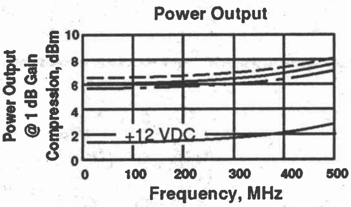
DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

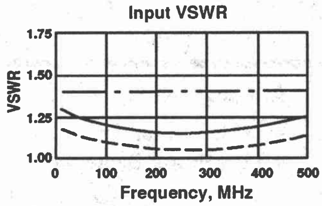
THERMAL CHARACTERISTICS*

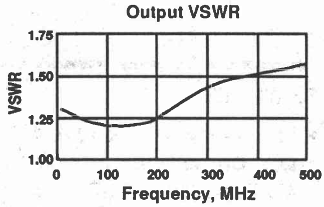
θ_{JC} .... 75/105°C/W
Active Transistor Power Dissipation .... 82/114 mW
Junction Temperature Above Case Temperature ...... 7/12°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 448,000 Hrs.
*For further information, see High Reliability section, p. 17–2.

WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)







AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.18	29.70	–40.33	–1.00	—	1.21	40.97
150.0	1.19	29.54	–60.48	–.30	1.14	1.20	44.03
200.0	1.17	29.46	–81.53	–.48	1.15	1.23	40.56
250.0	1.18	29.51	–102.04	–.14	1.10	1.26	42.06
300.0	1.17	29.43	–121.05	1.70	1.11	1.29	43.10
350.0	1.16	29.37	–141.86	1.75	1.17	1.31	45.12
400.0	1.14	29.31	–163.32	1.14	1.22	1.30	41.91
450.0	1.13	29.36	174.20	–.47	1.25	1.32	41.00
500.0	1.14	29.55	151.64	–2.17	1.27	1.40	39.90
550.0	1.20	29.55	128.62	—	1.37	1.52	38.51
600.0	1.40	29.46	102.45	—	1.53	1.80	40.82
650.0	1.85	29.09	73.62	—	1.67	2.29	44.57
700.0	2.62	28.35	42.43	—	1.68	3.14	40.06

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.150	154.7	28.590	–42.4	–46.02	3.8	.186	.4
200.00	.135	131.6	28.251	–81.3	–44.44	–6.3	.176	–1.3
300.00	.123	105.4	28.358	–119.2	–43.10	–15.7	.155	–2.0
400.00	.106	85.5	28.368	–160.4	–43.10	–20.6	.115	2.1
500.00	.106	86.8	29.566	156.1	–41.94	–34.7	.062	40.2
600.00	.219	91.1	29.812	108.2	–40.92	–53.4	.164	100.8
700.00	.506	57.2	27.417	49.0	–40.92	–89.9	.423	84.8
800.00	.772	14.6	18.164	–9.4	–44.44.	–131.8	.628	55.0
900.00	.886	–21.7	9.986	–57.7	–50.46	–157.5	.681	30.6
1000.00	.910	–47.2	5.417	–93.3	–60.00	161.1	.633	14.5

AVANTEK

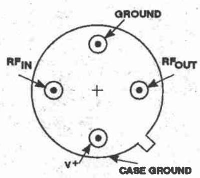
UTO/UTC 440 Series
Thin-Film Cascadable Amplifier
10 to 400 MHz

FEATURES

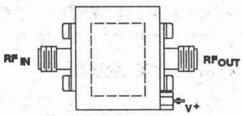
- Frequency Range: 10 to 400 MHz
- Low Current Drain: 15 mA (Typ)
- Medium Gain: 13 dB (Typ)
- Temperature Compensated
- High Efficiency

APPLICATIONS

- IF/RF Amplification
- Low Power Systems



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

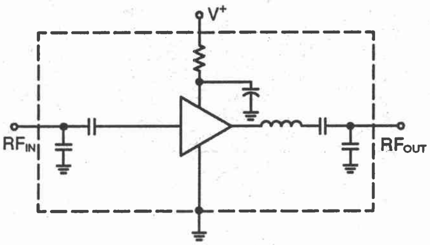
DESCRIPTION

The 440 Series is a medium-gain bipolar RF amplifier built on a thin-film substrate using output transformer coupling to increase efficiency. Blocking capacitors couple the RF through the amplifier. The 440 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range	10-500	10-400	10-400	MHz
GP	Small Signal Gain (Min.)	13.0	12.5	12.0	dB
—	Gain Flatness (Max.)	±0.1	±0.7	±0.7	dB
NF	Noise Figure (Max.)	3.6	4.5	5.0	dB
$P_{1 dB}$	Power Output @ +1 dB Compression (Min.)	+9.0	+8.0	+7.5	dBm
—	Input VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+23.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+26.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+35.0	—	—	dBm
I_D	DC Current	15	—	—	mA

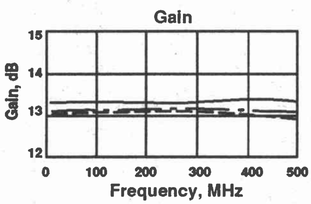
SCHEMATIC

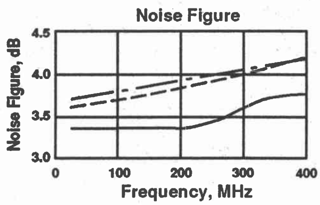


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ————
+85°C — — — —
–55°C —— - ——





MAXIMUM RATINGS

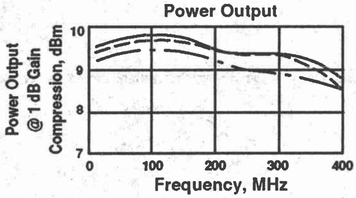
DC Voltage . . . . +17 Volts
Continuous RF Input Power . . . . +13 dBm
Operating Case Temperature . . . . –55°C to +125°C
Storage Temperature . . . . –62°C to +150°C
"R" Series Burn-In Temperature . . . . +125°C

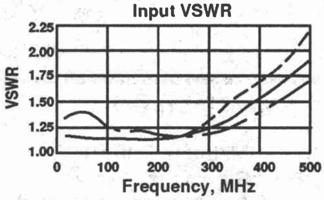
THERMAL CHARACTERISTICS*

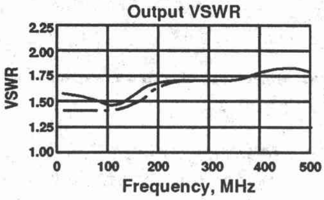
θ_{JC} . . . . 105°C/W
Active Transistor Power Dissipation . . . . 114 mW
Junction Temperature Above Case Temperature . . . . 12°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) . . . . 526,724 Hrs.
*For further information, see High Reliability section, p. 17–2.

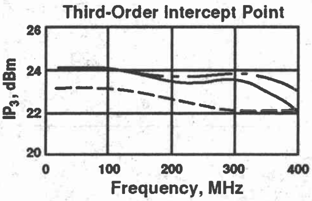
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

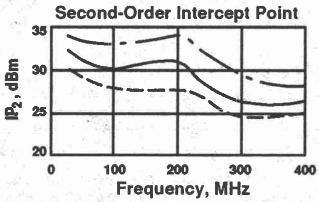
TYPICAL PERFORMANCE OVER TEMPERATURE (continued)











AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.21	13.14	160.14	–.17	.00	1.49	19.31
200.0	1.11	13.13	138.96	–.03	.58	1.53	19.54
300.0	1.14	13.08	118.26	.59	.60	1.59	19.66
400.0	1.35	13.13	95.98	–.37	.62	1.64	19.91
500.0	1.66	13.12	73.48		.66	1.70	20.04
600.0	2.05	12.60	48.81		.73	1.81	20.05
700.0	2.49	11.68	20.72		.76	2.08	20.29
800.0	2.84	10.36	–6.18		.74	2.62	20.56
900.0	3.02	8.40	–32.43		.66	3.35	21.17
1000.0	3.25	5.91	–53.76		.56	4.14	22.03
1100.0	3.60	3.33	–72.84		.49	5.05	22.89
1200.0	4.05	1.03	–89.06		.39	5.51	23.51
1300.0	4.56	–1.34	–101.23		.31	5.78	24.29
1400.0	4.96	–3.70	–111.45		.32	6.11	24.87
1500.0	5.40	–5.58	–124.08		.29	6.58	25.19
1600.0	5.76	–6.90	–132.54		.22	6.69	25.44
1700.0	6.24	–7.77	–140.12		.25	7.47	25.82
1800.0	6.94	–7.67	–150.63		.35	8.70	26.99
1900.0	7.94	–7.85	–165.11		.48	10.13	29.19
2000.0	9.34	–7.86	175.15		.00	11.26	31.06

LINEARIZATION RANGE: 100.0 to 400.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.088	175.6	13.153	159.8	–19.308	–11.1	.197	177.8
200.00	.045	–165.0	13.086	138.8	–19.540	–19.2	.208	171.3
300.00	.064	–86.8	13.112	118.0	–19.665	–29.5	.225	159.9
400.00	.151	–79.1	13.139	95.6	–19.913	–39.3	.241	141.3
500.00	.251	–87.5	13.125	72.7	–20.044	–49.3	.255	113.6
600.00	.346	–97.0	12.629	47.7	–20.054	–59.1	.284	75.4
700.00	.421	–108.8	11.693	19.2	–20.286	–69.6	.343	30.8
800.00	.472	–117.9	10.339	–8.0	–20.562	–82.3	.445	–9.5
900.00	.499	–124.8	8.307	–34.6	–21.173	–95.0	.542	–42.3
1000.00	.528	–129.4	5.772	–55.4	–22.033	–105.6	.618	–66.7
1100.00	.559	–133.0	3.066	–74.2	–22.887	–116.2	.666	–85.8
1200.00	.598	–135.9	.794	–90.1	–23.510	–125.6	.714	–100.0
1300.00	.636	–139.2	–1.631	–102.1	–24.290	–135.1	.725	–111.5
1400.00	.663	–142.2	–4.087	–112.0	–24.874	–145.2	.732	–122.1
1500.00	.682	–145.9	–5.941	–123.6	–25.193	–156.4	.736	–131.2
1600.00	.703	–150.0	–7.293	–131.7	–25.436	–167.9	.748	–137.8
1700.00	.725	–153.2	–8.049	–139.5	–25.824	176.9	.767	–142.5
1800.00	.752	–155.4	–7.678	–148.5	–26.991	162.1	.803	–147.3
1900.00	.782	–157.6	–7.587	–164.5	–29.190	151.1	.848	–153.7
2000.00	.816	–161.3	–7.650	173.9	–31.057	151.5	.854	–160.3

AVANTEK

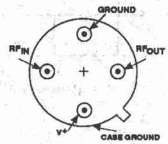
UTO/UTC/PPA 441 Series
Thin-Film Cascadable Amplifier
20 to 400 MHz

FEATURES

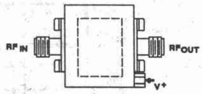
- Frequency Range: 20 to 400 MHz
- Low Current Drain: 32 mA (Typ)
- Medium Output Power: +16 dBm (Typ)
- High Dynamic Range, 85 dB (Typ)[1]
- Three Package Options
- Temperature Compensated

APPLICATIONS

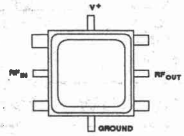
- Medium Gain RF/IF Signal Processing
- Surface Mount Assembly



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42



PPA—PP-38, p. 16–35

DESCRIPTION

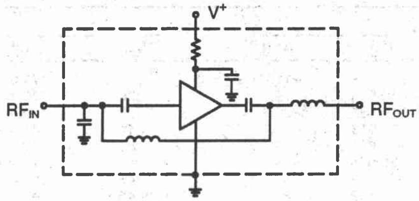
The 441 Series RF amplifiers are medium gain, bipolar components built on a thin-film substrate, using output transformer coupling to increase efficiency. Internal blocking capacitors couple the RF signal through the amplifier. The 441 Series amplifiers are available in three packages: the hermetic surface mount PP-38 (.375 in. x .375 in.) case weighing 0.5 grams, the connectorized TC-1 case weighing 21.5 grams and the hermetic TO-8T case weighing 2.1 grams.

ELECTRICAL SPECIFICATIONS[2] (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range	20-400	20-400	20-400	MHz
GP	Small Signal Gain (Min.)	14.4	13.5	13.0	dB
—	Gain Flatness (Max.)	±0.1	±0.7	±0.7	dB
NF	Noise Figure (Max.)	3.7	4.5	5.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+16.0	+15.0	+15.0	dBm
—	Input VSWR (Max.)	1.3:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+32.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+44.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+53.0	—	—	dBm
I_D	DC Current	32	—	—	mA

NOTES 1: Calculated spurious free dynamic range in 1 MHz bandwidth
2: A portion of any DC voltage applied to the RF input pin will appear at the RF output pin (i.e., a resistive DC path exists between pins.) There is no input or output blocking capacitor

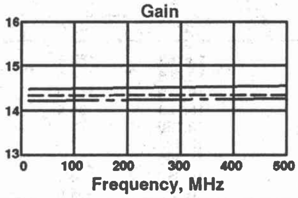
SCHEMATIC

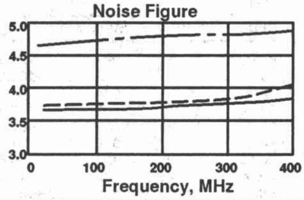


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ——— +85°C — — — –55°C — · —





MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

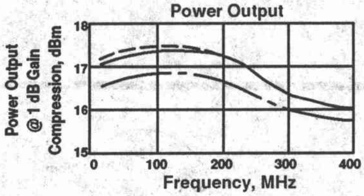
θ_{JC}	105°C/W
Active Transistor Power Dissipation	275 mW
Junction Temperature Above Case Temperature	29°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	523,897 Hrs.

*For further information, see High Reliability section, p. 17–2.

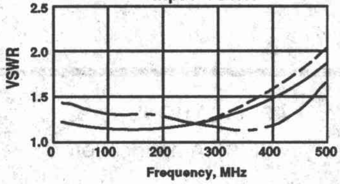
WEIGHT: (typical) PPA— 0.5 grams; UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

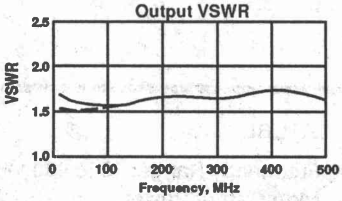
Power Output



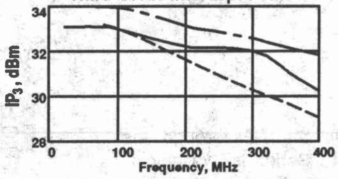
Input VSWR



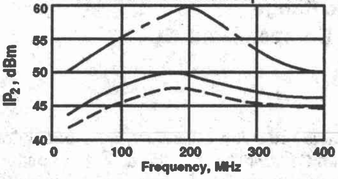
Output VSWR



Third-Order Intercept Point



Second-Order Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

NUMERICAL READINGS — BIAS = 15.00 VOLTS

FREQ. MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GROUP DELAY ns	VSWR OUT	ISOL dB
100.0	1.29	14.47	159.85	–.20	.00	1.58	20.57
200.0	1.16	14.48	137.59	–.04	.61	1.60	20.54
300.0	1.10	14.47	115.94	.71	.63	1.62	20.67
400.0	1.31	14.55	92.37	–.46	.66	1.61	20.80
500.0	1.65	14.55	68.22		.71	1.58	20.75
600.0	2.06	14.02	40.97		.81	1.62	20.80
700.0	2.42	12.99	9.62		.86	2.05	21.14
800.0	2.57	11.24	–20.83		.81	2.97	21.80
900.0	2.62	8.62	–48.65		.69	4.23	22.93
1000.0	2.85	5.58	–70.55		.56	5.82	24.28
1100.0	3.22	2.48	–88.84		.48	7.37	25.47
1200.0	3.73	–.38	–105.01		.39	8.14	26.46
1300.0	4.35	–3.09	–116.83		.30	8.94	27.45
1400.0	4.91	–5.58	–126.82		.31	10.05	28.28
1500.0	5.33	–7.73	–138.87		.29	11.49	28.62
1600.0	5.80	–9.13	–147.96		.26	11.93	29.21
1700.0	6.49	–10.02	–157.56		.33	14.13	29.82
1800.0	7.49	–10.22	–171.66		.43	15.96	31.03
1900.0	8.86	–10.72	171.53		.52	17.35	32.54
2000.0	10.69	–11.10	151.12		.00	19.05	32.88

LINEARIZATION RANGE: 100.0 to 400.0 MHz

S-PARAMETERS — BIAS = 15 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.125	175.3	14.498	159.7	–20.566	–9.0	.226	175.3
200.00	.067	173.3	14.473	137.4	–20.541	–20.6	.231	170.6
300.00	.044	–98.1	14.512	115.4	–20.672	–29.1	.235	159.9
400.00	.140	–79.8	14.572	92.0	–20.798	–40.4	.230	141.4
500.00	.251	–90.2	14.575	67.6	–20.749	–51.7	.215	108.7
600.00	.349	–102.5	14.047	40.0	–20.802	–63.7	.233	56.4
700.00	.408	–116.5	12.979	8.1	–21.145	–77.8	.336	–.4
800.00	.430	–125.3	11.186	–22.4	–21.804	–93.2	.493	–41.5
900.00	.441	–129.2	8.527	–50.5	–22.933	–107.6	.625	–71.5
1000.00	.476	–130.9	5.423	–71.7	–24.275	–118.8	.711	–92.8
1100.00	.522	–133.1	2.179	–89.8	–25.472	–128.5	.765	–108.7
1200.00	.575	–135.9	–.609	–105.1	–26.457	–137.7	.806	–120.2
1300.00	.624	–139.6	–3.362	–116.9	–27.448	–147.4	.815	–130.0
1400.00	.660	–143.2	–6.063	–125.9	–28.277	–156.6	.827	–139.1
1500.00	.683	–147.3	–8.075	–136.5	–28.621	–167.8	.841	–146.6
1600.00	.708	–151.6	–9.429	–144.2	–29.211	–178.9	.858	–152.7
1700.00	.733	–154.9	–9.908	–153.8	–29.815	166.1	.874	–157.7
1800.00	.773	–157.2	–9.395	–168.5	–31.033	155.2	.898	–162.9
1900.00	.816	–160.5	–9.778	170.3	–32.541	151.5	.911	–168.1
2000.00	.848	–165.4	–10.473	146.1	–32.885	150.5	.907	–172.4

![AVANTEK]

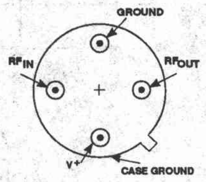
UTO/UTC 442 Series
Thin-Film Cascadable Amplifier
10 to 400 MHz

FEATURES

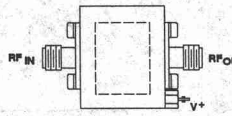
- **Frequency Range: 10 to 400 MHz**
- **High Output Power: +21.5 dBm (Typ)**
- **High Dynamic Range**
- **Temperature Compensated**

APPLICATIONS

- **IF/RF Amplification**



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

DESCRIPTION

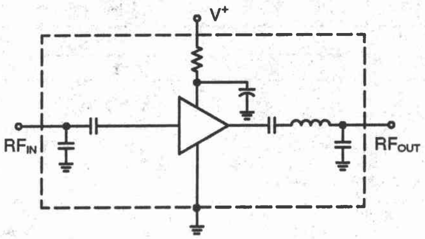
The 442 Series is a high-efficiency, medium-gain bipolar RF amplifier built on a thin-film substrate using output transformer coupling to increase efficiency. Blocking capacitors couple the RF through the amplifier. The 442 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS[1] (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range	10-400	20-400	20-400	MHz
GP	Small Signal Gain (Min.)	14.0	13.0	12.5	dB
—	Gain Flatness (Max.)	±0.1	±0.7	±0.7	dB
NF	Noise Figure (Max.)	4.7	5.5	6.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+21.5	+20.0	+19.0	dBm
—	Input VSWR (Max.)	1.4:1	2.0:1	2.0:1.	—
—	Output VSWR (Max.)	1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+33.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+47.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+54.0	—	—	dBm
I_D	DC Current	62	—	—	mA

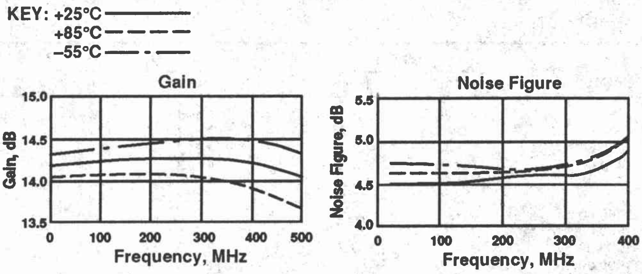
NOTE: A portion of any DC voltage applied to the RF input pin will appear at the RF output pin (i.e., a resistive DC path exists between pins). There is no input or output blocking capacitor.

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+15 dBm
Operating Case Temperature	–55°C to +100°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+100°C

THERMAL CHARACTERISTICS*

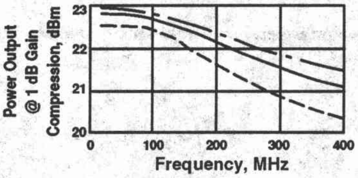
θ_{JC}	75°C/W
Active Transistor Power Dissipation	560 mW
Junction Temperature Above Case Temperature	42°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	437,500 Hrs.

*For further information, see High Reliability section, p. 17–2.

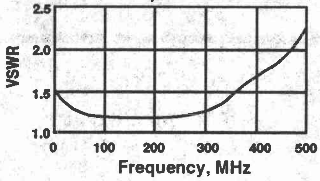
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

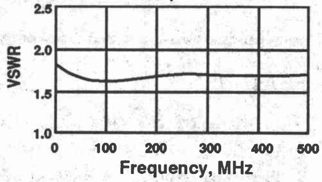
Power Output



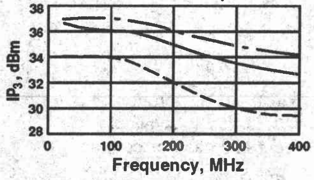
Input VSWR



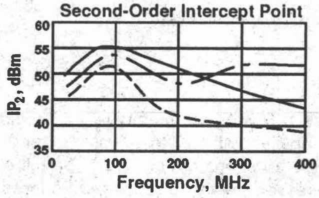
Output VSWR



Third-Order Intercept Point



Second-Order Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.27	14.28	159.58	–.10	.00	1.56	20.19
200.0	1.16	14.24	135.61	–.18	.65	1.63	20.04
300.0	1.20	14.21	112.60	.69	.67	1.71	19.93
400.0	1.42	14.28	87.62	–.39	.71	1.70	19.54
500.0	1.79	14.16	61.81		.75	1.66	18.97
600.0	2.18	13.35	33.33		.81	1.84	18.74
700.0	2.38	12.00	3.35		.79	2.48	19.14
800.0	2.25	10.16	–23.81		.71	3.47	19.82
900.0	2.03	7.96	–47.93		.61	4.50	20.78
1000.0	1.92	5.67	–67.95		.53	5.61	21.60
1100.0	1.91	3.48	–86.21		.51	6.50	22.37
1200.0	2.05	1.57	–104.37		.48	6.85	22.92
1300.0	2.37	–.24	–120.63		.44	7.29	23.45
1400.0	2.83	–1.95	–136.35		.48	7.97	23.82
1500.0	3.37	–3.61	–155.27		.50	9.08	24.33
1600.0	3.90	–4.97	–172.42		.45	9.81	25.05
1700.0	4.35	–6.42	172.50		.43	12.30	25.83
1800.0	4.47	–7.58	156.80		.39	14.53	26.73
1900.0	4.26	–8.68	144.23		.37	16.73	27.88
2000.0	3.97	–9.10	129.81		.00	19.75	29.13

LINEARIZATION RANGE: 100.0 to 400.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.114	–174.4	14.267	159.5	–20.192	–6.4	.222	174.1
200.00	.078	–161.1	14.200	135.7	–20.036	–15.1	.236	168.9
300.00	.088	–110.1	14.200	112.5	–19.930	–24.0	.259	153.6
400.00	.173	–97.4	14.267	87.7	–19.535	–33.5	.255	122.8
500.00	.278	–107.8	14.108	62.4	–18.969	–45.4	.248	77.1
600.00	.375	–123.5	13.328	34.0	–18.737	–60.1	.301	17.3
700.00	.423	–137.5	12.030	4.4	–19.137	–76.4	.424	–30.4
800.00	.399	–148.3	10.245	–22.9	–19.818	–91.6	.548	–64.2
900.00	.347	–154.1	8.040	–47.3	–20.776	–104.6	.635	–87.7
1000.00	.316	–152.4	5.730	–67.1	–21.600	–115.9	.699	–104.6
1100.00	.320	–145.6	3.545	–85.6	–22.371	–126.0	.734	–116.7
1200.00	.358	–138.1	1.649	–104.1	–22.915	–137.3	.746	–127.0
1300.00	.410	–134.2	–.234	–119.9	–23.449	–149.5	.759	–135.9
1400.00	.480	–135.5	–1.931	–135.2	–23.823	–162.5	.780	–143.1
1500.00	.547	–140.3	–3.591	–154.4	–24.334	–177.1	.799	–148.7
1600.00	.601	–146.6	–4.917	–171.5	–25.052	168.4	.819	–154.1
1700.00	.631	–154.6	–6.355	173.5	–25.826	153.1	.852	–158.7
1800.00	.640	–161.5	–7.511	157.7	–26.731	140.7	.869	–163.1
1900.00	.631	–166.7	–8.626	144.9	–27.885	128.4	.887	–168.0
2000.00	.604	–171.7	–9.017	130.7	–29.130	117.6	.905	–172.5

AVANTEK

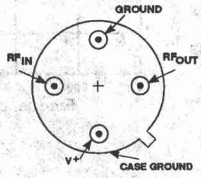
UTO/UTC 443 Series
Thin-Film Cascadable Amplifier
10 to 400 MHz

FEATURES

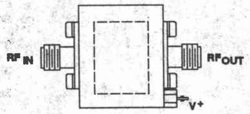
- Frequency Range: 10 to 400 MHz
- Low Current Drain: 10 mA (Typ)
- Output Power: +5.5 dBm (Typ)
- 5 Volt Supply
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- Low Power Systems



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

DESCRIPTION

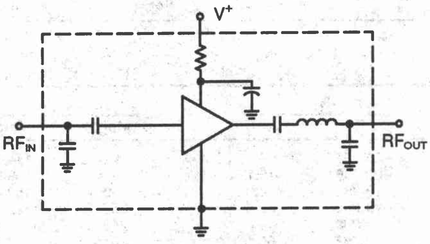
The 443 Series is a 5-volt bias medium-gain bipolar RF amplifier built on a thin-film substrate using output transformer coupling to increase efficiency. Blocking capacitors couple the RF through the amplifier. The 443 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS[1] (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	10-400	10-400	10-400	MHz
GP	Small Signal Gain (Min.)	13.2	12.5	12.0	dB
—	Gain Flatness (Max.)	±0.1	±0.7	±0.7	dB
NF	Noise Figure (Max.)	3.6	4.5	5.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+5.5	+4.5	+4.0	dBm
—	Input VSWR (Max.)	1.3:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+19.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+25.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+32.0	—	—	dBm
I_D	DC Current	10	—	—	mA

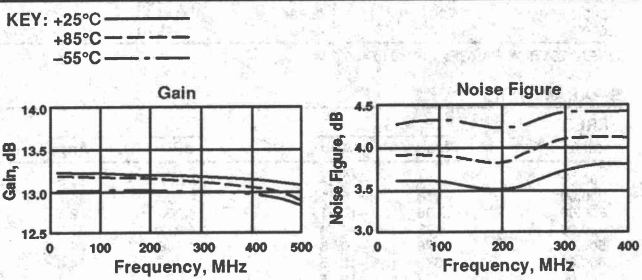
NOTE: A portion of any DC voltage applied to the RF input pin will appear at the RF output pin (i.e., a resistive DC path exists between pins). There is no input or output blocking capacitor.

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +5 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage .... +10 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

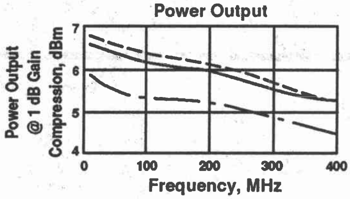
THERMAL CHARACTERISTICS*

θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 28 mW
Junction Temperature Above Case Temperature .... 3°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 629,500 Hrs.
*For further information, see High Reliability section, p. 17–2.

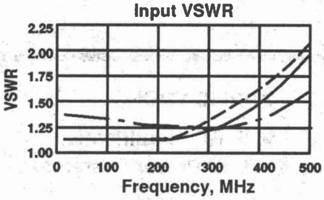
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

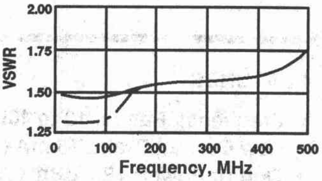
Power Output



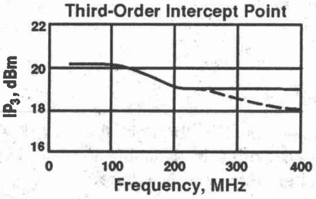
Input VSWR



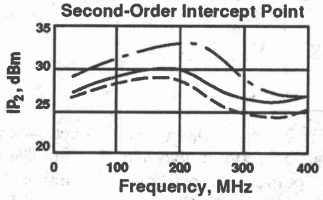
Output VSWR



Third-Order Intercept Point



Second-Order Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 5.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.26	13.33	159.56	–.23	.00	1.50	19.51
200.0	1.18	13.30	138.13	.03	.59	1.52	19.55
300.0	1.20	13.27	117.02	.63	.61	1.58	19.66
400.0	1.38	13.28	94.25	–.43	.64	1.62	19.76
500.0	1.68	13.20	71.24		.67	1.67	19.78
600.0	2.03	12.61	46.30		.73	1.79	19.67
700.0	2.41	11.61	18.33		.76	2.09	19.87
800.0	2.64	10.23	–8.25		.72	2.65	20.21
900.0	2.71	8.25	–33.73		.64	3.38	20.87
1000.0	2.86	5.86	–54.40		.55	4.12	21.76
1100.0	3.11	3.43	–73.22		.49	4.97	22.62
1200.0	3.45	1.26	–89.61		.41	5.37	23.24
1300.0	3.87	–.94	–102.39		.34	5.60	23.90
1400.0	4.28	–3.11	–113.78		.36	5.87	24.48
1500.0	4.75	–4.86	–128.37		.36	6.33	24.82
1600.0	5.28	–6.14	–140.03		.32	6.46	25.45
1700.0	6.04	–7.32	–151.61		.35	7.06	25.87
1800.0	6.96	–8.15	–164.99		.38	7.66	26.80
1900.0	7.78	–9.43	–178.69		.40	8.34	27.79
2000.0	8.75	–10.45	166.01		.00	9.61	28.49

LINEARIZATION RANGE: 100.0 to 400.0 MHz

S-PARAMETERS

BIAS = 5.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.113	–178.4	13.376	159.1	–19.514	–9.0	.202	176.7
200.00	.074	–159.9	13.283	137.8	–19.547	–18.0	.208	168.9
300.00	.083	–113.2	13.294	116.6	–19.662	–27.0	.220	155.8
400.00	.156	–98.1	13.298	93.7	–19.761	–37.3	.233	134.1
500.00	.251	–102.4	13.217	70.5	–19.781	46.8	.244	104.2
600.00	.340	–110.3	12.641	45.2	–19.667	–57.6	.279	63.8
700.00	.407	–120.9	11.615	16.7	–19.873	–68.6	.347	19.7
800.00	.441	–129.0	10.216	–10.0	–20.212	–82.3	.450	–17.6
900.00	.457	–134.9	8.200	–35.9	–20.867	–95.3	.543	–47.8
1000.00	.478	–137.8	5.766	–56.3	–21.759	–106.3	.615	–69.9
1100.00	.506	–139.2	3.166	–74.8	–22.616	–115.8	.662	–87.6
1200.00	.542	–140.7	1.043	–90.7	–23.245	–125.9	.705	–100.6
1300.00	.584	–142.7	–1.207	–103.4	–23.899	–134.8	.716	–111.3
1400.00	.618	–145.5	–3.466	–114.4	–24.481	–145.7	.723	–121.3
1500.00	.646	–148.6	–5.154	–127.9	–24.823	–157.5	.729	–129.7
1600.00	.681	–152.1	–6.435	–138.9	–25.447	–168.5	.744	–136.3
1700.00	.717	–155.9	–7.396	–151.3	–25.868	178.7	.762	–141.0
1800.00	.756	–159.2	–7.860	–164.6	–26.804	168.6	.786	–146.0
1900.00	.785	–162.9	–9.016	179.1	–27.794	160.5	.812	–150.9
2000.00	.806	–167.3	–10.304	161.3	–28.487	153.3	.824	–155.0

AVANTEK

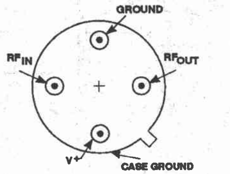
UTO/UTC 444 Series
Thin-Film Cascadable Amplifier
10 to 400 MHz

FEATURES

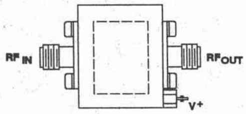
- Frequency Range: 10 to 400 MHz
- Low Current Drain: 15 mA (Typ)
- Output Power: +8.7 dBm (Typ)
- Temperature Compensated
- 5-Volt Supply
- High Efficiency

APPLICATIONS

- IF/RF Amplification
- Low Power Systems



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

DESCRIPTION

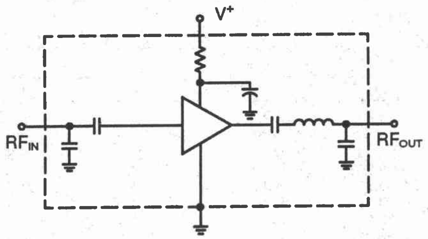
The 444 Series is a 5-volt, medium-gain bipolar RF amplifier built on a thin-film substrate using output transformer coupling to increase efficiency. Blocking capacitors couple the RF through the amplifier. The 444 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS[1] (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted)

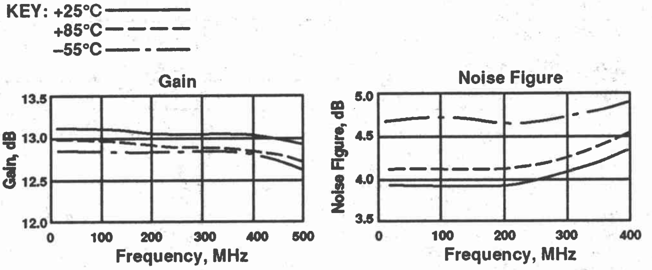
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	10-400	10-400	10-400	MHz
GP	Small Signal Gain (Min.)	13.0	12.5	12.0	dB
—	Gain Flatness (Max.)	±0.1	±0.7	±0.7	dB
NF	Noise Figure (Max.)	4.0	5.0	5.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+8.7	+8.0	+7.5	dBm
—	Input VSWR (Max.)	1.4:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+22.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+35.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+41.0	—	—	dBm
I_D	DC Current	15	—	—	mA

NOTE: A portion of any DC voltage applied to the RF input pin will appear at the RF output pin (i.e., a resistive DC path exists between pins). There is no input or output blocking capacitor.

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +5 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage .... +10 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

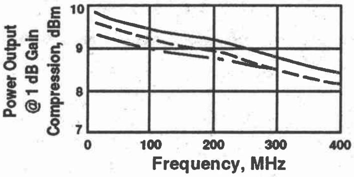
THERMAL CHARACTERISTICS*

θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 45 mW
Junction Temperature Above Case Temperature .... 5°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 627,400 Hrs.
*For further information, see High Reliability section, p. 17–2.

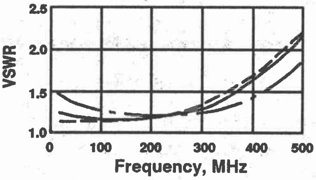
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

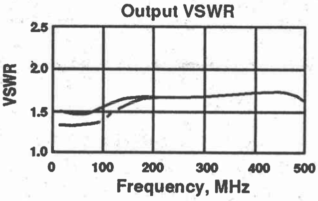
Power Output



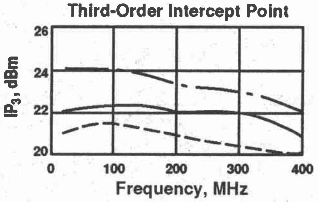
Input VSWR



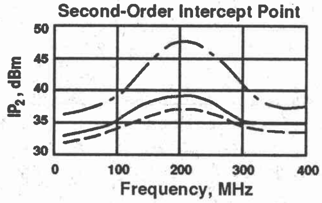
Output VSWR



Third-Order Intercept Point



Second-Order Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 5.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.23	13.21	158.56	–.13	.00	1.52	19.61
200.0	1.12	13.15	136.10	–.06	.62	1.58	19.68
300.0	1.18	13.07	114.15	.54	.63	1.63	19.70
400.0	1.43	13.11	90.72	–.33	.66	1.62	19.74
500.0	1.82	13.08	66.71		.70	1.55	19.64
600.0	2.24	12.53	40.08		.79	1.52	19.57
700.0	2.62	11.55	9.86		.83	1.87	19.82
800.0	2.69	9.97	–19.52		.79	2.70	20.55
900.0	2.62	7.63	–46.67		.68	3.86	21.68
1000.0	2.72	4.89	–68.33		.56	5.30	23.00
1100.0	2.98	2.12	–86.69		.49	6.78	24.16
1200.0	3.37	–.42	–103.32		.41	7.60	25.07
1300.0	3.84	–2.78	–115.92		.33	8.44	25.95
1400.0	4.31	–4.90	–127.01		.34	9.73	26.75
1500.0	4.75	–6.75	–140.57		.35	11.01	27.17
1600.0	5.27	–8.04	–152.20		.33	11.64	27.88
1700.0	5.98	–9.04	–164.18		.37	13.42	28.60
1800.0	6.92	–9.76	–178.99		.40	14.82	29.79
1900.0	7.88	–10.70	166.69		.43	16.32	30.17
2000.0	8.68	–11.39	150.37		.00	18.63	30.27

LINEARIZATION RANGE: 100.0 to 400.0 MHz

S-PARAMETERS

BIAS = 5.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.097	176.5	13.245	158.2	–19.608	–10.6	.210	–178.7
200.00	.051	–160.6	13.121	135.8	–19.683	–20.6	.226	177.2
300.00	.083	–92.2	13.093	113.7	–19.702	–30.0	.237	166.1
400.00	.183	–88.6	13.094	90.1	–19.735	–41.7	.232	146.1
500.00	.293	–98.5	13.050	65.9	–19.637	–52.8	.206	112.5
600.00	.383	–110.7	12.514	39.0	–19.570	–65.4	.202	55.7
700.00	.439	–124.2	11.506	8.3	–19.819	–80.1	.299	–7.1
800.00	.446	–133.3	9.892	–21.1	–20.547	–96.4	.459	–48.5
900.00	.437	–137.2	7.498	–48.5	–21.677	–111.4	.591	–77.9
1000.00	.452	–137.4	4.719	–69.1	–23.003	–123.1	.685	–98.7
1100.00	.486	–137.3	1.823	–87.6	–24.159	–132.2	.748	–114.4
1200.00	.533	–138.4	–.632	–103.5	–25.070	–142.2	.789	–126.1
1300.00	.581	–140.2	–3.045	–115.8	–25.951	–151.8	.803	–135.9
1400.00	.619	–143.4	–5.335	–125.9	–26.754	–161.1	.818	–145.2
1500.00	.645	–146.9	–7.067	–138.2	–27.170	–173.3	.837	–152.7
1600.00	.674	–150.7	–8.197	–148.6	–27.877	176.4	.855	–158.6
1700.00	.708	–153.9	–8.787	–160.8	–28.595	163.8	.871	–163.9
1800.00	.751	–156.9	–8.753	–176.8	–29.788	157.4	.894	–169.3
1900.00	.786	–160.7	–9.644	164.0	–30.169	152.5	.898	–174.3
2000.00	.806	–165.7	–10.704	143.5	–30.272	144.5	.899	–178.2

AVANTEK

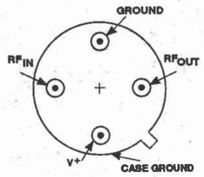
UTO/UTC 501 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

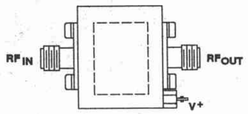
- Frequency Range: 5 to 500 MHz
- Medium Gain: 15.5 dB (Typ)
- Low Current Drain: 10 mA (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- Low Power Systems



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

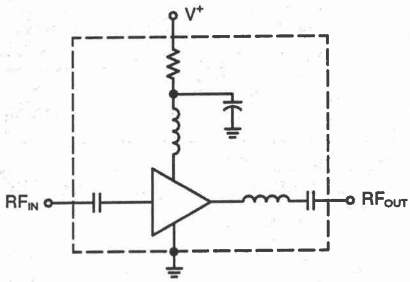
DESCRIPTION

The 501 Series is a thin-film bipolar RF amplifier that uses resistive feedback and active bias. Input/output blocking capacitors couple the RF through the circuit and inductive tuning provides low VSWR. The 501 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

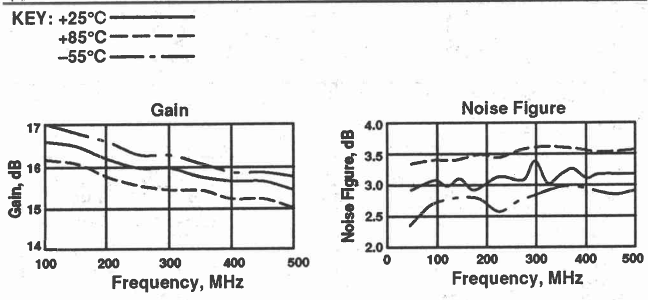
Symbol	Characteristic	Typical $T_c = 25°C$	Guaranteed Specifications		Unit
			$T_c = 0°$ to 50°C	$T_c = -55°$ to +85°C	
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	15.5	14.0	13.5	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	3.0	4.0	4.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+1.0	–2.0	–3.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	1.3:1	—
IP_3	Two Tone 3rd Order Intercept Point	+12.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+13.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+19.0	—	—	dBm
I_D	DC Current	10	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

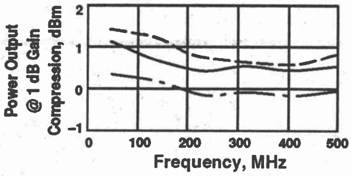
θ_{JC}	90°C/W
Active Transistor Power Dissipation	67 mW
Junction Temperature Above Case Temperature	6°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	1,170,000 Hrs.

*For further information, see High Reliability section, p.17–2 .

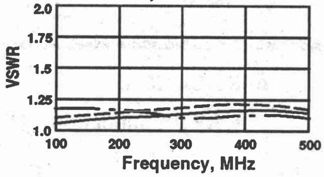
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

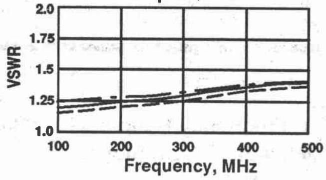
Power Output



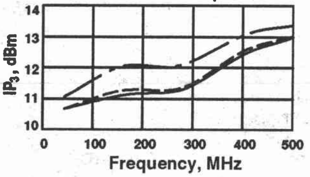
Input VSWR



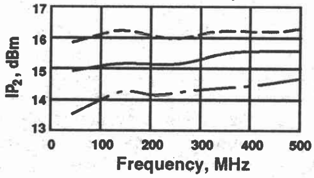
Output VSWR



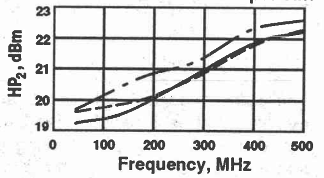
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.07	15.06	158.71	−.69	—	1.06	19.84
150.0	1.14	14.96	149.37	.22	.53	1.10	20.16
200.0	1.17	14.89	139.51	.62	.58	1.10	19.98
250.0	1.19	14.90	128.38	−.24	.58	1.12	20.16
300.0	1.22	14.92	118.62	.25	.55	1.14	20.03
350.0	1.24	14.83	108.62	.51	.59	1.17	19.93
400.0	1.25	14.84	97.36	−.47	.59	1.20	20.14
450.0	1.24	14.97	87.46	−.10	.56	1.22	19.87
500.0	1.22	14.94	77.21	−.09	.57	1.26	19.80
550.0	1.19	14.99	66.82	—	.60	1.31	19.92
600.0	1.12	15.05	55.74	—	.61	1.34	19.54
650.0	1.08	15.00	44.96	—	.64	1.36	19.81
700.0	1.07	15.15	32.62	—	.63	1.35	19.92
750.0	1.15	15.20	22.29	—	.62	1.42	19.61
800.0	1.28	15.13	10.21	—	.70	1.43	19.65
850.0	1.45	15.07	−3.08	—	.72	1.41	19.68
900.0	1.70	14.99	−15.78	—	.73	1.42	20.09
950.0	2.02	14.68	−29.33	—	.76	1.44	19.92
1000.0	2.41	14.49	−43.11	—	.75	1.43	20.42
1050.0	2.91	14.03	−56.17	—	.69	1.46	20.99
1100.0	3.61	13.42	−68.11	—	.70	1.53	21.38
1150.0	4.65	12.97	−81.29	—	.73	1.59	22.47
1200.0	5.63	12.04	−94.41	—	.72	1.66	23.61

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.031	74.2	15.06	156.9	−19.83	−5.0	.027	−178.7
200.00	.059	67.8	14.94	138.7	−19.83	−11.9	.038	169.8
300.00	.078	58.2	14.96	118.0	−19.74	−19.3	.060	154.9
400.00	.083	49.8	14.89	96.9	−19.91	−26.2	.083	139.9
500.00	.070	45.5	14.96	77.1	−19.66	−35.0	.113	123.4
600.00	.042	60.7	15.05	55.8	−19.66	−43.4	.137	105.8
700.00	.055	132.8	15.19	33.3	−19.49	−52.3	.163	85.0
800.00	.144	142.6	15.02	11.0	−19.58	−63.4	.176	61.7
900.00	.271	132.2	14.95	−15.2	−19.83	−76.8	.178	31.2
1000.00	.419	117.4	14.49	−40.5	−20.18	−90.4	.164	−8.6

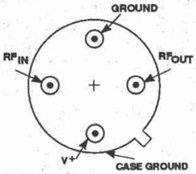
UTO/UTC 502 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

- Frequency Range: 5 to 500 MHz
- Medium Gain Stage: 14.5 dB (Typ)
- Medium Output Power: +8.0 dBm (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



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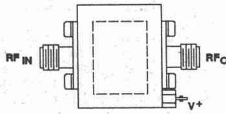


UTC—TC-1, p. 16–42

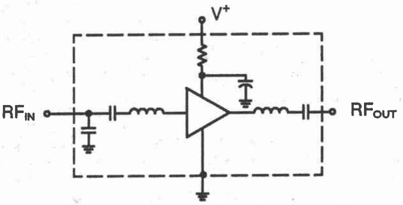
DESCRIPTION

The 502 Series is a thin-film bipolar RF amplifier that uses resistive feedback and active bias. Input/output blocking capacitors couple the RF through the circuit and inductive tuning provides low VSWR. The 502 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

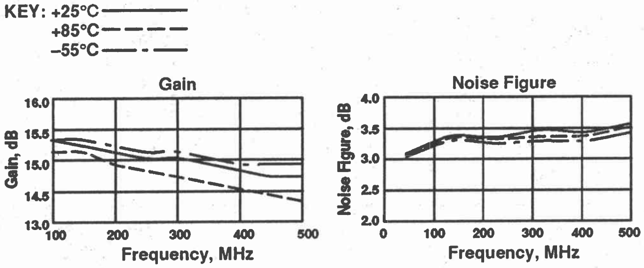
Symbol	Characteristic	Typical $T_c = 25°C$	Guaranteed Specifications $T_c = 0°$ to $50°C$	Guaranteed Specifications $T_c = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	14.5	14.0	13.5	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	3.5	4.0	4.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+8.0	+7.0	+7.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+21.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+30.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+37.0	—	—	dBm
I_D	DC Current	23	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... −55°C to +125°C
Storage Temperature .... −62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

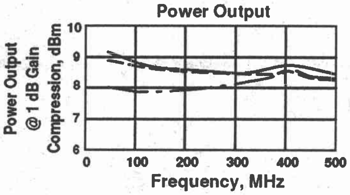
THERMAL CHARACTERISTICS*

θ_{JC} .... 90°C/W
Active Transistor Power Dissipation .... 120 mW
Junction Temperature Above Case Temperature .... 11°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 1,165,000 Hrs.
*For further information, see High Reliability section, p. 17–2.

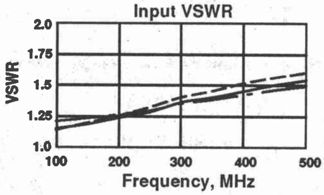
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

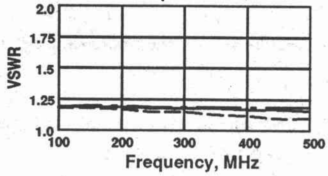
Power Output



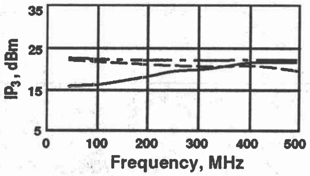
Input VSWR



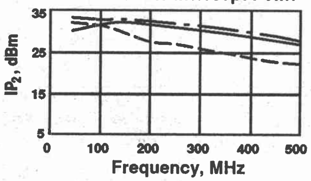
Output VSWR



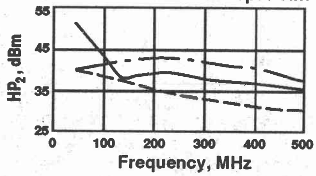
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.06	14.88	159.07	–.72	—	1.06	20.91
150.0	1.11	14.78	149.98	.35	.53	1.10	20.51
200.0	1.13	14.74	140.11	.65	.59	1.12	21.06
250.0	1.14	14.74	128.87	–.40	.58	1.15	20.82
300.0	1.17	14.81	119.31	.21	.54	1.16	20.69
350.0	1.18	14.67	109.49	.55	.59	1.21	21.10
400.0	1.19	14.68	98.24	–.51	.58	1.25	20.98
450.0	1.19	14.79	88.51	–.07	.55	1.25	20.81
500.0	1.19	14.76	78.37	–.04	.57	1.29	20.89
550.0	1.19	14.81	68.04	—	.59	1.35	20.52
600.0	1.18	14.83	57.17	—	.60	1.38	20.58
650.0	1.23	14.74	46.35	—	.63	1.41	20.01
700.0	1.29	14.85	34.54	—	.61	1.45	20.86
750.0	1.41	14.89	24.51	—	.60	1.45	21.78
800.0	1.56	14.77	12.88	—	.67	1.45	21.09
850.0	1.77	14.71	.23	—	.68	1.43	21.20
900.0	2.02	14.62	–11.75	—	.69	1.39	21.26
950.0	2.41	14.32	–24.58	—	.72	1.38	22.47
1000.0	2.81	14.15	–37.67	—	.70	1.33	22.11
1050.0	3.34	13.77	–49.83	—	.64	1.29	21.94
1100.0	4.20	13.26	–60.89	—	.66	1.27	22.13
1150.0	5.33	12.88	–73.51	—	.70	1.27	23.24
1200.0	6.49	12.10	–86.00	—	.68	1.29	23.94

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.030	73.6	14.66	157.7	–20.54	–5.4	.025	–153.0
200.00	.056	69.3	14.55	139.9	–20.63	–12.2	.040	–164.0
300.00	.073	63.1	14.59	119.8	–20.54	–19.8	.062	178.5
400.00	.079	59.3	14.50	99.4	–20.72	–27.0	.086	161.3
500.00	.074	62.4	14.59	80.1	–20.54	–35.8	.116	143.5
600.00	.066	84.8	14.68	59.7	–20.72	–43.4	.139	126.3
700.00	.093	115.5	14.83	38.1	–20.94	–51.7	.164	106.3
800.00	.173	125.4	14.73	16.9	–20.82	–61.9	.177	86.0
900.00	.293	120.1	14.76	–8.3	–21.11	–74.6	.179	60.4
1000.00	.438	108.3	14.47	–32.7	–21.51	–86.9	.154	31.5

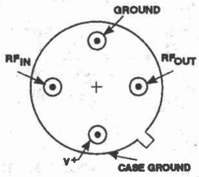
UTO/UTC 503 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

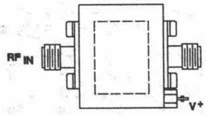
- Frequency Range: 5 to 500 MHz
- Medium Output Power: +15.0 dBm (Typ)
- 24-Volt Supply
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

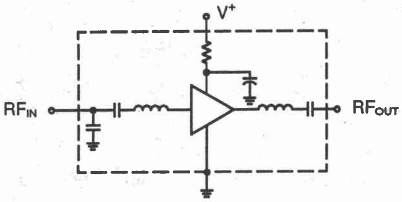
DESCRIPTION

The 503 Series is a thin-film bipolar RF amplifier that uses resistive feedback and active bias. Input/output blocking capacitors couple the RF through the circuit and inductive tuning provides low VSWR. The 503 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +24 VDC nominal unless otherwise noted)

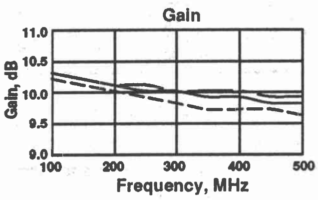
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	10.0	9.0	8.5	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	4.5	5.0	6.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+15	+13.0	+13.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+29.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+42.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+48.0	—	—	dBm
I_D	DC Current	50	—	—	mA

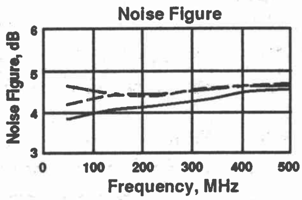
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +24 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
–55°C —— - ——





MAXIMUM RATINGS

DC Voltage	+26 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +115°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+115°C

THERMAL CHARACTERISTICS*

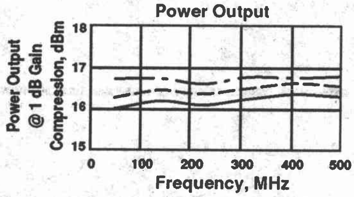
θ_{JC}	85°C/W
Active Transistor Power Dissipation	360 mW
Junction Temperature Above Case Temperature	31°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	1,178,000 Hrs.

*For further information, see High Reliability section, p. 17–2.

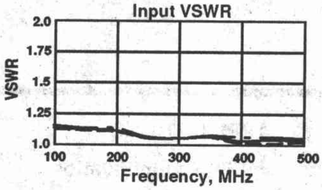
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

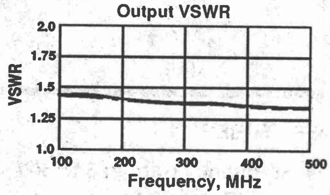
Power Output



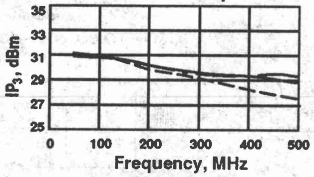
Input VSWR



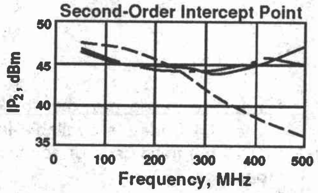
Output VSWR



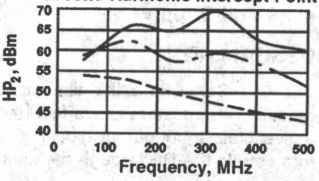
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 24.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.16	10.90	163.43	.08	—	1.09	16.96
150.0	1.18	10.79	155.51	.26	.45	1.10	16.96
200.0	1.23	10.82	147.23	.09	.47	1.11	16.94
250.0	1.28	10.85	138.76	–.28	.46	1.12	16.96
300.0	1.33	10.98	130.74	–.19	.45	1.14	16.98
350.0	1.39	11.11	122.54	–.30	.45	1.15	17.01
400.0	1.48	11.24	114.64	–.10	.44	1.16	17.02
450.0	1.57	11.39	106.81	.16	.44	1.17	17.06
500.0	1.68	11.60	98.81	.27	.45	1.18	17.10
550.0	1.83	11.82	90.45	—	.46	1.19	17.19
600.0	1.98	12.06	82.09	—	.49	1.20	17.32
650.0	2.18	12.36	72.90	—	.53	1.19	17.47
700.0	2.39	12.72	63.04	—	.57	1.19	17.67
750.0	2.66	13.13	52.30	—	.64	1.19	17.92
800.0	3.07	13.57	40.09	—	.73	1.18	18.25

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 24.00 VOLTS

FREQ MHz	S_{11}		S_{21}		S_{12}		S_{22}	
	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.061	174.0	9.07	162.5	–16.13	–7.6	.149	162.1
200.00	.046	170.6	9.62	148.9	–16.25	–15.7	.153	144.9
300.00	.027	176.0	9.72	133.2	–16.25	–24.6	.164	128.4
400.00	.018	–116.4	9.70	117.0	–16.54	–33.3	.170	114.3
500.00	.045	–87.7	9.97	101.6	–16.48	–44.1	.177	103.3
600.00	.079	–97.1	10.20	85.6	–16.77	–53.6	.176	94.2
700.00	.105	–113.5	10.59	67.7	–17.14	–62.5	.172	85.7
800.00	.113	–143.2	11.04	49.5	–17.85	–72.0	.160	81.4
900.00	.098	154.3	11.65	26.2	–18.56	–80.7	.139	80.3
1000.00	.189	63.2	11.88	–1.3	–19.02	–85.5	.118	95.8

AVANTEK

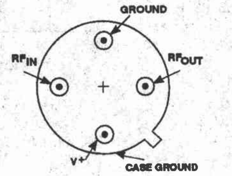
UTO/UTC 504 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

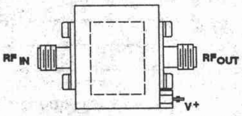
- Frequency Range: 5 to 500 MHz
- High Output Power: +21.0 dBm (Typ)
- Temperature Compensated
- 24-Volt Supply

APPLICATIONS

- IF/RF Amplification
- Output Stage



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

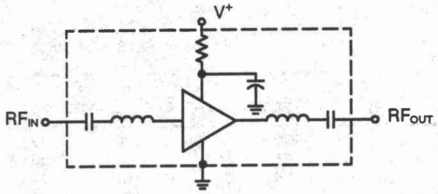
DESCRIPTION

The 504 Series is a thin-film bipolar RF amplifier that uses resistive feedback and active bias. Input/output blocking capacitors couple the RF through the circuit and inductive tuning provides for low VSWR. The 504 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +24 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	7.0	6.0	6.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	7.5	11.0	11.0	dB
$P_{1 dB}$	Power Output @ +1 dB Compression (Min.)	+21.0	+17.0	+17.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.2:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+34.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+44.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+50.0	—	—	dBm
I_D	DC Current	100	—	—	mA

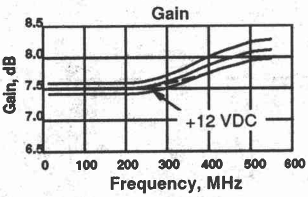
SCHEMATIC

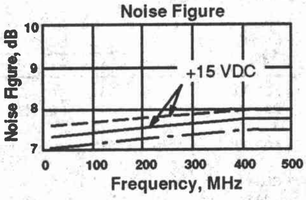


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +24 VDC unless otherwise noted)

KEY: +25°C ———
+85°C — — —
–55°C — - —





MAXIMUM RATINGS

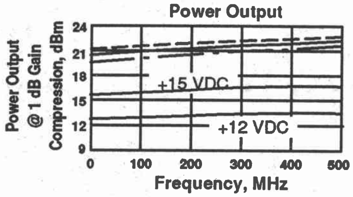
DC Voltage .... +26 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +115°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +115°C

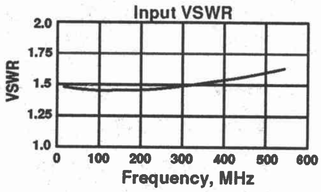
THERMAL CHARACTERISTICS*

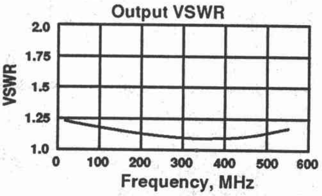
θ_{JC} .... 85°C/W
Active Transistor Power Dissipation .... 380 mW
Junction Temperature Above Case Temperature .... 32°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 624,100 Hrs.
*For further information, see High Reliability section, p. 17–2.

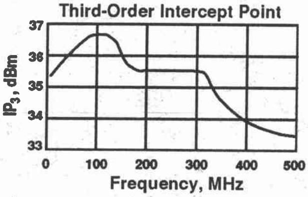
WEIGHT: (typical) — 2.1 grams; UTC — 21.5 grams

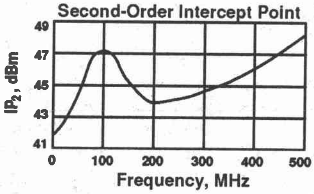
TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

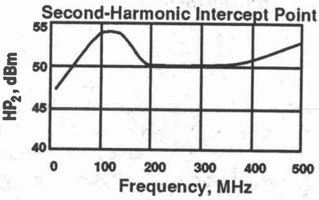












AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 24.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.25	7.06	162.04	–.93	—	1.35	16.35
150.0	1.30	7.26	151.15	–1.39	.55	1.34	16.54
200.0	1.35	7.38	142.12	.00	.51	1.31	16.70
250.0	1.40	7.45	132.92	1.21	.53	1.28	16.87
300.0	1.46	7.52	122.88	1.59	.57	1.24	16.95
350.0	1.52	7.62	112.34	1.47	.61	1.19	17.00
400.0	1.58	7.70	100.98	.52	.64	1.15	16.92
450.0	1.64	7.79	89.32	–.71	.64	1.11	16.59
500.0	1.72	7.83	77.84	–1.77	.65	1.11	16.16
550.0	1.81	7.72	65.76	—	.67	1.16	15.71
600.0	1.92	7.64	53.70	—	.67	1.25	15.31
650.0	2.06	7.39	41.72	—	.68	1.36	14.95
700.0	2.29	6.99	29.32	—	.71	1.49	14.65
750.0	2.54	6.54	16.27	—	.72	1.64	14.38
800.0	2.90	5.97	3.42	—	.70	1.81	14.22

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 24.00 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.105	–16.9	7.113	165.0	–16.290	–6.8	.130	163.9
150.00	.094	–27.5	7.171	157.3	–16.493	–9.3	.129	157.7
200.00	.080	–43.1	7.260	148.8	–16.519	–12.4	.123	148.9
250.00	.065	–69.3	7.407	140.0	–16.644	–14.1	.116	143.0
300.00	.062	–112.5	7.574	130.7	–16.742	–16.1	.110	139.4
350.00	.087	–151.9	7.753	120.8	–16.752	–17.7	.106	139.2
400.00	.134	–176.8	7.923	110.8	–16.735	–19.4	.102	142.3
450.00	.197	165.0	7.991	100.6	–16.638	–20.5	.106	148.3
500.00	.268	150.3	7.959	89.8	–16.430	–22.6	.121	153.5
550.00	.347	137.5	7.800	78.9	–16.226	–25.3	.144	155.9
600.00	.427	125.8	7.475	67.9	–15.978	–28.7	.173	155.1
650.00	.499	115.4	7.041	57.1	–15.792	–32.8	.207	151.3
700.00	.563	105.8	6.506	47.0	–15.722	–37.1	.242	146.3
750.00	.616	96.6	5.850	37.2	–15.666	–41.2	.273	141.1
800.00	.659	88.2	5.143	28.1	–15.682	–45.7	.300	135.9
850.00	.697	80.6	4.406	19.8	–15.775	–49.8	.324	130.3
900.00	.729	73.7	3.672	11.9	–15.887	–53.9	.346	125.2
950.00	.754	67.5	2.933	4.7	–16.033	–57.9	.386	120.5
1000.00	.777	61.9	2.230	–2.0	–16.152	–61.6	.381	116.0
1050.00	.795	56.6	1.538	–8.3	–16.344	–64.9	.395	111.8
1100.00	.809	51.7	.871	–14.3	–16.529	–68.1	.410	107.9
1150.00	.821	47.0	.275	–20.4	–16.750	–71.4	.422	104.2

AVANTEK

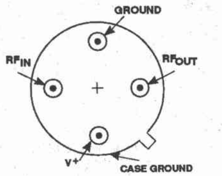
UTO/UTC 505 Series
Thin-Film Cascadable Amplifier
10 to 500 MHz

FEATURES

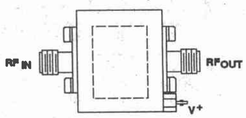
- Frequency Range: 10 to 500 MHz
- High Output Power: +20.0 dBm (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- Output Stage



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

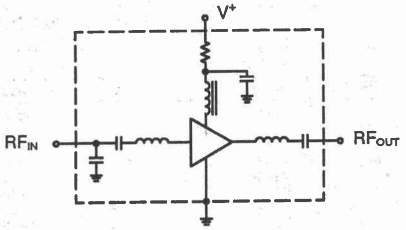
DESCRIPTION

The 505 Series is a thin-film bipolar RF amplifier that uses resistive feedback and active bias. Input/output blocking capacitors couple the RF through the circuit and inductive tuning provides for low VSWR. The 505 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	10-500	10-500	10-500	MHz
GP	Small Signal Gain (Min.)	10.5	9.0	9.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	6.0	7.0	7.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+20.0	+18.0	+18.0	dBm
—	Input VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.4:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+29.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+35.0	—	—	dBm
HP_3	One Tone 2nd Harmonic Intercept Point	+40.0	—	—	dBm
I_D	DC Current	100	—	—	mA

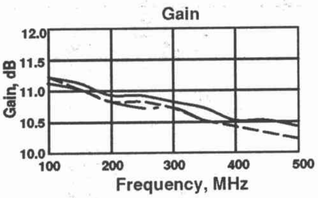
SCHEMATIC

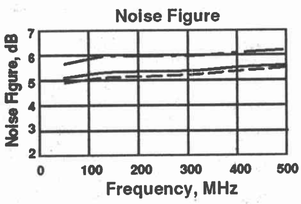


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C — — — —
–55°C —·—





MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

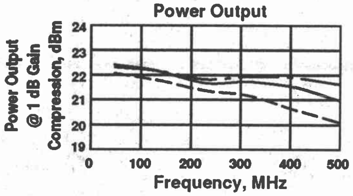
θ_{JC}	55°C/W
Active Transistor Power Dissipation	510 mW
Junction Temperature Above Case Temperature	28°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	991,900 Hrs.

*For further information, see High Reliability section, p. 17–2.

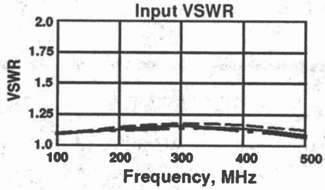
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

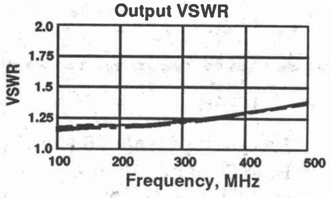
Power Output



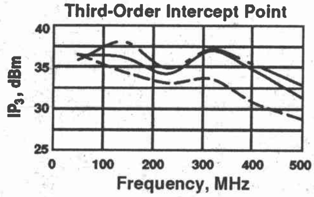
Input VSWR



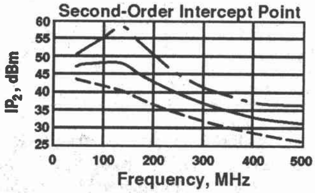
Output VSWR



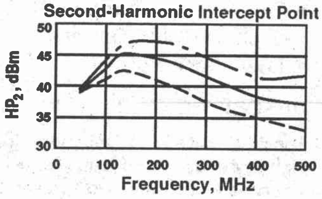
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.33	11.14	160.33	.57	.00	17.56	1.24
150.0	1.32	11.07	150.09	.18	.57	17.54	1.25
200.0	1.33	11.00	139.79	−.24	.56	17.48	1.27
250.0	1.32	10.96	129.83	−.35	.55	17.43	1.28
300.0	1.32	10.95	119.84	−.46	.55	17.40	1.31
350.0	1.30	10.89	110.06	−.39	.53	17.35	1.35
400.0	1.28	10.86	100.67	.07	.53	17.23	1.39
450.0	1.24	10.81	91.06	.33	.54	17.17	1.45
500.0	1.20	10.76	81.16	.30	.55	17.13	1.52
550.0	1.15	10.72	71.31	—	.56	17.07	1.62
600.0	1.11	10.67	61.13	—	.58	17.03	1.75
650.0	1.11	10.67	50.55	—	.60	17.01	1.89
700.0	1.18	10.64	39.60	—	.61	17.01	2.06
750.0	1.30	10.67	28.71	—	.66	17.01	2.29
800.0	1.48	10.67	15.96	—	.75	17.16	2.58
850.0	1.76	10.65	1.87	—	.83	17.43	2.85
900.0	2.22	10.50	−13.96	—	.93	17.83	3.09
950.0	3.02	10.05	−31.74	—	1.00	18.50	3.24
1000.0	4.37	9.08	−49.80	—	.96	19.44	3.21
1050.0	6.27	7.59	−66.42	—	.85	20.58	3.02
1100.0	8.39	5.80	−80.45	—	.71	21.65	2.82
1150.0	10.47	3.85	−91.94	—	.57	22.71	2.70
1200.0	12.33	1.96	−101.07	—	.49	23.68	2.63

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.127	−169.7	11.118	162.9	−17.619	−5.6	.110	178.7
200.00	.132	−166.8	10.999	145.5	−17.550	−12.7	.116	−175.5
300.00	.133	−167.8	10.923	128.4	−17.466	−19.9	.134	−172.3
400.00	.122	−173.7	10.849	111.9	−17.325	−27.5	.163	−171.5
500.00	.096	174.0	10.748	95.5	−17.183	−36.5	.207	−173.6
600.00	.059	139.1	10.659	78.5	−17.103	−46.7	.266	−179.8
700.00	.077	61.9	10.632	59.7	−17.025	−58.5	.347	171.4
800.00	.182	30.4	10.678	38.9	−17.208	−71.0	.434	159.1
900.00	.366	13.5	10.502	12.1	−17.924	−87.1	.505	142.4
1000.00	.620	−7.8	9.113	−20.5	−19.481	−103.5	.516	123.9

AVANTEK

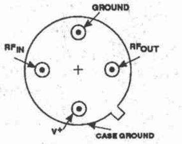
UTO/UTC/PPA 509 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

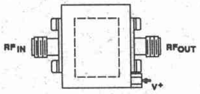
- Frequency Range: 5 to 500 MHz
- High Dynamic Range
- Output Power: +22.3 dBm (Typ)
- Noise Figure: 4.5 dB (Typ)
- Temperature Compensated
- Surface Mount Option
- Low Phase Noise

APPLICATIONS

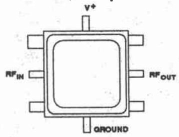
- IF/RF Amplification
- Output Stage
- Surface Mount Assembly



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42



PPA—PP-38, p. 16–35

DESCRIPTION

The 509 Series is a wideband single stage high power bipolar RF amplifier using thin-film construction with two Avantek transistors in parallel for better RF and thermal performance. Resistive feedback and active bias provide for temperature compensation and increased immunity to bias voltage variations. Blocking capacitors couple the RF through the amplifier. The 509 Series amplifiers are available in three packages: the surface mount PlanarPak PP-38 (.375 in. x .375 in.) case, the TO-8 hermetic case and the connectorized TC-1 case.

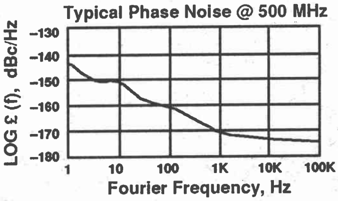
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	14.3	13.0	12.0	dB
—	Gain Flatness (Max.)	±0.5	±0.7	±1.0	dB
NF	Noise Figure (Max.)	4.5	5.5	6.0	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+22.3	+20.0	+20.0	dBm
—	Input VSWR (Max.)	<1.4:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+35.0	+30.0	+29.0	dBm
IP_2	Two Tone 2nd Order Intercept Point	+45.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+47.0	—	—	dBm
I_D	DC Current	90	—	—	mA
—	Phase Noise @ 500 MHz; 1KHz Offset	–170	—	—	dBc/Hz

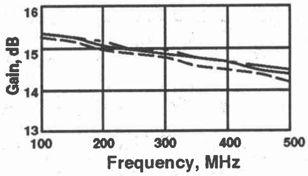
TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C — — —
–55°C — - —

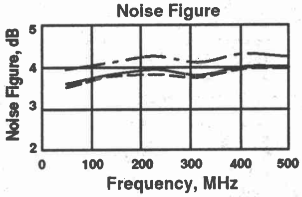
Typical Phase Noise @ 500 MHz



Gain



Noise Figure



MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+15 dBm
Operating Case Temperature	–55°C to +115°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+115°C

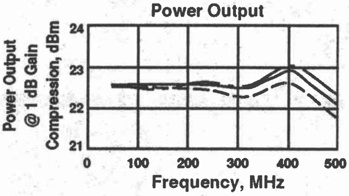
THERMAL CHARACTERISTICS*

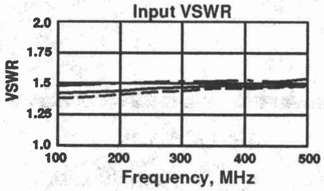
θ_{JC}	75°C/W
Active Transistor Power Dissipation	413 mW
Junction Temperature Above Case Temperature	31°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	486,500 Hrs.

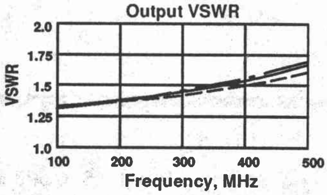
*For further information, see High Reliability section, p. 17–2.

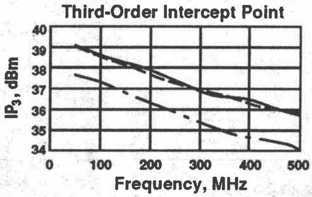
WEIGHT: (typical) PPA—0.5 grams; UTO—2.1 grams; UTC—21.5 grams

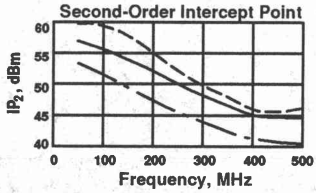
TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

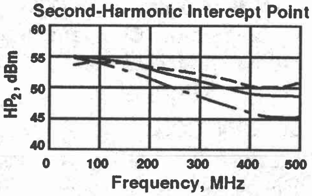












AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.11	14.69	167.83	–.21	.00	1.09	18.73
150.0	1.12	14.70	161.60	–.36	.32	1.11	18.68
200.0	1.14	14.61	156.20	.32	.32	1.14	18.59
250.0	1.16	14.54	149.99	.19	.34	1.16	18.67
300.0	1.17	14.49	143.81	.09	.34	1.20	18.64
350.0	1.19	14.38	137.89	.25	.33	1.24	18.61
400.0	1.19	14.32	131.76	.20	.35	1.29	18.61
450.0	1.20	14.24	125.23	–.24	.35	1.34	18.58
500.0	1.21	14.22	119.13	–.25	.34	1.40	18.54
550.0	1.23	14.27	112.91	—	.35	1.46	18.40
600.0	1.24	14.23	106.42	—	.36	1.53	18.34
650.0	1.29	14.21	100.01	—	.38	1.59	18.31
700.0	1.37	14.17	92.65	—	.43	1.66	18.25
750.0	1.49	14.12	84.40	—	.48	1.74	18.27
800.0	1.64	14.04	75.54	—	.52	1.80	18.32
850.0	1.86	14.12	65.84	—	.55	1.84	18.38
900.0	2.27	14.02	55.59	—	.60	1.83	18.75
950.0	2.96	13.73	44.41	—	.68	1.75	19.15
1000.0	4.04	13.12	31.03	—	.70	1.63	20.02
1050.0	5.65	12.10	19.02	—	.64	1.49	21.02
1100.0	7.83	10.69	7.85	—	.56	1.35	22.26
1150.0	10.64	8.92	–1.24	—	.44	1.25	23.57
1200.0	12.36	7.07	–8.08	—	.31	1.21	24.30
1250.0	12.36	5.29	–12.57	—	.21	1.21	25.47
1300.0	12.31	3.62	–15.74	—	.13	1.23	26.15
1350.0	13.42	2.10	–17.32	—	.08	1.26	26.85
1400.0	13.75	.67	–18.71	—	.08	1.30	27.78
1450.0	13.02	–.78	–20.10	—	.04	1.33	28.30
1500.0	12.66	–2.03	–20.17	—	.00	1.35	28.52

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.053	–152.1	14.644	166.7	–18.644	–2.1	.044	–160.3
200.00	.065	–162.4	14.574	153.6	–18.711	–6.8	.064	–133.6
300.00	.078	–179.6	14.473	140.2	–18.704	–11.8	.091	–128.1
400.00	.087	159.4	14.295	126.8	–18.637	–17.4	.126	–128.4
500.00	.097	130.4	14.181	113.1	–18.580	–24.2	.163	–132.0
600.00	.111	98.6	14.192	99.4	–18.428	–31.7	.205	–138.9
700.00	.161	72.4	14.129	84.4	–18.270	–40.1	.246	–148.6
800.00	.242	48.4	14.047	66.0	–18.330	–50.3	.282	–162.5
900.00	.389	26.2	14.033	44.4	–18.731	–63.0	.293	179.5
1000.00	.608	–1.0	13.111	19.0	–19.939	–78.4	.239	157.2
1100.00	.776	–29.1	10.641	–5.7	–22.229	–88.3	.151	143.9
1200.00	.855	–51.6	7.060	–22.9	–24.374	–88.9	.098	158.7
1300.00	.857	–68.2	3.547	–31.6	–26.234	–88.4	.104	176.0
1400.00	.867	–79.3	.613	–35.6	–27.653	–90.8	.131	173.3
1500.00	.868	–87.1	–2.105	–38.2	–28.563	–90.7	.153	164.1
1600.00	.865	–92.8	–4.330	–40.6	–29.732	–93.3	.179	152.4
1700.00	.875	–97.4	–6.341	–41.4	–30.476	–94.3	.199	142.8
1800.00	.864	–101.4	–8.131	–43.6	–31.627	–92.8	.231	133.9
1900.00	.900	–105.7	–9.563	–43.8	–32.251	–93.6	.257	127.6
2000.00	.884	–108.7	–11.263	–43.7	–32.793	–94.3	.284	124.2

AVANTEK

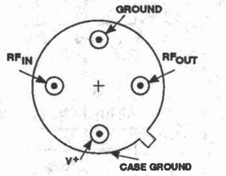
UTO/UTC 510 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

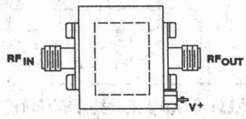
- Frequency Range: 5 to 500 MHz
- Low Noise: 2.3 dB (Typ)
- Medium Gain: 16 dB (Typ)
- Temperature Compensated
- Low Supply Current: 10 mA (Typ)

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

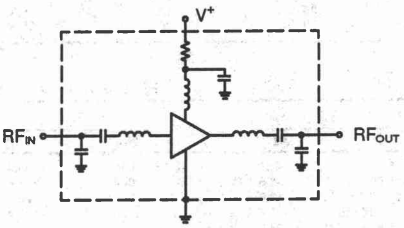
DESCRIPTION

The 510 Series is an efficient medium-gain thin-film bipolar RF amplifier. Resistive feedback and active bias provide temperature compensation and increased immunity to bias voltage variations. Blocking capacitors couple the RF through the amplifier. The 510 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

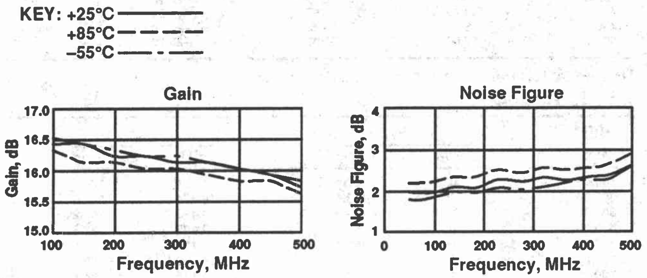
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = −55° to +85°C	Unit
BW	Frequency Range	5-500	5-500	10-500	MHz
GP	Small Signal Gain (Min.)	16.0	15.0	15.0	dB
—	Gain Flatness (Max.)	±0.6	±1.0	±1.0	dB
NF	Noise Figure (Max.)	2.3	3.0	3.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+1.0	−2.0	−3.0	dBm
—	Input VSWR (Max.)	<1.8:1	2.0:1	2.2:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+12.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+16.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+20.0	—	—	dBm
I_D	DC Current	10	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

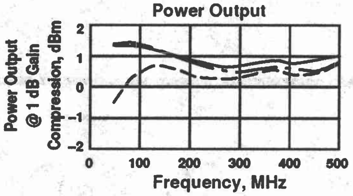
DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... −55°C to +125°C
Storage Temperature .... −62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

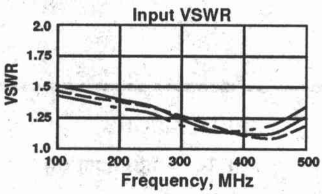
THERMAL CHARACTERISTICS*

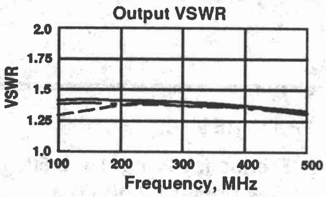
θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 67 mW
Junction Temperature Above Case Temperature .... 7°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 957,900 Hrs.
*For further information, see High Reliability section, p. 17–2.

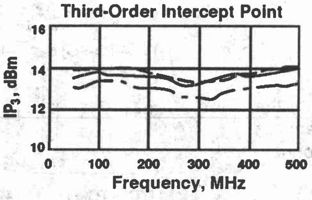
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

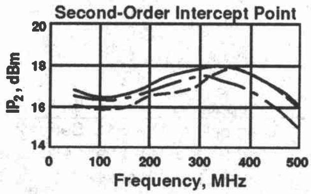
TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

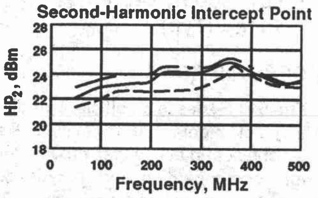












AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	FLAT dB	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.69	17.39	147.77	−4.04	.06	—	1.51	23.07
150.0	1.59	17.28	133.10	−.64	.16	.86	1.52	22.97
200.0	1.49	17.31	116.89	1.23	.14	.95	1.49	22.68
250.0	1.39	17.33	99.01	1.43	.06	.96	1.50	22.64
300.0	1.33	17.51	52.39	2.89	−.06	.98	1.49	22.49
350.0	1.34	17.50	63.82	2.39	−.05	1.04	1.53	22.42
400.0	1.40	17.58	45.07	1.73	−.12	1.07	1.53	22.29
450.0	1.54	17.61	25.35	.09	−.16	1.19	1.53	21.69
500.0	1.79	17.49	2.11	−5.08	−.04	1.32	1.54	22.32
550.0	2.16	17.06	−22.23	—	—	1.43	1.50	22.09
600.0	2.97	16.03	−49.43	—	—	1.45	1.37	23.18

LINEARIATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.202	166.7	17.38	145.8	−22.73	−10.6	.176	163.1
200.00	.154	160.3	17.30	115.3	−22.62	−24.3	.169	148.1
300.00	.121	168.4	17.37	81.6	−22.27	−39.8	.171	135.8
400.00	.152	168.2	17.38	45.6	−22.27	−58.4	.177	124.4
500.00	.229	122.5	17.46	4.7	−22.16	−83.1	.206	105.6
600.00	.422	45.4	16.49	−45.2	−23.35	−114.4	.181	63.5
700.00	.706	−24.1	12.90	−95.6	−27.74	−146.7	.081	−35.8
800.00	.834	−67.9	7.19	−132.0	−34.42	−159.1	.172	−143.5
900.00	.886	−95.7	1.95	−155.8	−39.17	−149.0	.292	−178.7
1000.00	.907	−112.7	−2.60	−170.8	−43.09	−131.4	.386	161.9

AVANTEK

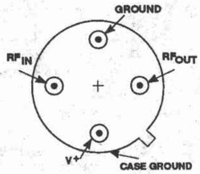
UTO/UTC 511 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

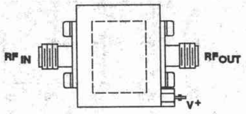
- Frequency Range: 5 to 500 MHz
- Low Noise: 2.3 dB (Typ)
- Temperature Compensated
- Low Supply Current: 10 mA (Typ)

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

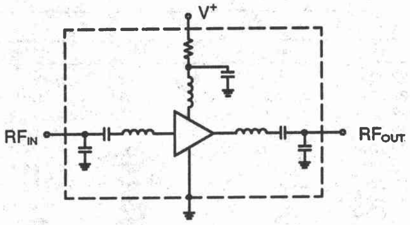
DESCRIPTION

The 511 Series is an efficient medium-gain thin-film bipolar RF amplifier. Resistive feedback and active bias provide temperature compensation and increased immunity to bias voltage variations. Blocking capacitors couple the RF through the amplifier. The 511 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

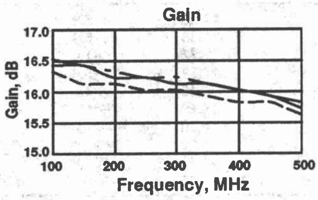
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	16.0	15.0	15.0	dB
—	Gain Flatness (Max.)	±0.6	±1.0	±1.0	dB
NF	Noise Figure (Max.)	2.3	2.5	3.0	dB
$P_{1\,dB}$	Power Output @ + 1 dB Compression (Min.)	+1.0	–2.0	–3.0	dBm
—	Input VSWR (Max.)	<1.8:1	2.0:1	2.2:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+12.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+16.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+20.0	—	—	dBm
I_D	DC Current	10	—	—	mA

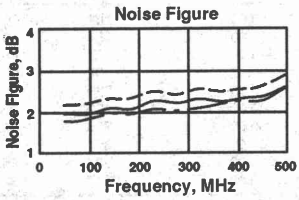
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ——————
+85°C — — — —
–55°C —— · ——





MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

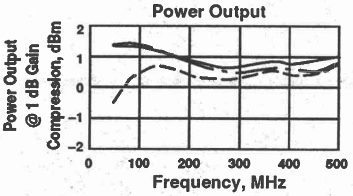
THERMAL CHARACTERISTICS*

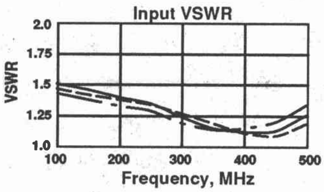
θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 67 mW
Junction Temperature Above Case Temperature .... 7°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 924,700 Hrs.

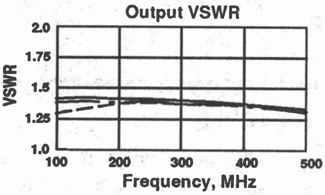
*For further information, see High Reliability section, p. 17–2.

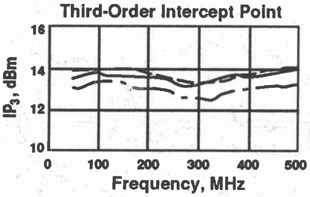
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

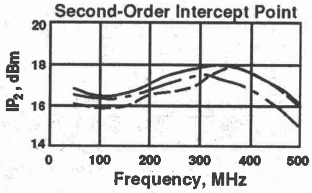
TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

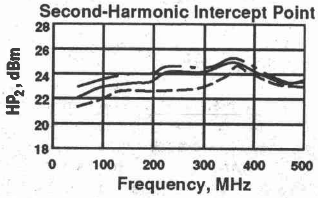












AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	FLAT dB	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.69	17.39	147.77	−4.04	.06	—	1.51	23.07
150.0	1.59	17.28	133.10	−.64	.16	.86	1.52	22.97
200.0	1.49	17.31	116.89	1.23	.14	.95	1.49	22.68
250.0	1.39	17.38	99.01	1.43	.06	.96	1.50	22.64
300.0	1.33	17.51	82.39	2.89	−.06	.98	1.49	22.49
350.0	1.34	17.50	63.82	2.39	−.05	1.04	1.53	22.42
400.0	1.40	17.58	45.07	1.73	−.12	1.07	1.53	22.29
450.0	1.54	17.61	25.35	.09	−.16	1.19	1.53	21.69
500.0	1.79	17.49	2.11	−5.08	.04	1.32	1.54	22.32
550.0	2.16	17.06	−22.23	—	—	1.43	1.50	22.09
600.0	2.97	16.03	−49.43	—	—	1.45	1.37	23.18

LINEARIATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.202	166.7	17.38	145.8	−22.73	−10.6	.176	163.1
200.00	.154	160.3	17.30	115.3	−22.62	−24.3	.169	148.1
300.00	.121	168.4	17.37	81.6	−22.27	−39.8	.171	135.8
400.00	.152	168.2	17.38	45.6	−22.27	−58.4	.177	124.4
500.00	.229	122.5	17.46	4.7	−22.16	−83.1	.206	105.6
600.00	.422	45.4	16.49	−45.2	−23.35	−114.4	.181	63.5
700.00	.706	−24.1	12.90	−95.6	−27.74	−146.7	.081	−35.8
800.00	.834	−67.9	7.19	−132.0	−34.42	−159.1	.172	−143.5
900.00	.886	−95.7	1.95	−155.8	−39.17	−149.0	.292	−178.7
1000.00	.907	−112.7	−2.60	−170.8	−43.09	−131.4	.386	161.9

AVANTEK

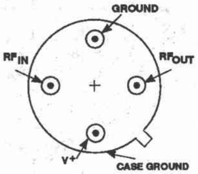
UTO/UTC 512 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

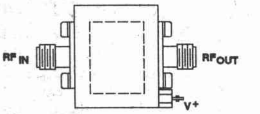
- Frequency Range: 5 to 500 MHz
- Medium Gain: 20.0 dB (Typ)
- Low Noise: 2.5 dB (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16-48



UTC—TC-1, p.16–42

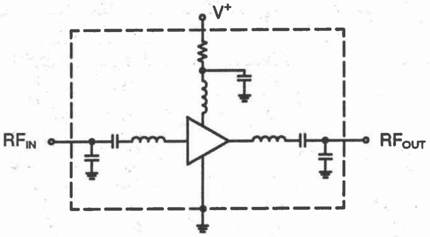
DESCRIPTION

The 512 Series is an efficient medium-gain thin-film bipolar RF amplifier. Resistive feedback and active bias provide temperature compensation and increased immunity to bias voltage variations. Blocking capacitors couple the RF through the amplifier. The 512 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical	Guaranteed Specifications		Unit
		T_C = 25°C	T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	21.0	20.0	19.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	2.5	3.0	3.0	dB
$P_{1 dB}$	Power Output @ +1 dB Compression (Min.)	+8.0	+7.0	+7.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+20.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+25.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+31.0	—	—	dBm
I_D	DC Current	23	—	—	mA

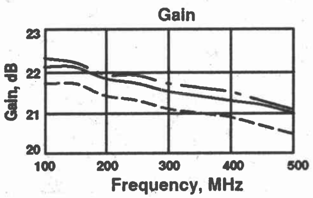
SCHEMATIC

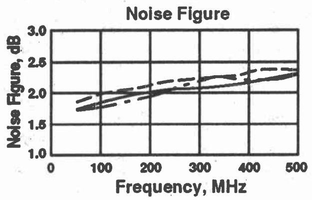


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
–55°C —·—





MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

THERMAL CHARACTERISTICS*

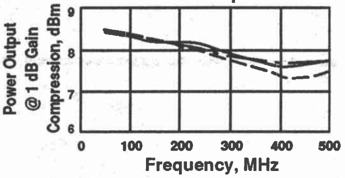
θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 190 mW
Junction Temperature Above Case Temperature .... 20°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 684,000 Hrs.

*For further information, see High Reliability section, p. 17–2.

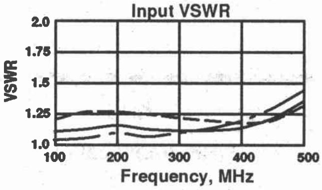
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

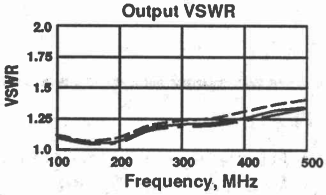
Power Output



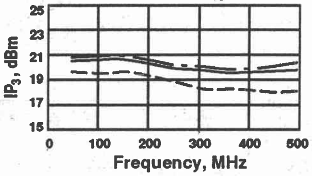
Input VSWR



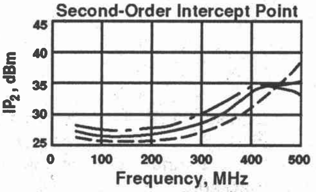
Output VSWR



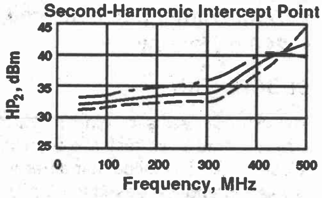
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS — **BIAS = 15.00 VOLTS**

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	FLAT dB	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.43	21.18	142.44	–1.88	–.41	—	1.29	26.76
150.0	1.42	20.97	125.36	.03	–.21	.99	1.29	26.01
200.0	1.40	20.82	106.77	.44	–.06	1.06	1.27	26.79
250.0	1.39	20.78	87.38	.04	–.01	1.03	1.27	26.25
300.0	1.35	20.75	69.83	1.49	.00	1.03	1.27	26.20
350.0	1.30	20.67	50.31	.99	.09	1.06	1.28	26.21
400.0	1.25	20.59	31.56	1.24	.16	1.07	1.27	27.19
450.0	1.24	20.58	11.79	.48	.17	1.17	1.23	26.20
500.0	1.39	20.48	–10.56	–2.85	.27	1.23	1.24	26.85
550.0	1.74	20.24	–32.64	—	—	1.30	1.26	26.70
600.0	2.39	19.76	–57.33	—	—	1.35	1.32	27.94

LINEARIATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS — **BIAS = 15.00 VOLTS**

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.171	135.7	20.68	141.5	–26.74	–10.8	.085	179.3
200.00	.171	135.7	20.68	141.5	–26.74	–10.8	.085	179.3
300.00	.143	65.8	20.47	71.1	–26.56	–39.9	.122	146.8
400.00	.119	64.0	20.42	33.1	–26.74	–58.5	.131	116.1
500.00	.213	78.7	20.34	–9.1	–26.74	–82.4	.124	68.2
600.00	.454	55.5	19.66	–55.1	–27.96	–110.4	.133	–20.2
700.00	.722	19.3	17.51	–100.7	–31.37	–143.0	.251	–97.1
800.00	.851	–12.3	13.88	–142.8	–37.07	–172.2	.386	–145.3
900.00	.914	–38.6	10.10	–178.5	–46.00	166.1	.493	–179.0
1000.00	.928	–58.5	6.28	153.9	–60.00	4.9	.559	157.0

AVANTEK

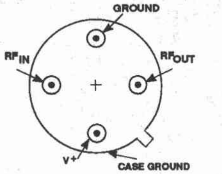
UTO/UTC 513 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

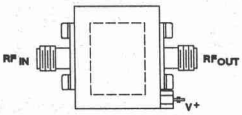
- Frequency Range: 5 to 500 MHz
- Medium Power Output: +16 dBm (Typ)
- Medium Gain: 17 dB (Typ)
- Temperature Compensated
- 24-Volt Supply

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

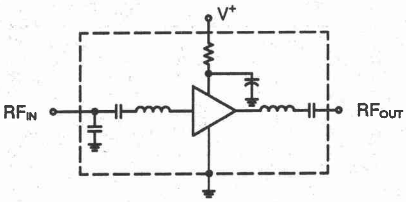
DESCRIPTION

The 513 Series is a thin-film bipolar RF amplifier that uses resistive feedback and active bias to provide temperature compensation and increased immunity to bias voltage variations. Blocking capacitors couple the RF through the amplifier. The 513 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +24 VDC nominal unless otherwise noted)

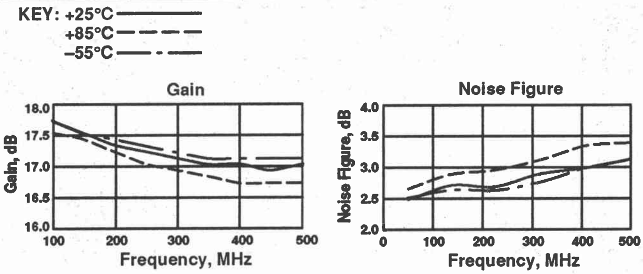
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	17.0	16.0	15.5	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	3.0	4.0	5.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+16.0	+14.0	+14.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+29.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+40.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+48.0	—	—	dBm
I_D	DC Current	50	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +24 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	+26 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

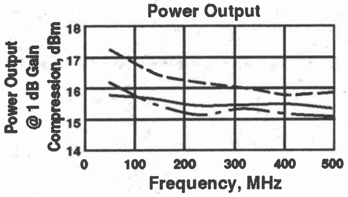
θ_{JC}	85°C/W
Active Transistor Power Dissipation	260 mW
Junction Temperature Above Case Temperature	22°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	1,221,000 Hrs.

*For further information, see High Reliability section, p. 17–2.

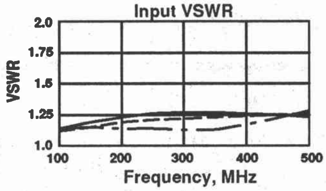
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

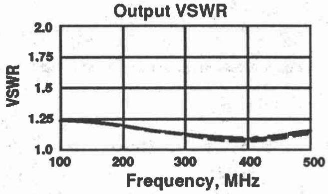
Power Output



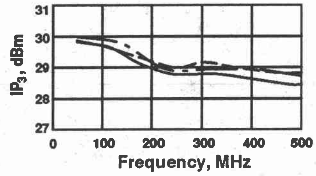
Input VSWR



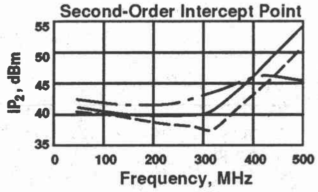
Output VSWR



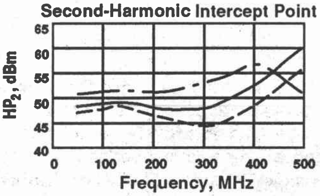
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 24.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.17	17.18	151.55	−1.67	—	1.06	22.61
150.0	1.27	17.02	137.68	−.74	.79	1.08	22.75
200.0	1.36	17.00	123.18	−.42	.79	1.10	22.89
250.0	1.46	17.01	109.32	.53	.76	1.12	22.97
300.0	1.54	17.07	95.67	1.71	.77	1.14	23.18
350.0	1.60	17.10	81.47	2.32	.81	1.15	23.30
400.0	1.59	17.19	66.50	2.17	.88	1.18	23.35
450.0	1.50	17.27	49.83	.31	1.00	1.24	23.17
500.0	1.40	17.32	30.47	−4.21	1.16	1.34	22.66
550.0	1.59	16.95	8.04	—	1.29	1.50	22.00
600.0	2.38	15.83	−15.82	—	1.28	1.69	21.58
650.0	3.83	13.95	−37.86	—	1.11	1.84	21.84

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 24.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.076	−99.8	16.91	152.4	−22.73	−10.7	.028	85.7
150.00	.112	−107.9	16.84	139.2	−22.97	−15.6	.038	68.8
200.00	.147	−115.9	16.81	125.5	−23.10	−21.4	.046	49.0
250.00	.179	−126.2	16.85	111.6	−23.22	−26.9	.052	28.9
300.00	.206	−139.2	16.97	97.7	−23.22	−31.9	.055	6.9
350.00	.225	−154.5	17.09	83.5	−23.48	−36.3	.058	−21.7
400.00	.230	−177.3	17.27	68.2	−23.48	−40.0	.072	−55.9
450.00	.219	147.4	17.43	50.6	−23.10	−44.9	.102	−89.5
500.00	.234	94.3	17.42	30.3	−22.50	−51.0	.154	−120.4
550.00	.339	36.6	16.93	7.0	−21.83	−61.1	.222	−148.7

![AVANTEK]

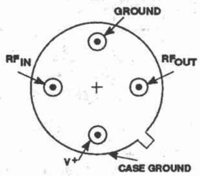
UTO/UTC 514 Series
Thin-Film Cascadable Amplifier
30 to 200 MHz

FEATURES

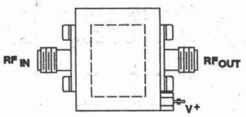
- Frequency Range: 30 to 200 MHz
- Low Noise Figure: 1.9 dB (Typ)
- Temperature Compensated
- Low Supply Current

APPLICATIONS

- IF/RF Amplification
- Low Power System



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

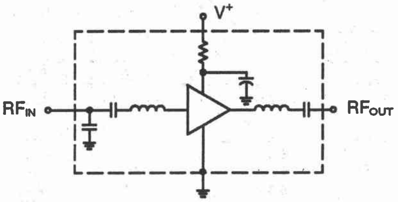
DESCRIPTION

The 514 Series is a thin-film bipolar RF amplifier that uses resistive feedback and active bias to provide temperature compensation and increased immunity to bias voltage variations. Blocking capacitors couple the RF through the amplifier. The 514 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_c = 25°C$	Guaranteed Specifications $T_c = 0°$ to 50°C	Guaranteed Specifications $T_c = -55°$ to +85°C	Unit
BW	Frequency Range	30–200	30-200	30-200	MHz
GP	Small Signal Gain (Min.)	16.0	15.0	14.5	dB
—	Gain Flatness (Max.)	±0.6	±0.75	±1.0	dB
NF	Noise Figure (Max.)	1.9	2.0	2.5	dB
$P_{1 dB}$	Power Output @ +1 dB Compression (Min.)	–2.0	–3.0	–4.0	dBm
—	Input VSWR (Max.)	<1.4:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.2:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+7.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+6.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+14.0	—	—	dBm
I_D	DC Current	8	—	—	mA

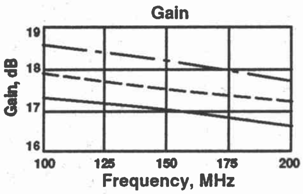
SCHEMATIC

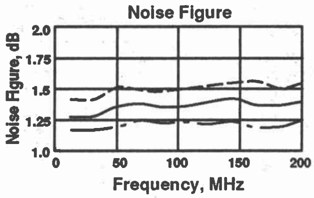


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
–55°C —— - ——





MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

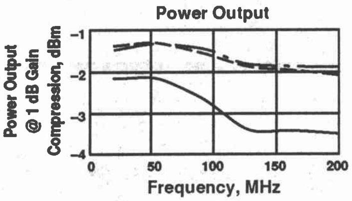
THERMAL CHARACTERISTICS*

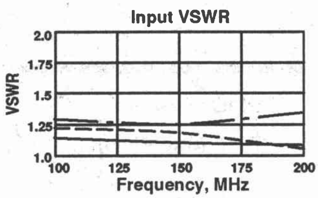
θ_{JC}	85°C/W
Active Transistor Power Dissipation	48 mW
Junction Temperature Above Case Temperature	4°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	1,649,000 Hrs.

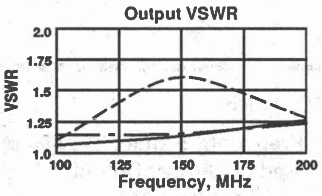
*For further information, see High Reliability section, p. 17–2.

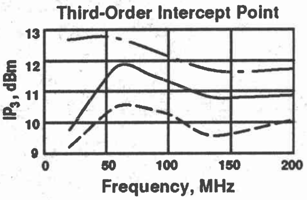
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

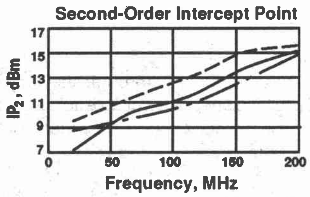
TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

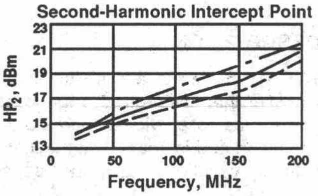












AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.10	17.27	133.06	–.05	.00	1.02	21.48
150.0	1.04	16.96	109.07	.10	1.34	1.08	21.54
200.0	1.27	16.60	84.76	–.05	1.38	1.20	21.70
250.0	1.85	15.83	59.53	—	1.43	1.35	22.05
300.0	3.03	14.43	33.43	—	1.41	1.52	23.00
350.0	5.28	12.41	8.75	—	1.27	1.68	24.68
400.0	9.05	9.95	–12.27	—	1.09	1.78	26.56
450.0	14.49	7.36	–30.45	—	.90	1.80	28.93
500.0	20.02	4.77	–44.59	—	.76	1.81	31.26
550.0	26.77	2.34	–57.79	—	.71	1.82	33.57
600.0	31.74	.02	–70.19	—	.64	1.79	35.66
650.0	35.25	–2.20	–80.94	—	.58	1.76	37.95
700.0	35.85	–4.41	–91.09	—	.50	1.73	40.62
750.0	34.56	–6.60	–99.01	—	.45	1.68	43.00
800.0	34.79	–8.88	–107.34	—	.42	1.59	45.33
850.0	35.62	–11.19	–114.25	—	.35	1.52	47.74
900.0	36.93	–13.42	–119.83	—	.28	1.46	49.86
950.0	37.46	–15.58	–124.40	—	.22	1.39	50.14
1000.0	38.85	–17.63	–127.82	-	.00	1.34	50.98

LINEARIZATION RANGE: 100.0 to 200.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.124	174.0	16.543	136.3	–21.930	–19.9	.025	–138.6
200.00	.191	90.5	15.776	92.6	–21.865	–42.2	.083	–128.5
300.00	.457	11.5	13.823	47.6	–22.705	–71.8	.166	–168.0
400.00	.743	–38.4	9,941	5.6	–25.462	–100.3	.191	147.7
500.00	.869	–66.8	5.135	–24.6	–29.152	–119.0	.171	114.8
600.00	.924	–83.4	.614	–47.2	–33.145	–128.9	.126	85.8
700.00	.943	–93.1	–3.628	–65.9	–36.821	–133.1	.071	56.1
800.00	.951	–99.2	–7.748	–78.7	–40.206	–128.7	.019	–24.5
900.00	.956	–103.0	–11.799	–88.2	–42.626	–123.5	.052	–138.8
1000.00	.962	–104.9	–15.452	–94.0	–44.026	–119.3	.092	–161.6

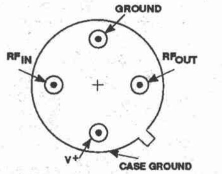
UTO/UTC 515 Series
Thin-Film Cascadable Amplifier
2 to 500 MHz

FEATURES

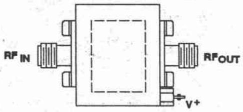
- Frequency Range: 2 to 500 MHz
- Medium Power Output: +15.5 dBm (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p.16–48.



UTC—TC-1, p. 16–42

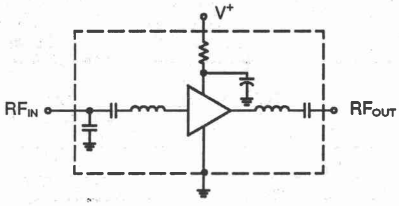
DESCRIPTION

The 515 Series is a thin-film bipolar RF amplifier that uses resistive feedback and active bias to provide temperature compensation and increased immunity to bias voltage variations. Blocking capacitors couple the RF through the amplifier. The 515 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	2-500	2-500	2-500	MHz
GP	Small Signal Gain (Min.)	12.5	12.0	11.0	dB
—	Gain Flatness (Max.)	±0.2	±0.5	±0.7	dB
NF	Noise Figure (Max.)	4.5	5.5	6.0	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+15.5	+14.0	+13.0	dBm
—	Input VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+24.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+35.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+40.0	—	—	dBm
I_D	DC Current	65	—	—	mA

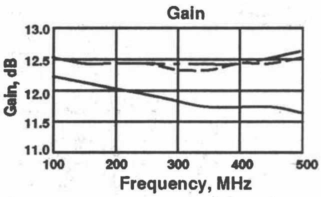
SCHEMATIC

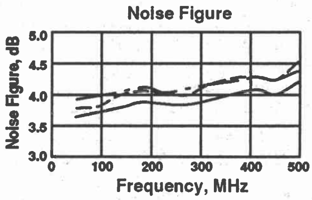


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
–55°C — - —





MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +100°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+100°C

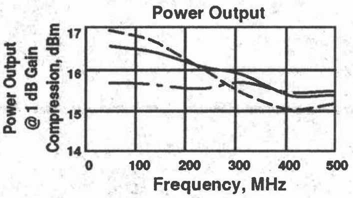
THERMAL CHARACTERISTICS*

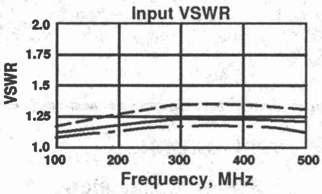
θ_{JC}	75°C/W
Active Transistor Power Dissipation	600 mW
Junction Temperature Above Case Temperature	45°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	1,328,000 Hrs.

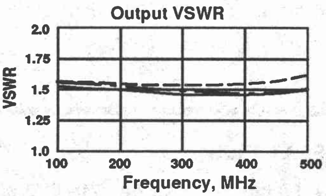
*For further information, see High Reliability section, p. 17–2.

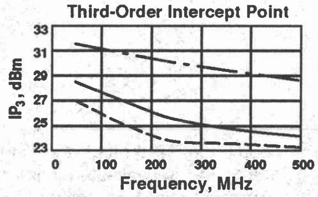
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)









AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.21	12.87	152.97	–.70	—	1.30	21.72
150.0	1.20	12.86	139.61	–.60	.73	1.31	21.72
200.0	1.17	12.70	126.69	–.05	.72	1.31	21.69
250.0	1.14	12.70	113.72	.44	.72	1.33	21.67
300.0	1.11	12.64	100.88	1.06	.73	1.36	21.59
350.0	1.10	12.61	87.30	.95	.77	1.40	21.50
400.0	1.11	12.59	73.33	.45	.78	1.46	21.47
450.0	1.16	12.63	59.29	–.12	.80	1.55	21.40
500.0	1.25	12.71	44.50	–1.44	.83	1.67	21.39
550.0	1.37	12.76	29.34	—	.87	1.84	21.47
600.0	1.55	12.82	13.21	—	.98	2.09	21.63

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.112	–18.6	13.16	151.4	–21.51	–14.1	.129	164.5
200.00	.090	–36.8	12.98	127.3	–21.51	–30.4	.133	146.1
300.00	.059	–42.3	12.97	100.2	–21.21	–47.6	.153	123.9
400.00	.036	5.2	12.88	72.5	–21.31	–67.5	.185	98.1
500.00	.094	42.2	12.84	44.0	–21.21	–90.9	.248	71.4
600.00	.208	37.1	12.86	12.7	–21.31	–115.5	.347	40.9
700.00	.408	20.4	12.85	–24.7	–22.38	–146.1	.487	7.2
800.00	.680	–5.2	11.30	–70.2	–25.68	–178.5	.549	–25.8
900.00	.880	–37.3	7.50	–115.2	–30.75	167.8	.523	–48.5
1000.00	.927	–61.4	2.54	–143.1	–33.15	166.8	.554	–58.6

AVANTEK

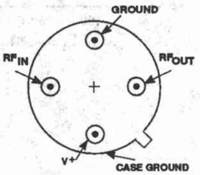
UTO/UTC 516 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

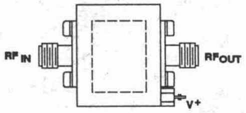
- Frequency Range: 5 to 500 MHz
- Medium Gain: 14.5 dB (Typ)
- Medium Power Output: +12.5 dBm (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

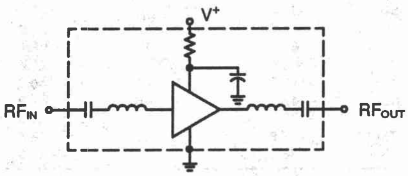
DESCRIPTION

The 516 Series is a thin-film bipolar RF amplifier that uses resistive feedback and active bias to provide temperature compensation and increased immunity to bias voltage variations. Blocking capacitors couple the RF through the amplifier. The 516 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

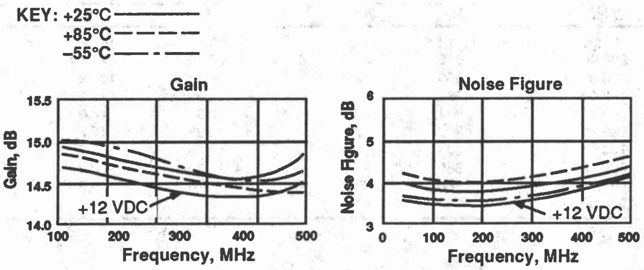
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	14.5	14.0	13.5	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	4.0	4.5	5.0	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+12.5	+10.0	+9.5	dBm
—	Input VSWR (Max.)	<1.4:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.2:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+24.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+37.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+42.0	—	—	dBm
I_D	DC Current	35	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... −55°C to +125°C
Storage Temperature .... −62°C to +150°C
"R" Series Burn-In Temperature .... 125°C

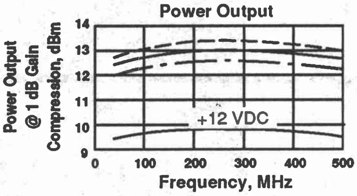
THERMAL CHARACTERISTICS*

θ_{JC} .... 85°C/W
Active Transistor Power Dissipation .... 180 mW
Junction Temperature Above Case Temperature .... 15°C
MTBF (MIL-HDBK-217E, A_{UF} 90°C) .... 1,320,000 Hrs.
*For further information, see High Reliability section, p. 17–2.

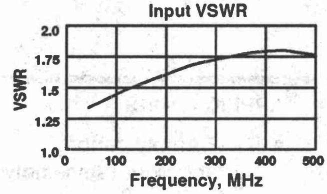
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

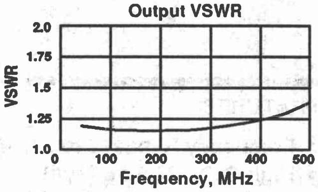
Power Output



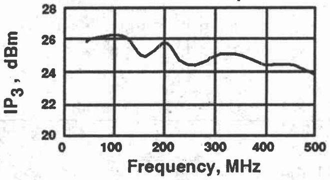
Input VSWR



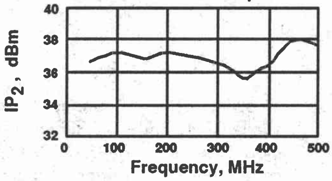
Output VSWR



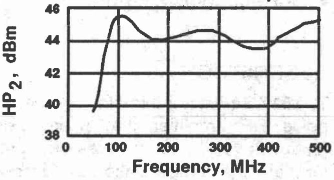
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.28	15.18	153.37	–.99	—	1.05	21.18
150.0	1.35	15.11	140.76	–.73	.69	1.07	21.29
200.0	1.41	14.87	128.36	–.27	.68	1.09	21.44
250.0	1.46	14.81	116.28	.50	.67	1.09	21.50
300.0	1.46	14.74	104.19	1.27	.68	1.09	21.62
350.0	1.43	14.66	91.64	1.58	.72	1.10	21.69
400.0	1.36	14.69	78.41	1.22	.76	1.10	21.81
450.0	1.23	14.81	64.34	.01	.82	1.13	21.88
500.0	1.09	14.97	48.89	–2.57	.92	1.18	21.95
550.0	1.26	15.07	31.40	—	1.03	1.27	21.99
600.0	1.78	14.88	11.85	—	1.16	1.38	22.10

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.098	–77.5	15.00	152.8	–21.11	–11.5	.024	63.3
200.00	.155	–110.0	14.73	130.3	–21.41	–24.3	.043	39.2
300.00	.173	–130.4	14.65	105.1	–21.51	–37.0	.048	10.5
400.00	.140	–152.4	14.65	78.9	–22.05	–49.4	.045	–37.6
500.00	.023	135.4	14.84	50.3	–22.27	–63.5	.068	–105.6
600.00	.270	–15.7	14.64	13.3	–22.38	–78.4	.144	–152.8
700.00	.648	–58.7	12.56	–29.8	–23.34	–97.6	.232	166.7
800.00	.837	–92.4	8.02	–62.9	–25.35	–116.4	.284	138.9
900.00	.906	–114.6	3.32	–84.7	–27.53	–130.8	.314	121.7
1000.00	.919	–127.5	–0.77	–98.1	–29.90	–138.8	.338	109.5

AVANTEK

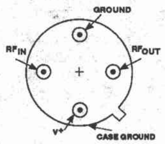
UTO/UTC/PPA 517 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

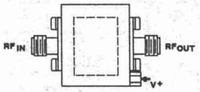
- Frequency Range: 5 to 500 MHz
- High Gain: 22.5 dB (Typ)
- Low Noise: 2.0 dB (Typ)
- Temperature Compensated
- Surface Mount Option

APPLICATIONS

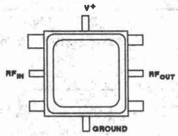
- IF/RF Amplification
- Surface Mount Assembly



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42



PPA—PP-38, p. 16–35

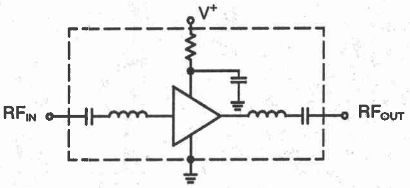
DESCRIPTION

The 517 Series is a thin-film high-gain, low-noise RF amplifier that uses resistive feedback and active bias to provide temperature compensation and increased immunity to bias voltage variations. Blocking capacitors couple the RF through the amplifier. The 517 Series amplifiers are available in three packages: the surface mount PlanarPak PP-38 (.375 in. x .375 in.) case, the TO-8 hermetic case and the connectorized TC-1 case.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	22.5	22.0	21.0	dB
—	Gain Flatness (Max.)	±0.7	±1.0	±1.0	dB
NF	Noise Figure (Max.)	2.0	2.5	3.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+6.5	+5.0	+4.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.7:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+15.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+22.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+27.0	—	—	dBm
I_D	DC Current	22	—	—	mA

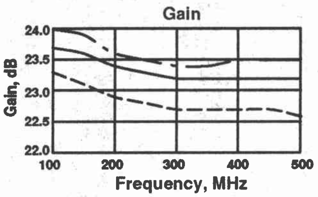
SCHEMATIC

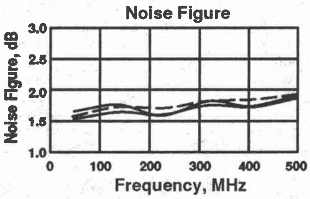


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
–55°C — · —





MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

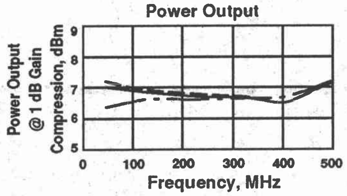
THERMAL CHARACTERISTICS*

θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 170 mW
Junction Temperature Above Case Temperature .... 18°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 1,158,000 Hrs.
*For further information, see High Reliability section, p. 17–2.

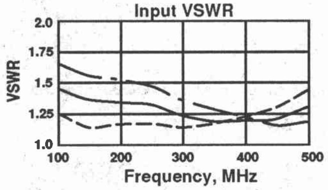
WEIGHT: (typical) PPA — 0.5 grams; UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

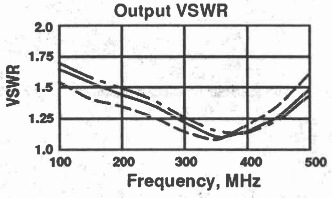
Power Output



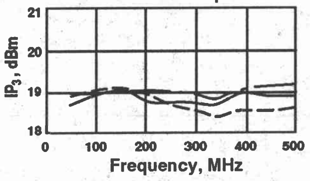
Input VSWR



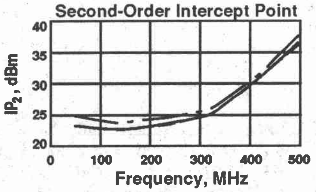
Output VSWR



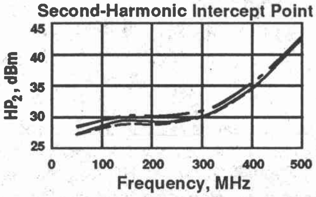
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.28	22.94	162.63	.00	1.45	30.99
150.0	1.29	23.02	152.17	.53	1.46	31.12
200.0	1.31	23.05	143.42	.49	1.48	31.07
250.0	1.35	23.01	134.43	.51	1.49	31.11
300.0	1.37	22.98	124.92	.54	1.51	31.10
350.0	1.39	22.99	115.09	.55	1.54	31.08
400.0	1.40	22.99	104.99	.58	1.57	31.02
450.0	1.38	22.99	94.37	.61	1.61	31.00
500.0	1.33	22.90	83.14	.63	1.64	30.92
550.0	1.27	22.83	71.63	.65	1.69	30.84
600.0	1.19	22.73	59.82	.66	1.76	30.71
650.0	1.12	22.56	47.78	.69	1.82	30.63
700.0	1.13	22.33	35.10	.70	1.90	30.58
750.0	1.24	22.05	22.51	.70	2.03	30.56
800.0	1.41	21.61	9.98	.72	2.19	30.52
850.0	1.62	20.99	–3.46	.75	2.41	30.50
900.0	1.88	20.29	–17.10	.78	2.73	30.64
950.0	2.22	19.39	–31.45	.81	3.18	30.81
1000.0	2.63	18.26	–46.31	.00	3.72	31.25

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.156	151.8	23.049	164.9	–29.646	11.1	.080	1.4
150.00	.165	134.6	22.612	156.1	–31.278	–1.1	.083	–2.8
200.00	.163	117.0	22.681	149.0	–31.053	11.2	.092	–6.1
250.00	.151	106.0	22.747	139.8	–30.067	7.7	.099	–12.5
300.00	.139	92.3	22.790	132.5	–29.378	4.9	.105	–17.7
350.00	.113	85.1	22.901	123.8	–28.143	2.5	.116	–30.6
400.00	.086	74.2	22.835	115.4	–28.370	–9.2	.091	–40.1
450.00	.044	85.4	22.943	106.1	–28.829	–18.9	.103	–64.7
500.00	.040	152.1	22.835	95.6	–29.833	–30.2	.112	–96.1
550.00	.103	170.1	22.789	85.7	–32.217	–33.6	.113	–126.6
600.00	.180	162.9	22.533	73.9	–35.323	–31.2	.110	–154.6
650.00	.258	152.0	21.994	62.9	–37.411	–11.6	.109	–175.3
700.00	.333	139.2	21.359	51.8	–37.387	7.1	.112	169.4
750.00	.397	127.4	20.542	41.2	–36.298	20.2	.121	156.1
800.00	.447	116.4	19.483	31.7	–35.465	25.3	.133	148.6
850.00	.489	106.2	18.590	23.8	–34.078	34.4	.150	140.3
900.00	.523	97.3	17.554	16.5	–33.008	31.6	.170	134.9
950.00	.547	89.7	16.496	10.4	–32.089	39.5	.190	130.3
1000.00	.563	81.9	15.739	4.6	–31.007	39.5	.215	126.9

AVANTEK

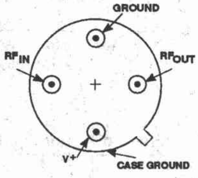
UTO/UTC 518 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

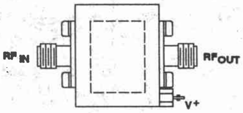
- Frequency Range: 5 to 500 MHz
- High Dynamic Range
- High Output Power: +24.5 dBm (Typ)
- Noise Figure: 5.5 dB (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- Output Stage



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

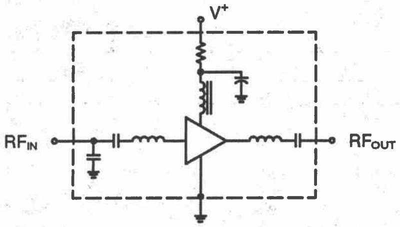
DESCRIPTION

The 518 Series is a thin-film high-power RF amplifier that uses two Avantek transistors in parallel for better RF and thermal performance. Resistive feedback and active bias provide temperature compensation and increased immunity to bias voltage variations. Blocking capacitors couple the RF through the amplifier. The 518 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	13.7	13.0	12.0	dB
—	Gain Flatness (Max.)	±0.4	±0.7	±1.0	dB
NF	Noise Figure (Max.)	5.5	6.0	6.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+24.5	+23.0	+22.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+35.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+36.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+41.0	—	—	dBm
I_D	DC Current	130	—	—	mA

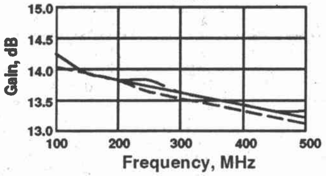
SCHEMATIC



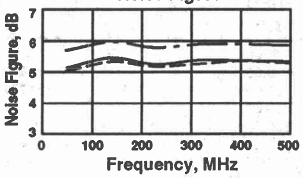
TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
–55°C —·—

Gain



Noise Figure



MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +15 dBm
Operating Case Temperature .... –55°C to +100°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +100°C

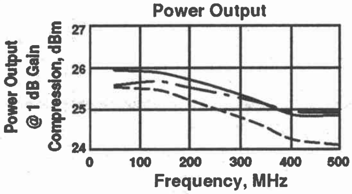
THERMAL CHARACTERISTICS*

θ_{JC} .... 75°C/W
Active Transistor Power Dissipation .... 580 mW
Junction Temperature Above Case Temperature .... 43°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 422,100 Hrs.
*For further information, see High Reliability section, p. 17–2.

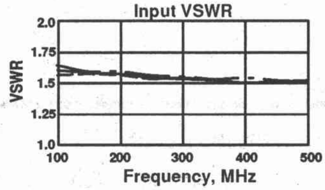
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

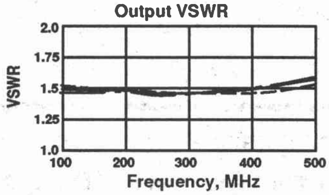
Power Output



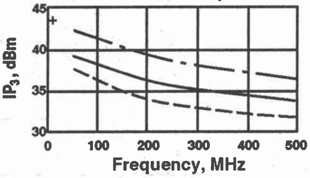
Input VSWR



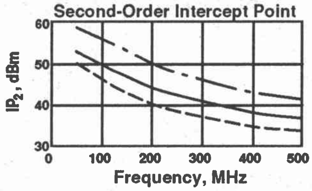
Output VSWR



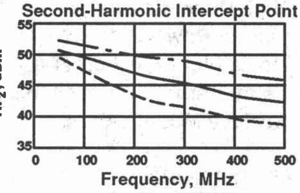
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.17	14.40	165.43	–.32	.00	1.08	18.69
150.0	1.21	14.36	158.09	–.33	.39	1.09	18.59
200.0	1.27	14.29	151.34	.26	.39	1.12	18.59
250.0	1.32	14.20	143.97	.25	.41	1.15	18.53
300.0	1.36	14.13	136.63	.25	.41	1.19	18.41
350.0	1.38	13.99	129.39	.35	.41	1.25	18.40
400.0	1.38	13.92	121.85	.15	.43	1.31	18.29
450.0	1.37	13.83	114.01	–.34	.42	1.39	18.17
500.0	1.36	13.82	106.71	–.28	.41	1.48	18.00
550.0	1.33	13.81	99.10	—	.44	1.60	17.70
600.0	1.30	13.71	90.88	—	.45	1.73	17.52
650.0	1.31	13.62	82.75	—	.49	1.87	17.30
700.0	1.41	13.49	73.14	—	.56	2.06	17.08
750.0	1.58	13.34	62.54	—	.59	2.29	16.95
800.0	1.84	13.12	51.78	—	.61	2.52	16.82
850.0	2.25	13.00	40.42	—	.62	2.76	16.92
900.0	2.89	12.54	29.38	—	.63	2.95	17.07
950.0	3.79	11.91	17.68	—	.71	3.00	17.62
1000.0	4.95	10.98	3.94	—	.68	3.04	18.33
1100.0	8.02	8.44	–18.71	—	.59	2.88	20.34
1200.0	10.92	5.12	–35.58	—	.44	2.71	22.48
1300.0	11.89	1.57	–49.19	—	.34	2.57	25.36
1400.0	13.98	–2.16	–60.92	—	.22	2.57	28.28
1500.0	13.12	–5.73	–69.36	—	.00	2.61	30.23

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.076	–123.7	14.377	164.3	–18.750	–3.5	.034	–161.9
200.00	.118	–134.3	14.274	149.0	–18.502	–7.2	.058	–125.5
300.00	.147	–149.8	14.131	133.4	–18.527	–12.6	.091	–118.0
400.00	.158	–168.2	13.922	117.3	–18.373	–18.6	.139	–118.6
500.00	.149	165.6	13.813	101.1	–18.033	–26.2	.199	–125.0
600.00	.126	124.1	13.710	84.4	–17.551	–35.1	.269	–135.7
700.00	.166	64.8	13.498	65.5	–17.049	–46.1	.350	–151.1
800.00	.287	15.7	13.169	43.1	–16.802	–60.0	.434	–171.8
900.00	.478	–17.3	12.596	19.0	–17.038	–76.5	.497	161.8
1000.00	.665	–45.4	11.060	–7.0	–18.179	–96.7	.509	128.8
1100.00	.782	–68.2	8.471	–30.7	–20.168	–112.6	.494	96.1
1200.00	.835	–84.2	5.222	–49.4	–22.480	–124.5	.468	65.8
1300.00	.856	–96.3	1.693	–63.9	–25.430	–133.4	.444	38.9
1400.00	.869	–104.2	–1.998	–77.6	–28.284	–141.4	.440	15.2
1500.00	.877	–109.5	–5.585	–86.9	–30.265	–143.2	.450	–5.3
1600.00	.870	–113.9	–9.402	–94.7	–32.729	–143.8	.449	–25.3
1700.00	.886	–117.4	–13.255	–99.8	–34.313	–142.5	.461	–48.4
1800.00	.876	–120.8	–17.945	–99.2	–36.121	–137.2	.466	–73.6
1900.00	.920	–124.1	–23.880	–82.9	–37.257	–136.2	.470	–103.5
2000.00	.909	–126.6	–24.890	–43.7	–38.152	–134.5	.475	–137.7

AVANTEK

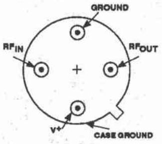
UTO/UTC/PPA 519 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

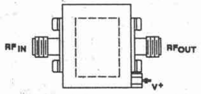
- Frequency Range: 5 to 500 MHz
- High Dynamic Range
- Output Power: +19 dBm (Typ)
- Noise Figure: 4.4 dB (Typ)
- Temperature Compensated
- Surface Mount Option

APPLICATIONS

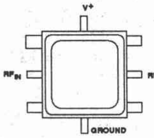
- IF/RF Amplification
- Surface Mount Assembly



UTO—TO-8T, p.16–48



UTC—TC-1, p. 16–42



PPA—PP-38, p. 16–35

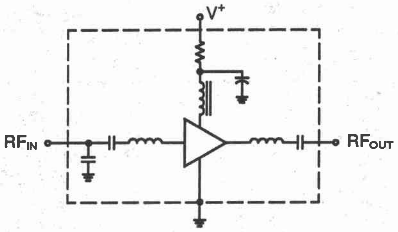
DESCRIPTION

The 519 Series is a wideband, high-power RF amplifier for lower cost applications. Using output choke coupling and Avantek® transistors on a thin-film substrate, this amplifier provides reliable and stable operation over wide temperature range. The 519 Series amplifiers are available in three packages: the surface mount PlanarPak PP-38 (.375 in. x .375 in.) case, the TO-8 hermetic case and the connectorized TC-1 case.

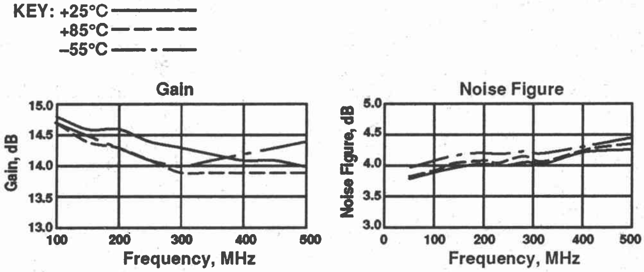
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	14.3	13.0	12.0	dB
—	Gain Flatness (Max.)	±0.3	±0.7	±1.0	dB
NF	Noise Figure (Max.)	4.4	5.5	6.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+19.0	+18.0	+17.0	dBm
—	Input VSWR (Max.)	<1.2:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.2:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+29.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+31.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+37.0	—	—	dBm
I_D	DC Current	70	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +100°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+100°C

THERMAL CHARACTERISTICS*

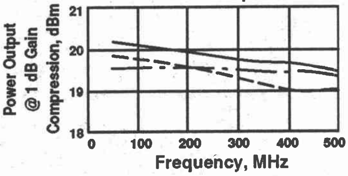
θ_{JC}	75°C/W
Active Transistor Power Dissipation	637 mW
Junction Temperature Above Case Temperature	48°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	785,200 Hrs.

*For further information, see High Reliability section, p. 17–2.

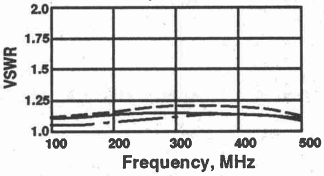
WEIGHT: (typical) PPA—0.5 grams; UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

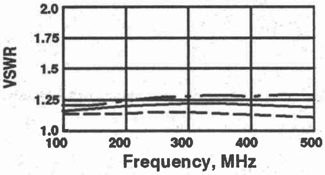
Power Output



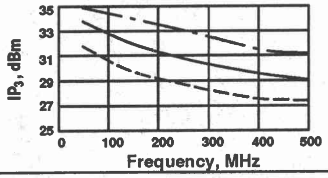
Input VSWR



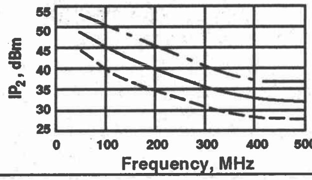
Output VSWR



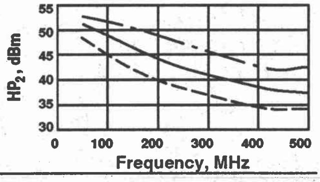
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.07	14.86	166.21	–.29	.00	1.02	19.06
150.0	1.07	14.84	159.21	–.43	.37	1.03	18.88
200.0	1.08	14.77	152.92	.13	.36	1.04	19.03
250.0	1.08	14.68	146.17	.24	.37	1.06	19.09
300.0	1.07	14.60	139.50	.44	.38	1.09	19.12
350.0	1.06	14.48	132.61	.42	.39	1.13	19.17
400.0	1.04	14.38	125.62	.30	.40	1.17	19.25
450.0	1.04	14.30	118.19	–.27	.40	1.22	19.27
500.0	1.08	14.24	111.04	–.54	.39	1.28	19.27
550.0	1.14	14.20	104.00	—	.41	1.34	19.26
600.0	1.23	14.06	96.11	—	.43	1.41	19.22
650.0	1.35	13.87	88.55	—	.45	1.47	19.31
700.0	1.50	13.66	80.04	—	.49	1.53	19.37
750.0	1.68	13.41	70.84	—	.52	1.59	19.47
800.0	1.93	13.11	61.30	—	.52	1.63	19.46
850.0	2.27	12.87	52.03	—	.52	1.65	19.84
900.0	2.70	12.44	42.73	—	.52	1.65	19.93
950.0	3.26	11.85	33.36	—	.55	1.62	20.57
1000.0	3.99	11.18	22.87	—	.55	1.58	21.05
1050.0	4.79	10.27	13.61	—	.52	1.55	21.65
1100.0	5.82	9.26	4.24	—	.50	1.52	22.48
1150.0	6.98	7.96	–4.41	—	.45	1.50	23.38
1200.0	8.00	6.66	–12.05	—	.42	1.51	24.10
1250.0	8.80	5.23	–19.40	—	.36	1.53	25.42
1300.0	9.81	3.82	–25.15	—	.31	1.57	26.28
1350.0	11.49	2.45	–30.63	—	.29	1.62	27.57
1400.0	12.57	.82	–35.56	—	.24	1.67	28.80
1450.0	12.66	–.63	–39.43	—	.23	1.71	29.61
1500.0	12.82	–2.16	–43.90	—	.00	1.75	30.21

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.034	–132.5	14.816	165.1	–18.942	–4.0	.012	92.9
200.00	.037	–132.6	14.737	150.5	–18.954	–10.3	.018	–4.2
300.00	.031	–133.2	14.587	136.0	–19.137	–16.5	.046	–29.2
400.00	.019	–98.7	14.366	120.9	–19.310	–23.4	.081	–53.1
500.00	.039	–22.5	14.208	105.2	–19.265	–31.4	.125	–72.9
600.00	.107	–21.7	14.044	89.4	–19.267	–39.9	.169	–92.2
700.00	.196	–27.2	13.645	72.2	–19.336	–49.2	.209	–112.3
800.00	.320	–39.3	13.122	52.2	–19.528	–60.0	.235	–135.5
900.00	.455	–52.3	12.451	32.1	–19.959	–71.7	.246	–162.1
1000.00	.600	–66.9	11.160	11.3	–21.060	–85.6	.223	165.4
1100.00	.709	–81.0	9.195	–8.4	–22.488	–98.3	.201	124.5
1200.00	.777	–92.8	6.628	–26.1	–24.144	–107.9	.198	82.8
1300.00	.823	–102.7	3.807	–40.1	–26.350	–115.9	.216	46.3
1400.00	.852	–109.8	.815	–52.0	–28.799	–124.2	.248	21.1
1500.00	.871	–114.9	–2.146	–61.2	–30.242	–128.0	.277	3.8
1600.00	.870	–119.4	–5.149	–69.7	–32.149	–131.4	.289	–9.4
1700.00	.891	–123.2	–7.756	–75.5	–33.359	–133.2	.297	–22.5
1800.00	.887	–127.1	–10.407	–79.7	–34.754	–131.2	.295	–33.8
1900.00	.937	–130.8	–13.149	–85.6	–35.497	–136.3	.288	–45.1
2000.00	.928	–133.9	–15.936	–90.3	–36.142	–139.2	.273	–60.5

AVANTEK

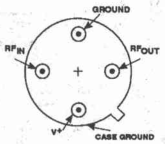
UTO/UTC/PPA 520 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

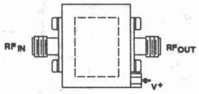
- Frequency Range: 5 to 500 MHz
- Output Power: +12.0 dBm
- 5 Volt Supply
- Temperature Compensated
- Surface Mount Option

APPLICATIONS

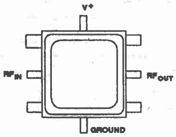
- IF/RF Amplification
- Surface Mount Assembly
- High Efficiency or Battery Powered Systems



UTO—TO-8T, p. 16–48



UTC—UTC-1, p. 16–42



PPA—PP-38, p. 16–35

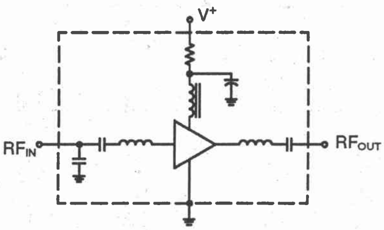
DESCRIPTION

The 520 Series is a highly-efficient low-voltage unit for use where power considerations are important. Output choke coupling, resistive feedback and active bias combine to provide a low-noise medium-gain amplifier that is temperature compensated and relatively insensitive to bias voltage variations. Blocking capacitors couple the RF through the amplifier. The 520 Series amplifiers are available in three packages: the surface mount PlanarPak PP-38 (.375 in. x .375 in.) case, the TO-8 hermetic case and the connectorized TC-1 case.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted)

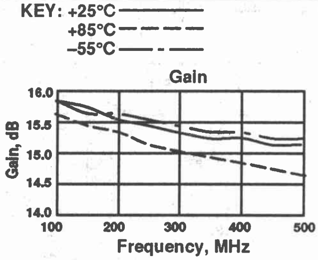
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-900	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	14.5	14.0	13.0	dB
—	Gain Flatness (Max.)	±0.2	±0.7	±1.0	dB
NF	Noise Figure (Max.)	3.5	4.5	5.0	dB
$P_{1 dB}$	Power Output @ +1 dB Compression (Min.)	+13.0	+12.0	+11.0	dBm
—	Input VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+22.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+21.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+30.0	—	—	dBm
I_D	DC Current	33	—	—	mA

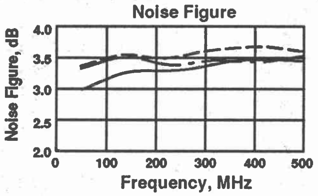
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +5 VDC unless otherwise noted)





MAXIMUM RATINGS

DC Voltage	+10 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	−55°C to +125°C
Storage Temperature	−62°C to +150°C
"R" Series Burn-In Temperature	+125°C

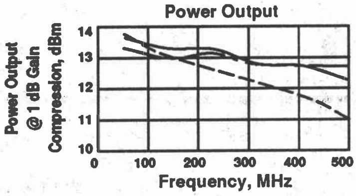
THERMAL CHARACTERISTICS*

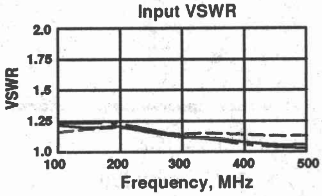
θ_{JC}	105°C/W
Active Transistor Power Dissipation	108 mW
Junction Temperature Above Case Temperature	11.4°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	1,012,000 Hrs.

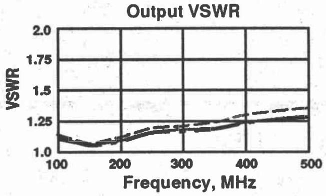
*For further information, see High Reliability section, p. 17–2.

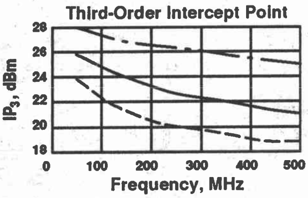
WEIGHT: (typical) PPA — 0.5 grams; UTO — 2.1 grams; UTC — 21.5 grams

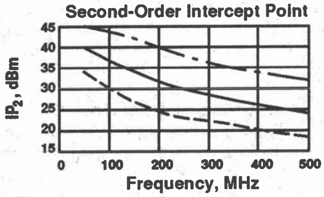
TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

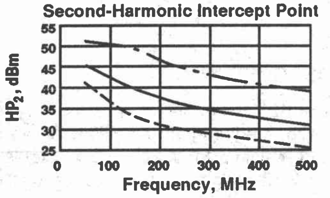












AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 5.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.05	15.88	163.82	.55	.00	1.16	20.82
200.0	1.08	15.64	146.85	–.55	.45	1.17	19.74
300.0	1.08	15.48	131.42	–.12	.44	1.20	19.89
400.0	1.11	15.42	115.36	–.31	.43	1.21	20.09
500.0	1.11	15.44	100.25	.43	.42	1.24	19.82
600.0	1.10	15.44	85.10	—	.44	1.24	19.70
700.0	1.06	15.33	68.49	—	.49	1.23	19.25
800.0	1.07	15.18	49.52	—	.54	1.25	19.19
900.0	1.30	15.18	29.39	—	.57	1.32	19.14
1000.0	1.70	15.04	8.29	—	.62	1.49	19.05
1100.0	2.47	14.54	–14.96	—	.68	1.82	19.45
1200.0	4.29	13.49	–40.58	—	.72	2.29	19.94
1300.0	9.20	12.12	–66.49	—	.72	2.77	21.27
1400.0	29.86	9.86	–92.07	—	.68	3.31	22.51

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 5.00 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.017	–110.2	15.784	166.0	–19.897	–4.6	.084	9.2
200.00	.024	–74.9	15.645	150.4	–19.967	–9.8	.099	3.3
300.00	.040	–79.9	15.527	135.9	–19.833	–15.1	.111	–7.3
400.00	.055	–85.1	15.433	121.2	–19.866	–20.8	.121	–21.9
500.00	.058	97.0	15.443	107.7	–19.691	–27.0	.125	–38.3
600.00	.054	–98.1	15.392	94.0	–19.634	–31.7	.127	–59.4
700.00	.036	–87.9	15.247	78.5	–19.392	–37.3	.120	–88.8
800.00	.037	–15.1	15.200	60.4	–19.238	–45.3	.122	–132.2
900.00	.108	3.7	15.345	41.3	–18.958	–54.2	.159	179.3
1000.00	.225	–6.3	15.210	19.3	–18.894	–66.3	.240	134.1
1100.00	.376	–22.7	14.695	–5.5	–19.105	–81.4	.368	95.7
1200.00	.537	–42.2	13.294	–31.6	–19.936	–93.7	.484	62.6
1300.00	.655	–60.7	11.020	–56.7	–21.578	–107.8	.554	32.2
1400.00	.733	–77.1	7.779	–81.2	–23.721	–119.3	.586	6.9
1500.00	.776	–89.7	4.409	–101.3	–25.143	–123.6	.588	–13.5
1600.00	.793	–99.8	.829	–116.6	–27.134	–128.0	.570	–30.3
1700.00	.793	–108.2	–3.026	–130.0	–28.339	–128.6	.566	–44.5
1800.00	.792	–115.5	–7.425	–140.9	–29.546	–126.0	.564	–55.4
1900.00	.797	–122.2	–13.994	–147.4	–29.889	–129.9	.562	–65.1
2000.00	.806	–127.7	–23.981	–117.9	–30.912	–134.1	.568	–74.8

AVANTEK

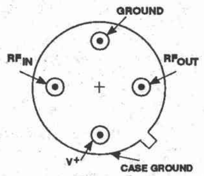
UTO/UTC 521 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

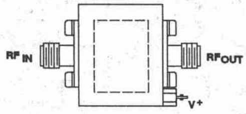
- **Frequency Range: 5 to 500 MHz**
- **High Gain: 30.0 dB (Typ)**

APPLICATION

- **IF/RF Amplification**



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

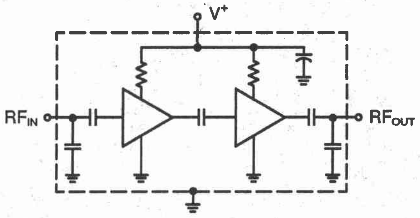
DESCRIPTION

The 521 Series is a high-frequency, low-noise, medium-gain amplifier. Active bias and resistive feedback assure stable operation on this two stage amplifier built on a thin-film substrate. The 521 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

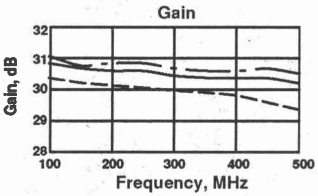
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	30.0	27.0	27.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	3.0	4.0	4.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+7.0	+6.0	+5.5	dBm
—	Input VSWR (Max.)	<1.7:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.4:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+18.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+25.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+32.0	—	—	dBm
I_D	DC Current	38	—	—	mA

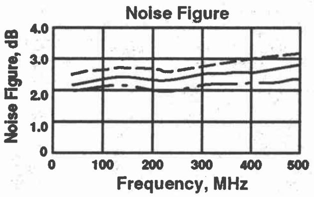
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C — — — —
−55°C —— · ——





MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... −55°C to +125°C
Storage Temperature .... −62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

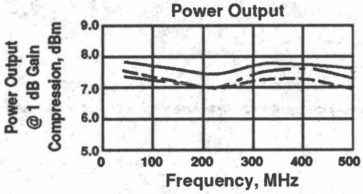
THERMAL CHARACTERISTICS*

θ_{JC} .... 105/75°C/W
Active Transistor Power Dissipation .... 16/92 mW
Junction Temperature Above Case Temperature ...... 2/7°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 492,300 Hrs.
*For further information, see High Reliability section, p. 17–2.

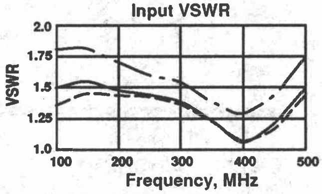
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

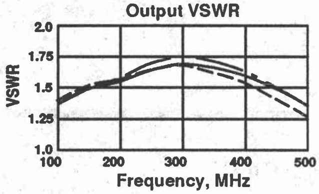
Power Output



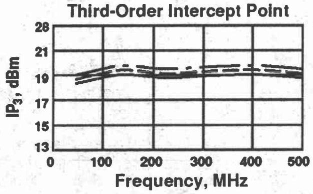
Input VSWR



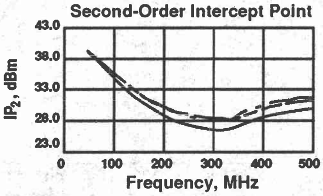
Output VSWR



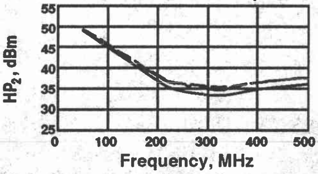
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.18	29.70	–40.33	–1.00	—	1.21	40.97
150.0	1.19	29.54	–60.48	–.30	1.14	1.20	44.03
200.0	1.17	29.46	–81.53	–.48	1.15	1.23	40.56
250.0	1.18	29.51	–102.04	–.14	1.10	1.26	42.06
300.0	1.17	29.47	–121.05	1.70	1.11	1.29	43.10
350.0	1.16	29.37	–141.86	1.75	1.17	1.31	45.12
400.0	1.14	29.31	–163.32	1.14	1.22	1.30	41.91
450.0	1.13	29.36	174.20	–.47	1.25	1.32	41.00
500.0	1.14	29.55	151.64	–2.17	1.27	1.40	39.90
550.0	1.20	29.55	128.62	—	1.37	1.52	38.51
600.0	1.40	29.46	102.45	—	1.53	1.80	40.82
650.0	1.85	29.09	73.62	—	1.67	2.29	44.57
700.0	2.62	28.35	42.43	—	1.68	3.14	40.06

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.150	154.7	28.590	–42.4	–46.02	3.8	.186	.4
200.00	.135	131.6	28.251	–81.3	–44.44	–6.3	.176	–1.3
300.00	.123	105.4	28.358	–119.2	–43.10	–15.7	.155	–2.0
400.00	.106	85.5	28.368	–160.4	–43.10	–20.6	.115	2.1
500.00	.106	86.8	29.566	156.1	–41.94	–34.7	.062	40.2
600.00	.219	91.1	29.812	108.2	–40.92	–53.4	.164	100.8
700.00	.506	57.2	27.417	49.0	–40.92	–89.9	.423	84.8
800.00	.772	14.6	18.164	–9.4	–44.44	–131.8	.628	55.0
900.00	.886	–21.7	9.986	–57.7	–50.46	–157.5	.681	30.6
1000.00	.910	–47.2	5.417	–93.3	–60.00	161.1	.663	14.5

AVANTEK

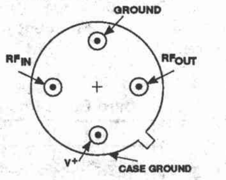
UTO/UTC 523 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

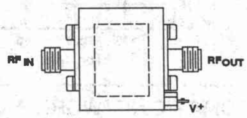
- Frequency Range: 5 to 500 MHz
- High Gain: 25.5 dB (Typ)
- Medium Output Power: +13.5 dBm (Typ)

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

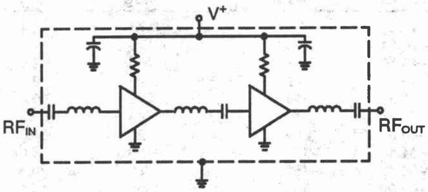
DESCRIPTION

The 523 Series is a high-gain, medium-power, two-stage amplifier. Built on a thin-film substrate, it will provide consistent performance over a wide range of temperatures variations. The 523 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

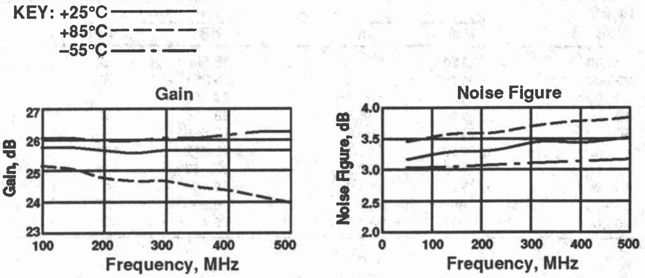
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	25.5	23.0	23.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	3.5	7.0	7.0	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+13.5	+12.0	+12.0	dBm
—	Input VSWR (Max.)	<1.2:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+25.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+33.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+40.0	—	—	dBm
I_D	DC Current	80	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

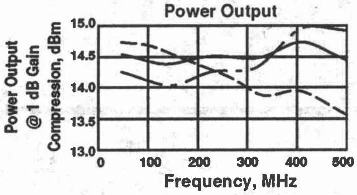
DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... −55°C to +125°C
Storage Temperature .... −62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

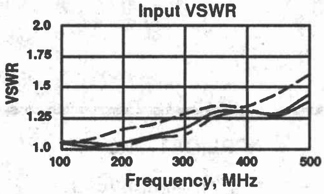
THERMAL CHARACTERISTICS*

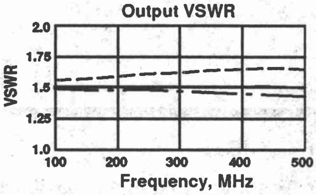
θ_{JC} .... 75/70°C/W
Active Transistor Power Dissipation .... 90/321 mW
Junction Temperature Above Case Temperature ..... 7/22°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 1,276,000 Hrs.
*For further information, see High Reliability section, p. 17–2.

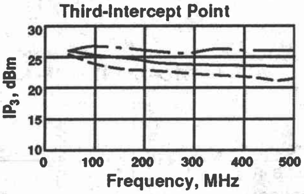
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

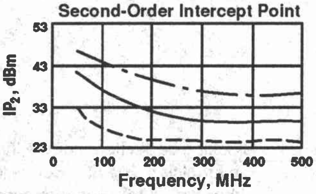
TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

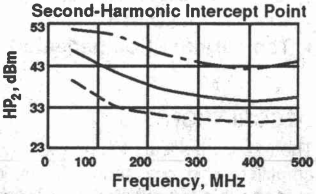












AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.07	26.02	–34.45	–.55	—	1.07	42.66
150.0	1.06	25.88	–52.04	–.09	1.00	1.06	46.44
200.0	1.02	25.77	–70.50	–.50	1.02	1.07	48.04
250.0	1.04	25.37	–88.59	–.54	.96	1.09	47.67
300.0	1.06	25.38	–105.00	1.08	.94	1.10	44.60
350.0	1.10	25.75	–122.59	1.55	1.01	1.09	46.45
400.0	1.15	25.66	–141.35	.83	1.04	1.13	41.06
450.0	1.20	25.62	–160.00	.24	1.08	1.17	46.12
500.0	1.29	25.76	179.70	–2.00	1.08	1.20	42.76
550.0	1.42	25.78	161.03	—	1.10	1.25	39.86
600.0	1.58	25.72	140.28	—	1.23	1.33	38.52
650.0	1.91	25.52	116.85	—	1.31	1.43	42.63
700.0	2.48	25.14	92.97	—	1.41	1.51	40.96

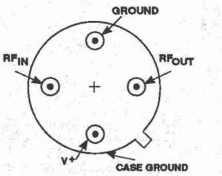
LINEARIZATION RANGE: 100.0 to 500.0 MHz

AVANTEK

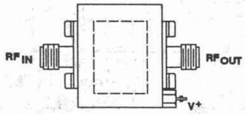
UTO/UTC 524 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES
- Frequency Range: 5 to 500 MHz
- High Gain: 31.0 dB (Typ)
- Medium Power Output: +17.0 dBm (Typ)
- Temperature Compensated

APPLICATIONS
- IF/RF Amplification



UTO—TO-8T, p. 16–48



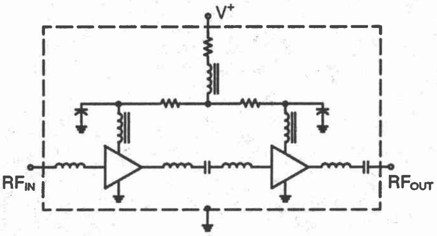
UTC—TC-1, p. 16–42

DESCRIPTION
The 524 Series is a high-power, low-noise amplifier. This two-stage RF amplifier is built on a thin-film substrate and is compensated for temperature and bias variations, by using resistive feedback and active bias. Blocking capacitors couple the RF through the amplifier. The 524 Series is available in either the TO-8 hermetic case or connectored TC- 1 package.

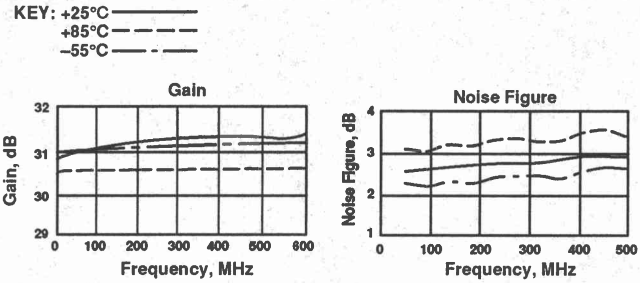
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	31.0	30.0	30.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	3.0	4.0	4.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+17.0	+14.0	+14.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.7:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+27.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+34.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+40.0	—	—	dBm
I_D	DC Current	70	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)



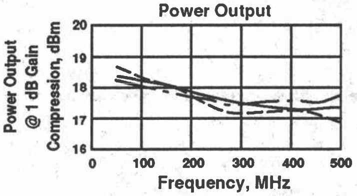
MAXIMUM RATINGS
DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +115°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +115°C

THERMAL CHARACTERISTICS*
θ_{JC} .... 105/75°C/W
Active Transistor Power Dissipation .... 131/410 mW
Junction Temperature Above Case Temperature .... 14/31°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 538,800 Hrs.
*For further information, see High Reliability section, p. 17–2.

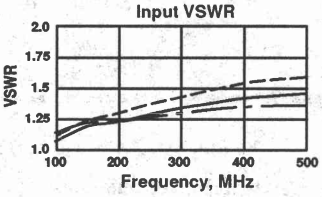
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

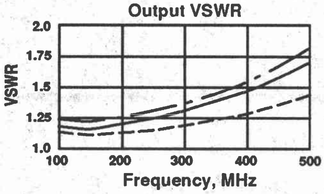
Power Output



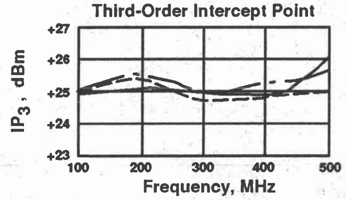
Input VSWR



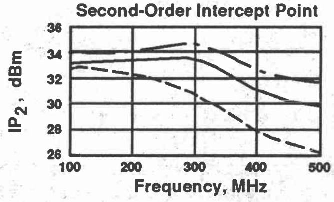
Output VSWR



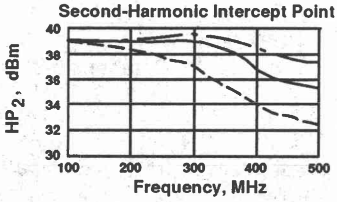
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.25	31.46	−20.38	.10	.00	1.05	40.57
150.0	1.34	31.51	−32.57	−.23	.66	1.04	39.54
200.0	1.42	31.44	−44.01	.19	.65	1.04	40.12
250.0	1.48	31.38	−56.01	.05	.67	1.04	40.34
300.0	1.52	31.38	−67.96	−.03	.66	1.03	39.95
350.0	1.54	31.34	−79.78	.00	.66	1.03	39.95
400.0	1.53	31.35	−91.84	−.20	.66	1.05	39.79
450.0	1.52	31.39	−103.59	−.09	.65	1.08	40.15
500.0	1.49	31.37	−115.14	.21	.65	1.11	40.04
550.0	1.46	31.33	−126.91	—	.67	1.15	40.03
600.0	1.46	31.27	−139.17	—	.69	1.20	40.47
650.0	1.46	31.23	−151.74	—	.72	1.24	40.26
700.0	1.53	31.22	−164.94	—	.76	1.30	40.74
750.0	1.66	31.13	−179.01	—	.81	1.34	40.68
800.0	1.86	31.04	−165.76	—	.86	1.36	40.68
850.0	2.18	30.81	149.93	—	.91	1.38	40.41
900.0	2.58	30.32	133.10	—	.94	1.36	39.58
950.0	3.04	29.59	116.05	—	.90	1.31	39.11
1000.0	3.48	28.52	100.77	—	.79	1.26	38.54

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.116	90.4	31.304	−20.6	−41.203	−2.1	.035	−11.8
200.00	.179	67.3	31.292	−43.6	−39.699	−4.1	.040	−55.7
300.00	.209	47.6	31.294	−67.4	−39.988	−14.8	.031	−109.3
400.00	.209	25.9	31.400	−91.4	−40.334	−25.1	.042	168.3
500.00	.186	−2.9	31.539	−115.2	−40.886	−29.3	.091	128.7
600.00	.166	−47.8	31.555	−140.4	−41.566	−33.0	.146	107.4
700.00	.193	−108.2	31.508	−168.0	−42.063	−37.1	.190	87.6
800.00	.296	−163.8	31.091	160.4	−41.981	−37.6	.203	65.3
900.00	.423	149.7	29.882	127.5	−40.913	−38.9	.177	46.8
1000.00	.515	112.6	27.794	98.0	−39.580	−50.7	.129	42.4

AVANTEK

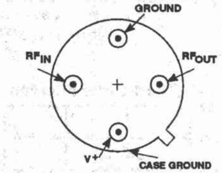
UTO/UTC 526
Thin-Film Cascadable Amplifier
10 to 500 MHz

FEATURES

- Frequency Range: 10 to 500 MHz
- High Gain: 28.0 dB (Typ)
- High Power Output: +21.0 dBm (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



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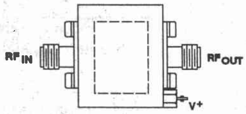


UTC—TC-1, p. 16–42

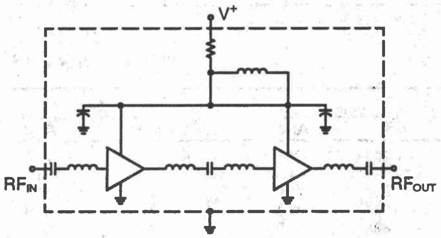
DESCRIPTION

The 526 Series is a high-power, low-noise amplifier. This two-stage RF amplifier is built on a thin-film substrate and is compensated for temperature and bias variations by using resistive feedback and active bias. Blocking capacitors couple the RF through the amplifier. The 526 Series is available in either the TO-8 hermetic case or connectored TC- 1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

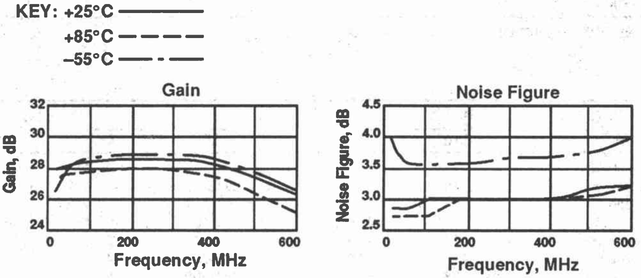
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	10-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	28.0	26.5	26.0	dB
—	Gain Flatness (Max.)	±0.4	±0.7	±1.0	dB
NF	Noise Figure (Max.)	3.0	4.0	4.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+21.0	+19.0	+18.5	dBm
—	Input VSWR (Max.)	<1.4:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.4:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+32.0	+28.0	+26.0	dBm
IP_2	Two Tone 2nd Order Intercept Point	+42.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+48.0	—	—	dBm
I_D	DC Current	93	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

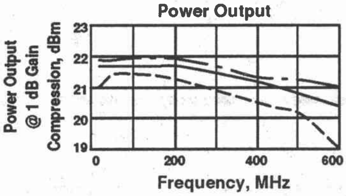
THERMAL CHARACTERISTICS*

θ_{JC}	105/87°C/W
Active Transistor Power Dissipation	70/303 mW
Junction Temperature Above Case Temperature	7.4/26.4°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	538,800 Hrs.

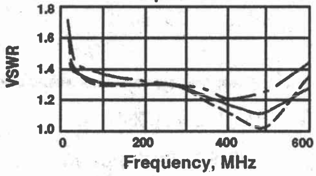
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

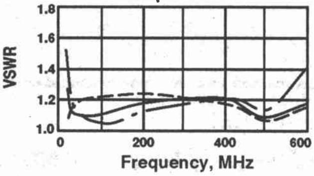
Power Output



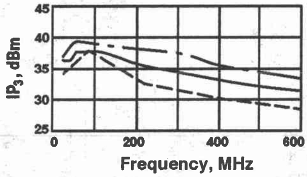
Input VSWR



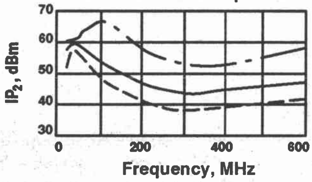
Output VSWR



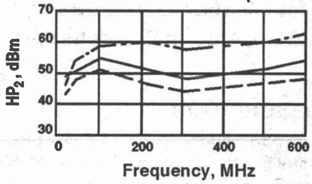
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
1.0	5.25	17.9	141.6			2.39	34.2
2.0	2.77	24.3	82.0			1.70	32.7
3.0	2.23	26.0	58.4			1.60	33.3
5.0	1.78	27.3	37.0			1.41	34.2
10.0	1.50	28.0	17.7	12.86	3.42	1.25	34.9
20.0	1.41	28.3	5.5	3.39	3.42	1.15	35.2
30.0	1.38	28.3	–.4	.30	1.66	1.13	35.2
50.0	1.35	28.3	–8.2	–1.76	.99	1.13	35.5
100.0	1.33	28.4	–22.8	–2.14	.77	1.15	35.4
150.0	1.33	28.4	–36.1	–1.17	.72	1.17	35.4
200.0	1.30	28.4	–49.4	–.31	.75	1.17	35.2
250.0	1.27	28.4	–63.0	.37	.76	1.20	35.2
300.0	1.22	28.4	–76.8	.71	.78	1.20	35.0
350.0	1.17	28.3	–90.9	.78	.76	1.20	34.9
400.0	1.13	28.1	–105.4	.50	.81	1.17	34.5
450.0	1.06	27.8	–120.1	–.08	.83	1.15	34.3
500.0	1.06	27.5	–135.1	–.91	.85	1.11	34.1
600.0	1.27	26.2	–164.5			1.15	33.5
800.0	1.74	22.6	145.0			1.41	32.9
1000.0	2.28	18.5	104.8			1.63	32.9
1500.0	4.26	11.8	28.9			1.78	33.7
2500.0	7.70	–1.1	–88.1			5.25	33.0

LINEARIZATION RANGE: 10.0 to 500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
1.0	.68	–128.2	17.9	141.6	–34.2	80.8	.41	162.13
2.0	.47	–171.2	24.3	82.0	–32.7	27.8	.26	24.98
3.0	.38	172.2	26.0	58.4	–33.3	12.5	.23	–17.93
5.0	.28	160.3	27.3	37.0	–34.2	3.6	.17	–54.70
10.0	.20	156.5	28.0	17.7	–34.9	–.7	.11	–94.20
20.0	.17	158.5	28.3	5.5	–35.2	–1.2	.07	–131.64
30.0	.16	158.6	28.3	–.4	–35.2	–1.7	.06	–154.12
50.0	.15	156.5	28.3	–8.2	–35.5	–1.0	.06	178.10
100.0	.14	146.6	28.4	–22.8	–35.4	–2.1	.07	139.28
150.0	.14	136.4	28.4	–36.1	–35.4	–3.0	.08	114.67
200.0	.13	125.0	28.4	–49.4	–35.2	–2.9	.08	94.76
250.0	.12	114.2	28.4	–63.0	–35.2	–4.3	.09	75.95
300.0	.10	102.7	28.4	–76.8	–35.0	–4.6	.09	56.29
350.0	.08	90.8	28.3	–90.9	–34.9	–6.0	.09	35.64
400.0	.06	80.2	28.1	–105.4	–34.5	–7.2	.08	14.62
450.0	.03	81.2	27.8	–120.1	–34.3	–8.7	.07	–9.18
500.0	.03	170.0	27.5	–135.1	–34.1	–10.4	.05	–44.25
600.0	.12	–176.2	26.2	–164.5	–33.5	–16.5	.07	–137.31
800.0	.27	155.2	22.6	145.0	–32.9	–28.6	.17	159.70
1000.0	.39	125.1	18.5	104.8	–32.9	–41.6	.24	118.14
1500.0	.62	75.5	11.8	28.9	–33.7	–75.0	.28	97.05
2000.0	.73	43.2	4.3	–36.7	–34.8	–82.8	.55	63.13
2500.0	.77	20.8	–1.1	–88.1	–33.0	–105.7	.68	40.22

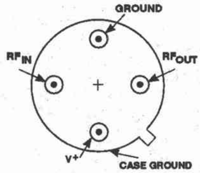
UTO/UTC 533 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

- Frequency Range: 5 to 500 MHz
- Medium Power Output: +17.0 dBm (Typ)
- Medium Gain: 17.0 dB (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



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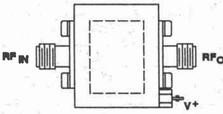


UTC—TC-1, p. 16–42

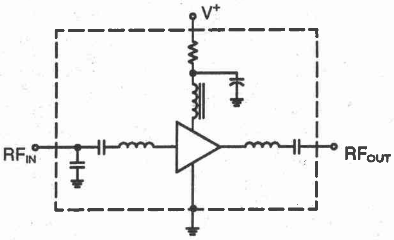
DESCRIPTION

The 533 Series is a single-stage bipolar RF amplifier built on a thin-film substrate. Resistive feedback and active bias compensate for temperature and voltage variations. A set of internal blocking capacitors couple RF through the amplifier. The 533 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	17.0	16.0	15.0	dB
—	Gain Flatness (Max.)	±0.5	±0.7	±1.0	dB
NF	Noise Figure (Max.)	3.5	5.0	5.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+17.0	+14.0	+13.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+30.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+43.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+49.0	—	—	dBm
I_D	DC Current	53	—	—	mA

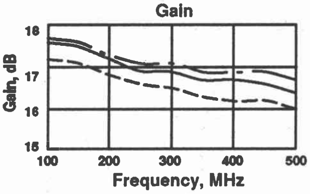
SCHEMATIC

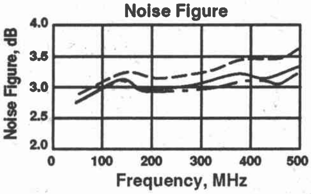


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ————
+85°C — — — —
–55°C —— · ——





MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +115°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +115°C

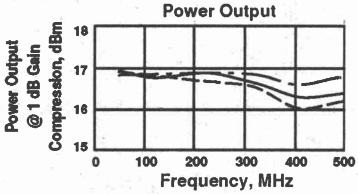
THERMAL CHARACTERISTICS*

θ_{JC} .... 75°C/W
Active Transistor Power Dissipation .... 475 mW
Junction Temperature Above Case Temperature .... 36°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 693,000 Hrs.
*For further information, see High Reliability section, p. 17–2.

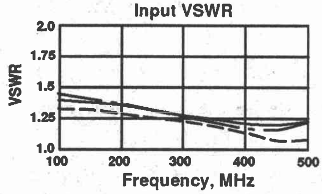
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

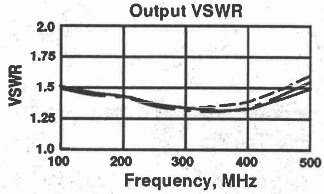
Power Output



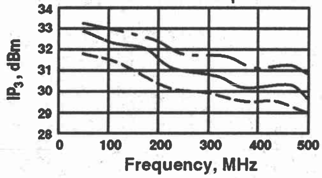
Input VSWR



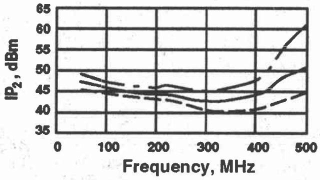
Output VSWR



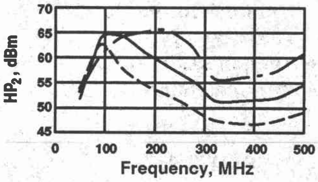
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

S-PARAMETERS — **BIAS = 15.00 VOLTS**

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.117	–169.9	16.959	155.6	–22.427	–13.3	.219	160.5
150.00	.119	–167.0	16.931	–143.1	–22.254	–18.4	.209	150.8
200.00	.121	–163.8	16.899	129.9	–22.473	–24.5	.204	142.6
250.00	.130	–159.2	16.971	117.0	–22.458	–30.7	.194	135.4
300.00	.145	–158.1	17.069	104.3	–22.181	–37.0	.185	128.5
350.00	.163	–163.3	17.174	91.3	–22.501	–44.6	.179	124.4
400.00	.180	–173.6	17.320	77.9	–22.585	–53.4	.174	121.6
450.00	.187	168.5	17.498	63.5	–22.464	–61.7	.176	120.9
500.00	.199	139.1	17.658	47.2	–22.640	–70.2	.190	120.2
550.00	.230	97.9	17.838	29.0	–22.925	–79.5	.215	117.4
600.00	.318	50.2	17.676	7.2	–23.363	–91.6	.248	110.2
650.00	.474	8.8	16.886	–17.0	–24.183	–103.1	.269	99.0
700.00	.629	–24.8	15.238	–40.4	–25.508	–111.3	.271	87.1
750.00	.737	–51.3	13.019	–59.7	–27.101	–118.1	.256	77.5
800.00	.809	–71.3	10.584	–75.0	–28.227	–122.9	.236	71.8
850.00	.851	–86.2	8.223	–87.7	–29.293	–125.8	.222	68.2
900.00	.874	–98.3	5.956	–97.1	–30.027	–129.6	.218	65.9
950.00	.892	–108.0	3.837	–104.7	–30.773	–132.1	.215	64.0
1000.00	.907	–115.9	1.928	–111.0	–31.479	–135.5	.216	61.8

AVANTEK

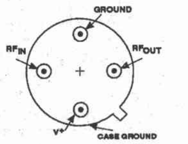
UTO/UTC/PPA 543 Series
Thin-Film Cascadable Amplifier
10 to 500 MHz

FEATURES

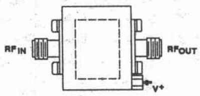
- Frequency Range: 10 to 500 MHz
- High Dynamic Range
- Low Noise Figure: 2.5 dB
- Medium Output Power: +8.0 dBm (Typ)
- Temperature Compensated
- Surface Mount Option

APPLICATIONS

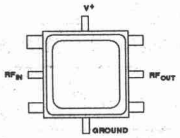
- System Front Ends
- IF/RF Amplification
- Surface Mount Assembly



UTO—TO-8T, p.16–48



UTC—TC-1, p. 16–42



PPA—PP-38, p.16–35

DESCRIPTION

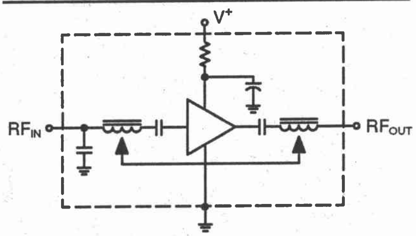
The 543 Series is a thin-film RF bipolar amplifier using lossless feedback for optimum noise figure and high dynamic range, and active bias to compensate for temperature and voltage variations. Internal blocking capacitors couple the RF through the amplifier. The 543 Series amplifiers are available in three packages: the surface mount PlanarPak PP-38 (.375 in. x .375 in.) case, the TO-8 hermetic case and the connectorized TC-1 case.

ELECTRICAL SPECIFICATIONS[1] (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	10-500	10-500	10-500	MHz
GP	Small Signal Gain (Min.)	11.0	10.0	9.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)[2]	2.5	2.5	3.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+8.0	+6.0	+6.0	dBm
—	Input VSWR (Max.)	<1.7:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.7:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+22.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+30.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+36.0	—	—	dBm
I_D	DC Current	25	—	—	mA

NOTES: 1. Both RF input and RF output pins are at DC ground—no blocking capacitor.
2. PPA, Noise Figure = 2.7 dB from 0° – 50°C and 3.2 from 55° to +85°C

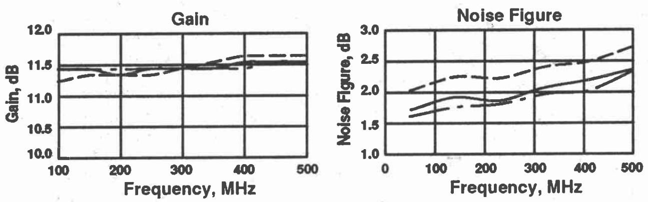
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ——— +85°C – – – – –55°C — · —



MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

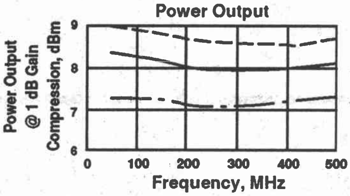
θ_{JC}	105°C/W
Active Transistor Power Dissipation	176 mW
Junction Temperature Above Case Temperature	19°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	1,682,000 Hrs.

*For further information, see High Reliability section, p. 17–2.

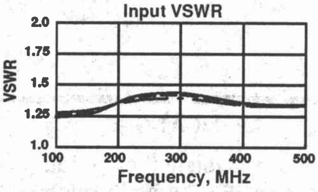
WEIGHT: (typical) PPA—0.5 grams; UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

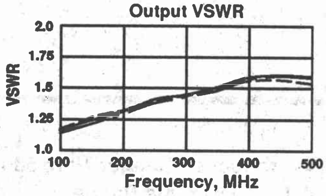
Power Output



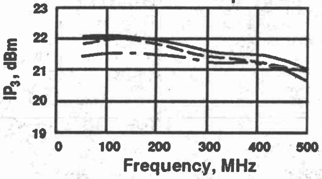
Input VSWR



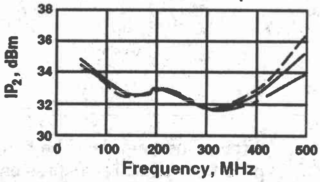
Output VSWR



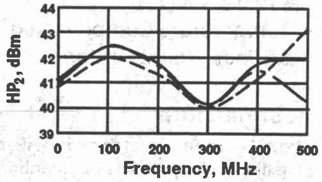
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.06	10.81	167.92	1.37	.00	1.15	16.41
150.0	1.11	10.70	159.48	.66	.46	1.21	16.15
200.0	1.16	10.69	151.41	.32	.44	1.27	16.26
250.0	1.22	10.64	143.51	.15	.44	1.33	16.45
300.0	1.25	10.64	135.73	.10	.43	1.39	16.56
350.0	1.29	10.64	128.09	.20	.42	1.42	16.47
400.0	1.31	10.62	120.64	.48	.41	1.45	16.47
450.0	1.32	10.61	113.38	.94	.41	1.46	16.45
500.0	1.32	10.58	105.83	1.12	.42	1.45	16.45
600.0	1.28	10.50	90.55	1.31	.43	1.38	16.38
700.0	1.23	10.29	74.82	1.03	.47	1.25	16.30
800.0	1.22	10.04	57.48	–.83	.46	1.12	16.23
900.0	1.33	9.54	40.71	–2.14	.47	1.20	16.24
1000.0	1.51	8.91	24.20	–3.19	.45	1.46	16.38
1100.0	1.76	8.07	8.33	–3.59	.42	1.80	16.71
1200.0	2.01	7.15	–6.40	–2.87	.39	2.20	17.09
1300.0	2.26	6.20	–19.73	–.72	.35	2.59	17.60

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.028	140.0	10.745	166.8	–16.327	169.3	.066	127.9
150.00	.052	99.1	10.702	158.7	–16.326	160.9	.091	103.5
200.00	.075	85.1	10.607	150.4	–16.398	154.0	.119	86.8
250.00	.098	73.2	10.577	142.2	–16.462	147.3	.141	77.3
300.00	.116	68.0	10.562	134.3	–16.635	140.4	.157	67.2
350.00	.128	61.6	10.579	126.5	–16.542	134.0	.171	59.8
400.00	.133	55.3	10.584	118.9	–16.381	127.6	.179	52.0
450.00	.135	49.6	10.596	111.4	–16.481	122.1	.180	45.2
500.00	.133	46.2	10.547	103.5	–16.410	115.8	.179	38.3
550.00	.126	44.6	10.553	95.9	–16.430	109.7	.166	32.2
600.00	.115	43.7	10.506	87.9	–16.397	103.5	.151	27.2
700.00	.097	53.8	10.317	71.7	–16.316	91.5	.102	23.0
800.00	.097	78.2	10.040	53.9	–16.298	78.3	.052	57.1
900.00	.147	93.7	9.561	36.7	–16.346	65.2	.100	111.9
1000.00	.207	93.7	8.920	19.7	–16.525	53.0	.193	113.2
1100.00	.278	86.8	8.092	3.4	–16.737	39.8	.286	104.1
1200.00	.328	76.7	7.211	–11.7	–17.171	27.7	.371	94.5
1300.00	.378	70.0	6.278	–25.3	–17.517	16.1	.437	84.8

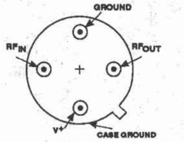
UTO/UTC/PPA 544 Series
Thin-Film Cascadable Amplifier
10 to 500 MHz

FEATURES

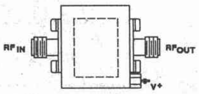
- Frequency Range: 10 to 500 MHz
- High Dynamic Range
- Low Noise Figure: 2.5 dB (Typ)
- Medium Power Output: +13.0 dBm (Typ)
- Temperature Compensated
- Surface Mount Option

APPLICATIONS

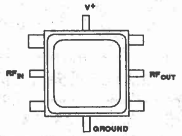
- System Front Ends
- IF/RF Amplification
- Surface Mount Assembly



UTO—TO-8T, p.16–48



UTC—TC-1, p.16–42



PPA—PP-38, p. 16–35

DESCRIPTION

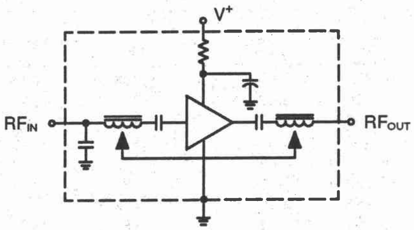
The 544 Series is a thin-film RF bipolar amplifier using lossless feedback for optimum noise figure and high dynamic range, and active bias to compensate for temperature and voltage variations. Internal blocking capacitors couple the RF through the amplifier. The 544 Series amplifiers are available in three packages: the surface mount PlanarPak PP-38 (.375 in. x .375 in.) case, the TO-8 hermetic case and the connectorized TC-1 case.

ELECTRICAL SPECIFICATIONS[1] (Measured in a 50–ohm system @ +15 VDC nominal unless otherwise noted)

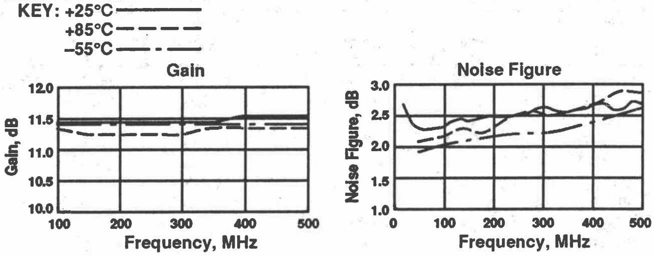
Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range	10-500	10-500	10-500	MHz
GP	Small Signal Gain (Min.)	11	10.0	9.0	dB
—	Gain Flatness (Max.)	±0.8	±1.0	±1.0	dB
NF	Noise Figure (Max.)	2.5	3.0	3.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+13.0	+12.0	+11.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.7:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+28.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+40.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+46.0	—	—	dBm
I_D	DC Current	36	—	—	mA

NOTE: 1. Both RF input and RF output pins are at DC ground—no blocking capacitor.

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

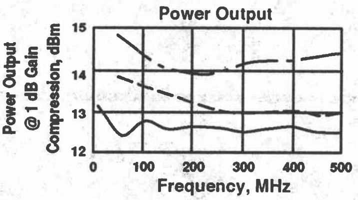
DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

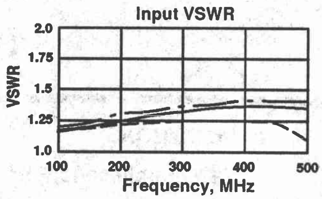
THERMAL CHARACTERISTICS*

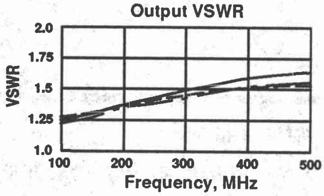
θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 256 mW
Junction Temperature Above Case Temperature .... 27°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 1,137,000 Hrs.
*For further information, see High Reliability section, p. NO TAG.

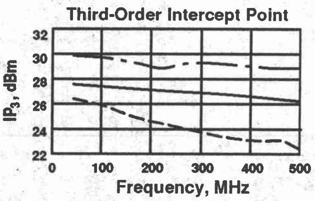
WEIGHT: (typical) PPA—0.5 grams; UTO—2.1 grams; UTC—21.5 grams

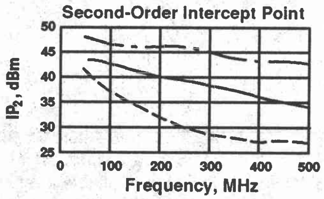
TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

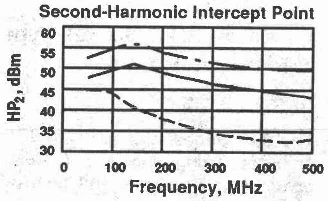












AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.10	11.12	167.20	.04	.00	1.18	15.90
150.0	1.12	11.02	158.40	–.61	.48	1.22	16.04
200.0	1.14	10.99	149.73	–1.14	.47	1.27	16.23
250.0	1.17	10.93	141.47	1.26	.46	1.32	16.26
300.0	1.19	10.90	133.27	–1.32	.45	1.37	16.31
350.0	1.20	10.87	125.36	–1.10	.43	1.41	16.35
400.0	1.21	10.84	117.71	–.62	.42	1.44	16.31
450.0	1.20	10.80	110.24	.04	.42	1.46	16.34
500.0	1.19	10.74	102.57	.51	.42	1.47	16.39
600.0	1.16	10.62	87.22	1.43	.43	1.46	16.38
700.0	1.13	10.43	71.50	2.00	.44	1.42	16.34
800.0	1.18	10.28	55.07	1.85	.49	1.39	16.35
900.0	1.31	9.90	37.33	.38	.48	1.40	16.34
1000.0	1.50	9.48	20.34	–.32	.47	1.50	16.43

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.048	159.9	11.112	166.3	–16.053	169.6	.082	143.7
150.00	.053	124.4	11.047	157.5	–16.251	161.5	.097	121.4
200.00	.064	100.5	10.930	148.7	–16.193	153.2	.119	104.8
250.00	.078	79.2	10.879	140.1	–16.290	147.2	.136	93.9
300.00	.087	65.7	10.850	131.8	–16.454	139.9	.151	84.7
350.00	.092	53.7	10.843	123.7	–16.448	133.8	.166	77.6
400.00	.090	40.2	10.815	115.8	–16.342	127.1	.176	71.3
450.00	.089	24.2	10.799	108.1	–16.299	121.3	.182	65.9
500.00	.084	11.3	10.726	100.1	–16.311	115.3	.185	60.7
600.00	.066	–26.9	10.634	84.4	–16.394	103.4	.183	55.4
700.00	.063	–82.5	10.462	68.1	–16.372	91.5	.172	54.5
800.00	.096	–136.7	10.254	51.4	–16.351	79.1	.166	59.7
900.00	.152	–171.1	9.915	33.1	–16.413	66.8	.177	68.4
1000.00	.214	167.5	9.489	15.7	–16.533	55.0	.206	75.2
1100.00	.169	147.5	8.913	–1.8	–16.714	41.9	.253	77.0
1200.00	.312	132.1	8.318	–18.7	–16.960	29.8	.300	75.4
1300.00	.346	118.1	7.581	–34.8	–17.323	17.3	.345	71.6
1400.00	.360	106.8	6.796	–50.8	–17.746	6.1	.382	67.0
1500.00	.370	96.9	6.015	–66.7	–18.275	–5.8	.416	62.9

AVANTEK

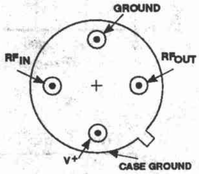
UTO/UTC 545 Series
Thin-Film Cascadable Amplifier
10 to 500 MHz

FEATURES

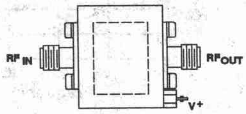
- Frequency Range: 10 to 500 MHz
- High Dynamic Range
- High Output Power: +19.0 dBm (Typ)
- Medium Gain: 10.5 dB (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

DESCRIPTION

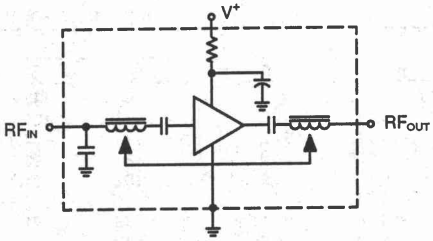
The 545 Series is a thin-film RF bipolar amplifier using lossless feedback for optimum noise figure and high dynamic range, and active bias to compensate for temperature and voltage variations. Internal blocking capacitors couple the RF through the amplifier. The 545 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	10-500	10-500	10-500	MHz
GP	Small Signal Gain (Min.)	10.5	10.0	10.0	dB
—	Gain Flatness (Max.)	±0.3	±0.5	±0.5	dB
NF	Noise Figure (Max.)	4.5	5.0	5.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+19.0	+17.0	+16.0	dBm
—	Input VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+32.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+45.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+48.0	—	—	dBm
I_D	DC Current	60	—	—	mA

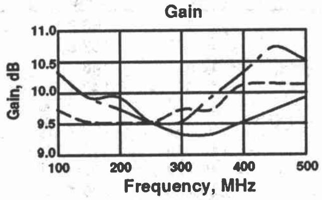
NOTE: 1. Both RF input and RF output pins are at DC ground—no blocking capacitor.

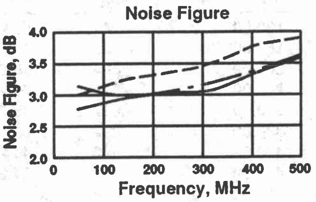
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ————
+85°C — — — —
−55°C —— · ——





MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... −55°C to +100°C
Storage Temperature .... −62°C to +150°C
"R" Series Burn-In Temperature .... +100°C

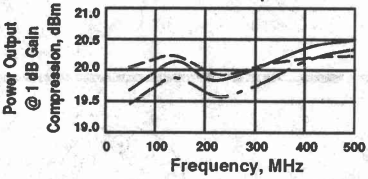
THERMAL CHARACTERISTICS*

θ_{JC} .... 75°C/W
Active Transistor Power .... 720 mW
Junction Temperature Above Case Temperature .... 54°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 1,103,000 Hrs.
*For further information, see High Reliability section, p. 17–2.

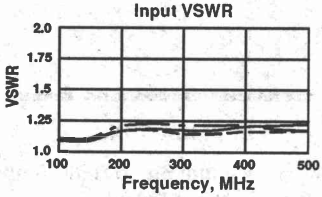
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

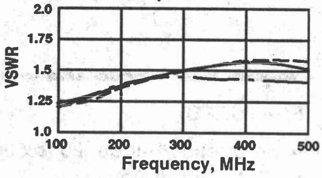
Power Output



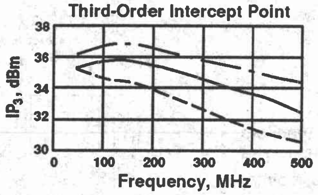
Input VSWR



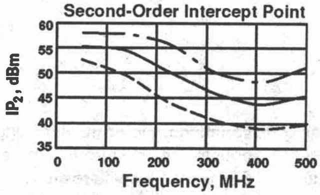
Output VSWR



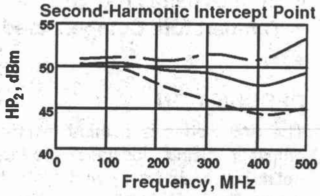
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.18	10.43	166.31	–5.59	.00	1.26	20.34
150.0	1.17	10.62	158.10	–4.40	.46	1.32	20.45
200.0	1.16	10.63	149.90	–3.21	.43	1.39	20.42
250.0	1.13	10.71	142.56	–1.15	.42	1.46	20.37
300.0	1.10	10.85	134.67	.34	.44	1.53	20.34
350.0	1.06	10.91	126.57	1.64	.42	1.60	20.29
400.0	1.02	11.06	119.49	3.96	.44	1.65	20.17
450.0	1.07	11.19	110.59	4.45	.50	1.68	20.03
500.0	1.16	11.30	101.37	4.62	.52	1.70	19.88
550.0	1.27	11.42	91.92	4.57	.55	1.68	19.75
600.0	1.42	11.51	81.70	3.75	.58	1.62	19.66
650.0	1.62	11.49	71.07	2.51	.59	1.53	19.64
700.0	1.85	11.43	60.46	1.30	.59	1.44	19.68
750.0	2.15	11.25	49.77	.01	.59	1.31	19.78
800.0	2.53	10.98	39.13	–1.23	.59	1.17	19.94
850.0	2.96	10.58	28.51	–2.46	.57	1.06	20.19
900.0	3.42	10.10	18.60	–2.98	.54	1.08	20.50
950.0	3.99	9.55	9.04	–3.15	.52	1.22	20.83
1000.0	4.56	8.94	–.20	–3.00	.00	1.36	21.22

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.081	3.3	10.617	167.5	–20.222	168.9	.120	30.5
200.00	.070	8.5	10.692	155.3	–20.441	160.8	.168	37.0
300.00	.046	10.2	10.888	142.2	–20.313	150.4	.214	34.3
400.00	.004	99.7	11.229	128.7	–20.128	140.0	.246	27.3
500.00	.072	175.8	11.519	114.4	–19.883	130.0	.254	17.4
600.00	.173	169.9	11.655	98.3	–19.765	118.7	.233	5.2
700.00	.300	160.9	11.544	80.4	–19.810	106.1	.170	–7.0
800.00	.433	149.9	11.027	62.4	–20.111	93.5	.075	–11.5
900.00	.546	138.8	10.067	44.5	–20.668	81.3	.054	106.1
1000.00	.633	129.5	8.811	28.4	–21.540	70.0	.162	111.1

AVANTEK

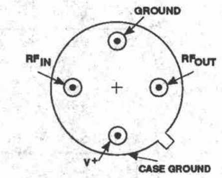
UTO/UTC 546 Series
Thin-Film Cascadable Amplifier
20 to 500 MHz

FEATURES

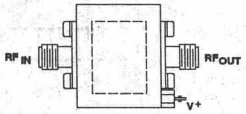
- Frequency Range: 20 to 500 MHz
- High Output Power: +23.5 dBm (Typ)
- High Dynamic Range
- Temperature Compensated

APPLICATIONS

- Final Stage RF/IF Amplifier
- Mixer Driver



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

DESCRIPTION

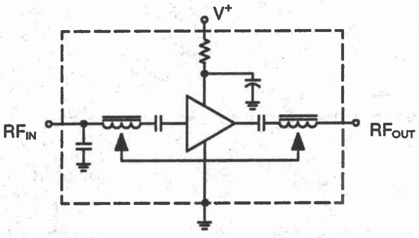
The 546 Series is a thin-film RF bipolar amplifier using lossless feedback for optimum noise figure and high dynamic range. Resistive feedback and active bias compensate for temperature and voltage variations. Internal blocking capacitors couple the RF through the amplifier. The 546 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	10-500	20-500	20-500	MHz
GP	Small Signal Gain (Min.)	11.5	10.0	10.0	dB
—	Gain Flatness (Max.)	±0.2	±0.5	±0.5	dB
NF	Noise Figure (Max.)	4.0	5.5	6.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+23.5	+23.0	+22.0	dBm
—	Input VSWR (Max.)	<1.7:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.8:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+35.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+40.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+50.0	—	—	dBm
I_D	DC Current	110	—	—	mA

NOTE: 1. RF input and output connected—no blocking capacitors.

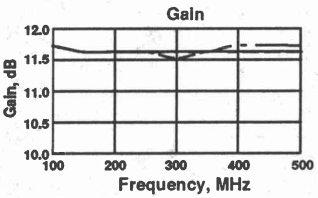
SCHEMATIC

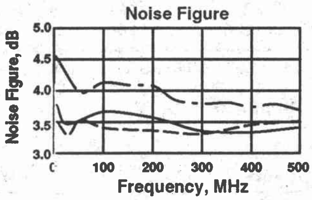


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C — — —
–55°C —-·—





MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +100°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+100°C

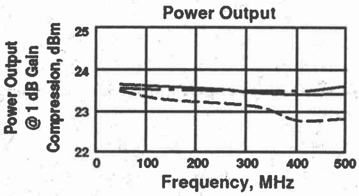
THERMAL CHARACTERISTICS*

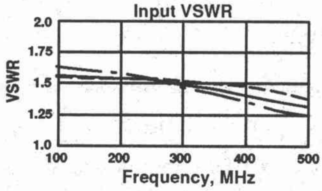
θ_{JC}	55°C/W
Active Transistor Power Dissipation	840 mW
Junction Temperature Above Case Temperature	46°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90C)	366,400 Hrs.

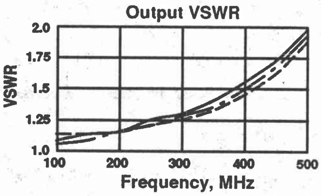
*For further information, see High Reliability section, p. 17–2.

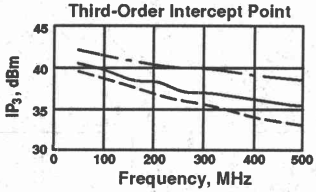
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

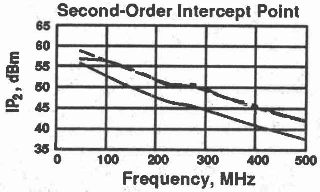
TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

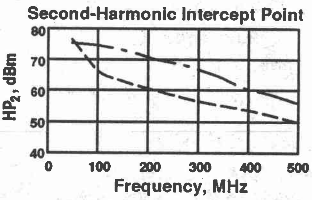












AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.70	10.80	153.07	−.41	.00	1.48	20.21
150.0	1.69	10.75	138.16	−.34	.83	1.56	20.25
200.0	1.72	10.75	123.16	−.39	.81	1.64	20.14
250.0	1.72	10.77	108.84	.26	.80	1.71	19.93
300.0	1.73	10.78	94.21	.60	.82	1.77	19.71
350.0	1.71	10.74	79.48	.84	.82	1.82	19.42
400.0	1.70	10.70	64.55	.88	.85	1.82	19.26
450.0	1.70	10.59	48.75	.05	.90	1.79	19.06
500.0	1.74	10.46	32.23	−1.49	.95	1.77	18.89
550.0	1.86	10.20	14.70	—	1.00	1.72	18.76
600.0	2.10	9.81	−3.69	—	1.05	1.63	18.85
650.0	2.51	9.26	−22.99	—	1.09	1.52	19.01
700.0	3.15	8.43	−42.99	—	1.09	1.38	19.51
750.0	4.09	7.38	−62.09	—	1.07	1.19	20.14
800.0	5.46	5.99	−81.67	—	1.05	1.12	21.13
850.0	7.35	4.30	−100.03	—	.99	1.31	22.42
900.0	9.75	2.35	−117.21	—	.95	1.62	24.04
950.0	12.78	.25	−134.39	—	.86	2.00	25.66
1000.0	16.33	−1.94	−148.23	—	.73	2.44	27.55

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.261	−170.5	10.828	153.5	−19.567	154.8	.166	−174.6
200.00	.250	−167.7	10.794	124.1	−19.406	123.1	.212	160.8
300.00	.241	−161.0	10.804	95.3	−19.034	93.6	.254	125.0
400.00	.239	−148.7	10.665	65.6	−18.778	64.6	.282	82.0
500.00	.278	−132.3	10.310	34.1	−18.614	34.4	.298	32.3
600.00	.378	−122.4	9.543	−.5	−18.744	2.5	.299	−21.0
700.00	.524	−122.3	8.190	−37.8	−19.444	−31.8	.242	−73.6
800.00	.684	−129.3	5.958	−75.1	−20.911	−66.0	.086	−131.5
900.00	.811	−139.5	2.546	−110.5	−23.611	−97.7	.146	30.6
1000.00	.889	−149.2	−1.652	−142.0	−26.836	−124.7	.355	−9.0

AVANTEK

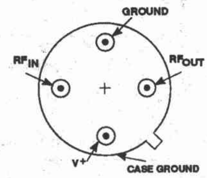
UTO/UTC 547
THin-Film Cascadable Amplifier
10 to 500 MHz

FEATURES

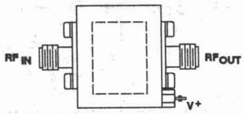
- Frequency Range: 10 to 500 MHz
- High Dynamic Range
- Low Noise: 2.8 db (Typ)
- High Output Power: +19.0 dBm (Typ)
- Medium Gain: 12.5 dB (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- System Front End



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

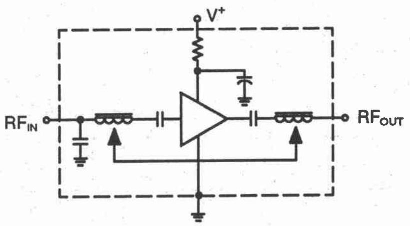
DESCRIPTION

The 547 Series is a thin-film RF bipolar amplifier using lossless feedback for optimum noise figure and high dynamic range, and active bias to compensate for temperature and voltage variations. Internal blocking capacitors couple the RF through the amplifier. The 547 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

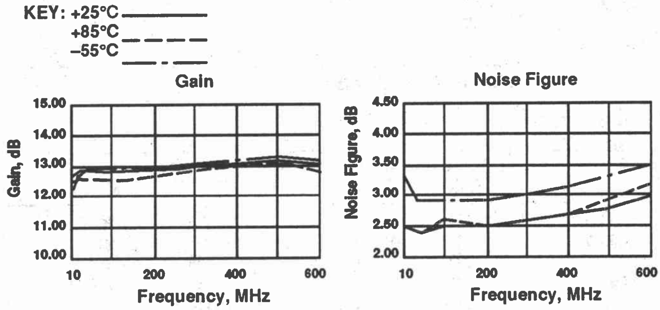
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			$T_C = 0°$ to 50°C	$T_C = -55$ to +85°C	
BW	Frequency Range	10-500	10-500	10-500	MHz
GP	Small Signal Gain (Min.)	12.5	11.5	11.0	dB
—	Gain Flatness (Max.)	±0.2	±0.7	±0.7	dB
NF	Noise Figure (Max.)	2.8	3.5	4.0	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+19.0	+18.0	+17.5	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+31.0	+28.0	+27.0	dBm
IP_2	Two Tone 2nd Order Intercept Point	+47.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+55.0	—	—	dBm
I_D	DC Current	55	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage .... +15 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

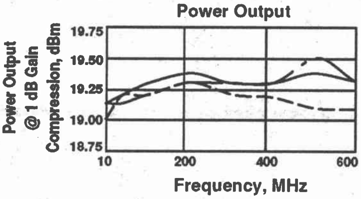
THERMAL CHARACTERISTICS*

θ_{JC} .... 105/105°C/W
Active Transistor Power .... 255/255 mW
Junction Temperature Above Case Temperature .... 27/27°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 1,103,000 Hrs.

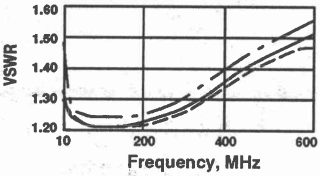
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

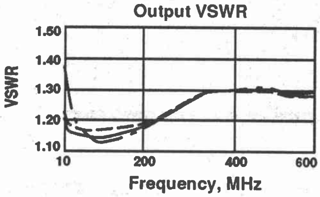
Power Output



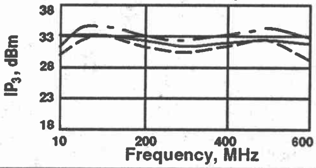
Input VSWR



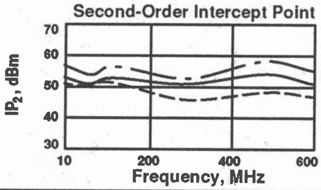
Output VSWR



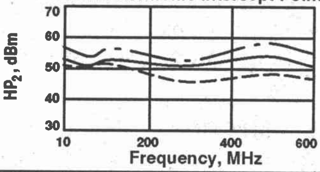
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
1.0	4.26	1.2	−85.6			2.92	16.1
5.0	1.63	12.4	−154.6			1.35	25.5
10.0	1.33	12.7	−168.2	8.94	2.29	1.20	22.6
20.0	1.22	12.8	−176.5	2.60	2.29	1.15	21.9
50.0	1.20	12.8	173.9	−1.10	.67	1.15	21.7
100.0	1.20	12.8	164.0	−1.54	.50	1.15	21.7
150.0	1.20	12.8	155.0	−1.02	.49	1.17	21.8
200.0	1.20	12.8	146.1	−.39	.49	1.22	21.8
250.0	1.20	12.9	137.2	.19	.49	1.25	21.9
300.0	1.22	12.9	128.2	.66	.50	1.27	21.9
350.0	1.25	13.0	118.9	.74	.52	1.30	21.9
400.0	1.30	13.1	109.4	.48	.54	1.30	22.0
450.0	1.35	13.1	99.5	−.07	.56	1.30	22.0
500.0	1.41	13.2	89.3	−1.00	.59	1.30	22.1
550.0	1.47	13.1	78.8			1.27	22.1
600.0	1.53	13.1	67.8			1.27	22.2
650.0	1.56	12.9	56.5			1.33	22.3
700.0	1.63	12.7	45.2			1.38	22.5
750.0	1.70	12.3	34.0			1.47	22.8
800.0	1.82	11.9	22.9			1.56	23.2
850.0	1.90	11.4	12.3			1.63	23.6
900.0	1.99	10.9	2.0			1.70	24.0
950.0	2.03	10.3	−8.1			1.78	24.6
1000.0	2.08	9.7	−17.9			1.90	25.2
1500.0	2.23	3.3	−109.3			3.55	22.9
2000.0	1.82	−7.2	−171.0			2.03	15.9
2500.0	2.51	−11.7	137.0			1.67	17.3
3000.0	5.06	−17.3	74.0			1.38	20.0

LINEARIZATION RANGE: 10.0 to 500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
1.0	.62	−1.6	1.2	−85.6	−16.1	−172.8	.49	−149.90
5.0	.24	−87.5	12.4	−154.6	−25.5	−155.5	.15	−44.62
10.0	.14	−111.0	12.7	−168.2	−22.6	−166.9	.09	−98.44
20.0	.10	−136.9	12.8	−176.5	−21.9	−175.8	.07	−140.34
50.0	.09	−166.6	12.8	173.9	−21.7	174.3	.07	174.87
100.0	.09	174.5	12.8	164.0	−21.7	163.9	.07	140.75
150.0	.09	162.0	12.8	155.0	−21.8	154.6	.08	117.85
200.0	.09	149.4	12.8	146.1	−21.8	145.6	.10	97.79
250.0	.09	138.2	12.9	137.2	−21.9	136.7	.11	79.23
300.0	.10	129.0	12.9	128.2	−21.9	128.2	.12	61.56
350.0	.11	121.1	13.0	118.9	−21.9	119.5	.13	44.66
400.0	.13	115.9	13.1	109.4	−22.0	110.9	.13	28.39
450.0	.15	112.0	13.1	99.5	−22.0	102.2	.13	12.19
500.0	.17	108.4	13.2	89.3	−22.1	93.5	.13	−4.66
550.0	.19	102.8	13.1	78.8	−22.1	84.5	.12	−24.56
600.0	.21	94.3	13.1	67.8	−22.2	75.3	.12	−48.04
650.0	.22	83.7	12.9	56.5	−22.3	66.0	.14	−72.52
700.0	.24	70.8	12.7	45.2	−22.5	56.6	.16	−94.29
750.0	.26	57.8	12.3	34.0	−22.8	47.3	.19	−112.98
800.0	.29	45.7	11.9	22.9	−23.2	38.3	.22	−129.84
850.0	.31	35.1	11.4	12.3	−23.6	29.6	.24	−145.74
900.0	.33	25.8	10.9	2.0	−24.0	21.4	.26	−161.36
950.0	.34	16.5	10.3	−8.1	−24.6	13.6	.28	−176.11
1000.0	.35	6.4	9.7	−17.9	−25.2	6.2	.31	170.45
1500.0	.38	−86.7	3.3	−109.3	−22.9	1.2	.56	70.43
2000.0	.29	−74.9	−7.2	−171.0	−15.9	−127.3	.34	−7.27
2500.0	.43	−83.0	−11.7	137.0	−17.3	142.0	.25	−36.04
3000.0	.67	−106.2	−17.3	74.0	−20.0	68.5	.16	−86.14

AVANTEK

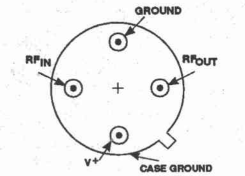
UTO/UTC 552 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

- Frequency Range: 5 to 500 MHz
- Medium Gain: 15.0 dB (Typ)
- 5-Volt System
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- High Efficiency



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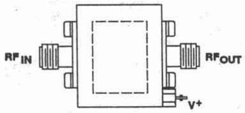


UTC—TC-1, p. 16–42

DESCRIPTION

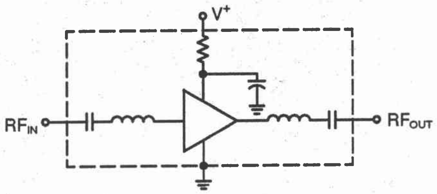
The 552 Series is a medium-gain, medium-power, thin-film RF bipolar amplifier that operates from 5-volt bias. It uses resistive feedback and active bias for stability over temperature and over bias variations.

Blocking capacitors couple the RF through the amplifier and inductors provide good VSWR. The 552 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_c = 25°C$	Guaranteed Specifications $T_c = 0°$ to 50°C	Guaranteed Specifications $T_c = -55°$ to +85°C	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	15.0	13.5	13.0	dB
—	Gain Flatness (Max.)	±0.2	±0.7	±0.7	dB
NF	Noise Figure (Max.)	2.9	4.0	4.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+8	+6.5	+6.5	dBm
—	Input VSWR (Max.)	<1.2:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+21.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+28.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+36.0	—	—	dBm
I_D	DC Current	18	—	—	mA

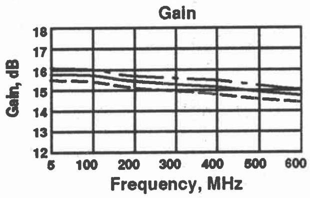
SCHEMATIC

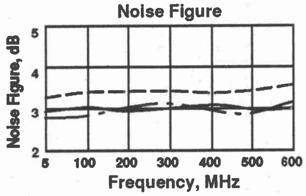


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +5 VDC unless otherwise noted)

KEY: +25°C ————
+85°C — — — —
–55°C —— · ——





MAXIMUM RATINGS

DC Voltage .... +9 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

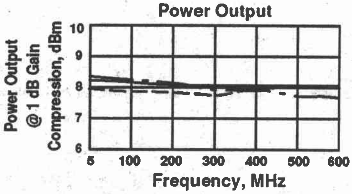
THERMAL CHARACTERISTICS*

θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 59 mW
Junction Temperature Above Case Temperature .... 6°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 1,483,000 Hrs.
*For further information, see High Reliability section, p. 17–2.

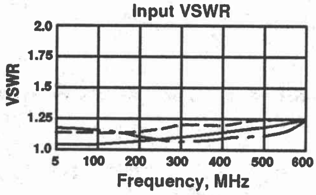
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

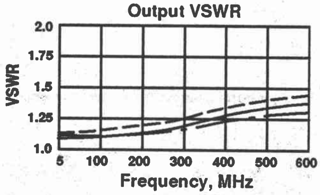
Power Output



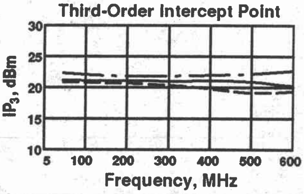
Input VSWR



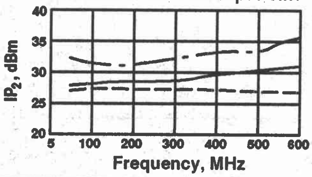
Output VSWR



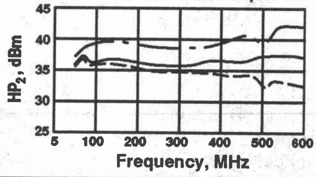
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

BIAS = 5.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}		GPDEL	PHASE
GHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	ns	DEG
.05	.02	−73.8	15.23	171.7	−19.3	−3.3	.06	19.90	.57	.59
.10	.01	−67.1	15.20	161.5	−19.3	−8.9	.06	14.47	.57	−.08
.15	.02	−64.4	15.17	151.8	−19.3	−14.0	.07	11.19	.54	−.24
.20	.02	−58.4	15.12	142.3	−19.3	−18.8	.08	7.39	.53	−.27
.25	.02	−53.7	15.07	132.8	−19.4	−23.8	.09	2.26	.53	−.24
.30	.03	−52.0	15.01	123.5	−19.4	−28.7	.09	−3.96	.52	−.02
.35	.04	−52.6	14.94	114.0	−19.4	−33.5	.10	−11.66	.53	−.07
.40	.05	−53.9	14.86	104.5	−19.4	−38.5	.11	−19.45	.53	−.01
.45	.06	−55.3	14.77	95.2	−19.4	−43.5	.12	−28.43	.52	.14
.50	.07	−57.3	14.69	85.7	−19.4	−48.5	.12	−38.23	.52	.20
.55	.08	−58.1	14.60	76.1	−19.4	−53.8	.13	−48.65	.53	
.60	.09	−58.6	14.52	66.5	−19.4	−59.0	.13	−59.35	.54	
.65	.10	−59.1	14.43	56.9	−19.4	−64.6	.13	−70.42	.53	
.70	.11	−58.6	14.33	47.1	−19.4	−70.1	.13	−82.64	.55	
.75	.13	−58.3	14.25	37.1	−19.4	−75.8	.12	−96.33	.55	
.80	.15	−57.1	14.16	27.0	−19.4	−81.8	.11	−111.57	.56	
.85	.17	−56.1	14.08	16.6	−19.3	−88.0	.11	−129.51	.58	
.90	.20	−55.8	14.00	5.9	−19.4	−94.5	.10	−152.32	.60	
.95	.24	−56.1	13.90	−5.4	−19.4	−101.2	.09	178.52	.62	
1.00	.29	−57.6	13.76	−17.2	−19.4	−108.4	.11	146.78	.66	
1.05	.34	−60.5	13.59	−29.6	−19.5	−115.9	.13	117.19	.69	
1.10	.41	−64.7	13.34	−42.5	−19.6	−123.9	.17	92.13	.72	
1.15	.48	−69.9	12.99	−56.2	−19.8	−132.1	.22	71.68	.76	
1.20	.55	−76.1	12.51	−70.2	−20.1	−140.7	.28	54.07	.78	
1.25	.62	−83.0	11.87	−84.7	−20.5	−149.3	.35	38.18	.80	
1.30	.68	−90.2	11.05	−99.3	−21.0	−157.7	.41	23.68	.81	
1.35	.74	−97.6	10.05	−113.9	−21.6	−165.6	.46	10.19	.81	
1.40	.78	−104.8	8.88	−128.2	−22.3	−173.2	.51	−2.03	.80	
1.45	.82	−111.5	7.51	−142.4	−23.0	−179.9	.54	−13.24	.78	
1.50	.84	−117.9	6.00	−156.0	−23.8	174.2	.56	−23.55	.76	
1.55	.86	−123.7	4.30	−169.4	−24.5	168.8	.58	−32.83	.75	
1.60	.87	−129.1	2.39	177.7	−25.1	163.9	.59	−41.20	.72	
1.65	.87	−133.9	.21	165.4	−25.7	159.5	.59	−48.83	.68	
1.70	.88	−138.3	−2.33	159.3	−26.3	155.2	.59	−55.70	.63	
1.75	.88	−142.3	−5.34	144.1	−26.8	151.2	.59	−62.00	.55	
1.80	.88	−146.0	−8.93	137.4	−27.2	147.2	.59	−67.96	.37	
1.85	.88	−149.5	−13.38	138.0	−27.7	143.3	.59	−73.62	−.06	
1.90	.89	−152.3	−17.92	157.4	−28.0	139.6	.59	−79.18	−1.06	
1.95	.89	−156.2	−18.41	−169.3	−28.4	135.3	.59	−85.13	−1.87	
2.00	.89	−159.6	−16.01	−155.8	−28.7	131.0	.59	−90.95	−.78	
2.05	.90	−162.8	−14.32	−154.8	−29.0	127.2	.60	−97.21	.04	
2.10	.90	−166.1	−13.23	−160.1	−29.3	123.4	.60	−103.83	.24	
2.15	.90	−169.5	−12.70	−167.5	−29.6	119.9	.60	−110.60	.41	
2.20	.90	−172.8	−12.45	−175.0	−29.8	115.4	.60	−117.62	.43	
2.25	.90	−176.2	−12.51	177.1	−30.1	111.3	.60	−124.93	.42	
2.30	.90	−179.5	−12.72	169.0	−30.3	107.4	.60	−132.30	.48	
2.35	.90	−177.1	−13.10	161.0	−30.7	103.5	.60	−139.72	.43	
2.40	.90	−173.6	−13.61	152.9	−30.9	99.5	.60	−147.17	.44	
2.45	.90	−170.0	−14.20	145.3	−31.2	95.4	.60	−154.44	.42	
2.50	.90	166.5	−14.80	137.5	−31.4	92.0	.61	−161.53	.44	

LINEARIZATION RANGE: 50.0 to 500.0 MHz

AVANTEK

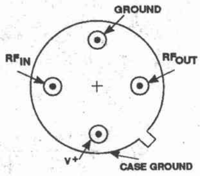
UTO/UTC 554 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

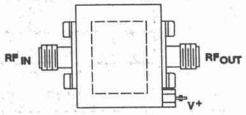
- Frequency Range: 5 to 500 MHz
- Low Noise Figure: 2.7 dB (Typ)
- High Gain: 29.0 dB (Typ)
- Temperature Compensated
- 5-Volt System

APPLICATIONS

- IF/RF Amplification
- High Efficiency



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

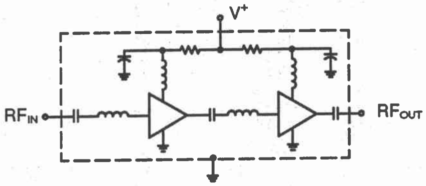
DESCRIPTION

The 554 Series is a two-stage thin-film bipolar RF amplifier that operates on 5-volt bias to provide efficiency, high gain and relatively low noise figure. Resistive feedback and active bias provide temperature compensation and increased immunity to bias voltage variations. Internal blocking capacitors couple the RF through the amplifier. The 554 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	29.0	28.0	27.0	dB
—	Gain Flatness (Max.)	±0.2	±0.7	±0.7	dB
NF	Noise Figure (Max.)	2.7	3.0	3.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+10.0	+9.0	+8.5	dBm
—	Input VSWR (Max.)	<1.4:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+21.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+38.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+44.0	—	—	dBm
I_D	DC Current	40	—	—	mA

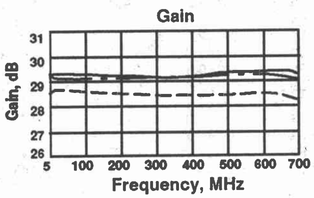
SCHEMATIC

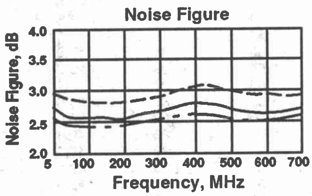


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +5 VDC unless otherwise noted)

KEY: +25°C ———
+85°C — — — —
−55°C —— - ——





MAXIMUM RATINGS

DC Voltage .... +10 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... −55°C to +125°C
Storage Temperature .... −62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

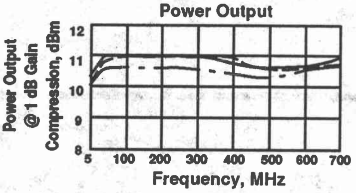
THERMAL CHARACTERISTICS*

θ_{JC} .... 105/75°C/W
Active Transistor Power Dissipation .... 48/109 mW
Junction Temperature Above Case Temperature ... 5.0/8.3°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90C) .... 575,700 Hrs.
*For further information, see High Reliability section, p. 17–2.

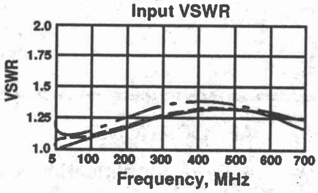
WEIGHT: (typical) UTO—1.7 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

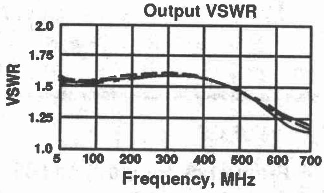
Power Output



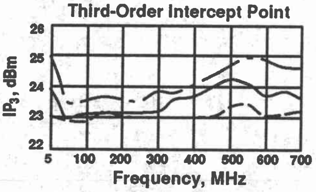
Input VSWR



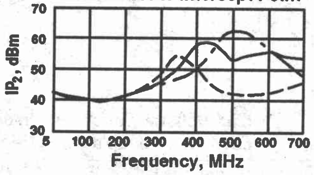
Output VSWR



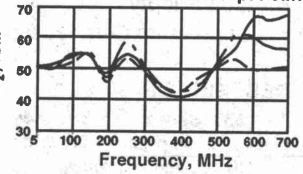
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS, MAGNITUDES AND ANGLES

BIAS = 5 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
.005	.02	171.1	28.8	18.8	–37.3	19.5	.22	178.52
.010	.00	129.1	28.8	6.9	–37.1	9.5	.22	179.04
.020	.01	–53.2	28.8	–.9	–37.1	3.5	.22	177.76
.030	.01	–66.8	28.8	–5.6	–37.1	1.1	.21	176.76
.040	.02	–70.9	28.9	–9.4	–37.0	–.7	.21	175.90
.050	.02	–78.2	28.9	–13.0	–37.0	–1.9	.21	174.94
.100	.04	–99.5	28.8	–29.0	–37.0	–6.4	.21	169.91
.150	.06	–115.1	28.8	–44.2	–37.2	–10.9	.22	165.61
.200	.08	–124.5	28.8	–59.3	–37.3	–14.5	.23	159.93
.250	.10	–133.9	28.7	–74.4	–37.3	–18.0	.24	152.73
.300	.12	–143.3	28.7	–89.3	–37.3	–22.0	.24	145.78
.350	.13	–150.3	28.7	–104.5	–37.5	–25.3	.23	136.14
.400	.13	–156.7	28.7	–119.9	–37.6	–28.6	.23	124.48
.450	.13	–164.2	28.7	–135.4	–37.8	–32.3	.21	112.81
.500	.13	–171.6	28.8	–151.4	–37.9	–35.9	.19	98.22
.550	.12	–179.4	28.8	–167.9	–38.0	–39.8	.16	80.88
.600	.10	171.5	28.8	174.7	–38.2	–42.8	.13	60.09
.650	.09	164.2	28.8	156.4	–38.5	–46.8	.09	28.10
.700	.07	159.3	28.7	137.1	–38.9	–50.6	.07	–29.25
.750	.06	166.6	28.3	116.6	–39.4	–53.3	.10	–97.46
.800	.06	–171.4	27.7	95.5	–39.8	–53.4	.17	–133.89
.850	.09	–160.3	26.7	74.4	–40.4	–52.6	.25	–158.64
.900	.13	–161.0	25.4	54.6	–40.4	–51.3	.32	–177.40
.950	.17	–168.2	23.9	36.3	–40.0	–48.4	.38	167.65
1.000	.20	–171.3	22.3	20.0	–39.3	–48.9	.42	155.35
1.500	.11	35.7	8.3	–91.9	–37.8	–89.5	.39	58.39
2.000	.42	–81.9	–5.2	–174.4	–35.6	–138.1	.30	–19.86
3.000	.82	149.5	–3.6	91.0	–25.9	116.9	.26	–149.80

FREQ GHz	GPDEL ns	PHASE DEG
.050	.92	.73
.075	.92	.11
.100	.88	–.10
.125	.87	–.30
.150	.85	–.33
.175	.85	–.30
.200	.84	–.26
.225	.85	–.25
.250	.84	–.17
.275	.84	.00
.300	.84	.12
.325	.83	.25
.350	.85	.25
.375	.85	.26
.400	.85	.28
.425	.85	.19
.450	.87	.11
.475	.87	–.13
.500	.88	–.46

LINEARIZATION RANGE: .05 to .50 GHz

AVANTEK

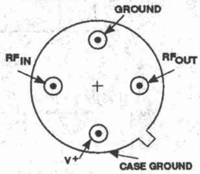
UTO/UTC 558 Series
Thin-Film Cascadable Amplifier
5 to 500 MHz

FEATURES

- Frequency Range: 5 to 500 MHz
- High Gain: 28.0 dB
- 5-Volt Supply
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



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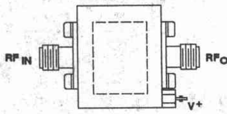


UTC—TC-1, p. 16–42

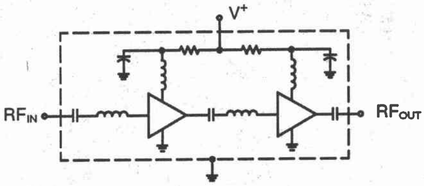
DESCRIPTION

The 558 Series is a two-stage thin-film bipolar RF amplifier that operates on 5-volt bias to provide efficiency, high gain and relatively low noise figure. Resistive feedback and active bias provide temperature compensation and increased immunity to bias voltage variations. Internal blocking capacitors couple the RF through the amplifier. The 558 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = −55° to +85°C	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	29.5	28.0	27.0	dB
—	Gain Flatness (Max.)	±0.2	±0.7	±0.7	dB
NF	Noise Figure (Max.)	2.7	3.2	3.6	dB
$P_{1 dB}$	Power Output @ +1 dB Compression (Min.)	+14.5	+13.5	+13.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+23.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+26.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+33.0	—	—	dBm
I_D	DC Current	70	—	—	mA

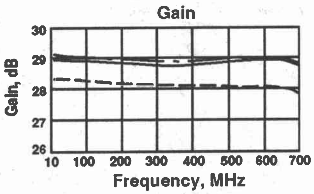
SCHEMATIC

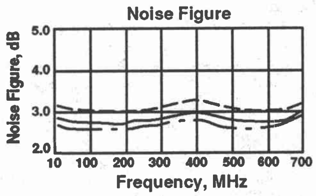


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +5 VDC unless otherwise noted)

KEY: +25°C ————
+85°C — — — —
−55°C —— - ——





MAXIMUM RATINGS

DC Voltage .... +9 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... −55°C to +125°C
Storage Temperature .... −62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

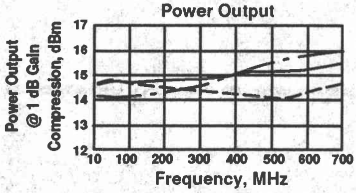
THERMAL CHARACTERISTICS*

θ_{JC} .... 105/75°C/W
Active Transistor Power Dissipation .... 48/228 mW
Junction Temperature Above Case Temperature .. 5.0/17.0°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 572,300 Hrs.
*For further information, see High Reliability section, p. 17–2.

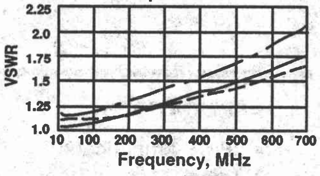
WEIGHT: (typical) UTO—1.7 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

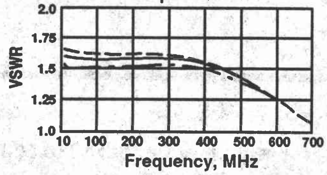
Power Output



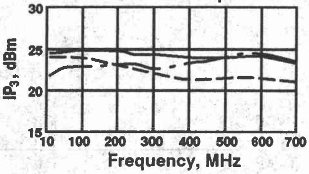
Input VSWR



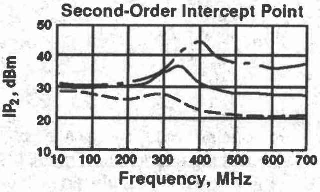
Output VSWR



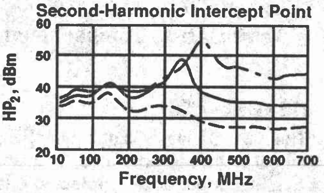
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS — **BIAS = 5 VOLTS**

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
.005	.03	141.3	28.7	21.8	–37.3	21.9	.25	172.18
.010	.01	68.3	28.8	8.2	–37.2	10.3	.23	176.01
.020	.01	3.3	28.7	–.1	–37.2	4.5	.23	176.31
.030	.01	–25.2	28.7	–4.8	–37.2	2.3	.23	175.85
.040	.01	–44.0	28.7	–8.6	–37.2	.3	.22	175.25
.050	.02	–56.6	28.7	–12.0	–37.2	–.4	.22	174.53
.100	.03	–93.0	28.7	–27.2	–37.2	–5.5	.22	170.91
.150	.05	–114.6	28.6	–41.5	–37.3	–8.4	.22	167.12
.200	.07	–130.1	28.6	–55.6	–37.3	10.4	.22	162.93
.250	.00	–143.0	28.6	–69.6	–37.3	–13.9	.23	158.31
.300	.11	–153.6	28.5	–83.5	–37.4	–16.4	.23	153.27
.350	.14	–164.1	28.5	–97.6	–37.3	–19.2	.22	147.15
.400	.16	–174.6	28.6	–111.9	–37.4	–21.8	.21	139.73
.450	.17	174.5	28.6	–126.4	–37.4	–23.8	.20	131.54
.500	.19	162.9	28.6	–141.4	–37.5	26.3	.17	122.52
.550	.21	150.6	28.7	–156.9	–37.5	–29.8	.15	113.09
.600	.23	137.9	28.7	–173.1	–37.5	–33.4	.11	103.82
.650	.25	125.1	28.7	169.9	–37.4	–36.4	.08	98.50
.700	.27	112.6	28.6	151.9	–37.6	–40.4	.04	118.83
.750	.29	100.8	28.3	133.0	–37.8	42.8	.05	–169.85
.800	.28	89.8	27.8	113.3	–38.2	–46.8	.11	–163.55
.850	.26	80.6	27.0	93.5	–38.7	–48.8	.18	–172.30
.900	.23	74.2	25.9	74.3	–39.0	–50.2	.24	176.85
.950	.19	71.9	24.5	56.4	–39.3	–49.5	.29	166.35
1.000	.15	74.8	23.0	40.0	–39.4	–48.1	.33	157.12
1.500	.23	63.5	8.2	–66.6	–37.3	–72.1	.22	75.12
2.000	.35	23.8	–1.9	–135.1	–35.3	–93.3	.22	–23.14
3.000	.87	–24.4	–23.4	156.3	–33.5	103.1	.31	–170.17

FREQ GHz	GPDEL ns	PHASE DEG
.050	.87	.48
.075	.87	–.09
.100	.82	–.27
.125	.81	–.34
.150	.79	–.31
.175	.78	–.23
.200	.78	–.09
.225	.79	–.08
.250	.78	.03
.275	.78	.19
.300	.77	.29
.325	.78	.40
.350	.80	.32
.375	.79	.28
.400	.80	.29
.425	.80	.15
.450	.81	–.04
.475	.82	–.31
.500	.83	–.66

LINEARIZATION RANGE: .05 to .50 GHz

AVANTEK

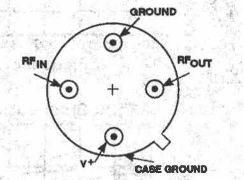
UTO/UTC 561 Series
Thin-Film Cascadable Amplifier
10 to 500 MHz

FEATURES

- Frequency Range: 10 to 500 MHz
- High Output Power: +27 dBm (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- Power Output Stage



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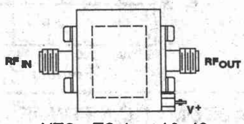


UTC—TC-1, p. 16–42

DESCRIPTION

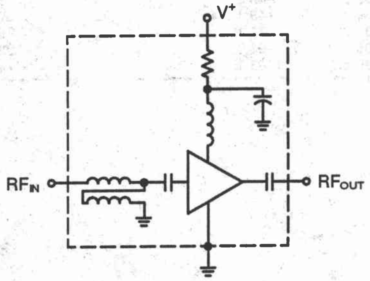
The 561 Series is a thin-film RF bipolar amplifier that is protected against excessive high input power protected and stabilized for temperature and voltage variations. The RF input is transformer coupled and the output is coupled through blocking capacitors. The 561 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	10-500	10-500	10-500	MHz
GP	Small Signal Gain (Min.)	13.0	11.0	10.0	dB
—	Gain Flatness (Max.)	±0.3	±0.7	±1.0	dB
NF	Noise Figure (Max.)	5.5	9.0	9.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+27.0	+26.0	+25.5	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+39.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+51.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+57.0	—	—	dBm
I_D	DC Current	190	—	—	mA

NOTE: 1. RF input is at DC ground—no blocking capacitor.

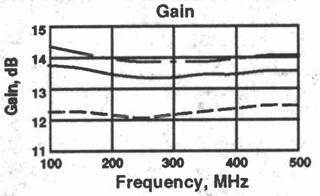
SCHEMATIC

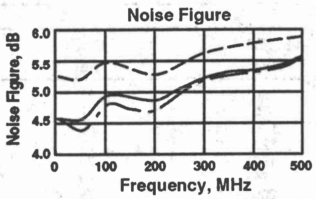


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ————
+85°C – – – –
–55°C —— - ——





MAXIMUM RATINGS

DC Voltage .... 16 Volts
Continuous RF Input Power .... +18 dBm
Operating Case Temperature .... –55°C to +100°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +100°C

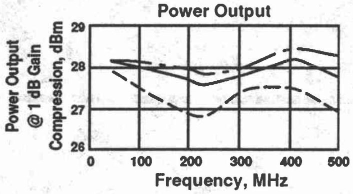
THERMAL CHARACTERISTICS*

θ_{JC} .... 55°C/W
Active Transistor Power Dissipation .... 950 mW
Junction Temperature Above Case Temperature .... 52°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 452,800 Hrs.
*For further information, see High Reliability section, p. 17–2.

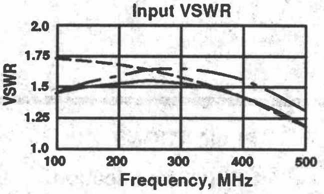
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

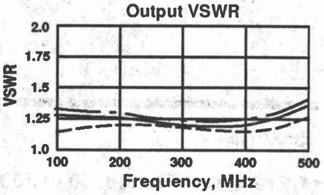
Power Output



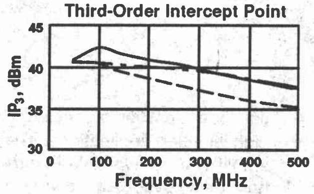
Input VSWR



Output VSWR



Third-Order Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.31	14.26	156.15	−1.77	.00	1.31	21.15
150.0	1.37	14.44	142.21	−1.49	.73	1.28	21.02
200.0	1.44	14.50	129.84	.34	.70	1.25	20.82
250.0	1.51	14.45	116.92	1.65	.75	1.21	20.60
300.0	1.57	14.45	102.98	1.92	.79	1.16	20.33
350.0	1.61	14.43	88.60	1.76	.82	1.10	20.01
400.0	1.61	14.32	73.57	.95	.85	1.06	19.65
450.0	1.54	14.14	57.83	−.54	.90	1.10	19.30
500.0	1.41	13.90	41.35	−2.81	.92	1.19	18.90
550.0	1.27	13.60	24.63	—	.95	1.34	18.47
600.0	1.16	13.16	7.01	—	1.00	1.55	18.09
650.0	1.33	12.64	−11.62	—	1.03	1.84	17.90
700.0	1.73	11.80	−30.17	—	1.07	2.26	17.93
750.0	2.42	10.57	−50.12	—	1.13	2.87	18.36
800.0	3.55	8.93	−70.82	—	1.16	3.48	19.42
850.0	5.17	6.63	−91.98	—	1.11	3.84	21.20
900.0	7.15	3.64	−110.84	—	1.01	3.88	23.75
950.0	8.82	.07	−128.38	—	.84	3.59	26.85
1000.0	9.44	−4.20	−141.06	—	.00	3.20	30.85

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.136	129.5	12.878	157.7	−20.685	−4.5	.076	154.9
150.00	.159	105.8	12.832	144.4	−20.716	−8.0	.083	160.0
200.00	.177	87.6	12.815	132.8	−20.703	−12.3	.092	159.2
250.00	.190	74.1	12.726	121.5	−20.721	−15.8	.098	153.6
300.00	.196	63.4	12.692	109.6	−20.691	−18.8	.100	149.2
350.00	.194	55.1	12.719	97.6	−20.639	−22.6	.095	144.3
400.00	.184	50.0	12.706	84.3	−20.528	−26.0	.083	140.6
450.00	.170	49.3	12.601	71.1	−20.391	−29.8	.065	140.9
500.00	.163	53.1	12.451	57.8	−20.247	−32.6	.045	150.6
550.00	.168	59.6	12.214	43.6	−20.018	−37.0	.031	−176.4
600.00	.185	64.5	11.903	29.6	−19.715	−41.6	.042	−132.0
650.00	.208	66.5	11.503	15.4	−19.446	−45.8	.068	−114.0
700.00	.227	66.9	11.121	2.0	−19.231	−51.5	.101	−106.0
800.00	.237	67.2	10.077	−24.4	−18.634	−65.8	.198	−100.1
900.00	.238	82.1	9.117	−54.7	−18.163	−85.2	.360	−108.4
1000.00	.381	99.9	7.407	−91.1	−18.489	−113.8	.554	−132.2

AVANTEK

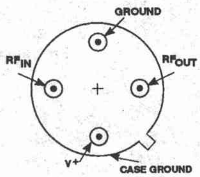
UTO/UTC 571 Series
Thin-Film Cascadable Amplifier
50 to 500 MHz

FEATURES

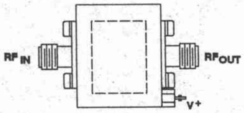
- Frequency Range: 50 to 500 MHz
- High Reverse Isolation: 50 dB
- Low VSWR
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- Pre-Mixer RF Stage
- Post LO Amplifier Stage



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

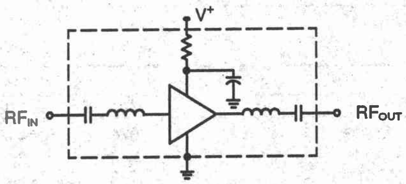
DESCRIPTION

The 571 Series is a medium-gain bipolar RF amplifier that uses resistive feedback and active bias for temperature compensation and increased immunity to bias voltage variations. Built on a thin-film substrate, this cascode amplifier is specially designed for high isolation applications. The 571 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	50-500	50-500	50-500	MHz
GP	Small Signal Gain (Min.)	15.5	14.5	14.0	dB
—	Gain Flatness (Max.)	±0.2	±0.5	±0.5	dB
NF	Noise Figure (Max.)	3.1	4.0	4.5	dB
—	Reverse Isolation	50	45	45	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+11.5	+10.0	+10.0	dBm
—	Input VSWR (Max.)	<1.4:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.4:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+27.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+36.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+42.0	—	—	dBm
I_D	DC Current	32	—	—	mA

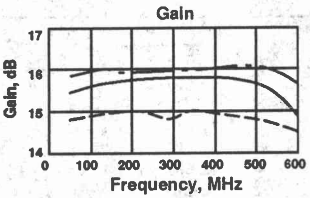
SCHEMATIC

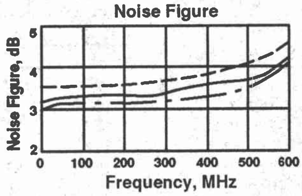


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C — — —
−55°C — - —





MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	−55°C to +125°C
Storage Temperature	−62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

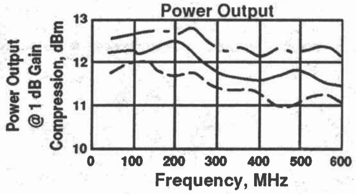
θ_{JC}	105/105°C/W
Active Transistor Power Dissipation	150/180 mW
Junction Temperature Above Case Temperature	16/19°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	537,400 Hrs.

*For further information, see High Reliability section, p. 17–2.

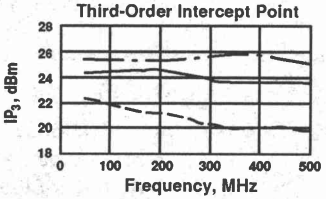
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

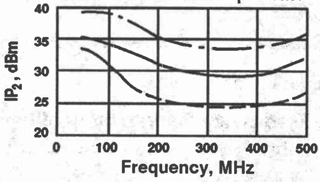
Power Output



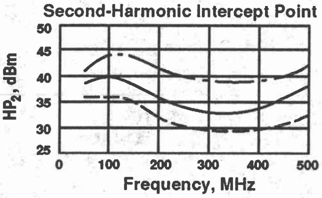
Third-Order Intercept Point



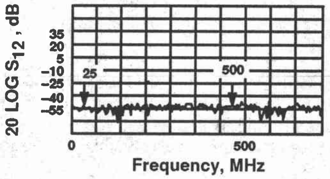
Second-Order Intercept Point



Second-Harmonic Intercept Point



Reverse Isolation



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.10	15.2	133.7	–.85	—	1.13	58.6
150.0	1.14	15.3	107.2	–.68	1.46	1.09	54.8
200.0	1.18	15.3	81.4	.19	1.45	1.06	52.5
250.0	1.21	15.3	55.1	.55	1.47	1.05	51.3
300.0	1.23	15.3	28.6	.72	1.47	1.06	50.4
350.0	1.23	15.3	2.3	1.09	1.49	1.09	49.7
400.0	1.23	15.3	–24.7	.76	1.51	1.13	49.5
450.0	1.26	15.3	–52.1	.03	1.55	1.18	49.4
500.0	1.36	15.3	–80.6	–1.80	1.58	1.24	49.6

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.049	–104.0	15.5	142.9	–58.6	53.6	.060	48.2
200.00	.087	–115.3	15.4	97.3	–53.1	35.5	.030	–48.3
300.00	.108	–123.2	15.3	51.7	–50.3	13.2	.040	–139.4
400.00	.112	–119.5	15.3	4.9	–48.9	–9.3	.069	160.1
500.00	.154	–101.0	15.4	–45.5	–48.7	–31.9	.116	112.0
600.00	.313	–102.6	15.0	–101.7	–49.9	–44.0	.171	65.0
700.00	.537	–124.4	13.3	–162.1	–51.0	–25.6	.217	15.3
800.00	.722	–150.7	9.8	142.9	–50.8	–53.7	.228	–25.6
900.00	.840	–175.5	6.0	93.2	–49.9	–89.0	.241	–53.9
1000.00	.885	163.2	1.7	49.5	–49.9	–110.6	.269	–80.3
1100.00	.900	144.5	2.5	10.0	–50.5	–121.8	.302	–106.3
1200.00	.901	128.1	–6.6	–26.5	–51.6	–129.0	.335	–132.2
1300.00	.902	113.9	–10.5	–59.1	–53.4	–138.7	.368	–156.7
1400.00	.893	100.4	–14.3	–90.2	–55.8	–148.2	.396	178.7
1500.00	.894	87.2	–17.9	–119.7	–55.8	–158.8	.422	155.5

AVANTEK

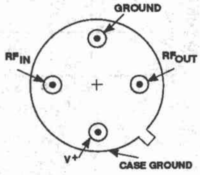
UTO/UTC 572 Series
Thin-Film Cascadable Amplifier
50 to 500 MHz

FEATURES

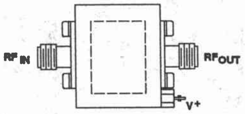
- Frequency Range: 50 to 500 MHz
- High Reverse Isolation: 50 dB
- Low VSWR
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- Pre-Mixer RF Stage
- Post LO Amplifier Stage



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

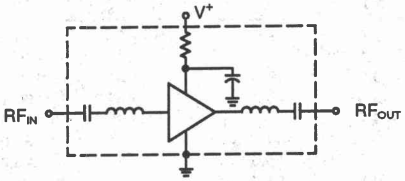
DESCRIPTION

The 572 Series is a medium-gain bipolar RF amplifier that uses resistive feedback and active bias for temperature compensation and increased immunity to bias voltage variations. Built on a thin-film substrate, this cascode amplifier is specially designed for high isolation applications. The 572 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range	50-500	50-500	50-500	MHz
GP	Small Signal Gain (Min.)	18.5	18.0	17.0	dB
—	Gain Flatness (Max.)	±0.3	±0.5	±1.0	dB
NF	Noise Figure (Max.)	3.0	3.5	3.7	dB
—	Reverse Isolation	50	45	45	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+12.0	+11.0	+10.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+24.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+34.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+42.0	—	—	dBm
I_D	DC Current	32	—	—	mA

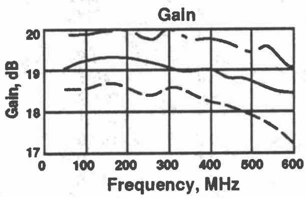
SCHEMATIC

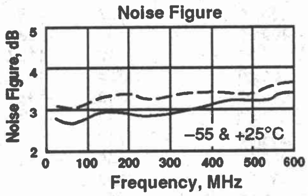


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C — — — —
–55°C —— · ——





MAXIMUM RATINGS

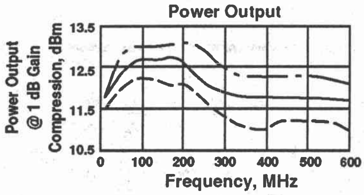
DC Voltage .... 17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

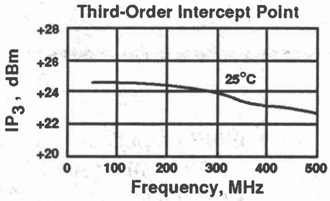
THERMAL CHARACTERISTICS*

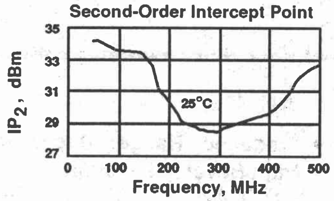
θ_{JC} .... 105/105°C/W
Active Transistor Power Dissipation .... 150/180 mW
Junction Temperature Above Case Temperature .... 16/19°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 539,400 Hrs.
*For further information, see High Reliability section, p. 17–2.

WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)







AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS — **BIAS = 15.00 VOLTS**

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.15	19.1	132.7	–.30	—	1.10	58.6
150.0	1.18	19.1	105.8	–.45	1.48	1.06	55.5
200.0	1.21	19.1	79.6	.10	1.47	1.08	53.0
250.0	1.23	19.0	52.9	.14	1.48	1.12	52.3
300.0	1.25	18.9	26.2	.19	1.47	1.17	51.3
350.0	1.25	18.8	–.1	.64	1.47	1.22	50.4
400.0	1.24	18.8	–26.7	.68	1.50	1.29	50.2
450.0	1.24	18.7	–54.0	.23	1.54	1.37	50.0
500.0	1.29	18.6	–82.2	–1.22	1.57	1.45	49.8

S-PARAMETERS — **BIAS = 15.00 VOLTS**

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.077	–62.6	19.4	141.9	–58.3	51.3	.044	31.3
200.00	.101	–109.4	19.3	95.6	–53.9	35.7	.047	–99.7
300.00	.112	–150.2	19.0	49.5	–51.0	12.0	.089	–159.3
400.00	.100	–157.4	18.9	3.0	–49.7	–11.8	.136	155.1
500.00	.109	72.9	18.8	–46.4	–49.4	–40.1	.191	113.4
600.00	.235	–4.9	18.3	–100.8	–49.6	–75.8	.254	70.4
700.00	.455	–58.6	16.6	–158.6	–48.7	–73.8	.282	25.3
800.00	.662	–103.2	13.5	148.1	–47.2	–23.9	.263	–10.4
900.00	.811	–140.0	10.2	98.4	–46.3	–67.4	.269	–33.3
1000.00	.870	–171.7	6.2	53.8	–46.4	–96.6	.309	–56.7
1100.00	.892	162.7	2.3	13.2	–47.0	–113.2	.351	–82.3
1200.00	.891	140.4	–1.2	–23.4	–48.4	–123.8	.389	–108.5
1300.00	.893	120.8	–4.9	–56.9	–50.5	–135.8	.423	–133.6
1400.00	.883	102.3	–8.4	–89.3	–53.9	–147.4	.450	–158.3
1500.00	.883	84.5	–11.6	–119.7	–57.1	–160.2	.479	178.7

![AVANTEK]

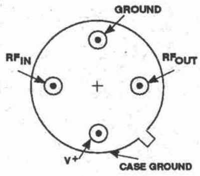
UTO/UTC 573
Thin-Film Cascadable Amplifier
10 to 500 MHz

FEATURES

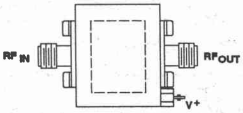
- Frequency Range: 10 to 500 MHz
- High Reverse Isolation: 50 dB (Typ)
- Low VSWR
- Temperature Stabilized

APPLICATIONS

- IF/RF Amplification
- Pre/Post Mixer Amp
- Communications Intelligence
- Signal Intelligence



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

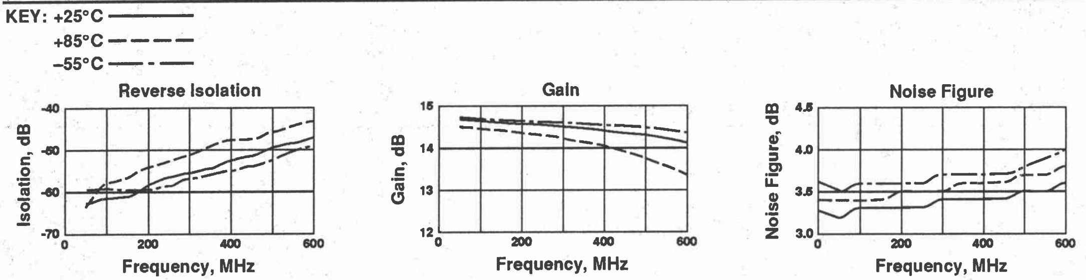
DESCRIPTION

The 573 Series is a medium-gain bipolar RF amplifier that uses feedback and active bias for temperature stabilization and increased immunity to bias voltage variations. Built on a thin-film substrate, this amplifier is specially designed for high reverse isolation applications. The 573 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_c = 25°C$	Guaranteed Specifications $T_c = 0°$ to 50°C	Guaranteed Specifications $T_c = -55°$ to +85°C	Unit
BW	Frequency Range	10-500	10-500	10-500	MHz
GP	Small Signal Gain (Min.)	14.5	13.0	12.5	dB
—	Gain Flatness (Max.)	±0.2	±0.5	±0.7	dB
NF	Noise Figure (Max.)	3.4	4.3	4.5	dB
—	Reverse Isolation				
	10-200 MHz	60	52	50	dB
	200-500 MHz	50	45	42	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+13.0	+11.0	+10.0	dBm
—	Input VSWR (Max.)	<1.2:1	1.5:1	1.7:1	—
—	Output VSWR (Max.)	<1.2:1	1.5:1	1.7:1	—
IP_3	Two Tone 3rd Order Intercept Point	+23.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+32.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+38.0	—	—	dBm
I_D	DC Current	33	—	—	mA

TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage .... 17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

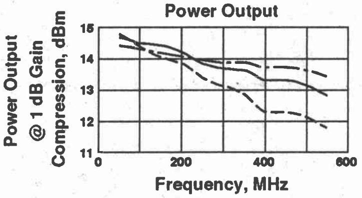
THERMAL CHARACTERISTICS

θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 150 mW
Junction Temperature Above Case Temperature .... 16°C

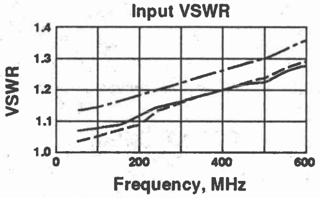
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

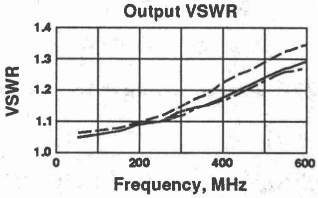
Power Output



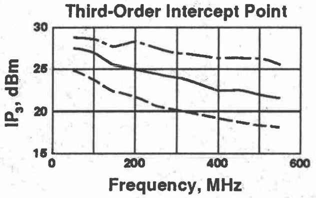
Input VSWR



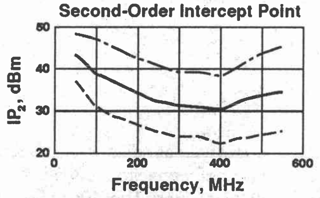
Output VSWR



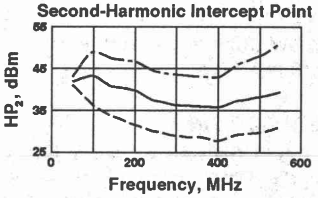
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

S-PARAMETERS **BIAS = 15.00 VOLTS**

FREQ	S_{11}		S_{21}		S_{12}		S_{22}			GPDEL	PHASE
GHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	K	ns	DEG
.005	.07	–115.9	14.6	–171.2	–65.1	15.6	.07	–65.76	165.64	3.23	
.010	.04	–135.7	14.7	–177.0	–64.3	10.6	.04	–51.47	151.16	3.23	2.72
.015	.04	–146.8	14.7	–179.6	–63.2	8.6	.03	–39.18	133.10	1.45	1.11
.020	.04	–153.4	14.7	178.7	–63.1	7.7	.03	–29.58	130.68	.98	.38
.025	.04	–157.5	14.7	177.2	–63.3	11.9	.03	–21.94	133.33	.81	–.07
.030	.03	–160.8	14.7	175.9	–63.5	8.3	.03	–15.81	136.78	.72	–.36
.035	.03	–162.7	14.7	174.7	–63.3	14.2	.02	–10.88	133.81	.65	–.55
.040	.03	–164.4	14.7	173.6	–63.5	14.2	.02	–6.77	136.45	.64	–.70
.045	.03	–165.8	14.7	172.5	–62.7	14.4	.02	–3.26	125.01	.61	–.80
.050	.03	–167.0	14.7	171.4	–62.8	17.6	.02	–.10	126.51	.60	–.86
.100	.04	–174.0	14.7	161.4	–61.3	31.5	.03	19.18	106.28	.56	–.92
.150	.04	–177.9	14.7	151.7	–59.6	41.1	.03	29.85	87.94	.54	–.66
.200	.05	177.5	14.7	142.0	–58.5	46.2	.04	37.55	77.58	.54	–.30
.250	.06	170.9	14.6	132.4	–56.9	48.6	.04	44.00	64.50	.54	.04
.300	.07	164.5	14.6	122.6	–55.3	51.6	.05	48.35	53.51	.54	.27
.350	.08	157.7	14.6	112.8	–53.6	52.4	.06	50.85	44.09	.55	.39
.400	.09	149.8	14.5	102.8	–52.1	50.8	.07	52.23	37.48	.56	.38
.450	.10	142.4	14.5	92.6	–50.8	50.1	.08	52.20	32.08	.57	.16
.500	.11	134.8	14.4	82.2	–49.4	47.5	.09	50.34	27.41	.58	–.23
.600	.12	119.4	14.2	60.6	–46.5	41.5	.11	44.36	19.92	.60	
.700	.12	105.1	13.9	37.8	–43.7	30.7	.14	34.09	14.98	.63	
.800	.10	97.4	13.2	13.6	–41.1	17.0	.17	20.41	11.94	.67	
.900	.07	112.3	12.1	–11.3	–38.9	–.4	.19	4.18	10.45	.69	
1.000	.10	144.8	10.5	–36.0	–37.1	–19.6	.20	–13.89	10.27	.68	
1.200	.28	132.9	5.4	–78.4	–35.2	–58.9	.19	–49.53	13.90	.59	
1.400	.44	104.1	–1.3	–99.5	–34.6	–93.3	.15	–80.67	24.36	.29	
1.600	.55	77.2	–5.6	–90.7	–34.2	–122.9	.13	–106.33	33.26	–.12	
1.800	.63	52.2	–4.7	–89.1	–33.8	–149.4	.11	–127.86	25.46	–.02	
2.000	.68	27.7	–3.5	–106.5	–33.2	–173.9	.11	–145.40	18.60	.24	
2.200	.71	2.3	–2.9	–131.0	–32.3	160.2	.11	–159.50	14.20	.34	

AVANTEK

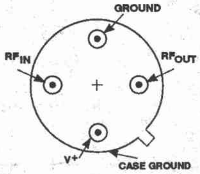
UTO/UTC 1001 Series
Thin-Film Cascadable Amplifier
5 to 1000 MHz

FEATURES

- Frequency Range: 5 to 1000 MHz
- Medium Gain: 15.0 dB (Typ)
- Low VSWR
- Low Current Operation: 10 mA (Typ)

APPLICATIONS

- IF/RF Amplification
- Low Power Systems



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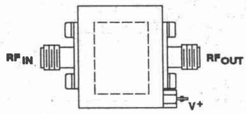


UTC—TC-1, p. 16–42

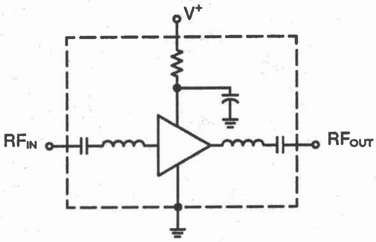
DESCRIPTION

The 1001 Series is a thin-film bipolar RF amplifier that uses resistive feedback and active bias to provide a stable, reliable gain stage. Inductively-coupled input and output circuits provide good VSWR under all conditions. Input and output blocking capacitors couple the RF through the amplifier. The 1001 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

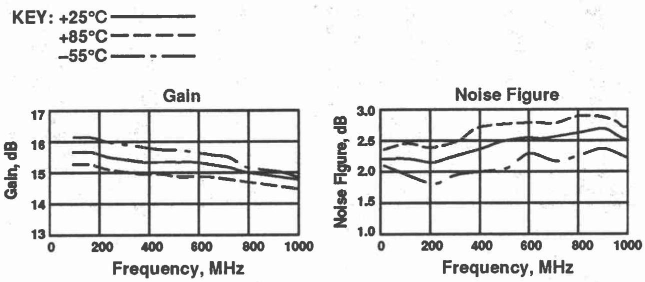
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range	5-1000	5-1000	5-1000	MHz
GP	Small Signal Gain (Min.)	15.0	14.0	13.5	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	3.0	5.0	5.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+1.0	–2.0	–3.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+12.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+13.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+18.0	—	—	dBm
I_D	DC Current	10	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

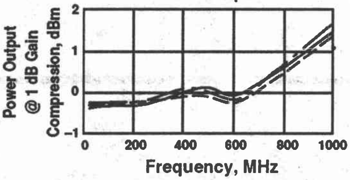
θ_{JC}	90°C/W
Active Transistor Power Dissipation	67 mW
Junction Temperature Above Case Temperature	6°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	1,156,000 Hrs.

*For further information, see High Reliability section, p. 17–2.

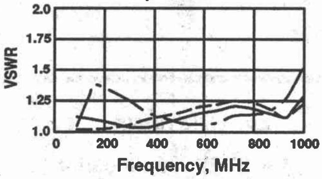
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

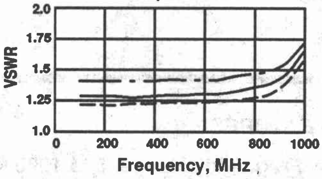
Power Output



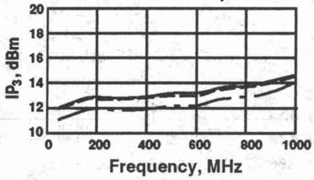
Input VSWR



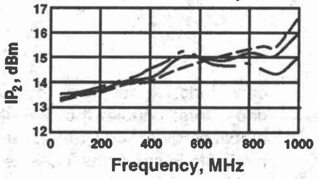
Output VSWR



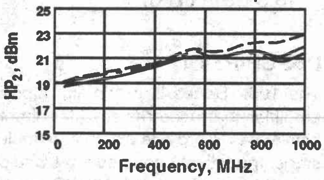
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	FLAT dB	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.24	15.77	157.94	–2.35	–.22	—	1.23	20.46
150.0	1.24	15.65	148.39	–1.06	–.10	.55	1.25	20.47
200.0	1.22	15.55	138.08	–.53	–.01	.60	1.24	20.55
250.0	1.24	15.53	126.62	–1.15	.00	.60	1.24	20.44
300.0	1.25	15.57	116.62	–.30	–.02	.56	1.26	20.23
350.0	1.25	15.41	106.42	.33	.12	.60	1.25	20.30
400.0	1.25	15.41	95.06	–.18	.12	.59	1.26	20.30
450.0	1.25	15.47	85.15	.74	.06	.56	1.24	20.20
500.0	1.25	15.41	74.99	1.43	.12	.58	1.25	20.13
550.0	1.23	15.44	64.36	1.64	.10	.59	1.26	20.18
600.0	1.20	15.42	53.62	1.75	.11	.59	1.25	20.23
650.0	1.20	15.36	43.04	2.02	.17	.62	1.24	20.23
700.0	1.18	15.52	31.25	1.07	.01	.60	1.23	20.22
750.0	1.15	15.58	21.59	2.25	–.04	.58	1.26	19.98
800.0	1.09	15.54	10.53	2.03	.00	.66	1.25	20.35
850.0	1.09	15.61	–2.21	.12	–.06	.67	1.24	20.28
900.0	1.15	15.67	–13.77	–.58	–.12	.67	1.22	20.38
950.0	1.25	15.63	–26.34	–2.32	–.08	.72	1.23	20.13
1000.0	1.38	15.69	–39.78	–4.92	–.15	.73	1.20	20.14
1050.0	1.56	15.62	–52.70	—	—	.71	1.19	20.85
1100.0	1.05	15.42	–65.49	—	—	.76	1.19	20.35
1150.0	2.26	15.28	–80.08	—	—	.82	1.20	21.04
1200.0	2.75	14.79	–94.92	—	—	.85	1.25	21.56

LINEARIATION RANGE: 100.0 to 1000.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.036	–8.9	15.18	155.9	–19.82	–7.2	.016	89.7
200.00	.052	–23.3	15.04	136.6	–19.82	–16.3	.031	63.5
300.00	.079	–36.4	15.05	114.5	–19.82	–25.6	.038	43.2
400.00	.110	–51.7	14.94	92.5	–20.09	–34.8	.037	17.9
500.00	.146	–68.0	14.92	71.2	–20.00	–45.6	.029	–19.9
600.00	.177	–85.3	14.88	50.1	20.09	–55.6	.027	–89.8
700.00	.198	–101.8	15.01	27.5	–20.26	–65.1	.048	–151.0
800.00	.206	–121.8	14.90	6.3	–20.45	–76.2	.081	177.8
900.00	.187	–147.0	15.12	–18.8	–20.53	–88.7	.114	149.6
1000.00	.139	172.7	15.35	–44.1	–20.45	–100.7	.133	125.6
1100.00	.146	87.9	15.39	–72.5	–20.72	–118.0	.122	95.6
1200.00	.320	24.2	14.95	–105.3	–21.51	–138.4	.052	59.9
1300.00	.558	–16.2	13.73	–141.6	–23.22	–161.7	.074	–130.1
1400.00	.744	–47.1	11.45	–174.0	–26.38	176.6	.212	–166.6
1500.00	.839	–71.6	8.38	157.7	–30.75	158.6	.325	166.4

AVANTEK

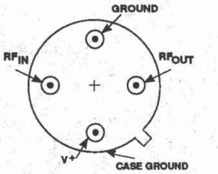
UTO/UTC 1002 Series
Thin-Film Cascadable Amplifier
5 to 1000 MHz

FEATURES

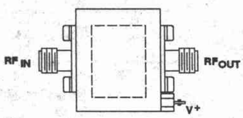
- Frequency Range: 5 to 1000 MHz
- Medium Gain: 14.5 dB (Typ)
- Medium Output Power: +8.5 dBm (Typ)

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

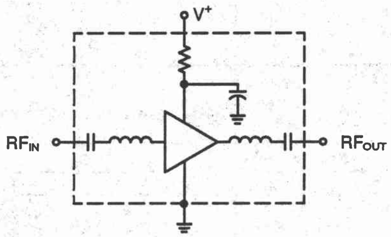
DESCRIPTION

The 1002 Series is a thin-film bipolar RF amplifier that uses resistive feedback and active bias to provide a stable, reliable gain stage. Inductively-coupled input and output circuits provide good VSWR under all conditions. Input and output blocking capacitors couple the RF through the amplifier. The 1002 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

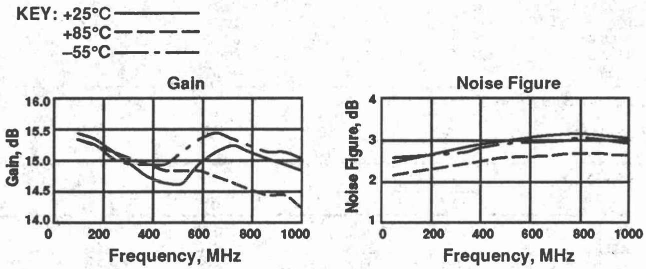
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-1000	5-1000	5-1000	MHz
GP	Small Signal Gain (Min.)	14.5	14.0	13.5	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	3.0	4.0	4.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+8.5	+7.0	+7.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+21.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+30.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+36.0	—	—	dBm
I_D	DC Current	23	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage .... 17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... −55°C to +125°C
Storage Temperature .... −62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

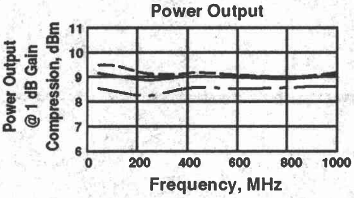
THERMAL CHARACTERISTICS*

θ_{JC} .... 90°C/W
Active Transistor Power Dissipation .... 120 mW
Junction Temperature Above Case Temperature .... 11°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 1,246,000 Hrs.
*For further information, see High Reliability section, p.17–2 .

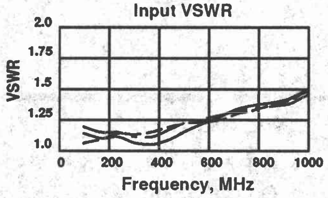
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

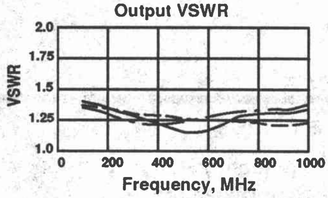
Power Output



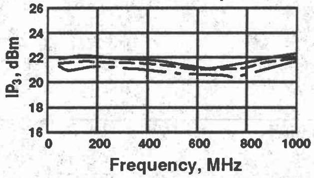
Input VSWR



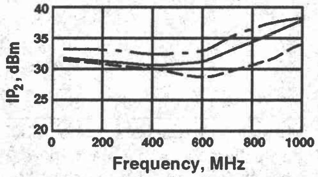
Output VSWR



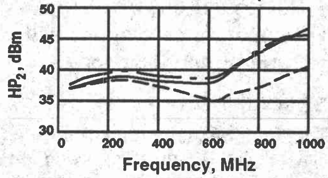
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.36	14.85	156.93	–.77	—	1.14	20.63
150.0	1.37	14.72	145.59	–.92	.63	1.13	20.69
200.0	1.40	14.66	134.27	–1.06	.63	1.14	20.69
250.0	1.43	14.67	122.98	–1.16	.62	1.15	20.70
300.0	1.45	14.70	111.95	–1.02	.60	1.16	20.75
350.0	1.49	14.68	101.24	–.54	.59	1.18	20.76
400.0	1.54	14.65	90.56	–.04	.59	1.20	20.76
450.0	1.57	14.56	80.05	.63	.59	1.23	20.81
500.0	1.60	14.53	69.29	1.05	.60	1.25	20.81
550.0	1.63	14.49	58.39	1.34	.60	1.28	20.84
600.0	1.65	14.44	47.72	1.86	.60	1.32	20.83
650.0	1.67	14.43	36.75	2.08	.61	1.37	20.82
700.0	1.66	14.40	25.68	2.20	.63	1.40	20.79
750.0	1.63	14.40	14.22	1.92	.64	1.45	20.73
800.0	1.59	14.42	2.58	1.46	.65	1.52	20.68
850.0	1.52	14.49	–9.35	.71	.68	1.57	20.60
900.0	1.43	14.52	–21.84	–.58	.71	1.62	20.51
950.0	1.31	14.62	–34.85	–2.40	.74	1.68	20.47
1000.0	1.18	14.69	–48.37	–4.74	.77	1.72	20.40
1050.0	1.08	14.73	–62.42	—	.81	1.73	20.41
1100.0	1.24	14.70	–77.41	—	.86	1.71	20.47
1150.0	1.54	14.50	–93.33	—	.93	1.65	20.66
1200.0	2.00	14.17	–110.74	—	.97	1.55	21.05
1250.0	2.70	13.68	–128.23	—	.95	1.41	21.75

LINEARIATION RANGE: 100.0 to 1000.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.048	.8	14.48	156.3	–20.00	–6.8	.031	174.6
200.00	.070	–10.2	14.38	137.1	–20.00	–15.3	.034	167.6
300.00	.102	–25.1	14.47	115.0	–19.91	–24.5	.042	163.5
400.00	.136	–41.6	14.45	93.1	–20.00	–33.2	.056	163.0
500.00	.175	–60.1	14.48	72.2	–19.74	–43.8	.081	159.5
600.00	.206	–79.0	14.57	50.0	–19.66	–53.1	.114	154.0
700.00	.224	–96.4	14.82	27.1	–19.57	–63.2	.161	140.2
800.00	.221	–117.4	14.81	5.6	–19.49	–75.5	.215	125.0
900.00	.185	–143.6	15.15	–20.6	–19.17	–89.7	.270	105.1
1000.00	.108	168.1	15.55	–47.4	–18.79	–105.0	.319	79.9
1100.00	.158	54.6	15.65	–78.0	–18.71	–127.1	.351	44.8
1200.00	.405	.8	15.07	–113.9	–19.66	–153.7	.324	–2.1
1300.00	.658	–36.6	13.45	–152.0	–21.83	176.4	.291	–65.7
1400.00	.818	–64.4	10.62	175.5	–25.51	149.7	.314	–125.3
1500.00	.885	–86.9	7.30	148.4	–30.46	126.0	.383	–170.0

AVANTEK

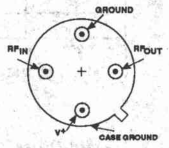
UTO/UTC/PPA 1005 Series
Thin-Film Cascadable Amplifier
5 to 1000 MHz

FEATURES

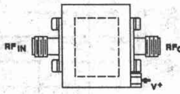
- Frequency Range: 5 to 1000 MHz
- High Dynamic Range
- High Output Power: +21.0 dBm (Typ)
- Noise Figure: 5.0 dB (Typ)
- Temperature Compensated
- Surface Mount Option

APPLICATIONS

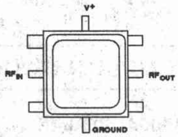
- IF/RF Amplification
- Output Stage
- Surface Mount Assembly



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42



PPA—PP-38, p. 16–35

DESCRIPTION

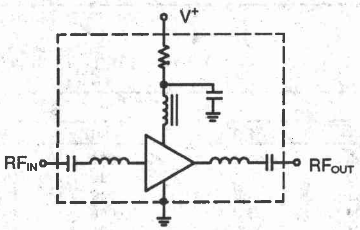
The 1005 Series is a medium-gain, thin-film bipolar RF amplifier using resistive feedback and active bias for stability over temperature and bias variations. Inductive networks maintain good VSWR while the RF is coupled through input and output blocking capacitors. The 1005 Series amplifiers are available in three packages: the surface mount hermetic PP-38 (.375 in. x .375 in.) case, the TO- 8 hermetic case and the connectorized TC-1 case.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	T_C = –55° to +85°C	Unit
BW	Frequency Range	5-1000	5-1000	5-1000	MHz
GP	Small Signal Gain (Min.)	12.6	11.0	10.5	dB
—	Gain Flatness (Max.)	±0.3	±1.0	±1.0	dB
NF	Noise Figure (Max.)	5.0	6.0	6.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)[1]	+21.0	+20.0	+19.0	dBm
—	Input VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)[2]	<1.4:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+35.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+45.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+49.0	—	—	dBm
I_D	DC Current	90	—	—	mA

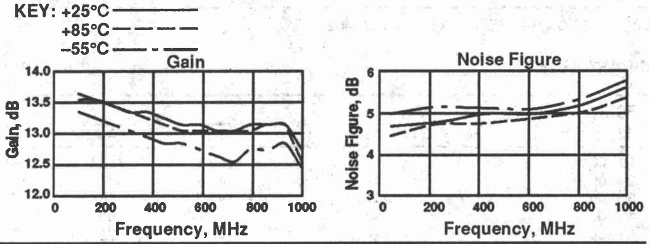
NOTES: 1. PPA, Power Output = +19.5 dBm from 0° to 50 °C and +18.5 from –55° to +85°C
2. PPA, Output VSWR = 2.2:1 (Max.) Guaranteed.

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+15 dBm
Operating Case Temperature	–55°C to +115°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+115°C

THERMAL CHARACTERISTICS*

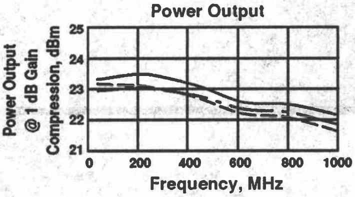
θ_{JC}	75°C/W
Active Transistor Power Dissipation	413 mW
Junction Temperature Above Case Temperature	31°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	498,452 Hrs.

*For further information, see High Reliability section, p. 17–2.

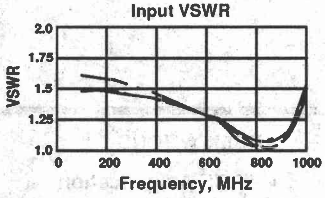
WEIGHT: (typical) PPA — 0.5 grams; UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

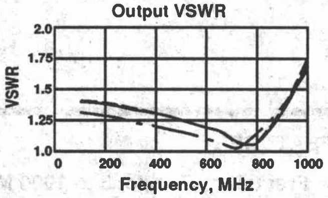
Power Output



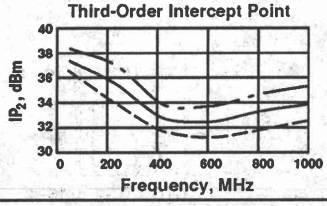
Input VSWR



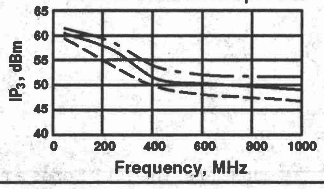
Output VSWR



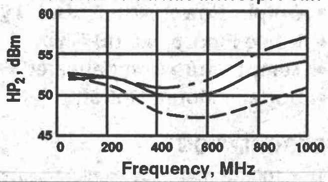
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS — **BIAS = 15.00 VOLTS**

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.31	13.31	170.85	–.69	.00	1.07	17.87
150.0	1.30	13.14	164.96	–1.22	.32	1.08	18.09
200.0	1.29	13.04	159.42	–1.42	.31	1.09	18.06
250.0	1.29	12.97	153.67	–1.81	.30	1.09	18.05
300.0	1.28	12.83	148.73	–1.41	.27	1.09	18.10
350.0	1.28	12.74	143.94	–.85	.27	1.09	18.13
400.0	1.26	12.61	139.10	–.34	.27	1.10	18.23
450.0	1.25	12.53	134.09	.00	.27	1.09	18.35
500.0	1.24	12.50	129.46	.71	.26	1.09	18.43
550.0	1.23	12.52	124.83	1.43	.25	1.09	18.42
600.0	1.23	12.54	120.54	2.49	.24	1.10	18.67
650.0	1.25	12.57	116.05	3.35	.26	1.11	18.97
700.0	1.28	12.64	111.18	3.82	.28	1.12	19.36
750.0	1.32	12.73	106.07	4.05	.32	1.16	19.92
800.0	1.36	12.85	99.81	3.13	.36	1.21	20.64
850.0	1.38	13.05	93.14	1.80	.41	1.28	21.48
900.0	1.39	13.26	84.96	–1.02	.47	1.37	22.55
950.0	1.40	13.40	76.33	–4.31	.48	1.48	23.42
1000.0	1.43	13.55	67.57	–7.71	.54	1.60	23.46
1050.0	1.58	13.23	56.83	—	.58	1.71	22.69
1100.0	1.88	12.83	46.81	—	.57	1.82	21.94
1150.0	2.33	12.23	36.16	—	.57	1.86	21.29
1200.0	2.89	11.14	26.14	—	.48	1.87	20.77
1250.0	3.67	10.05	18.92	—	.44	1.84	20.56
1300.0	4.46	8.91	10.41	—	.41	1.79	20.66
1350.0	5.30	7.69	4.30	—	.32	1.73	20.75
1400.0	6.18	6.65	–.94	—	.28	1.65	21.57
1450.0	7.18	5.42	–5.89	—	.25	1.58	22.17
1500.0	8.43	4.21	–9.78	—	.20	1.52	22.53

LINEARIZATION RANGE: 100.0 to 1000.0 MHz

S-PARAMETERS — **BIAS = 15.00 VOLTS**

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.124	–170.0	13.316	169.8	–17.967	–2.2	.035	134.5
200.00	.131	–173.2	13.075	158.9	–17.958	–5.8	.038	119.3
300.00	.125	–173.9	12.887	148.4	–18.079	–9.2	.039	110.2
400.00	.115	–173.0	12.661	138.7	–18.224	–13.8	.036	95.5
500.00	.105	–167.6	12.522	129.3	–18.430	–19.3	.031	67.1
600.00	.098	–155.6	12.569	120.5	–18.674	–25.6	.037	26.7
700.00	.125	–144.1	12.683	111.3	–19.272	–32.2	.067	–1.8
800.00	.163	–154.1	12.927	99.9	–20.491	–38.2	.117	–23.5
900.00	.180	174.0	13.272	85.4	–22.339	–37.8	.186	–43.9
1000.00	.180	113.1	13.495	68.5	–23.134	–25.1	.254	–67.1
1100.00	.279	36.6	12.796	48.5	–21.647	–19.5	.302	–91.7
1200.00	.466	–12.0	11.269	27.9	–20.486	–25.7	.303	–115.7
1300.00	.633	–43.3	9.129	12.0	–20.358	–38.0	.274	–139.4
1400.00	.738	–65.4	6.834	.3	–21.262	–49.5	.232	–160.6
1500.00	.808	–80.8	4.320	–8.8	–22.363	–56.4	.190	177.9
1600.00	.850	–91.9	1.955	–15.3	–23.876	–62.9	.157	154.1
1700.00	.867	–100.5	–.364	–20.7	–24.976	–66.2	.148	128.5
1800.00	.877	–107.4	–2.485	–25.6	–26.442	–64.4	.158	108.3
1900.00	.883	–113.5	–4.374	–27.8	–27.140	–66.2	.179	92.6
2000.00	.967	–121.7	–5.778	–29.8	–27.628	–67.5	.220	80.6
2100.00	.978	–126.0	–7.555	–30.8	–28.498	–63.7	.250	73.8
2200.00	.980	–130.0	–9.321	–33.3	–29.495	–64.5	.280	69.2
2300.00	.975	–133.7	–10.759	–35.1	–29.340	–67.4	.300	66.4
2400.00	.973	–137.8	–12.602	–36.9	–30.389	–68.8	.322	62.1
2500.00	.969	–141.1	–14.529	–37.1	–31.776	–61.6	.339	60.2

AVANTEK

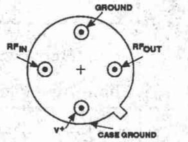
UTO/UTC/PPA 1006 Series
Thin-Film Cascadable Amplifier
5 to 1000 MHz

FEATURES

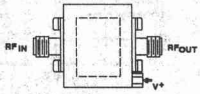
- Frequency Range: 5 to 1000 MHz
- High Dynamic Range
- Output Power: +18.5 dBm (Typ)
- Noise Figure: 4.8 dB (Typ)
- Temperature Compensated
- Surface Mount Option

APPLICATIONS

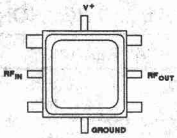
- IF/RF Amplification
- Surface Mount Assembly



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42



PPA—PP-38, p. 16–35

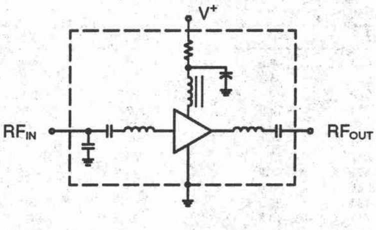
DESCRIPTION

The 1006 Series is a medium-gain, thin-film bipolar RF amplifier using resistive feedback and active bias for stability over temperature and bias variations. Inductive networks maintain good VSWR while RF is coupled through input and output blocking capacitors. The 1006 Series amplifiers are available in three packages: the surface mount hermetic PP-38 (.375 in. x .375 in.) case, the TO- 8 hermetic case and the connectorized TC-1 case.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

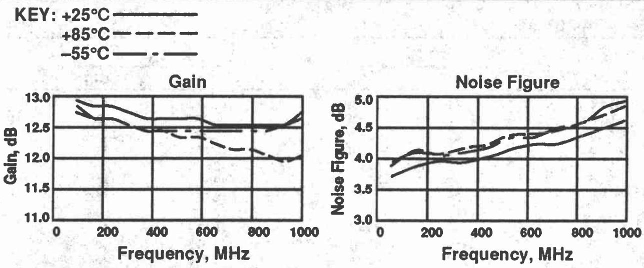
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-1000	5-1000	5-1000	MHz
GP	Small Signal Gain (Min.)	12.0	11.0	10.5	dB
—	Gain Flatness (Max.)	±0.3	±1.0	±1.0	dB
NF	Noise Figure (Max.)	4.8	6.0	6.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+18.5	+17.0	+16.0	dBm
—	Input VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+27.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+30.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+36.0	—	—	dBm
I_D	DC Current	70	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	−55°C to +100°C
Storage Temperature	−62°C to +150°C
"R" Series Burn-In Temperature	+100°C

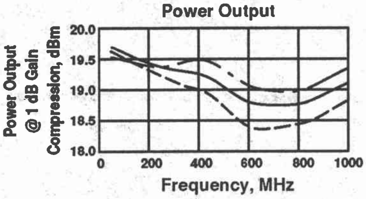
THERMAL CHARACTERISTICS*

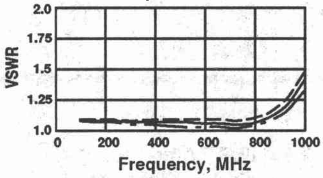
θ_{JC}	75°C/W
Active Transistor Power Dissipation	640 mW
Junction Temperature Above Case Temperature	48°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	743,600 Hrs.

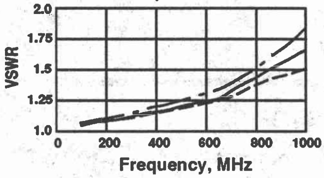
*For further information, see High Reliability section, p. 17–2.

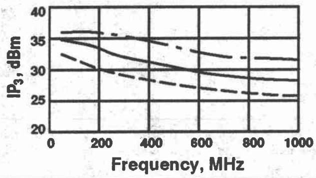
WEIGHT: (typical) PPA—0.5 grams; UTO—2.1 grams; UTC—21.5 grams

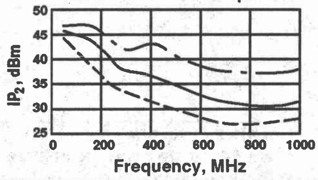
TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

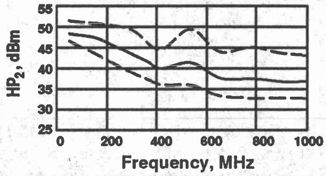












AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.44	12.63	170.36	–.01	.00	1.20	17.41
150.0	1.43	12.55	165.04	–.31	.29	1.20	17.30
200.0	1.42	12.46	159.97	–.35	.29	1.20	17.35
250.0	1.40	12.40	154.76	–.53	.28	1.20	17.42
300.0	1.38	12.34	149.83	–.43	.27	1.19	17.46
350.0	1.36	12.27	145.02	–.22	.27	1.18	17.51
400.0	1.34	12.20	139.96	–.25	.28	1.16	17.54
450.0	1.33	12.13	135.07	–.11	.27	1.15	17.61
500.0	1.32	12.10	130.23	.07	.27	1.12	17.59
550.0	1.31	12.12	125.50	.36	.26	1.10	17.54
600.0	1.29	12.13	120.91	.81	.26	1.07	17.47
650.0	1.27	12.11	116.24	1.17	.27	1.04	17.35
700.0	1.27	12.09	111.20	1.16	.28	1.03	17.27
750.0	1.27	12.04	106.16	1.15	.29	1.06	17.17
800.0	1.28	11.97	100.68	.69	.31	1.10	17.13
850.0	1.27	11.97	95.13	.17	.31	1.14	17.10
900.0	1.27	11.96	89.38	–.55	.32	1.19	16.94
950.0	1.28	11.96	83.76	–1.13	.31	1.24	16.95
1000.0	1.28	12.06	78.20	–1.67	.31	1.30	16.85
1050.0	1.28	11.99	72.66	—	.32	1.36	16.78
1100.0	1.29	12.03	66.85	—	.36	1.42	16.72
1200.0	1.36	11.88	52.69	—	.39	1.55	16.39
1300.0	1.58	11.73	37.09	—	.47	1.72	16.22
1400.0	2.11	11.37	18.41	—	.54	1.95	16.52
1500.0	3.20	10.30	–.79	—	.57	2.23	17.43
1600.0	5.16	8.32	–20.98	—	.51	2.61	18.99
1700.0	7.80	5.94	–38.40	—	.44	2.95	20.62
1800.0	10.73	3.46	–50.25	—	.32	3.25	22.50
1900.0	13.12	.79	–62.74	—	.30	3.60	23.46
2000.0	15.53	–1.82	–74.60	—	.00	3.76	24.62

LINEARIZATION RANGE: 100.0 to 1000.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.0	.184	–177.9	12.616	170.2	–17.438	–1.3	.093	164.3
200.00	.174	176.9	12.453	159.8	–17.342	–2.3	.089	151.6
300.00	.161	176.3	12.369	149.6	–17.451	–3.9	.085	138.9
400.00	.152	177.7	12.265	139.6	–17.464	–6.0	.076	126.1
500.00	.143	–179.2	12.222	129.3	–17.503	–8.5	.064	110.8
600.00	.131	–172.5	12.195	119.4	–17.384	–11.6	.046	98.9
700.00	.142	–162.1	12.085	109.4	–17.275	–14.6	.017	79.6
800.00	.142	–156.6	11.907	98.8	–17.171	–17.5	.022	–90.5
900.00	.141	–149.4	11.869	87.2	–17.050	–21.6	.069	–108.1
1000.00	.154	–138.0	11.954	76.0	–16.958	–24.6	.126	–121.5
1100.00	.159	–124.6	11.904	64.2	–16.872	–29.7	.186	–137.4
1200.00	.185	–108.7	11.761	49.3	–16.509	–36.6	.243	–158.5
1300.00	.258	–93.3	11.526	32.6	–16.393	–45.8	.306	172.1
1400.00	.398	–90.1	11.044	12.7	–16.885	–60.1	.370	136.0
1500.00	.572	–96.1	9.645	–7.7	–18.062	–75.1	.432	96.5
1600.00	.711	–107.1	7.102	–29.2	–20.192	–87.9	.491	60.7
1700.00	.786	–119.3	3.872	–46.4	–22.673	–95.7	.531	31.7
1800.00	.786	–133.4	–.551	–55.2	–26.297	–92.6	.556	6.9
1900.00	.383	–136.6	–.896	–23.7	–25.231	–54.9	.532	–14.4
2000.00	.788	–112.6	–.753	–65.2	–23.488	–89.8	.562	–26.9

AVANTEK

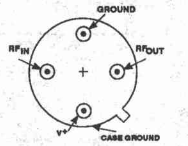
UTO/UTC/PPA 1007 Series
Thin-Film Cascadable Amplifier
5 to 1000 MHz

FEATURES

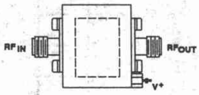
- Frequency Range: 5 to 1000 MHz
- Output Power: +12.0 dBm (Typ)
- 5-Volt Supply
- Surface Mount Option

APPLICATIONS

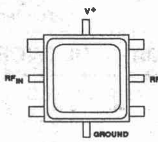
- IF/RF Amplification
- 5 Volt Systems
- Surface Mount Assembly



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42



PPA—PP-38, p. 16–35

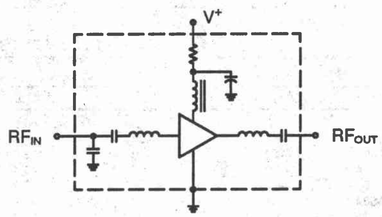
DESCRIPTION

The 1007 Series is a 5-volt wideband thin-film bipolar RF amplifier that can be used where voltage or power requirements are important. Output choke coupling, resistive feedback and active bias combine to provide a low noise, medium gain amplifier. Blocking capacitors couple the RF through the amplifier. The 1007 Series amplifiers are available in three packages: the surface mount hermetic PP-38 (.375 in. x .375 in.) case, the TO-8 hermetic case and the connectorized TC-1 case.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted)

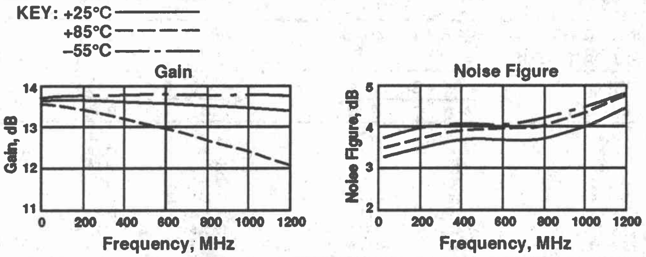
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-1200	5-1000	5-1000	MHz
GP	Small Signal Gain (Min.)	13.5	12.5	11.5	dB
—	Gain Flatness (Max.)	±0.1	±0.7	±1.0	dB
NF	Noise Figure (Max.)	3.8	5.0	5.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+12.0	+11.0	+10.0	dBm
—	Input VSWR (Max.)	<1.4:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+21.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+21.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+28.0	—	—	dBm
I_D	DC Current	33	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +5 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	10 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	−55°C to +125°C
Storage Temperature	−62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

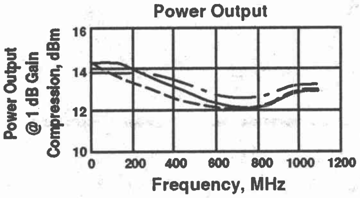
θ_{JC}	105°C/W
Active Transistor Power Dissipation	110 mW
Junction Temperature Above Case Temperature	11.4°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	1,645,000 Hrs.

*For further information, see High Reliability section, p. 17–2.

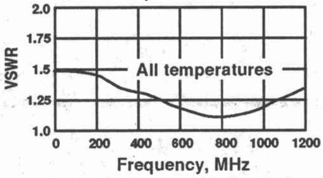
WEIGHT: (typical) PPA — 0.5 grams; UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

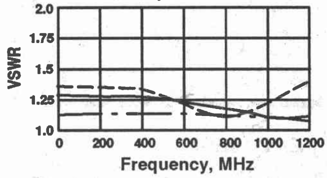
Power Output



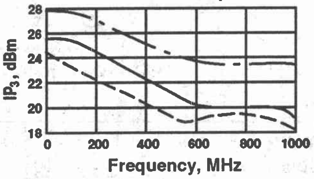
Input VSWR



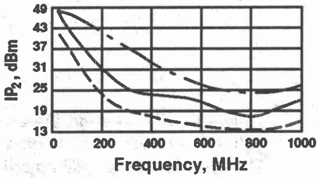
Output VSWR



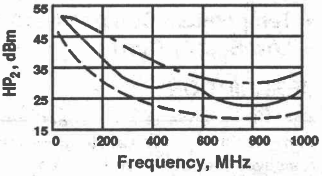
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 5.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.46	13.90	166.73	–.31	.00	1.28	19.39
200.0	1.31	13.66	152.58	–1.11	.37	1.27	18.15
300.0	1.32	13.82	139.76	–.58	.36	1.25	18.36
400.0	1.25	13.61	126.72	–.29	.35	1.24	18.59
500.0	1.20	13.65	114.26	.58	.34	1.19	18.31
600.0	1.14	13.72	102.22	1.89	.35	1.16	18.19
700.0	1.06	13.66	88.96	1.96	.38	1.15	18.14
800.0	1.09	13.45	74.69	1.06	.41	1.11	18.03
900.0	1.16	13.42	59.41	–.88	.42	1.06	17.90
1000.0	1.26	13.48	44.64	–2.31	.41	1.04	17.83
1200.0	1.60	13.32	12.61	—	.47	1.18	17.85
1400.0	2.57	13.00	–23.11	—	.53	1.47	18.20
1600.0	6.10	11.17	–64.48	—	.60	2.03	19.81
1800.0	25.80	8.00	–104.99	—	.48	2.53	21.54
2000.0	88.94	4.10	–135.14	—	.00	3.14	22.93

ILINEARIZATION RANGE: 100.0 to 1000.0 MHz

S-PARAMETERS

BIAS = 5.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.170	170.2	13.870	168.9	–18.380	–2.1	.117	158.2
200.00	.147	155.0	13.762	156.3	–18.454	–7.1	.116	132.7
300.00	.123	142.9	13.754	144.5	–18.224	–11.2	.112	111.2
400.00	.094	127.4	13.756	132.7	–18.194	–16.0	.108	87.8
500.00	.069	110.5	13.821	121.6	–18.042	–20.6	.106	66.8
600.00	.048	72.1	13.822	110.7	–17.984	–25.4	.101	43.1
700.00	.045	25.1	13.657	98.6	–17.959	–30.2	.090	17.4
800.00	.064	–10.0	13.486	84.9	–18.041	–35.4	.072	–11.4
900.00	.091	–28.5	13.458	70.9	–17.926	–41.1	.054	–48.2
1000.00	.124	–36.4	13.431	57.3	–18.029	–47.0	.037	–106.5
1100.00	.161	–43.2	13.368	42.3	–17.932	–54.3	.057	176.1
1200.00	.210	–48.1	13.250	26.5	–17.836	–61.7	.113	135.4
1300.00	.275	–52.1	12.931	9.2	–18.122	–69.7	.180	102.3
1400.00	.357	–58.2	12.369	–10.1	–18.616	–80.6	.261	73.4
1500.00	.455	–66.9	11.215	–29.9	–19.290	–90.4	.343	45.9
1600.00	.556	–76.7	9.380	–49.3	–20.354	–100.1	.404	20.4
1700.00	.630	–87.8	7.117	–66.8	–21.351	–106.9	.436	–3.0
1800.00	.679	–98.1	5.462	–78.1	–22.819	–107.9	.454	–24.0
1900.00	.714	–107.6	3.348	–88.5	–23.328	–112.1	.458	–41.5
2000.00	.741	–116.1	1.435	–97.7	–24.279	–115.2	.452	–57.6

AVANTEK

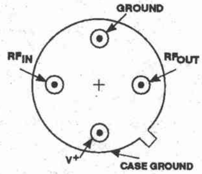
UTO/UTC 1011 Series
Thin-Film Cascadable Amplifier
2 to 1000 MHz

FEATURES

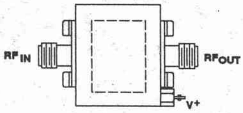
- Frequency Range: 2 to 1000 MHz
- Low Noise Figure: 3.0 dB (Typ)
- Medium Gain: 14.5 dB (Typ)
- Temperature Compensated
- Low Supply Current

APPLICATIONS

- IF/RF Amplification
- Low Power Systems



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

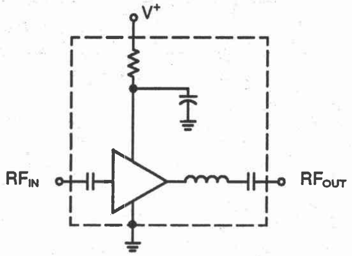
DESCRIPTION

The 1011 Series is a wideband, general-purpose thin-film bipolar RF amplifier using resistive feedback and active bias for stability over temperature and bias verifications. Input and output blocking capacitors couple the RF through the amplifier while output inductance maintains a low VSWR. The 1011 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

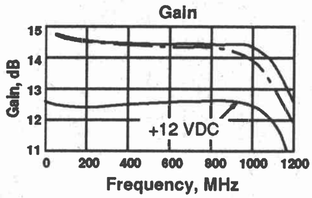
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	2-1000	2-1000	2-1000	MHz
GP	Small Signal Gain (Min.)	14.5	14.0	13.5	dB
—	Gain Flatness (Max.)	±0.5	±0.7	±1.0	dB
NF	Noise Figure (Max.)	3.0	3.5	4.0	dB
$P_{1 dB}$	Power Output @ +1 dB Compression (Min.)	–2.0	–5.0	–6.0	dBm
—	Input VSWR (Max.)	<1.4:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<2.0:1	2.2:1	2.2:1	—
IP_3	Two Tone 3rd Order Intercept Point	+10.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+7.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+13.0	—	—	dBm
I_D	DC Current	8	—	—	mA

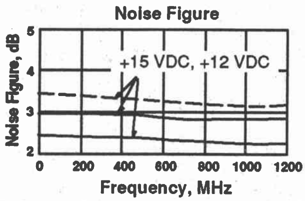
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ————
+85°C – – – –
–55°C — - —





MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

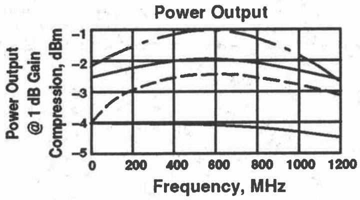
THERMAL CHARACTERISTICS*

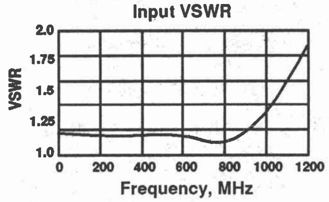
θ_{JC}	105°C/W
Active Transistor Power Dissipation	44 mW
Junction Temperature Above Case Temperature	5°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	1,452,000 Hrs.

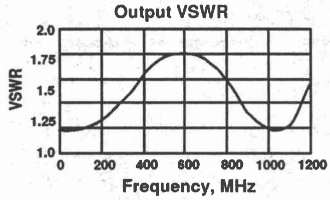
*For further information, see High Reliability section, p. 17–2.

WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)







AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.18	14.46	162.04	–8.68	.00	19.44	1.21
150.0	1.18	14.40	153.79	–7.54	.46	19.47	1.30
200.0	1.20	14.32	145.52	–6.40	.45	19.47	1.39
250.0	1.20	14.25	137.56	–4.94	.44	19.45	1.49
300.0	1.21	14.20	129.68	–3.44	.44	19.45	1.58
350.0	1.21	14.10	121.56	–2.15	.41	19.41	1.67
400.0	1.22	14.05	114.76	.45	.41	19.34	1.76
450.0	1.21	14.00	106.69	1.78	.45	19.27	1.83
500.0	1.21	14.00	98.59	3.07	.45	19.18	1.90
550.0	1.20	14.00	90.45	4.34	.46	19.05	1.95
600.0	1.19	14.05	82.00	5.30	.47	18.96	1.97
650.0	1.17	14.08	73.36	6.05	.48	18.88	1.97
700.0	1.15	14.14	64.55	6.65	.49	18.82	1.96
750.0	1.12	14.20	55.65	7.15	.50	18.78	1.91
800.0	1.11	14.26	46.42	7.32	.52	18.77	1.82
850.0	1.12	14.31	36.76	7.07	.54	18.77	1.70
900.0	1.17	14.33	26.89	6.61	.57	18.85	1.59
950.0	1.26	14.32	16.32	5.43	.60	18.98	1.44
1000.0	1.38	14.20	5.33	3.84	.62	19.29	1.31
1050.0	1.53	13.99	–5.94	1.98	.63	19.56	1.24
1100.0	1.70	13.64	–17.43	–.10	.64	20.03	1.29
1150.0	1.90	13.17	–28.87	–2.14	.63	20.55	1.47
1200.0	2.10	12.51	–40.24	–4.11	.62	21.14	1.72
1250.0	2.30	11.76	–51.16	–5.62	.58	21.64	2.00
1300.0	2.49	10.90	–61.05	–6.11	.53	22.14	2.31
1350.0	2.64	9.94	–70.29	–5.95	.49	22.53	2.68
1400.0	2.75	9.02	–78.82	–5.08	.45	22.75	3.06
1450.0	2.84	8.03	–86.65	–3.51	.42	22.82	3.38
1500.0	2.90	7.11	–93.80	–1.26	.00	22.84	3.71

LIINEARIZATION RANGE: 100.0 to 1500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.097	–175.5	14.689	162.7	–19.747	–6.8	.108	119.5
200.00	.105	179.1	14.499	145.7	–19.718	–13.0	.173	85.9
300.00	.108	175.2	14.425	128.7	–19.394	–19.7	.231	66.4
400.00	.111	171.2	14.395	112.7	–19.471	–26.6	.279	50.9
500.00	.106	165.6	14.327	96.9	–19.247	–34.4	.312	35.6
600.00	.097	161.7	14.327	80.9	–19.051	–42.4	.331	20.8
700.00	.078	160.3	14.335	64.0	–18.834	–51.3	.324	4.6
800.00	.058	–176.3	14.402	45.9	–18.793	–61.3	.292	–14.4
900.00	.073	–135.6	14.415	25.8	–18.669	–72.6	.228	–39.2
1000.00	.151	–126.6	14.222	3.7	–19.053	–84.8	.134	–82.7
1100.00	.251	–137.8	13.582	–20.1	–19.685	–96.2	.124	179.0
1200.00	.350	–153.0	12.409	–43.1	–20.714	–105.0	.259	124.3
1300.00	.415	–169.2	10.704	–63.7	–21.525	–110.5	.399	95.9
1400.00	.451	177.7	8.849	–82.6	–22.087	–114.7	.503	74.5
1500.00	.468	165.7	7.090	–97.4	–22.175	–118.8	.583	58.1

AVANTEK

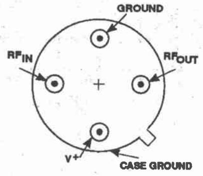
UTO/UTC 1012 Series
Thin-Film Cascadable Amplifier
5 to 1000 MHz

FEATURES

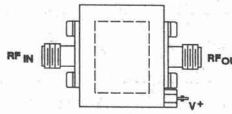
- Frequency Range: 5 to 1000 MHz
- Low Noise Figure: 2.5 dB (Typ)
- Medium Gain: 16.0 dB (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

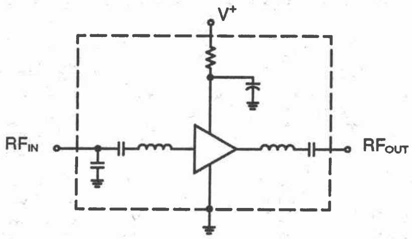
DESCRIPTION

The 1012 Series is a wideband, general-purpose thin-film bipolar RF amplifier using resistive feedback and active bias for stability over temperature and bias variations. Input and output blocking capacitors couple the RF through the amplifier while output inductance maintains a low VSWR. The 1012 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

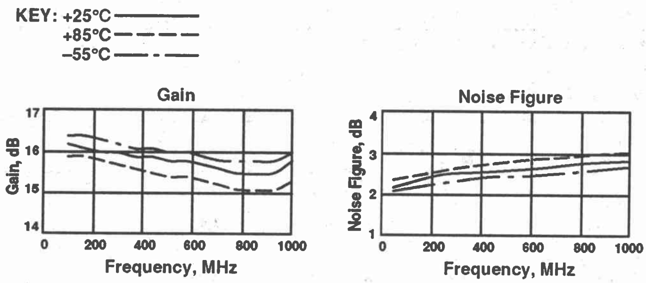
Symbol	Characteristic	Typical $T_c = 25°C$	Guaranteed Specifications $T_c = 0°$ to $50°C$	Guaranteed Specifications $T_c = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-1000	5-1000	5-1000	MHz
GP	Small Signal Gain (Min.)	16.0	15.0	14.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	2.5	4.0	4.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+5.0	+4.0	+3.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+17.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+23.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+30.0	—	—	dBm
I_D	DC Current	18	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	−55°C to +125°C
Storage Temperature	−62°C to +150°C
"R" Series Burn-In Temperature	+125°C

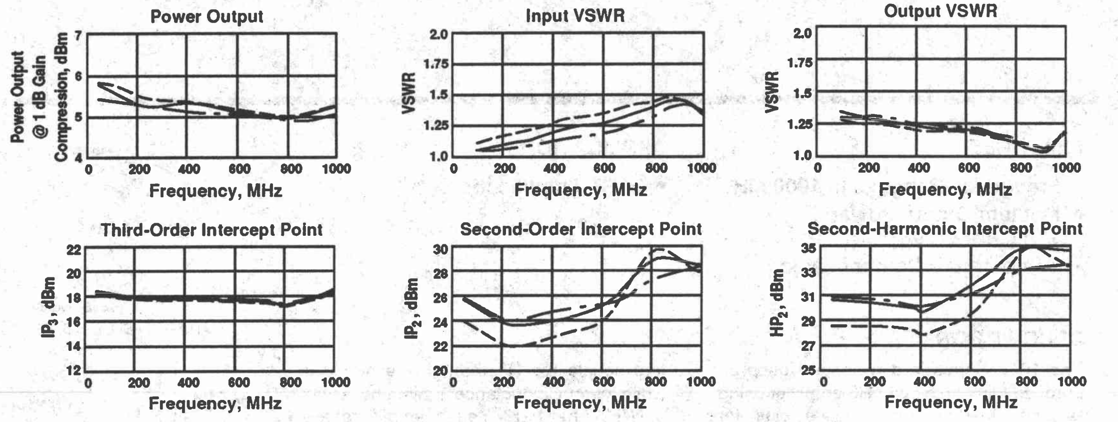
THERMAL CHARACTERISTICS*

θ_{JC}	105°C/W
Active Transistor Power Dissipation	120 mW
Junction Temperature Above Case Temperature	13°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	1,253,000 Hrs.

*For further information, see High Reliability section, p. 17–2.

WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.13	17.03	167.43	−.46	.00	1.20	22.33
150.0	1.13	17.09	161.48	−.77	.31	1.18	22.45
200.0	1.13	17.07	156.10	−.50	.30	1.18	22.27
250.0	1.14	16.96	150.74	−.21	.30	1.17	22.48
300.0	1.15	16.92	145.33	.01	.30	1.16	22.71
350.0	1.16	16.85	140.01	.34	.30	1.15	22.83
400.0	1.18	16.77	134.47	.44	.31	1.14	22.80
450.0	1.18	16.65	128.96	.57	.32	1.13	22.90
500.0	1.21	16.56	122.97	.22	.31	1.11	22.98
550.0	1.23	16.46	117.72	.61	.31	1.11	23.28
600.0	1.25	16.40	111.81	.36	.34	1.11	23.64
650.0	1.28	16.43	105.60	−.20	.32	1.11	23.65
700.0	1.31	16.47	100.30	.12	.30	1.13	23.99
750.0	1.36	16.46	94.95	.42	.30	1.15	24.23
800.0	1.41	16.43	89.51	.62	.31	1.18	24.53
850.0	1.48	16.44	83.70	.44	.32	1.22	24.86
900.0	1.56	16.46	77.85	.24	.34	1.26	25.12
950.0	1.66	16.48	71.46	−.50	.37	1.31	25.58
1000.0	1.80	16.56	64.54	−1.79	.39	1.37	26.02
1100.0	2.21	16.66	49.98	—	.45	1.53	27.19
1200.0	2.86	16.58	32.77	—	.45	1.75	29.35
1300.0	3.76	15.87	15.05	—	.54	2.02	31.86
1400.0	4.67	14.55	−3.57	—	.50	2.33	34.08
1500.0	5.17	12.72	−19.84	—	.37	2.51	32.48

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.026	−12.0	17.090	167.5	−22.180	−6.5	.092	170.5
150.00	.044	−32.5	17.084	162.0	−22.099	−5.8	.084	167.5
200.00	.053	−40.0	17.019	155.9	−22.274	−6.5	.084	163.5
250.00	.056	−45.1	16.964	149.8	−22.317	−10.2	.076	160.0
300.00	.063	−46.5	16.966	144.1	−22.559	−13.1	.074	156.3
350.00	.073	−49.2	16.942	138.5	−22.669	−14.3	.071	156.6
400.00	.083	−51.1	16.905	133.2	−22.774	−16.8	.066	156.4
450.00	.094	−52.9	16.796	127.8	−22.946	−20.0	.063	155.7
500.00	.106	−55.4	16.727	122.4	−23.142	−21.5	.059	161.0
550.00	.116	−57.0	16.677	117.0	−23.342	−23.5	.058	165.8
600.00	.128	−59.8	16.629	111.6	−23.378	−27.1	.056	175.4
650.00	.142	−61.9	16.580	106.2	−23.704	−28.8	.056	−175.4
700.00	.158	−64.5	16.568	100.8	−23.711	−31.0	.062	−167.8
750.00	.173	−67.2	16.551	95.2	−24.059	−33.2	.072	−160.4
800.00	.192	−71.0	16.516	89.4	−24.432	−35.6	.084	−153.9
850.00	.211	−75.9	16.532	83.3	−24.883	−38.3	.100	−150.7
900.00	.237	−80.5	16.560	77.4	−24.993	−40.4	.118	−149.5
950.00	.263	−86.0	16.573	70.9	−25.518	−41.7	.138	−149.5
1000.00	.295	−92.2	16.595	64.1	−25.979	−44.5	.160	−150.5
1100.00	.379	−107.1	16.633	49.1	−27.098	−49.3	.212	−154.6
1200.00	.479	−124.6	16.531	32.3	−29.122	−50.7	.277	−161.5
1300.00	.572	−144.6	15.908	13.6	−31.710	−44.2	.343	−172.6
1400.00	.642	−165.5	14.638	−3.7	−33.189	−26.2	.398	174.3
1500.00	.674	176.0	12.896	−17.6	−32.245	−5.5	.432	160.8

AVANTEK

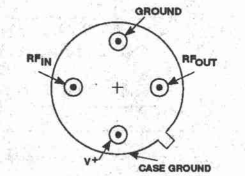
UTO/UTC 1013 Series
Thin-Film Cascadable Amplifier
5 to 1000 MHz

FEATURES

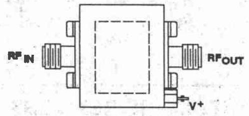
- Frequency Range: 5 to 1000 MHz
- Medium Output Power: +10.5 dBm (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

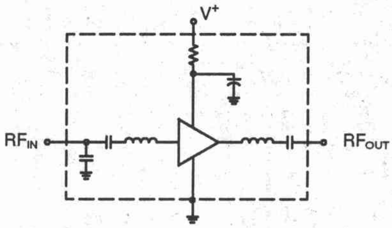
DESCRIPTION

The 1013 Series is a wideband general-purpose thin-film bipolar RF amplifier using resistive feedback and active bias for stability over temperature and bias variations. Input and output blocking capacitors couple the RF through the amplifier while output inductance maintains a low VSWR. The 1013 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range	5-1000	5-1000	5-1000	MHz
GP	Small Signal Gain (Min.)	16.0	15.0	14.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	3.0	4.5	5.0	dB
$P_{1 dB}$	Power Output @ +1 dB Compression (Min.)	+10.5	+9.0	+8.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+20.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+27.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+33.0	—	—	dBm
I_D	DC Current	29	—	—	mA

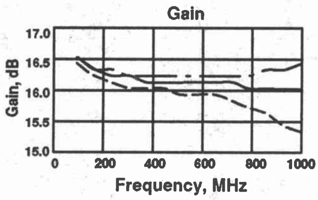
SCHEMATIC

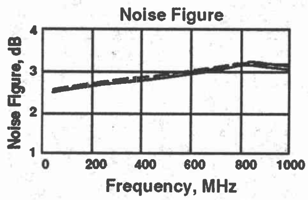


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
–55°C —— - ——





MAXIMUM RATINGS

DC Voltage .... 17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

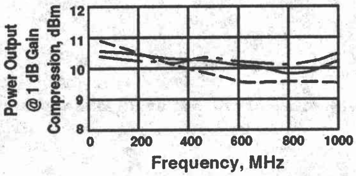
THERMAL CHARACTERISTICS*

θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 200 mW
Junction Temperature Above Case Temperature .... 21°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 1,249,000 Hrs.
*For further information, see High Reliability section, p. 17–2.

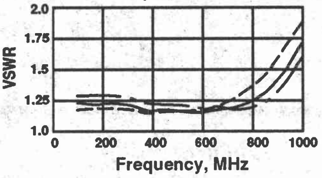
WEIGHT: (typical) UTO— 2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

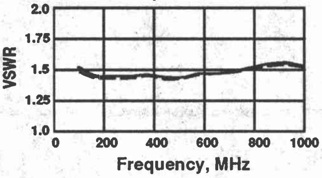
Power Output



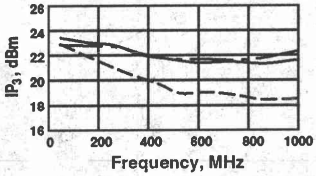
Input VSWR



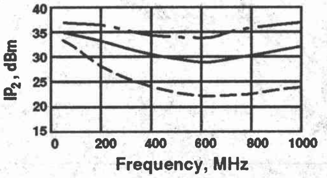
Output VSWR



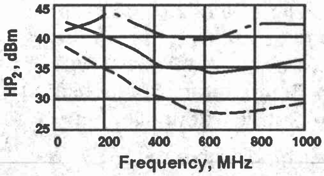
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.15	16.80	168.54	−1.03	.00	1.44	21.69
150.0	1.13	16.90	163.11	−1.16	.29	1.42	21.87
200.0	1.14	16.91	158.23	−.71	.27	1.42	21.85
250.0	1.13	16.83	153.30	−.33	.27	1.42	22.16
300.0	1.13	16.80	148.47	.16	.27	1.41	22.29
350.0	1.13	16.78	143.57	.59	.28	1.41	22.21
400.0	1.12	16.72	138.41	.73	.29	1.41	22.35
450.0	1.12	16.67	133.32	.96	.30	1.40	22.35
500.0	1.11	16.58	127.63	.59	.29	1.39	22.42
550.0	1.12	16.54	122.75	1.03	.29	1.37	22.54
600.0	1.11	16.53	117.05	.66	.33	1.36	22.86
650.0	1.11	16.58	111.04	−.01	.31	1.35	22.89
700.0	1.12	16.70	105.89	.15	.28	1.33	22.91
750.0	1.13	16.74	100.81	.40	.29	1.31	23.27
800.0	1.16	16.74	95.61	.52	.30	1.28	23.31
850.0	1.19	16.80	90.00	.23	.31	1.24	23.54
900.0	1.24	16.86	84.48	.02	.32	1.21	23.63
950.0	1.31	16.93	78.37	−.77	.35	1.17	23.97
1000.0	1.40	16.99	71.78	−2.04	.38	1.12	24.10
1100.0	1.69	17.16	57.57	—	.43	1.06	24.93
1200.0	2.17	17.19	41.05	—	.45	1.19	26.56
1300.0	2.90	16.56	24.54	—	.51	1.43	29.10
1400.0	3.82	15.39	6.14	—	.48	1.73	32.43
1500.0	4.75	13.80	−9.81	—	.38	2.01	31.88

S-PARAMETER

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.101	177.4	16.864	168.8	−22.054	−4.4	.179	169.6
150.00	.092	−178.6	16.885	163.7	−21.943	−4.4	.173	163.5
200.00	.090	−177.3	16.824	158.1	−21.843	−4.8	.176	156.6
250.00	.088	−176.5	16.792	152.6	−22.033	−8.0	.171	151.0
300.00	.084	−177.1	16.834	147.3	−22.121	−9.8	.172	145.4
350.00	.079	−175.3	16.838	142.1	−22.414	−10.8	.171	140.9
400.00	.073	−174.1	16.848	137.2	−22.395	−13.2	.170	135.4
450.00	.067	−170.9	16.789	132.2	−22.276	−15.3	.169	130.8
500.00	.062	−166.8	16.764	127.3	−22.535	−16.7	.167	126.8
550.00	.057	−165.4	16.768	122.3	−22.590	−18.2	.165	122.7
600.00	.054	−157.7	16.748	117.3	−22.645	−20.8	.158	117.8
650.00	.052	−147.8	16.755	112.2	−22.792	−22.6	.153	112.7
700.00	.054	−138.4	16.795	107.1	−22.784	−24.8	.147	108.5
750.00	.057	−128.4	16.829	101.8	−22.980	−26.8	.139	−103.8
800.00	.067	−119.3	16.847	96.4	−23.214	−28.0	.127	98.7
850.00	.082	−115.3	16.902	90.4	−23.532	−30.3	.115	93.6
900.00	.103	−113.0	16.989	84.8	−23.644	−33.2	.100	87.3
950.00	.128	−114.9	17.051	78.6	−23.893	−34.3	.083	80.2
1000.00	.159	−117.3	17.102	71.9	−24.072	−36.4	.064	70.0
1100.00	.246	−127.5	17.216	57.5	−24.932	−41.6	.024	−7.4
1200.00	.356	−143.0	17.186	41.5	−26.478	−46.6	.081	−97.3
1300.00	.478	−161.6	16.709	23.4	−28.700	−46.8	.173	−125.6
1400.00	.586	178.7	15.624	6.0	−31.741	−31.8	.265	−148.0
1500.00	.654	160.2	14.076	−7.7	−31.789	−1.7	.335	−187.4

AVANTEK

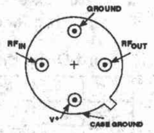
UTO/UTC/PPA 1021 Series Thin-Film Cascadable Amplifier 5 to 1000 MHz

FEATURES

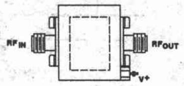
- Frequency Range: 5 to 1000 MHz
- High Gain: 23.0 dB (Typ)
- Medium Output Power: +14.0 dBm (Typ)
- Temperature Compensated
- Surface Mount Option

APPLICATIONS

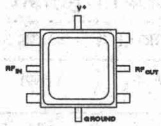
- IF/RF Amplification
- Output Stage



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42



PPA—PP-38, p. 16–35

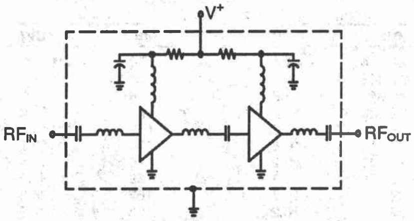
DESCRIPTION

The 1021 Series is a two-stage bipolar RF amplifier built on a thin-film substrate. Active bias and resistive feedback provide for stability over temperature and bias voltage variations. Input/output blocking capacitors couple the RF through the amplifier while a low VSWR is maintained through the use of inductive tuning. The 1021 Series amplifiers are available in three packages: the TO-8 hermetic case, the connectored TC-1 package or the surface mount PlanarPak PP-38.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-1000	5-1000	5-1000	MHz
GP	Small Signal Gain (Min.)	23.0	22.0	21.0	dB
—	Gain Flatness (Max.)	±0.7	±1.0	±1.0	dB
NF	Noise Figure (Max.)	3.8	4.5	5.0	dB
$P_{1 dB}$	Power Output @ +1 dB Compression (Min.)	+14.0	+12.0	+11.0	dBm
—	Input VSWR (Max.)	<1.6:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+25.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+30.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+40.0	—	—	dBm
I_D	DC Current	85	—	—	mA

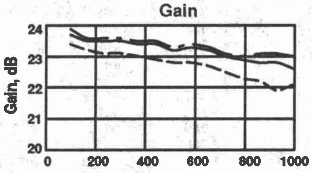
SCHEMATIC

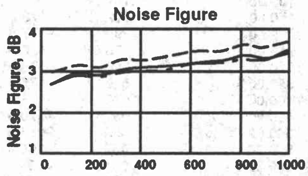


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C — — —
−55°C —·—





MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	−55°C to +115°C
Storage Temperature	−62°C to +150°C
"R" Series Burn-In Temperature	+115°C

THERMAL CHARACTERISTICS*

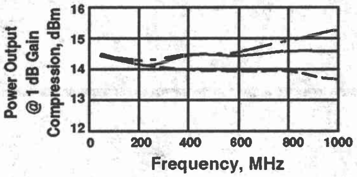
θ_{JC}	105/75°C/W
Active Transistor Power Dissipation	230/460 mW
Junction Temperature Above Case Temperature	24/34°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	575,400 Hrs.

*For further information, see High Reliability section, p. 17–2.

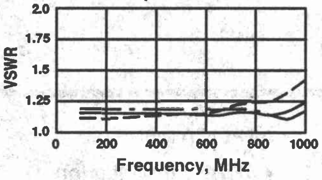
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams; PPA — 0.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

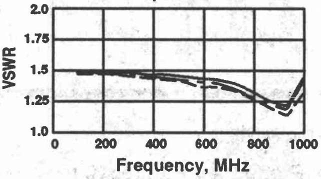
Power Output



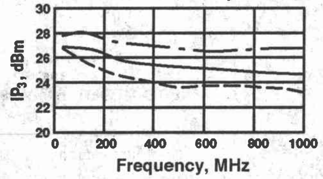
Input VSWR



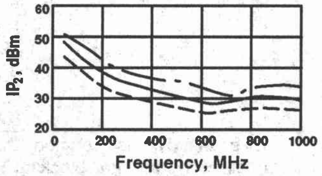
Output VSWR



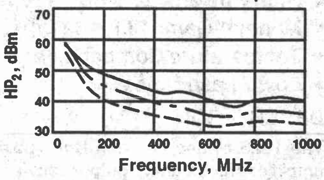
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.23	23.92	–19.76	–1.86	.00	1.46	39.57
200.0	1.29	23.86	–38.37	–.30	.53	1.47	38.06
300.0	1.32	23.81	–58.28	–.05	.55	1.50	38.34
400.0	1.33	23.86	–77.78	.60	.56	1.53	38.86
500.0	1.33	24.06	–97.55	.99	.53	1.57	39.30
600.0	1.33	24.08	–117.37	1.32	.56	1.62	40.29
700.0	1.37	24.08	–137.82	1.02	.58	1.69	41.20
800.0	1.46	23.88	–158.85	.17	.59	1.75	42.65
900.0	1.60	23.79	179.93	–.87	.57	1.80	44.65
1000.0	1.75	23.77	158.44	–2.20	.60	1.80	46.55
1100.0	1.92	23.89	137.08	—	.63	1.74	47.79
1200.0	2.05	23.50	113.77	—	.67	1.57	45.26
1300.0	1.94	22.61	89.77	—	.61	1.41	44.27
1400.0	1.81	21.46	68.99	—	.55	1.32	43.97
1500.0	1.75	20.55	50.19	—	.52	1.29	45.01

LINEARIZATION RANGE: 100.0 to 1000.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.0	.185	146.0	23.784	–18.6	–38.957	6.3	.127	171.9
200.0	.196	121.9	23.853	–36.4	–38.320	–7.7	.130	172.8
300.0	.208	101.8	23.911	–55.6	–38.914	–13.9	.144	166.8
400.0	.217	82.3	24.117	–74.8	–38.946	–21.9	.157	156.7
500.0	.214	60.7	24.500	–94.9	–39.187	–30.0	.174	142.7
600.0	.204	33.0	24.667	–115.4	–40.060	–39.4	.194	126.6
700.0	.203	–1.5	24.741	–137.0	–41.302	–46.9	.214	110.3
800.0	.218	–37.0	24.566	–159.8	–43.007	–53.4	.235	94.0
900.0	.249	–67.7	24.335	177.3	–44.784	–54.5	.249	79.7
1000.0	.277	–93.1	24.053	154.6	–47.587	–41.4	.248	65.2
1100.0	.297	–116.5	23.828	132.8	–47.857	–23.1	.227	45.2
1200.0	.299	–143.5	23.064	109.9	–44.830	–21.8	.181	31.5
1300.0	.255	–172.2	21.912	87.4	–43.135	–30.0	.137	18.9
1400.0	.204	158.6	20.568	68.2	–42.697	–40.6	.110	6.5
1500.0	.169	127.2	19.516	50.7	–42.957	–43.3	.108	–9.7

AVANTEK

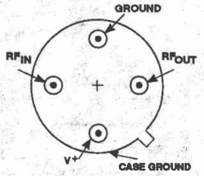
UTO/UTC 1023 Series
Thin-Film Cascadable Amplifier
10 to 1000 MHz

FEATURES

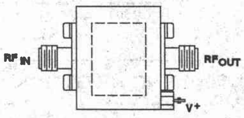
- Frequency Range: 10 to 1000 MHz
- High Power: +26.5 dBm (Typ)
- Medium Gain: 13.0 dB (Typ)
- Temperature Compensated
- Low Phase Noise

APPLICATIONS

- IF/RF Amplification
- Output Stage



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

DESCRIPTION

The 1023 Series is a thin-film bipolar RF amplifier for higher output power and medium-gain applications up to 1000 MHz. Resistive feedback and active bias assure temperature compensation and increased immunity to bias voltage variations. Low VSWR is maintained by inductive tuning while the RF is coupled through the amplifier by internal blocking capacitors. The 1023 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package. See page 3–128 for schematic.

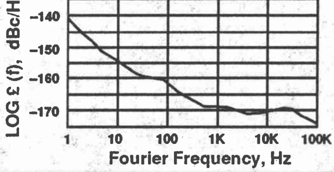
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	10-1000	10-1000	10-1000	MHz
GP	Small Signal Gain (Min.)	13.0	12.0	12.0	dB
—	Gain Flatness (Max.)	±0.2	±1.0	±1.0	dB
NF	Noise Figure (Max.)				
	30-500 MHz (Max.)	7.0	7.5	8.0	dB
	500-1000 MHz (Max.)	8.0	8.5	9.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)				
	10-500 MHz	+28.0	+26.0	+25.5	dBm
	500-1000 MHz	+26.5	+24.5	+24.0	dBm
—	Input VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+36.0	+32.0	+30.0	dBm
IP_2	Two Tone 2nd Order Intercept Point	+42.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+48.0	—	—	dBm
I_D	DC Current	205	—	—	mA
—	Phase Noise @ 500 MHz; 1KHz Offset	–165	—	—	dBc/Hz

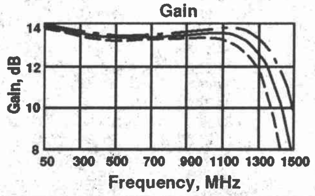
TYPICAL PERFORMANCE OVER TEMPERATURE (@ +15 VDC unless otherwise noted)

KEY: +25°C ———— +85°C – – – – –55°C — - —

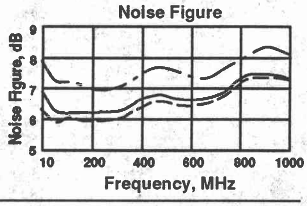
Typical Phase Noise @ 500 MHz @ +25°C



Gain



Noise Figure



MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+17 dBm
Operating Case Temperature	–55°C to +100°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+100°C

THERMAL CHARACTERISTICS*

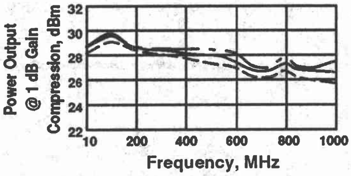
θ_{JC}	52°C/W
Active Transistor Power Dissipation	924/661/661 mW
Junction Temperature Above Case Temperature	48/34/34°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	410,200 Hrs.

*For further information, see High Reliability section, p. 17–2.

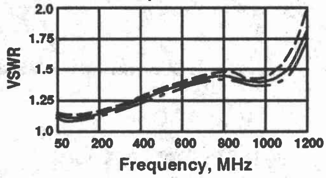
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

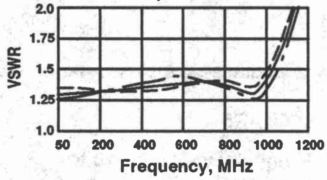
Power Output



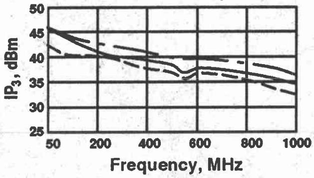
Input VSWR



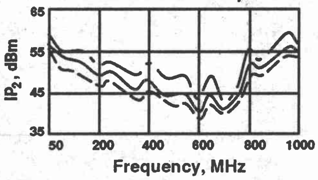
Output VSWR



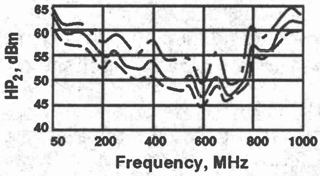
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}			GPDEL	PHASE
GHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	K	ns	DEG
.05	.05	–31.0	13.6	171.8	–19.9	–3.0	.13	174.08	1.25	.64	–.32
.10	.04	–21.4	13.6	160.3	–19.9	–9.6	.13	–178.73	1.25	.64	–1.24
.15	.05	–20.8	13.5	149.5	–19.9	–15.4	.13	–174.13	1.26	.59	–1.32
.20	.06	–23.4	13.5	139.0	–20.0	–20.9	.13	–170.65	1.27	.59	–1.26
.25	.07	–29.8	13.4	128.7	–20.0	–26.4	.13	–167.63	1.27	.58	–.98
.30	.08	–37.0	13.4	118.6	–20.0	–31.9	.14	–164.78	1.28	.56	–.47
.35	.09	–45.8	13.3	108.3	–20.0	–37.4	.14	–162.71	1.28	.57	–.09
.40	.10	–55.1	13.3	98.1	–20.0	–42.9	.15	–160.83	1.28	.57	.32
.45	.12	–64.3	13.2	87.9	–20.0	–48.6	.16	–159.18	1.29	.57	.70
.50	.13	–74.0	13.2	77.7	–20.1	–54.4	.16	–157.64	1.29	.57	1.15
.55	.14	–84.2	13.2	67.6	–20.1	–60.0	.16	–156.40	1.29	.56	1.63
.60	.16	–94.7	13.1	57.2	–20.0	–66.0	.17	–155.50	1.29	.57	1.91
.65	.17	–105.1	13.1	46.8	–20.0	–72.0	.17	–154.47	1.29	.58	2.10
.70	.17	–116.4	13.2	36.2	–20.0	–78.4	.16	–153.12	1.29	.59	2.11
.75	.18	–128.4	13.2	25.3	–20.0	–84.9	.16	–151.21	1.28	.60	1.88
.80	.18	–141.6	13.2	14.3	–20.0	–91.8	.15	–147.75	1.28	.62	1.42
.85	.17	–156.1	13.3	2.9	–20.0	–99.0	.14	–141.66	1.28	.64	.65
.90	.17	–173.3	13.4	–9.1	–19.3	–106.4	.13	–132.12	1.27	.66	–.72
.95	.16	166.3	13.5	–21.5	–19.9	–114.5	.13	–117.40	1.26	.69	–2.50
1.00	.16	140.7	13.5	–34.6	–19.9	–123.2	.15	–102.32	1.26	.73	–4.97
1.10	.19	80.8	13.6	–63.0	–20.2	–141.9	.25	–86.40	1.24	.81	
1.20	.29	30.6	13.3	–94.9	–20.8	–162.2	.41	–89.64	1.23	.91	
1.30	.40	–6.9	12.6	–131.1	–22.0	177.7	.57	–100.99	1.21	1.04	
1.40	.48	–35.6	10.7	–171.2	–23.7	158.9	.71	–115.51	1.22	1.14	
1.50	.52	–53.7	7.0	149.7	–25.9	143.8	.80	–130.62	1.43	1.04	
1.60	.57	–66.0	2.0	120.7	–28.3	133.8	.83	–144.34	2.28	.72	
1.70	.63	–77.6	–3.1	102.8	–31.0	129.7	.84	–156.22	4.63	.43	
1.80	.68	–88.8	–7.6	92.0	–33.3	138.5	.84	–166.66	9.44	.25	
1.90	.71	–99.0	–11.5	85.2	–32.5	154.0	.82	–175.60	13.15	.14	
2.00	.74	–108.0	–14.8	82.6	–29.5	152.8	.81	177.14	13.42	.05	
2.10	.77	–116.2	–17.3	81.5	–27.4	138.6	.81	170.41	12.87	.02	
2.20	.79	–123.9	–19.1	78.3	–26.6	122.3	.82	163.51	12.44	.08	
2.30	.81	–131.2	–20.7	73.9	–26.5	107.5	.84	156.54	12.61	.14	
2.40	.82	–138.0	–22.0	69.1	–26.6	93.8	.85	149.70	13.26	.14	
2.50	.83	–144.6	–23.5	62.5	–27.0	81.9	.85	143.51	15.06	.18	

LINEARIZATION RANGE: .05 to 1.00 GHz

AVANTEK

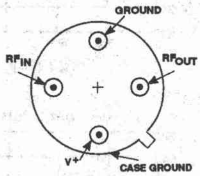
UTO/UTC 1024 Series
Thin-Film Cascadable Amplifier
10 to 1000 MHz

FEATURES

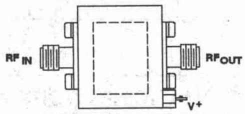
- Frequency Range: 10 to 1000 MHz
- High Power Output: +24 dBm (Typ)
- Medium Gain: 13.0 dB (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- Output Stage



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

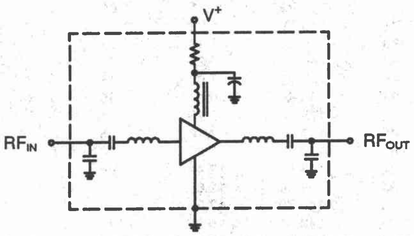
DESCRIPTION

The 1024 Series is a thin-film bipolar RF amplifier for higher output power and medium-gain applications up to 1000 MHz. Resistive feedback and active bias assure temperature compensation and increased immunity to bias voltage variations. Low VSWR is maintained by inductive tuning while the RF is coupled through the amplifier by internal blocking capacitors. The 1024 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

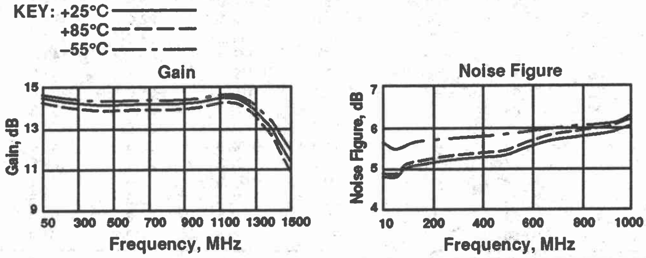
Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	T_C = –55° to +85°C	Unit
BW	Frequency Range	10-1000	10-1000	10-1000	MHz
GP	Small Signal Gain (Min.)	13.0	12.0	12.0	dB
—	Gain Flatness (Max.)	±0.2	±1.0	±1.0	dB
NF	Noise Figure (Max.)	5.5	6.5	7.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression				
	10-500 MHz (Min.)	+26.0	+24.5	+24.0	dBm
	500-1000 MHz (Min.)	+24.0	+22.0	+21.5	dBm
—	Input VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+35.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+42.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+48.0	—	—	dBm
I_D	DC Current	155	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage .... 17 Volts
Continuous RF Input Power .... +14 dBm
Operating Case Temperature .... –55°C to +100°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +100°C

THERMAL CHARACTERISTICS*

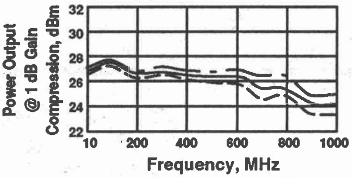
θ_{JC} .... 72/52/52°C/W
Active Transistor Power Dissipation .... 663/498/498 mW
Junction Temperature Above Case Temperature .. 48/26/26°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 454,100 Hrs.

*For further information, see High Reliability section, p. 17–2.

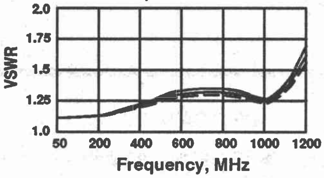
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

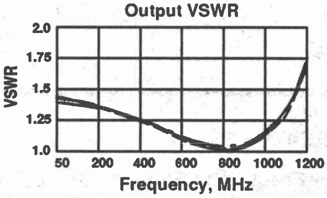
Power Output



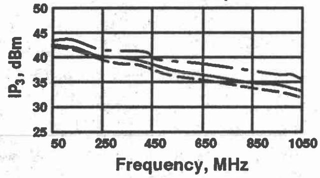
Input VSWR



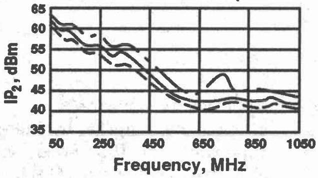
Output VSWR



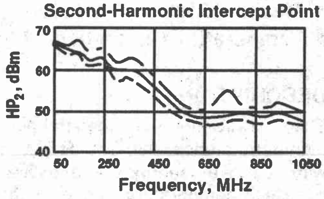
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS — **BIAS = 15.00 VOLTS**

FREQ	S_{11}		S_{21}		S_{12}		S_{22}		GPDEL	PHASE
GHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	ns	DEG
.05	.03	−75.5	14.0	173.0	−20.3	−3.0	.17	167.95	.56	.28
.10	.03	−81.5	14.0	163.1	−20.3	−8.4	.17	162.02	.56	−.67
.15	.04	−84.5	13.9	153.8	−20.3	−13.5	.16	155.20	.51	−.83
.20	.04	−87.2	13.9	144.8	−20.4	−18.2	.15	148.08	.50	−.83
.25	.05	−88.2	13.9	135.9	−20.4	−23.1	.14	140.82	.50	−.69
.30	.06	−90.3	13.8	127.2	−20.4	−27.8	.13	133.74	.48	−.39
.35	.07	−92.6	13.8	118.4	−20.4	−32.6	.12	126.79	.49	−.15
.40	.09	−95.1	13.8	109.6	−20.4	−37.6	.11	119.60	.49	.11
.45	.10	−97.2	13.8	100.8	−20.4	−42.3	.09	112.39	.49	.36
.50	.11	−100.0	13.7	92.0	−20.4	−47.3	.08	104.69	.49	.63
.55	.12	−103.2	13.7	83.3	−20.5	−52.5	.06	97.15	.49	.93
.60	.13	−106.0	13.7	74.5	−20.5	−57.4	.04	88.39	.49	1.13
.65	.14	−108.9	13.7	65.4	−20.5	−62.7	.03	78.21	.50	1.12
.70	.14	−111.7	13.7	56.4	−20.5	−68.0	.02	63.26	.50	1.20
.75	.14	−114.1	13.7	47.3	−20.5	−73.4	.01	30.58	.51	1.06
.80	.14	−115.4	13.8	38.0	−20.5	−79.3	.00	−67.33	.51	.84
.85	.14	−115.6	13.8	28.5	−20.5	−85.1	.00	−142.32	.53	.41
.90	.13	−113.5	13.9	−18.7	−20.4	−91.2	.01	116.90	.54	−.34
.95	.12	−107.5	13.9	8.7	−20.4	−97.6	.02	85.99	.56	−1.38
1.00	.12	−97.0	14.0	−1.8	−20.4	−104.7	.05	70.20	.58	−2.80
1.10	.15	−69.6	14.1	−24.2	−20.4	−119.7	.13	46.32	.64	
1.20	.26	−60.7	14.0	−49.0	−20.6	−136.9	.26	24.62	.70	
1.30	.41	−68.1	13.4	−75.7	−21.3	−155.7	.42	2.25	.75	
1.40	.57	−82.1	12.4	−102.8	−22.5	−174.6	.58	−20.06	.75	
1.50	.68	−97.2	10.8	−128.5	−24.2	168.9	.70	−40.77	.70	
1.60	.74	−111.2	8.9	−151.9	−26.5	156.4	.78	−59.50	.63	
1.70	.76	−123.5	7.0	−173.0	−28.8	150.5	.82	−75.96	.57	
1.80	.76	−133.7	5.2	167.2	−30.4	154.2	.82	−90.25	.54	
1.90	.72	−141.3	3.7	147.2	−30.2	159.7	.80	−102.36	.57	
2.00	.69	−145.7	2.2	124.4	−28.7	155.8	.79	−112.25	.66	
2.10	.67	−146.7	.1	97.2	−27.6	144.9	.79	−121.69	.77	
2.20	.70	−147.0	−3.1	69.9	−27.1	131.5	.79	−131.24	.73	
2.30	.75	−150.1	−7.4	48.7	−27.1	118.8	.80	−140.87	.53	
2.40	.80	−155.5	−12.0	36.0	−27.1	106.5	.81	−150.78	.29	
2.50	.83	−161.6	−16.2	31.6	−27.4	94.3	.82	−160.49	.08	

LINEARIZATION RANGE: .05 to 1.00 GHz

AVANTEK

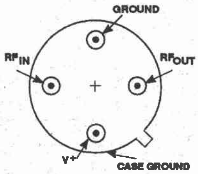
UTO/UTC 1033 Series
Thin-Film Cascadable Amplifier
5 to 1000 MHz

FEATURES

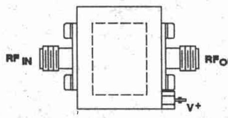
- Frequency Range: 5 to 1000 MHz
- Output Power: +16.0 dBm (Typ)
- Medium Gain: 11.0 dB (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- Output Stage



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

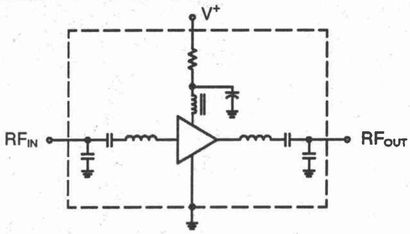
DESCRIPTION

The 1033 Series is a general-purpose, high-performance thin-film RF amplifier with resistive feedback and active bias circuits for temperature compensation and increased immunity to bias voltage variations. Low VSWR is maintained by inductive tuning while the RF is coupled through the amplifier by internal blocking capacitors. The 1033 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_c = 25°C	Guaranteed Specifications		Unit
			T_c = 0° to 50°C	T_c = –55° to +85°C	
BW	Frequency Range	5-1000	5-1000	5-1000	MHz
GP	Small Signal Gain (Min.)	11.0	10.0	9.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	5.5	6.5	7.0	dB
$P_{1 dB}$	Power Output @ +1 dB Compression (Min.)	+16.0	+14.0	+13.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+28.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+40.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+46.0	—	—	dBm
I_D	DC Current	48	—	—	mA

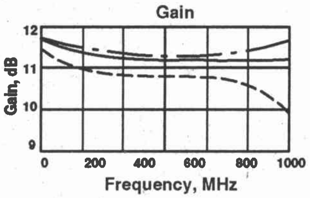
SCHEMATIC

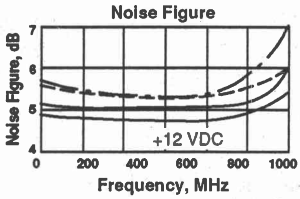


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C — — —
–55°C —·—





MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +115°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+115°C

THERMAL CHARACTERISTICS*

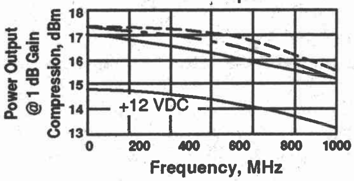
θ_{JC}	75°C/W
Active Transistor Power Dissipation	400 mW
Junction Temperature Above Case Temperature	30°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	1,291,000 Hrs.

*For further information, see High Reliability section, p. 17–2.

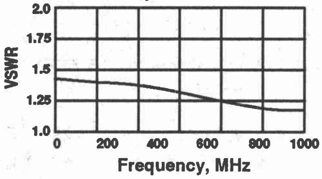
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

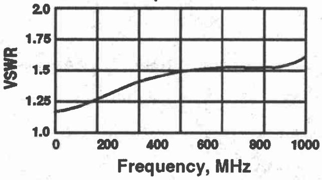
Power Output



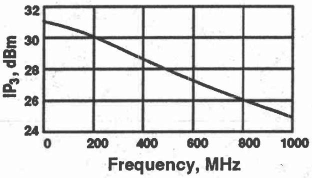
Input VSWR



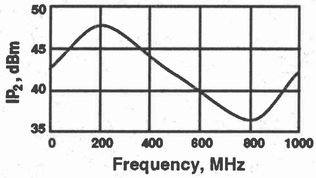
Output VSWR



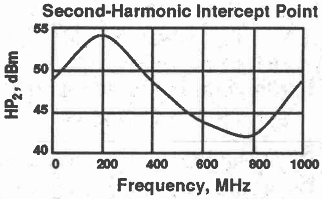
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS **BIAS = 15.00 VOLTS**

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.39	10.53	166.21	1.28	–3.05	.00	1.24	16.18
200.0	1.37	10.45	151.69	.19	–3.03	.39	1.27	16.14
300.0	1.36	10.42	137.51	–.56	–2.69	.40	1.32	16.20
400.0	1.35	10.44	123.83	–.83	–1.85	.36	1.36	16.23
500.0	1.34	10.43	110.55	–.69	–.60	.37	1.41	16.29
600.0	1.32	10.40	97.76	–.05	1.13	.36	1.44	16.33
700.0	1.28	10.38	84.54	.14	2.43	.35	1.48	16.37
800.0	1.25	10.43	71.73	.74	4.15	.38	1.50	16.34
900.0	1.22	10.49	57.96	.40	4.91	.40	1.53	16.36
1000.0	1.20	10.56	43.42	–.71	4.89	.41	1.55	16.44
1100.0	1.20	10.66	27.99	—	4.00	.44	1.59	16.57
1200.0	1.23	10.75	11.66	—	2.21	.47	1.64	16.77
1300.0	1.30	10.81	–5.93	—	–.84	.51	1.71	17.08
1400.0	1.44	10.69	–24.70	—	–5.09	.54	1.79	17.45
1500.0	1.67	10.22	–44.90	—	–10.77	.58	1.90	17.83
1600.0	2.02	9.33	–65.69	—	—	.55	1.93	18.14
1700.0	2.52	8.08	–84.19	—	—	.47	1.91	18.28

LINEARIZATION RANGE: 100.0 to 1000.0 MHz

S-PARAMETERS **BIAS = 15.00 VOLTS**

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.104	–169.5	10.846	165.1	–15.973	–5.7	.066	134.5
200.00	.113	–168.3	10.700	152.6	–16.157	–12.1	.083	108.2
300.00	.126	–169.6	10.665	138.5	–16.038	–17.7	.105	87.8
400.00	.136	–172.6	10.579	123.5	–16.236	–23.8	.128	71.6
500.00	.147	–178.1	10.561	110.8	–16.090	–30.5	.146	57.8
600.00	.148	176.4	10.430	97.3	–16.184	–37.1	.161	42.7
700.00	.147	170.0	10.411	83.6	–16.148	–41.7	.176	28.9
800.00	.138	162.6	10.377	70.3	–16.223	–48.8	.182	16.4
900.00	.125	154.9	10.456	56.1	–16.076	–56.0	.191	1.1
1000.00	.106	145.3	10.447	42.6	–15.991	–61.7	.198	15.5
1100.00	.081	133.5	10.636	28.2	–16.097	–68.4	.207	–32.0
1200.00	.052	115.6	10.642	12.9	–16.178	–75.4	.221	–49.7
1300.00	.037	68.9	10.752	–4.1	–16.290	–83.9	.241	–70.1
1400.00	.059	13.0	10.790	–21.2	–16.441	–90.4	.265	–90.1
1500.00	.115	–8.4	10.467	–40.4	–16.762	–96.8	.295	–112.3
1600.00	.199	–24.1	9.750	–60.4	–17.071	–102.6	.323	–135.6
1700.00	.302	–39.3	8.771	–80.3	–17.036	–108.2	.335	–157.2
1800.00	.402	–52.3	7.209	–96.1	–17.036	–115.2	.336	–178.6
1900.00	.494	–67.3	5.523	–110.3	–16.990	–122.3	.329	163.1
2000.00	.565	–79.3	3.904	–122.7	–17.141	–129.0	.314	148.4

AVANTEK

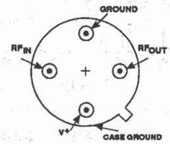
UTO/UTC/PPA 1043 Series
Thin-Film Cascadable Amplifier
10 to 1000 MHz

FEATURES

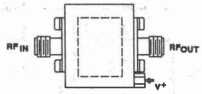
- Frequency Range: 10 to 1000 MHz
- High Dynamic Range
- Low Noise Figure: 2.5 dB (Typ)
- Medium Power Output: +8.0 dBm (Typ)
- Temperature Compensated
- Surface Mount Option

APPLICATIONS

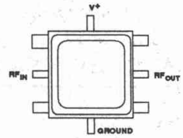
- Wideband RF System Front End
- Surface Mount Assembly



UTO—TO-8T, p. 608



UTC—TC-1, p. 602



PPA—PP-38, p. 595

DESCRIPTION

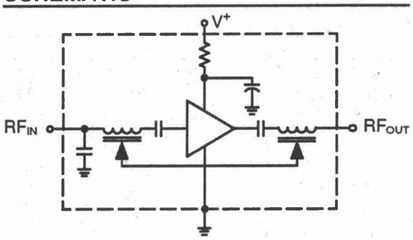
The 1043 Series is a thin-film bipolar RF amplifier using lossless feedback for low noise, high dynamic range and efficient operation; and active bias circuits to assure good temperature compensation and increased immunity to bias voltage variations. The 1043 Series amplifiers are available in three packages: the surface mount PlanarPak PP-38 (.375 in. x .375 in.) case, the TO-8 hermetic case and the connectorized TC-1 case.

ELECTRICAL SPECIFICATIONS[1,2] (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to 50°C	Guaranteed Specifications $T_C = -55°$ to +85°C	Unit
BW	Frequency Range	10-1000	10-1000	10-1000	MHz
GP	Small Signal Gain (Min.)	10.5	10.0	9.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	2.5	4.0	4.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+8.0	+6.0	+6.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.7:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+19.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+28.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+35.0	—	—	dBm
I_D	DC Current	25	—	—	mA

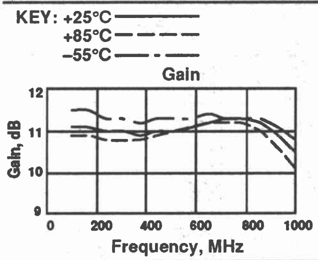
NOTE: 1. Both RF input and RF output pins are at DC ground—no blocking capacitor.
2. PPA = Preliminary

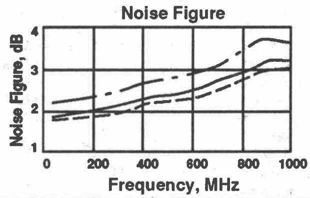
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)





MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

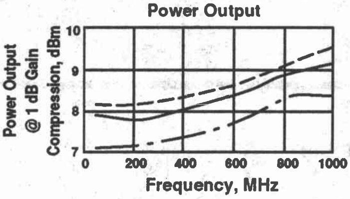
θ_{JC}	105°C/W
Active Transistor Power Dissipation	176 mW
Junction Temperature Above Case Temperature	19°C
MTBF (MIL-HDBK-217E, A_{UF}@ 90°C)	767,000 Hrs.

*For further information, see High Reliability section, p. 17–2.

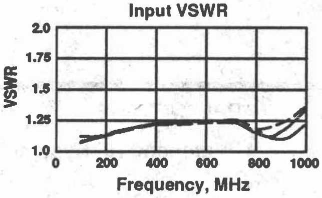
WEIGHT: (typical) PPA—0.5 grams; UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

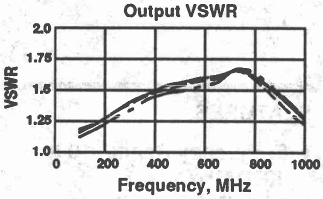
Power Output



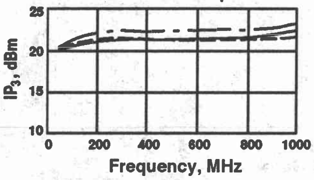
Input VSWR



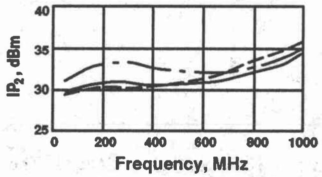
Output VSWR



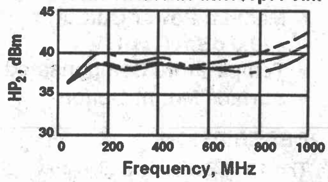
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.09	10.77	160.26	–5.71	.00	1.17	16.80
200.0	1.19	10.67	152.36	–4.78	.43	1.35	16.72
300.0	1.29	10.67	137.24	–3.07	.42	1.53	17.08
400.0	1.36	10.72	122.72	–.75	.39	1.69	17.24
500.0	1.39	10.83	108.58	1.94	.40	1.79	17.32
600.0	1.38	10.95	94.02	4.22	.42	1.81	17.39
700.0	1.32	11.05	78.88	5.71	.44	1.74	17.40
800.0	1.22	11.19	61.92	5.79	.48	1.58	17.35
900.0	1.08	11.14	43.90	4.59	.52	1.35	17.29
1000.0	1.08	10.95	25.03	2.56	.54	1.10	17.20
1100.0	1.25	10.43	5.65	.02	.56	1.15	17.43
1200.0	1.44	9.69	–14.26	–3.04	.51	1.45	17.60
1300.0	1.61	8.73	–31.95	–3.90	.47	1.80	18.14
1400.0	1.73	7.63	–48.41	–3.53	.44	2.16	18.72
1500.0	1.80	6.46	–63.92	–2.20	.00	2.56	19.37

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.043	132.7	10.733	167.3	–16.533	169.4	.074	114.0
150.00	.065	104.3	10.682	159.2	–16.771	161.0	.109	96.5
200.00	.088	87.0	10.607	151.1	–16.946	154.2	.149	83.7
250.00	.113	73.5	10.572	143.2	–16.949	147.6	.181	73.9
300.00	.131	65.9	10.599	135.6	–17.247	140.9	.207	65.2
350.00	.146	57.4	10.632	126.0	–17.155	134.5	.233	57.7
400.00	.154	49.2	10.685	120.6	–17.085	129.0	.252	50.8
450.00	.161	41.2	10.757	113.5	–17.273	123.3	.267	43.5
500.00	.163	34.0	10.784	105.9	–17.291	117.7	.277	36.7
550.00	.158	26.5	10.885	98.6	–17.319	112.0	.280	30.0
600.00	.151	20.2	10.965	91.0	–17.320	106.5	.281	23.6
650.00	.142	12.0	11.017	83.1	–17.373	100.9	.273	17.1
700.00	.125	4.5	11.080	75.0	–17.426	96.1	.259	9.9
750.00	.103	–4.6	11.173	66.5	–17.279	90.3	.239	3.0
800.00	.080	–14.7	11.216	57.7	–17.303	84.6	.211	–4.0
850.00	.052	–24.8	11.235	48.6	17.327	78.6	.176	–11.9
900.00	.017	–53.0	11.167	39.0	–17.281	72.6	.132	–18.4
950.00	.025	177.0	11.113	29.1	–17.233	66.6	.085	–25.8
1000.00	.057	153.7	10.971	19.4	–17.276	60.7	.032	–28.0
1100.00	.131	128.2	10.422	–.7	–17.405	47.6	.083	125.0
1200.00	.188	112.5	9.693	–21.0	–17.669	34.8	.193	112.1
1300.00	.236	88.9	8.713	–39.0	–18.138	22.0	.291	99.6
1400.00	.259	87.9	7.607	–56.0	–18.694	10.0	.368	86.4
1500.00	.279	80.0	6.496	–72.2	–19.401	–1.2	.433	78.7

AVANTEK

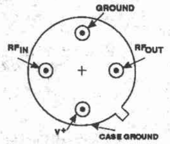
UTO/UTC/PPA 1044 Series
Thin-Film Cascadable Amplifier
10 to 1000 MHz

FEATURES

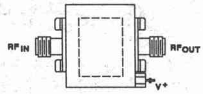
- Frequency Range: 10 to 1000 MHz
- High Dynamic Range
- Low Noise Figure: 2.5 dB (Typ)
- Medium Power Output: +13.0 dBm (Typ)
- Temperature Compensated
- Surface Mount Option

APPLICATIONS

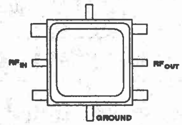
- Wideband RF System Front End



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42



PPA—PP-38, p. 16–35

DESCRIPTION

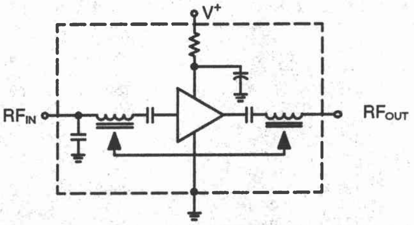
The 1044 Series is a high-power thin-film bipolar RF amplifier using lossless feedback for low noise, high dynamic range, and efficient operation; and active bias circuits to assure good temperature compensation and increased immunity to bias voltage variations. The 1044 Series amplifiers are available in three packages: the surface mount PlanarPak PP-38 (.375 in. x .375 in.) case, the TO-8 hermetic case and the connectorized TC-1 case.

ELECTRICAL SPECIFICATIONS[1] (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	20-1000	20-1000	20-1000	MHz
GP	Small Signal Gain (Min.)	11.0	10.0	9.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)[2]	2.5	4.5	5.0	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)[3]	+13.0	+12.0	+11.0	dBm
—	Input VSWR (Max.)	<1.8:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.8:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+25.0	+22.0	+21.0	dBm
IP_2	Two Tone 2nd Order Intercept Point	+35.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+46.0	—	—	dBm
I_D	DC Current	35	—	—	mA

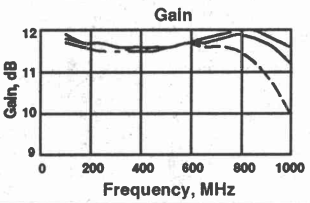
NOTES: 1. Both Rf input and RF output pins are at DC ground—no blocking capacitor/PPA-1044 = Preliminary.
2. PPA-1044 Frequency Range is 20-1000 MHz.
3. PPA-1044, Power Output = 12 dBm (typ) @ 0° to 25°C, 11.5 dBm from 0° to 50°C and 11.0 dBm from –55° to +85°C.

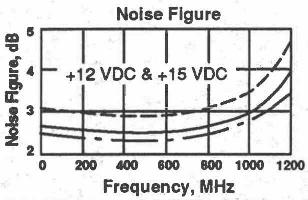
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ——— +85°C – – – – –55°C — · —





MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

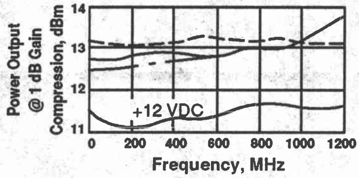
θ_{JC}	105°C/W
Active Transistor Power Dissipation	256 mW
Junction Temperature Above Case Temperature	27°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	955,100 Hrs.

*For further information, see High Reliability section, p. 17–2.

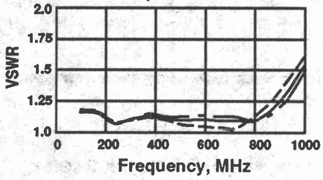
WEIGHT: (typical) PPA—0.5 grams; UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

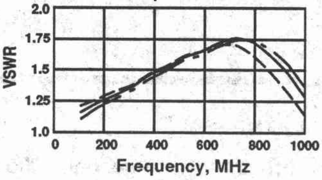
Power Output



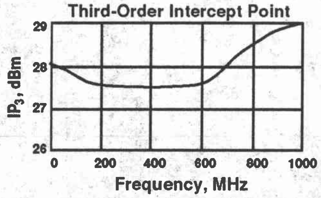
Input VSWR



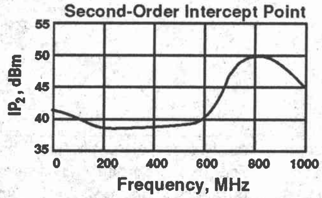
Output VSWR



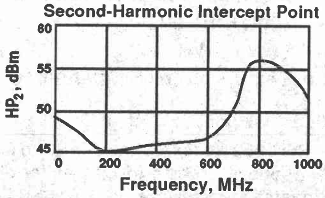
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.13	11.12	168.56	–2.87	.00	1.17	16.40
200.0	1.20	11.02	152.79	–2.76	.43	1.28	16.39
300.0	1.27	11.01	137.95	–1.73	.41	1.41	16.56
400.0	1.31	11.04	123.61	–.21	.39	1.49	16.64
500.0	1.30	11.12	109.58	1.63	.39	1.54	16.66
600.0	1.24	11.19	95.25	3.19	.41	1.52	16.52
700.0	1.18	11.21	80.12	3.78	.43	1.45	16.47
800.0	1.02	11.24	63.73	3.42	.47	1.35	16.44
900.0	1.23	11.04	46.58	2.14	.50	1.30	16.33
1000.0	1.51	10.69	28.83	.28	.52	1.40	16.44

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.063	154.8	11.090	167.6	–16.592	169.3	.077	141.1
150.00	.075	120.6	11.053	159.7	–16.417	161.1	.096	114.7
200.00	.089	101.4	10.958	151.8	–16.537	152.8	.124	100.4
250.00	.108	85.3	10.930	143.9	–16.541	146.0	.145	88.3
300.00	.123	75.5	10.946	136.4	–16.639	139.5	.164	79.6
350.00	.130	65.9	10.980	129.0	–16.626	132.6	.182	71.7
400.00	.134	56.4	11.016	121.7	–16.607	126.4	.193	65.0
450.00	.132	46.7	11.073	114.7	–16.601	120.6	.201	58.7
500.00	.127	39.5	11.084	107.2	–16.583	114.3	.207	53.1
550.00	.114	32.6	11.157	100.1	–16.585	108.4	.204	48.6
600.00	.096	24.7	11.202	92.6	–16.565	102.1	.199	44.9
650.00	.075	18.2	11.221	84.7	–16.503	96.5	.189	41.8
700.00	.046	15.5	11.228	76.9	–16.470	90.3	.176	40.5
750.00	.011	28.3	11.254	68.7	–16.407	84.4	.160	41.8
800.00	.028	156.2	11.233	60.2	–16.406	77.7	.144	46.0
850.00	.072	153.9	11.183	51.5	–16.434	71.0	.135	53.9
900.00	.123	147.5	11.062	42.5	–16.370	64.7	.136	65.3
950.00	.173	140.7	10.896	33.2	–16.366	58.1	.148	75.0
1000.00	.220	133.4	10.691	24.3	–16.460	51.8	.174	82.9
1050.00	.269	123.8	10.378	14.5	–16.543	45.4	.212	85.8
1100.00	.316	116.2	10.038	5.5	–16.648	38.8	.251	86.3
1200.00	.390	101.4	9.272	–11.7	–17.028	26.0	.326	82.0
1300.00	.449	87.8	8.368	–27.1	–17.369	14.3	.393	74.7
1400.00	.486	75.0	7.393	–41.8	–17.792	3.8	.445	67.0
1500.00	.511	64.0	6.429	–55.2	–18.261	–6.5	.484	60.0

AVANTEK

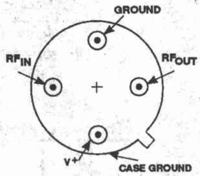
UTO/UTC 1052 Series
Thin-Film Cascadable Amplifier
5 to 1000 MHz

FEATURES

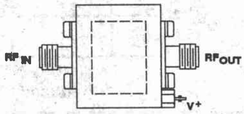
- Frequency Range: 5 to 1000 MHz
- 5-Volt Supply
- Medium Power: +7.5 dBm (Typ)
- High Efficiency
- Low VSWR
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- 5 Volt Systems



UTO—TO-8T, p. 16–48



UTC—TC-1, p.16–42

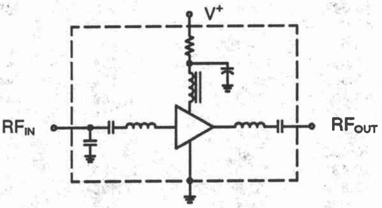
DESCRIPTION

The 1052 Series is a medium-gain thin-film RF amplifier using 5-volt bias for efficient operation. Resistive feedback and active bias assure temperature compensation and increased immunity to bias voltage variations. Low VSWR is maintained by inductive tuning while the RF is coupled through the amplifier by internal blocking capacitors. The 1052 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted)

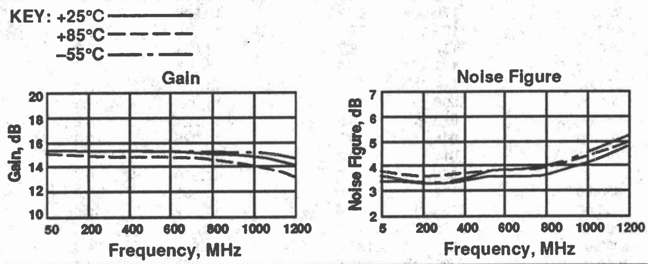
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-1000	5-1000	5-1000	MHz
GP	Small Signal Gain (Min.)	14.3	13.0	12.0	dB
—	Gain Flatness (Max.)	±0.2	±0.7	±1.0	dB
NF	Noise Figure (Max.)	3.7	5.0	5.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+7.5	+6.0	+5.5	dBm
—	Input VSWR (Max.)	<1.3:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.4:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+18.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+28.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+35.0	—	—	dBm
I_D	DC Current	18	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +5 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage .... 9 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

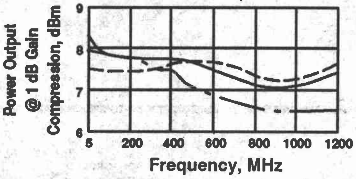
THERMAL CHARACTERISTICS*

θ_{JC} .... 130/130°C/W
Active Transistor Power Dissipation .... 125/175 mW
Junction Temperature Above Case Temperature .... 6°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 1,550,000 Hrs.
*For further information, see High Reliability section, p. 17–2.

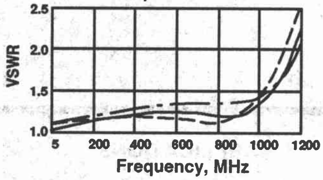
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

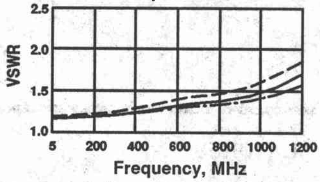
Power Output



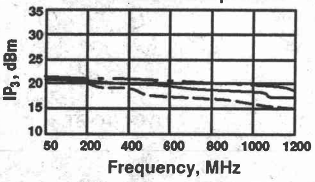
Input VSWR



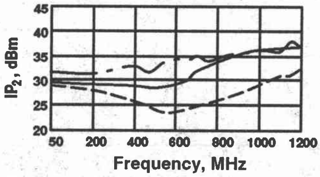
Output VSWR



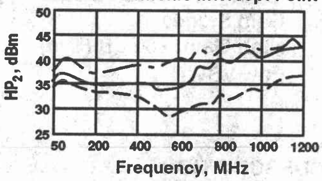
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS BIAS = 5.00 VOLTS

FREQ GHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang	K	GPDEL ns	PHASE DEG
.05	.02	1.1	14.43	172.9	–18.9	–3.6	.08	9.88	1.13	.50	–1.20
.10	.03	39.2	14.42	163.8	–18.9	–9.6	.08	4.99	1.13	.50	–1.44
.15	.04	42.7	14.41	155.2	–18.9	–15.0	.09	2.07	1.13	.48	–1.27
.20	.05	40.7	14.40	146.7	–19.0	–20.1	.09	–.25	1.13	.47	–.95
.25	.07	36.2	14.39	138.3	–19.0	–25.5	.10	–2.86	1.13	.47	–.54
.30	.08	30.3	14.37	130.1	–19.1	–30.7	.10	–5.75	1.13	.46	0.00
.35	.09	23.3	14.36	121.6	–19.1	–35.8	.11	–9.32	1.13	.47	.35
.40	.10	16.7	14.34	113.2	–19.2	–41.3	.12	–12.75	1.14	.47	.71
.45	.11	9.0	14.33	104.8	–19.3	–46.4	.12	–16.88	1.14	.47	1.13
.50	.11	1.5	14.33	96.3	–19.4	–51.8	.13	–21.61	1.14	.47	1.40
.55	.11	–4.9	14.32	87.7	–19.4	–57.1	.14	–26.32	1.14	.48	1.58
.60	.11	–11.1	14.32	78.9	–19.5	–62.6	.14	–30.87	1.14	.49	1.64
.65	.11	–16.2	14.31	70.2	–19.6	–68.2	.15	–34.73	1.15	.48	1.69
.70	.11	–19.8	14.31	61.2	–19.7	–73.6	.16	–38.59	1.16	.50	1.50
.75	.10	–21.7	14.30	52.1	–19.8	–79.1	.16	–42.27	1.16	.51	1.24
.80	.09	–18.9	14.30	42.9	–20.0	–85.0	.17	–45.28	1.17	.51	.79
.85	.09	–11.3	14.29	33.4	–20.1	–90.7	.18	–47.90	1.18	.53	.11
.90	.09	.5	14.27	23.7	–20.3	–96.5	.18	–49.88	1.19	.54	–.84
.95	.11	10.9	14.24	13.6	–20.4	–102.5	.19	–51.84	1.20	.56	–2.10
1.00	.15	16.6	14.18	3.1	–20.6	–108.8	.20	–53.84	1.21	.58	–3.80
1.05	.19	16.6	14.08	–7.8	–20.8	–115.1	.22	–55.73	1.22	.60	
1.10	.25	12.8	13.92	–19.0	–21.1	–121.1	.24	–57.73	1.23	.62	
1.15	.32	6.9	13.69	–30.6	–21.4	–127.7	.25	–60.48	1.25	.65	
1.20	.39	–.5	13.38	–42.4	–21.7	–134.0	.27	–63.98	1.26	.66	
1.25	.46	–8.7	12.95	–54.5	–22.1	–140.1	.29	–68.19	1.27	.67	
1.30	.53	–17.6	12.40	–66.4	–22.5	–146.3	.31	–72.90	1.28	.66	
1.35	.60	–26.7	11.74	–78.3	–23.0	–151.8	.33	–77.94	1.29	.66	
1.40	.66	–35.6	10.98	–89.7	–23.4	–157.4	.34	–83.29	1.31	.64	
1.45	.71	–44.1	10.14	–100.7	–23.2	–162.2	.35	–88.84	1.32	.61	
1.50	.75	–52.2	9.24	–111.2	–24.3	–167.0	.35	–94.42	1.34	.58	
1.55	.79	–59.8	8.30	–121.3	–24.6	–171.9	.35	–99.92	1.37	.56	
1.60	.22	–66.8	7.32	–130.8	–25.0	–176.5	.35	–105.48	1.40	.52	
1.65	.84	–73.5	6.33	–139.2	–25.3	179.6	.34	–111.13	1.45	.50	
1.70	.85	–79.6	5.31	–148.4	–25.7	175.1	.34	–116.61	1.51	.48	
1.75	.87	–85.3	4.29	–156.6	–26.0	171.2	.33	–122.27	1.60	.46	
1.80	.88	–90.5	3.29	–164.5	–26.2	166.8	.32	–127.94	1.70	.44	
1.85	.88	–95.4	2.29	–171.9	–26.4	162.8	.31	–133.67	1.82	.42	
1.90	.89	–100.1	1.30	–179.3	–26.6	158.6	.30	–139.76	1.99	.40	
1.95	.89	–104.4	.32	173.6	–26.8	154.2	.29	–146.09	2.16	.40	
2.00	.90	–108.7	–.67	166.6	–27.0	149.2	.28	–152.28	2.40	.38	
2.05	.90	–112.5	–1.61	159.7	–27.2	145.5	.27	–158.86	2.58	.38	
2.10	.90	–116.4	–2.59	153.2	–27.3	140.5	.26	–165.48	2.87	.37	
2.15	.91	–120.1	–3.54	146.2	–27.5	136.1	.26	–171.93	3.18	.38	
2.20	.91	–123.6	–4.49	139.9	–27.7	131.6	.25	–178.40	3.60	.34	
2.25	.91	–127.1	–5.44	133.7	–27.7	126.8	.25	175.33	4.04	.36	
2.30	.91	–130.5	–6.38	127.2	–27.9	122.3	.25	169.58	4.54	.37	
2.35	.91	–133.9	–7.36	121.0	–28.1	117.7	.25	164.06	5.18	.33	
2.40	.91	–137.4	–8.32	114.6	–28.3	112.7	.25	159.16	5.88	.36	
2.45	.91	–140.9	–9.30	108.4	–28.4	107.9	.26	154.89	6.63	.36	
2.50	.90	–144.3	–10.30	101.9	–28.6	103.6	.26	151.29	7.80	.35	

LINEARIZATION RANGE: .05 to 1.00 GHz

AVANTEK

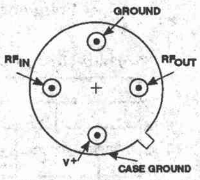
UTM-1053
Thin-Film Cascadable Amplifier
5 to 1000 MHz

FEATURES

- Frequency Range: 5 to 1000 MHz
- MODAMP Silicon Monolithic Gain Stages
- High Gain: +30 dB (Typ)
- Low VSWR

APPLICATIONS

- IF/RF Amplification



UTO—TO-8T, p. 16–48

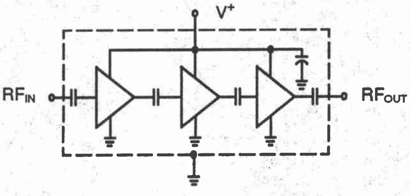
DESCRIPTION

The UTM-1053 contains three silicon monolithic microwave integrated circuit RF amplifiers mounted on a thin-film substrate to provide wideband, high gain performance. Internal blocking capacitors couple the RF through this three-stage amplifier. The UTM-1053 is available in the TO-8 hermetic package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

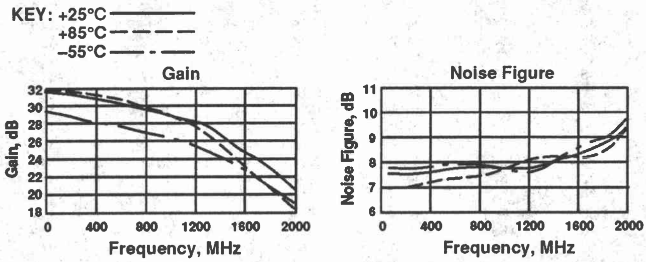
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-1000	5-1000	5-1000	MHz
GP	Small Signal Gain (Min.)	30.0	27.0	25.0	dB
—	Gain Flatness (Max.)	±1.5	±2.0	±2.0	dB
NF	Noise Figure (Max.)	8.0	9.0	9.0	dB
$P_{1 dB}$	Power Output @ +1 dB Compression (Min.)	+9.0	+5.0	+4.0	dBm
—	Input VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+21.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+30.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+35.0	—	—	dBm
I_D	DC Current	90	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+17 dBm
Operating Case Temperature	–55°C to +71°C
Storage Temperature	–62°C to +71°C
"R" Series Burn-In Temperature	+71°C

THERMAL CHARACTERISTICS

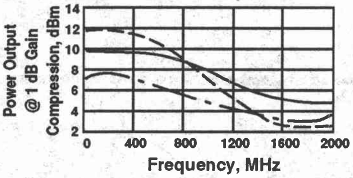
θ_{JC}[1]	130/130/130°C/W
Active Transistor Power Dissipation[1]	125/125/175 mW
Junction Temperature Above Case Temperature[1]	16/16/23°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	535,000 Hrs.

Note 1: Values refer to 1st and 2nd stage transistors respectively.

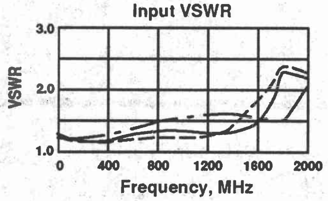
WEIGHT: (typical) UTO — 2.1 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

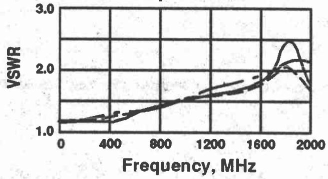
Power Output



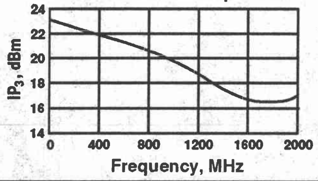
Input VSWR



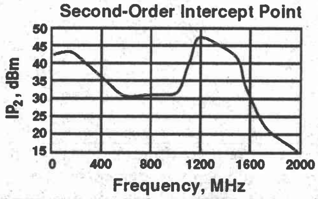
Output VSWR



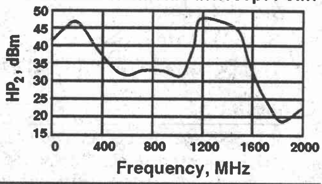
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.15	31.10	2.01	.00	1.06	43.20
200.0	1.08	30.79	.12	.74	1.13	48.73
300.0	1.12	30.46	−.76	.67	1.15	58.84
400.0	1.16	30.11	−.94	.68	1.20	55.41
500.0	1.22	29.90	−.96	.66	1.24	51.72
600.0	1.27	29.77	−.07	.65	1.30	54.65
700.0	1.31	29.48	.17	.67	1.33	49.54
800.0	1.36	29.20	.60	.68	1.39	51.27
900.0	1.39	28.99	.34	.69	1.43	49.36
1000.0	1.41	28.85	−.55	.70	1.49	47.69

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.055	−166.8	31.488	159.6	−49.622	23.4	.041	−18.5
150.00	.044	−162.6	31.381	148.6	−52.352	8.1	.048	−16.8
200.00	.044	−151.7	31.268	137.8	−54.150	39.4	.058	−24.8
250.00	.049	−139.7	31.171	128.3	−55.565	80.8	.064	−33.3
300.00	.051	−127.9	31.000	118.6	−59.922	73.1	.067	−39.4
350.00	.059	−118.6	30.855	109.3	−62.893	30.4	.080	−45.1
400.00	.069	−115.4	30.656	100.1	−58.065	91.3	.088	−50.9
450.00	.080	−109.4	30.510	90.7	−56.606	54.3	.098	−55.2
500.00	.090	−109.4	30.398	81.6	−59.501	70.4	.110	−60.7
550.00	.101	−108.8	30.297	72.5	−60.129	47.5	.121	−64.0
600.00	.113	−110.1	30.230	63.6	−55.868	61.5	.133	−67.3
650.00	.123	−110.7	30.113	54.6	−53.130	96.5	.144	−69.9
700.00	.132	−112.5	29.959	45.6	−55.095	70.4	.152	−73.8
750.00	.140	−115.8	29.853	36.4	−54.666	85.4	.164	−77.6
800.00	.149	−119.4	29.662	26.8	−51.949	80.2	.176	−78.5
850.00	.155	−122.0	29.525	16.8	−53.425	106.0	.181	−79.9
900.00	.159	−124.5	29.375	6.9	−51.872	93.9	.186	−82.6
950.00	.166	−128.1	29.324	−3.2	−50.651	113.6	.198	−84.3
1000.00	.169	−130.1	29.172	−13.0	−51.330	100.3	.206	−84.9
1100.00	.167	−132.8	28.807	−32.5	−49.174	118.9	.216	−88.3
1200.00	.163	−132.6	28.347	−52.9	−46.878	123.1	.233	−89.2
1300.00	.156	−129.7	27.681	−72.8	−46.023	116.7	.242	−91.5
1400.00	.157	−123.8	26.792	−92.0	−44.046	115.0	.259	−92.8
1500.00	.171	−117.3	25.869	−109.8	−42.855	112.2	.270	−94.0
1600.00	.204	−112.8	24.811	−126.6	−40.686	112.2	.301	−97.7
1700.00	.222	−109.9	23.520	−142.2	−38.903	108.0	.292	−100.5
1800.00	.389	−95.2	23.283	−154.1	−35.449	53.8	.427	−93.3
1900.00	.394	−126.1	21.584	−175.4	−44.824	72.7	.352	−120.1
2000.00	.363	−137.2	20.254	172.3	−41.273	95.2	.280	−123.3

AVANTEK

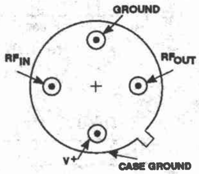
UTO/UTC 1054 Series
Thin-Film Cascadable Amplifier
5 to 1000 MHz

FEATURES

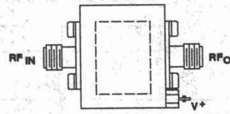
- Frequency Range: 5 to 1000 MHz
- High Gain: 24 dB (Typ)
- Low Noise Figure: 3.5 dB (Typ)
- 5-Volt Supply
- High Dynamic Range
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- 5 Volt Systems



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

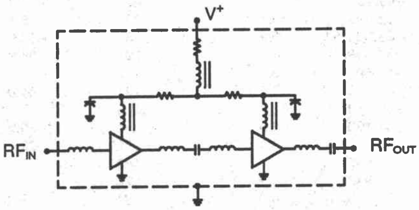
Description

The 1054 Series is a 5-volt two-stage, thin-film RF amplifier using active bias and resistive feedback for temperature compensation and increased immunity to bias voltage variations. Low VSWR is maintained by inductive tuning while the RF is coupled through the amplifier by internal blocking capacitors. The 1054 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted)

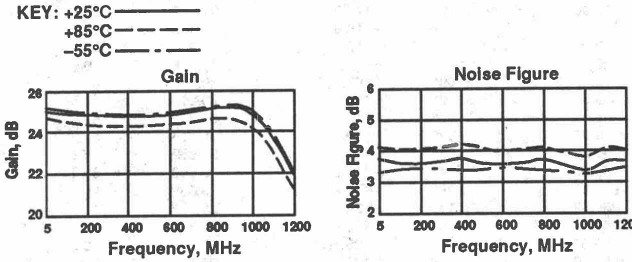
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			$T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	
BW	Frequency Range	5-1000	5-1000	5-1000	MHz
GP	Small Signal Gain (Min.)	24.0	23.5	23	dB
—	Gain Flatness (Max.)	±0.3	±0.7	±0.7	dB
NF	Noise Figure (Max.)	3.5	4.0	4.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+10.5	+9.5	+9.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+21.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+38.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+44.0	—	—	dBm
I_D	DC Current	40	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +5 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage .... 10.0 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

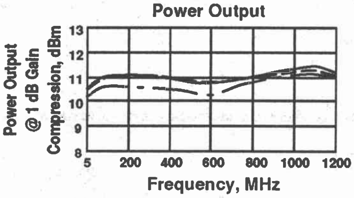
THERMAL CHARACTERISTICS*

θ_{JC} .... 105/75°C/W
Active Transistor Power Dissipation .... 48/109 mW
Junction Temperature Above Case Temperature ... 5.0/8.3°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 575,700 Hrs.
*For further information, see High Reliability section, p. 17–2.

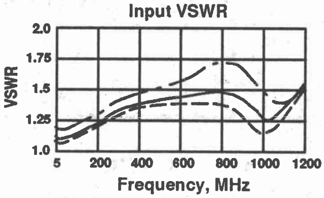
WEIGHT: (typical) UTO — 1.7 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

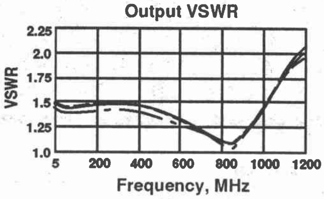
Power Output



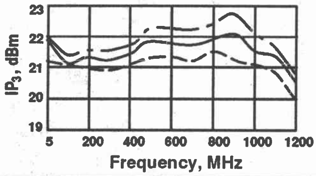
Input VSWR



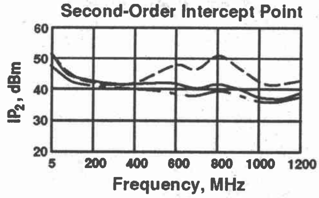
Output VSWR



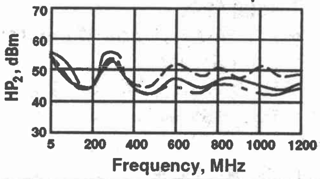
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

NUMERICAL READINGS

BIAS = 5 VOLTS

FREQ GHz	GPDEL ns	PHASE DEG	FREQ GHz	GPDEL ns	PHASE DEG
.050	.78	–2.18	.525	.73	2.76
.075	.78	–2.30	.550	.73	3.11
.100	.77	–2.37	.575	.73	3.46
.125	.77	–2.50	.600	.74	3.64
.150	.75	–2.40	.625	.75	3.79
.175	.74	–2.18	.650	.75	3.90
.200	.74	–1.91	.675	.76	3.91
.225	.74	–1.78	.700	.77	3.80
.250	.71	–1.31	.725	.79	3.56
.275	.72	–.90	.750	.80	3.20
.300	.73	–.65	.775	.82	2.71
.325	.72	–.29	.800	.83	2.05
.350	.73	.05	.825	.85	1.25
.375	.72	.40	.850	.87	.25
.400	.71	.82	.825	.89	–.86
.425	.70	1.32	.900	.92	–2.29
.450	.73	1.66	.925	.93	–3.88
.475	.72	2.06	.950	.96	–5.59
.500	.72	2.43	.975	.98	–7.47
			1.000	.96	9.28

LINEARIZATION RANGE: .05 to 1.00 GHz

S-PARAMETERS

BIAS = 5 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
.005	.07	–178.1	24.6	20.5	–34.0	21.1	.21	166.95
.010	.05	–179.7	24.6	7.8	–34.0	9.8	.19	172.71
.020	.04	–175.4	24.6	.1	–33.9	3.6	.18	174.29
.030	.04	–171.7	24.6	–4.4	–33.9	1.0	.18	174.63
.040	.04	–167.7	24.6	–7.9	–33.9	–.8	.18	174.60
.050	.04	–164.4	24.6	–11.1	–33.9	–2.4	.18	174.50
.100	.06	–152.2	24.6	–25.4	–34.0	–7.5	.18	173.04
.150	.07	–148.8	24.5	–38.7	–34.0	11.4	.18	171.17
.200	.09	–150.3	24.5	–51.8	–34.0	–15.4	.18	168.86
.250	.11	–154.5	24.4	–64.8	–34.1	–19.7	.18	166.00
.300	.13	–159.8	24.4	–77.7	–34.1	–23.3	.19	162.32
.350	.14	–165.6	24.4	–90.6	–34.2	–27.4	.19	157.86
.400	.16	–172.5	24.4	–103.5	–34.2	–31.0	.18	152.91
.450	.16	–179.3	24.4	–116.5	–34.3	–34.5	.18	147.27
.500	.17	171.3	24.4	–129.6	–34.4	–38.6	.17	141.05
.550	.17	162.0	24.5	–142.8	–34.3	–42.6	.15	134.50
.600	.18	151.4	24.5	–156.3	–34.4	–46.5	.14	127.59
.650	.18	139.9	24.6	–169.9	–34.4	–50.5	.12	121.05
.700	.19	127.6	24.6	176.1	–34.4	–54.6	.10	115.30
.750	.19	114.9	24.7	161.8	–34.4	–59.5	.08	111.99
.800	.19	101.4	24.8	146.9	–34.6	–64.1	.05	116.92
.850	.19	86.8	24.8	131.4	–34.6	–69.3	.03	152.00
.900	.17	69.5	24.8	115.2	–34.8	–74.2	.06	–158.75
.950	.15	47.1	24.7	98.1	–35.1	–79.1	.11	–149.77
1.000	.12	15.1	24.4	80.4	–35.5	–83.9	.17	–153.20
1.100	.14	–63.7	23.3	44.8	–36.8	–91.3	.28	–168.85
1.200	.22	–105.7	21.5	11.6	–37.6	–91.7	.33	173.92
1.250	.24	–117.8	20.4	–3.5	–37.6	–89.5	.33	165.62
1.300	.25	–126.5	19.3	–17.9	–37.4	–89.8	.31	157.44
1.400	.23	–139.1	17.1	–44.8	–36.5	–92.0	.26	139.07
1.500	.17	–144.5	14.9	–70.1	–35.5	–102.1	.19	115.14
2.000	.26	–97.6	4.2	–175.1	–34.8	–159.0	.11	–83.31
3.000	.76	171.8	–16.4	45.9	–36.5	105.7	.41	136.14

AVANTEK

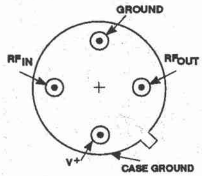
UTM-1056
Thin-Film Cascadable Amplifier
10 to 1000 MHz

FEATURES

- Frequency Range: 10 to 1000 MHz
- MODAMP Silicon Monolithic Gain Stages
- High Gain: 26.5 dB (Typ)
- Low VSWR

APPLICATIONS

- IF/RF Amplification



UTO—TO-8T, p. 16–48

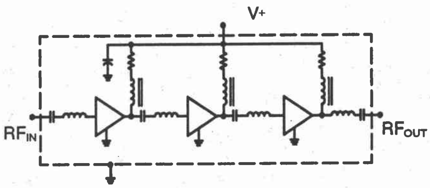
DESCRIPTION

The UTM-1056 contains three monolithic microwave integrated circuits mounted on a thin-film substrate to provide an RF amplifier suitable for wideband, high-gain applications. Internal blocking capacitors couple the RF through this three-stage amplifier. The UTM-1056 is offered in the TO-8 hermetic package.

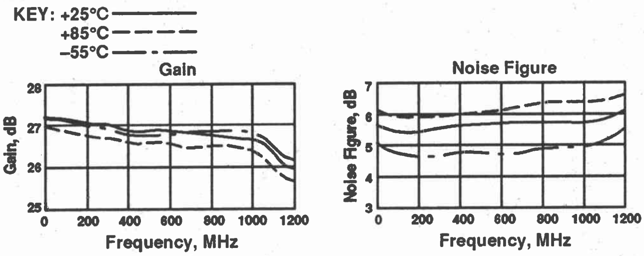
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range	10-1000	10-1000	10-1000	MHz
GP	Small Signal Gain (Min.)	26.5	25.5	25.0	dB
—	Gain Flatness (Max.)	±0.2	±0.7	±1.0	dB
NF	Noise Figure (Max.)	5.5	6.5	7.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+13.5	+12.0	+10.5	dBm
—	Input VSWR (Max.)	1.4:1	1.7:1	1.7:1	—
—	Output VSWR (Max.)	1.4:1	1.7:1	1.7:1	—
IP_3	Two Tone 3rd Order Intercept Point	+26.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+40.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+45.0	—	—	dBm
I_D	DC Current	135	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+20 dBm
Operating Case Temperature	–55°C to +100°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+100°C

THERMAL CHARACTERISTICS

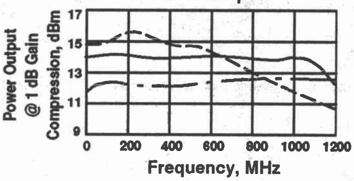
θ_{JC}[1]	100/90/90°C/W
Active Transistor Power Dissipation[1]	175/240/308 mW
Junction Temperature Above Case Temperature[1]	18/22/28°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	284,100 Hrs.

Note 1: Values refer to 1st and 2nd stage transistors respectively.

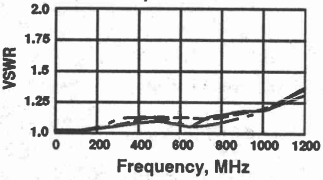
WEIGHT: (typical) UTO — 2.1 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

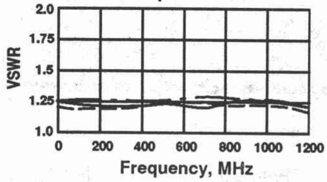
Power Output



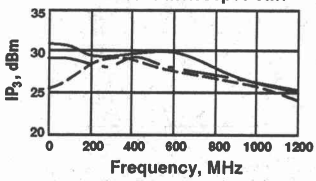
Input VSWR



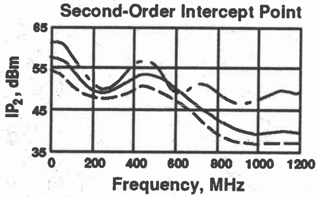
Output VSWR



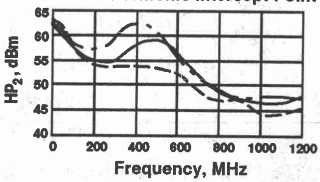
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEV	GPDEL ns	VSWR OUT
100.0	1.06	27.11	–1.39	.00	1.16
200.0	1.04	26.99	–.77	.67	1.21
300.0	1.05	26.73	–.48	.67	1.23
400.0	1.06	26.48	.18	.66	1.26
500.0	1.05	26.52	.94	.65	1.30
600.0	1.06	26.76	2.49	.67	1.30
700.0	1.13	26.68	1.91	.71	1.31
800.0	1.18	26.70	.47	.72	1.34
900.0	1.22	26.70	–.39	.73	1.31
1000.0	1.28	26.49	–2.96	.77	1.24
1100.0	1.36	26.12		.79	1.14
1200.0	1.44	25.73		.79	1.09
1300.0	1.55	25.00		.80	1.30
1400.0	1.70	23.67		.78	1.63
1500.0	1.68	23.16		.79	1.87
1600.0	1.72	21.70		.81	2.50
1700.0	1.77	19.89		.75	3.20
1800.0	1.81	17.56		.70	3.82
1900.0	1.76	15.65		.63	4.18
2000.0	1.70	13.62		.00	4.46

LINEARIZATION RANGE: 100.0 to 1000.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS
135 mA

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.005	66.7	26.968	155.9	–58.461	–86.5	.095	4.2
200.00	.014	71.0	26.819	129.9	–51.146	–18.7	.096	7.3
300.00	.022	60.6	26.771	107.9	–62.887	29.9	.105	4.0
400.00	.029	66.4	26.495	82.6	–52.593	–9.4	.117	1.2
500.00	.016	74.1	26.567	59.1	–55.136	–.8	.132	–4.7
600.00	.017	95.3	26.513	35.1	–52.968	–21.2	.134	–13.2
700.00	.062	112.8	26.689	10.1	–51.633	–26.9	.128	–18.2
800.00	.074	99.2	26.636	–15.3	–51.910	–39.9	.148	–26.9
900.00	.078	91.6	26.532	–41.2	–52.173	–66.5	.144	–44.3
1000.00	.107	84.8	26.515	–68.2	–53.165	–61.3	.115	–64.6
1100.00	.134	84.6	25.953	–96.9	–52.159	–82.0	.060	–99.7
1200.00	.170	74.9	25.763	–125.3	–51.498	–78.5	.041	151.7
1300.00	.213	67.3	24.976	–153.2	–55.669	–95.1	.123	96.2
1400.00	.241	55.5	24.022	178.3	–57.330	–76.3	.235	66.2
1500.00	.284	39.1	22.711	150.5	–50.292	.6	.299	41.7
1600.00	.257	27.7	21.627	120.4	–48.659	–44.7	.433	31.8
1700.00	.256	21.9	19.874	94.0	–50.520	–117.8	.524	12.1
1800.00	.274	15.5	17.720	68.4	–58.857	–33.9	.580	–5.3
1900.00	.267	6.7	15.558	45.4	–55.695	–39.2	.618	–18.5
2000.00	.258	–.8	13.380	25.0	–58.326	–30.1	.643	–29.6

AVANTEK

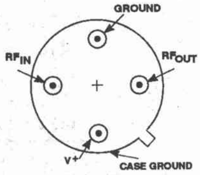
UTM-1057
Thin-Film Cascadable Amplifier
10 to 1000 MHz

FEATURES

- Frequency Range: 10 to 1000 MHz
- MODAMP Silicon Monolithic Gain Stages
- High Gain: 27.0 dB (Typ)
- Low VSWR

APPLICATIONS

- IF/RF Amplification



UTO—TO-8T, p. 16–48

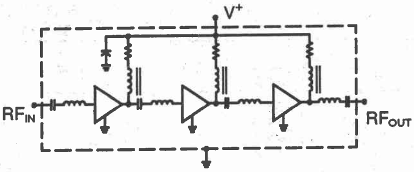
DESCRIPTION

The UTM-1057 contains three monolithic microwave integrated circuits mounted on a thin-film substrate to provide a RF amplifier suitable for wideband, high-gain applications. Internal blocking capacitors couple the RF through this three-stage amplifier. The UTM-1057 is available in the TO-8 hermetic package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

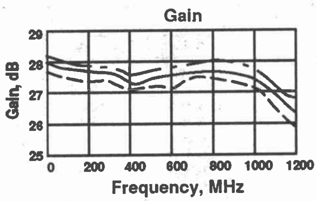
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to 50°C	$T_C = -55°$ to +85°C	Unit
BW	Frequency Range	10-1000	10-1000	10-1000	MHz
GP	Small Signal Gain (Min.)	27.0	26.0	25.5	dB
—	Gain Flatness (Max.)	±0.2	±0.7	±1.0	dB
NF	Noise Figure (Max.)	5.5	6.5	7.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+15.5	+14.0	+12.5	dBm
—	Input VSWR (Max.)	1.4:1	1.7:1	1.7:1	—
—	Output VSWR (Max.)	1.3:1	1.7:1	1.7:1	—
IP_3	Two Tone 3rd Order Intercept Point	+29.0	—	—	dBm
IP_3	Two Tone 2nd Order Intercept Point	+42.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+48.0	—	—	dBm
I_D	DC Current	170	—	—	mA

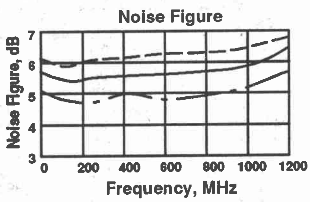
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C — — —
–55°C — - —





MAXIMUM RATINGS

DC Voltage .... 17 Volts
Continuous RF Input Power .... +20 dBm
Operating Case Temperature .... –55°C to +100°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +100°C

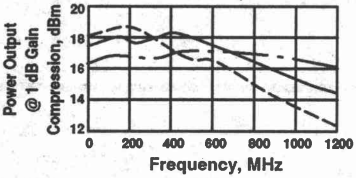
THERMAL CHARACTERISTICS

θ_{JC}[1] .... 100/90/90°C/W
Active Transistor Power Dissipation[1] .... 175/300/480 mW
Junction Temperature Above Case Temperature[1] . 18/27/43°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 161,700 Hrs.
Note 1: Values refer to 1st and 2nd stage transistors respectively.

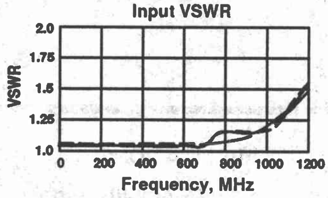
WEIGHT: (typical) UTO — 2.1 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

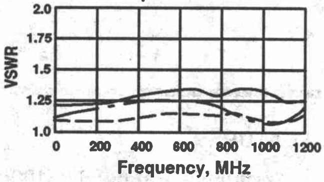
Power Output



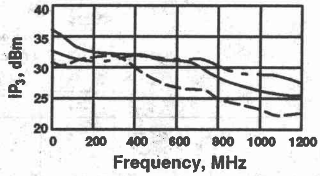
Input VSWR



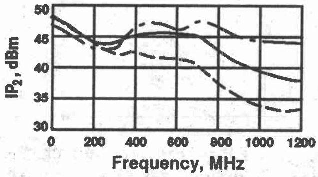
Output VSWR



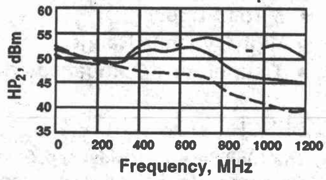
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEV	GPDEL ns	VSWR OUT
100.0	1.05	27.60	–2.30	.00	1.14
200.0	1.05	27.49	–1.39	.66	1.16
300.0	1.06	27.27	–.62	.66	1.18
400.0	1.06	27.06	.63	.65	1.21
500.0	1.05	27.11	1.84	.65	1.24
600.0	1.07	27.48	3.48	.68	1.22
700.0	1.15	27.46	2.76	.72	1.24
800.0	1.20	27.52	.95	.74	1.25
900.0	1.26	27.55	–.81	.76	1.21
1000.0	1.34	27.28	–4.54	.80	1.11
1100.0	1.43	26.74		.80	1.07
1200.0	1.53	26.07		.79	1.27
1300.0	1.65	25.02		.74	1.62
1400.0	1.70	23.82		.76	1.82
1500.0	1.71	23.06		.80	2.54
1600.0	1.75	21.50		.77	3.34
1700.0	1.80	19.76		.73	4.29
1800.0	1.82	17.35		.67	5.03
1900.0	1.75	15.42		.60	5.34
2000.0	1.66	13.42		.00	5.57

LINEARIZATION RANGE: 100.0 to 1000.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.008	114.1	27.481	156.1	–48.333	19.4	.063	2.7
200.00	.019	71.2	27.369	130.1	–54.226	–30.7	.076	11.8
300.00	.028	62.1	27.334	108.1	–59.069	–56.6	.085	11.6
400.00	.036	60.9	27.044	83.6	–55.500	–53.7	.094	10.4
500.00	.025	61.7	27.153	60.4	–58.835	–4.4	.108	–6.7
600.00	.015	108.1	27.207	38.7	–53.476	–7.4	.106	–6.0
700.00	.077	101.7	27.355	10.7	–53.406	–59.9	.109	5.0
800.00	.082	99.9	27.463	–14.4	–52.683	–43.3	.119	–13.2
900.00	.095	99.0	27.429	–41.3	–53.902	–69.2	.104	–36.1
1000.00	.130	89.5	27.363	–69.8	–52.103	–53.8	.060	–65.7
1100.00	.165	84.9	26.608	–99.6	–52.052	–80.9	.033	161.3
1200.00	.202	74.7	26.158	–128.6	–55.613	–49.7	.121	113.0
1300.00	.241	66.5	25.094	–155.9	–62.287	–98.2	.226	88.4
1400.00	.272	54.2	23.788	176.9	–55.422	37.3	.334	60.2
1500.00	.251	40.3	22.988	150.6	–48.524	–32.6	.412	50.9
1600.00	.268	33.5	21.404	121.2	–49.941	–54.1	.551	31.9
1700.00	.263	27.5	19.688	95.8	–53.413	–108.7	.625	12.2
1800.00	.273	21.7	17.533	71.2	–54.797	–21.7	.662	–5.3
1900.00	.264	12.6	15.331	49.3	–55.126	–18.8	.687	–18.7
2000.00	.242	6.4	13.173	30.1	–52.753	–34.2	.707	–30.5

AVANTEK

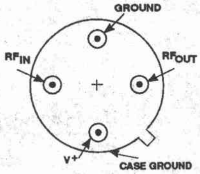
UTO/UTC 1058 Series
Thin-Film Cascadable Amplifier
5 to 1000 MHz

FEATURES

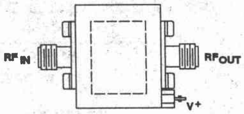
- Frequency Range: 5 to 1000 MHz
- High Gain: 24.5 dB (Typ)
- Low Noise Figure: 3.7 dB (Typ)
- 5 Volt Supply
- High Dynamic Range
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- 5 Volt Systems



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

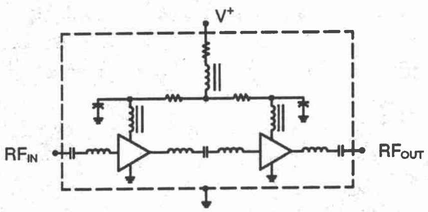
DESCRIPTION

The 1058 Series is a wideband, 5-volt, two-stage, thin-film RF amplifier using active bias and resistive feedback for temperature compensation and increased immunity to bias voltage variations. Low VSWR is maintained by inductive tuning, while the RF is coupled through the amplifier by internal blocking capacitors. The 1058 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted)

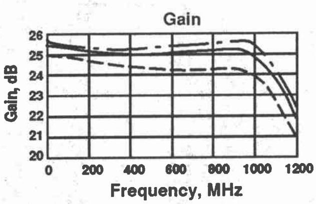
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-1000	5-1000	5-1000	MHz
GP	Small Signal Gain (Min.)	24.5	23.5	22.5	dB
—	Gain Flatness (Max.)	±0.3	±0.7	±1.0	dB
NF	Noise Figure (Max.)	3.7	4.2	4.7	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+13.5	+13.0	+12.0	dBm
—	Input VSWR (Max.)	1.6:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+22.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+23.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+28.0	—	—	dBm
I_D	DC Current	70	—	—	mA

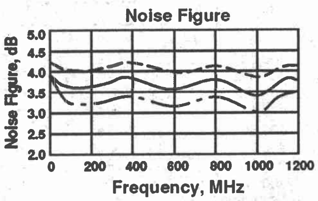
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +5 VDC unless otherwise noted)

KEY: +25°C———— +85°C – – – – –55°C —·—





MAXIMUM RATINGS

DC Voltage	9.0 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

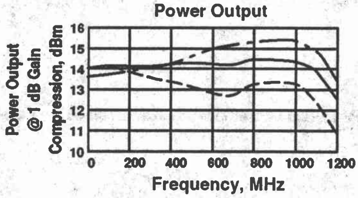
θ_{JC}	105/75°C/W
Active Transistor Power Dissipation	48/228 mW
Junction Temperature Above Case Temperature	5.0/17.0°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	572,300 Hrs.

*For further information, see High Reliability section, p. 17–2.

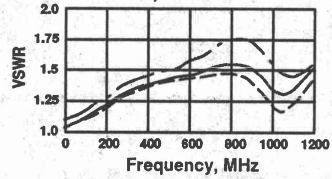
WEIGHT: (typical) UTO— 1.7 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

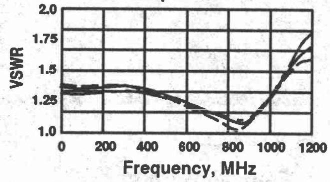
Power Output



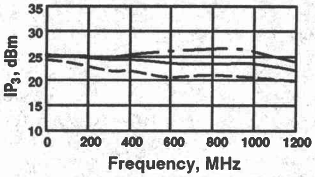
Input VSWR



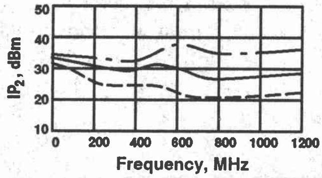
Output VSWR



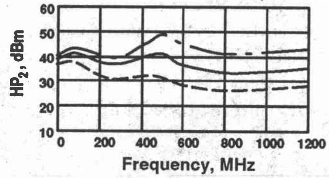
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

NUMERICAL READINGS

BIAS = 5 VOLTS

FREQ GHz	GPDEL ns	PHASE DEG	FREQ GHz	GPDEL ns	PHASE DEG
.050	.80	–1.57	.525	.72	2.57
.075	.80	–1.88	.550	.71	2.93
.100	.78	–2.11	.575	.72	3.19
.125	.77	–2.31	.600	.73	3.45
.150	.76	–2.31	.625	.74	3.61
.175	.73	–2.08	.650	.75	3.70
.200	.73	–1.87	.675	.75	3.72
.225	.74	–1.78	.700	.76	3.70
.250	.71	–1.34	.725	.78	3.47
.275	.71	–.98	.750	.79	3.14
.300	.73	.74	.775	.81	2.67
.325	.71	–.37	.800	.82	2.03
.350	.72	–.11	.825	.84	1.30
.375	.72	.10	.850	.86	.37
.400	.71	.67	.825	.88	–.79
.425	.71	1.11	.900	.91	–2.11
.450	.71	1.47	.925	.92	–3.59
.475	.72	1.81	.950	.94	–5.27
.500	.71	2.22	.975	.96	–7.13
			1.000	.96	–8.95

LINEARIZATION RANGE: .05 to 1.00 GHz

S-PARAMETERS

BIAS = 5 VOLTS

FREQ MHz	S_{11}		S_{21}		S_{12}		S_{22}	
	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
.005	.03	130.7	25.2	22.4	–34.0	23.4	.23	166.76
.010	.01	130.2	25.1	8.5	–34.1	10.6	.21	173.54
.020	.01	124.7	25.0	.1	–34.1	4.1	.21	175.80
.030	.01	–113.1	25.0	–4.5	–34.2	.7	.21	176.20
.040	.02	–112.4	25.0	–8.1	–34.2	–1.0	.21	176.11
.050	.02	111.3	25.0	–11.4	–34.3	–2.3	.21	175.77
.100	.04	118.3	24.9	–25.8	–34.2	–7.5	.21	173.45
.150	.07	124.7	24.8	–39.2	–34.4	–11.3	.21	171.44
.200	.09	–130.9	24.8	–52.4	–34.4	–15.2	.21	168.94
.250	.11	138.4	24.7	–65.4	–34.4	–19.1	.21	165.78
.300	.13	–147.1	24.7	–78.3	–34.5	–23.1	.21	162.66
.350	.14	–154.4	24.7	–91.2	–34.6	–26.7	.21	158.54
.400	.15	162.6	24.6	–104.2	–34.6	–30.3	.21	153.53
.450	.16	–171.3	24.6	–117.2	–34.6	–33.9	.20	148.61
.500	.17	179.2	24.6	–130.3	–34.6	–38.8	.18	143.06
.550	.18	169.1	24.6	–143.4	–34.8	–42.1	.17	137.19
.600	.18	158.0	24.6	–156.8	–34.6	–46.0	.15	131.53
.650	.19	146.1	24.7	–170.3	–34.6	–49.5	.13	126.11
.700	.20	133.7	24.7	175.9	–34.6	–54.1	.12	121.82
.750	.21	121.2	24.7	161.8	–34.7	–58.3	.10	120.25
.800	.22	108.3	24.8	147.3	34.7	–63.5	.07	125.09
.850	.22	94.3	24.8	132.1	–34.8	–68.0	.06	146.37
.900	.20	78.5	24.8	116.2	–34.9	–73.3	.06	–176.47
.950	.18	58.6	24.8	99.4	–35.0	–78.2	.11	–158.67
1.000	.15	31.8	24.5	82.0	–35.3	–84.2	.17	–156.81
1.100	.14	–46.1	23.4	46.4	–36.5	–93.5	.29	–168.07
1.200	.21	–96.7	21.6	13.4	–37.6	–96.2	.35	176.45
1.300	.24	–120.9	19.4	–15.6	–37.8	–95.6	.34	160.90
1.400	.22	–133.1	17.1	–41.0	–37.3	–97.5	.28	143.49
1.500	.17	136.0	15.1	64.3	–36.7	103.0	.20	119.83
2.000	.28	98.8	5.1	171.0	–35.0	149.9	.08	–73.35
3.000	.75	172.2	–14.2	44.3	–33.8	104.3	.43	157.65

AVANTEK

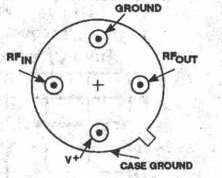
UTO/UTC 1076
Thin-Film Cascadable Amplifier
10 to 1000 MHz

FEATURES

- Frequency Range: 10 to 1000 MHz
- High Reverse Isolation: 49 dB (Typ)
- Low VSWR
- Temperature Stabilized

APPLICATIONS

- IF/RF Amplification
- Pre/Post Mixer Amp
- Communications Intelligence
- Signal Intelligence



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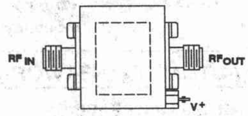


UTC—TC-1, p. 16–42

DESCRIPTION

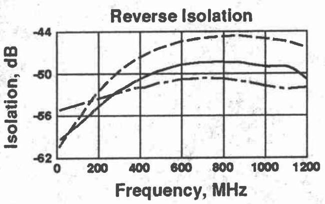
The 1076 Series is a medium-gain bipolar RF amplifier that uses resistive feedback and active bias for temperature stabilization and increased immunity to bias voltage variations. Built on a thin-film substrate, this amplifier is specially designed for high reverse isolation applications. The 1076 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

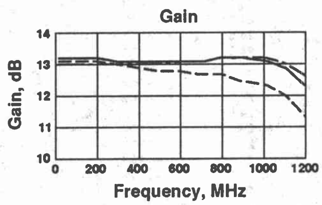
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

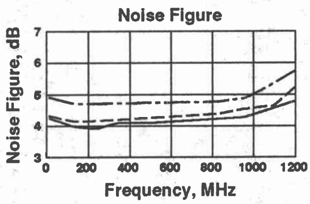
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			$T_C = 2°$ to $52°C$	$T_C = -55°$ to $+85°C$	
BW	Frequency Range	10-1000	10-1000	10-1000	MHz
GP	Small Signal Gain (Min.)	13.0	11.5	11.0	dB
—	Reverse Isolation (Min.)	49.0	43.0	40.0	dB
—	Gain Flatness (Max.)	±0.2	±0.5	±0.7	dB
NF	Noise Figure (Max.)	4.2	5.5	6.0	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+11.5	+10.0	+9.0	dBm
	Input VSWR (Max.)	1.4:1	1.8:1	2.0:1	—
	Output VSWR (Max.)	1.4:1	1.8:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+22.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+23.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+28.0	—	—	dBm
I_D	DC Current	34	—	—	mA

TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C — — — —
−55°C — - —







MAXIMUM RATINGS

DC Voltage	17 Volts
Contunuous RF Power	+13 dBm
Operating Case Temperature	−55°C to +125°C
Storage Temperature	−62°C to +150°C
"R" Series Burn-In Temperature	+125°C

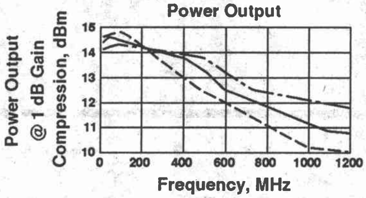
THERMAL CHARACTERISTICS

θ_{JC}	105°C/W
Active TransistorPower Dissapation	150 mW
Junction Temperature Above Case Temperature	16°C

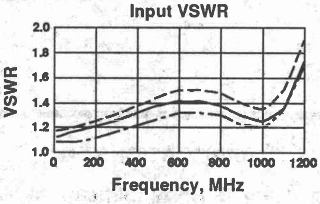
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

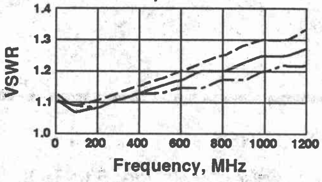
Power Output



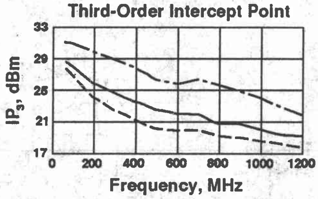
Input VSWR



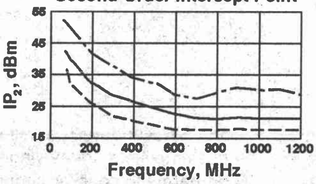
Output VSWR



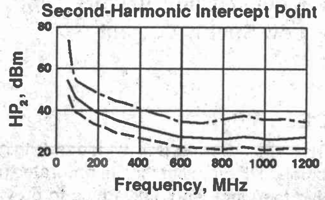
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

S-PARAMETERS AND NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang	GPDEL (ns)	PHASE DEV (deg)
5.0	.08	–38.0	13.1	–171.2	–61.5	14.7	.08	–63.68	3.15	—
10.0	.06	–24.5	13.2	–176.8	–59.6	7.1	.05	–46.40	3.15	1.90
25.0	.06	–19.8	13.2	177.7	–59.1	8.8	.03	–18.14	1.01	–.84
50.0	.06	–26.5	13.2	172.3	–58.7	14.1	.03	–.23	.60	–1.67
100.0	.07	–43.7	13.2	163.1	–57.4	23.0	.03	15.31	.51	–1.76
150.0	.08	–59.7	13.2	154.3	–56.1	27.4	.04	22.92	.49	–1.49
200.0	.09	–73.8	13.2	145.6	–54.7	29.1	.04	27.57	.48	–1.07
250.0	.10	–86.0	13.2	137.0	–53.5	28.6	.05	31.61	.48	–.65
300.0	.11	–97.2	13.1	128.3	–52.4	26.4	.05	33.59	.48	–.17
350.0	.12	–107.7	13.1	119.7	–51.6	23.1	.06	34.37	.48	.27
400.0	.14	–117.5	13.1	111.0	–50.8	19.4	.06	35.64	.48	.69
450.0	.15	–127.0	13.1	102.3	–50.1	15.0	.07	35.82	.48	1.08
500.0	.16	–136.3	13.1	93.6	–49.6	10.1	.07	34.60	.49	1.44
550.0	.16	–145.8	13.1	84.7	–49.2	4.8	.08	34.59	.49	1.67
600.0	.17	–155.4	13.1	75.7	–48.8	–.8	.08	34.22	.50	1.79
650.0	.17	–164.9	13.1	66.7	–48.6	–6.8	.08	31.97	.50	1.81
700.0	.17	–175.3	13.1	57.4	–48.4	–12.8	.09	30.84	.51	1.69
750.0	.17	173.5	13.1	48.0	–48.3	–19.3	.09	29.64	.52	1.36
800.0	.16	161.5	13.2	38.4	–48.3	–26.4	.09	26.71	.53	.87
850.0	.14	146.9	13.2	28.6	–48.4	–33.5	.10	24.91	.54	.16
900.0	.13	129.1	13.2	18.5	–48.5	–41.4	.10	23.29	.56	–.91
950.0	.12	106.5	13.1	8.0	–48.8	–49.9	.10	20.08	.58	–2.23
1000.0	.11	76.1	13.1	–2.7	–49.1	–59.1	.11	17.56	.60	–3.92
1100.0	.15	11.3	12.9	–25.4	–50.0	–80.1	.11	11.80	.63	—
1200.0	.26	–32.4	12.3	–49.6	–50.8	–104.5	.12	5.48	.67	—
1300.0	.41	–53.6	11.4	–74.4	–51.2	–131.6	.12	–3.39	.69	—
1400.0	.54	–89.1	10.1	–98.8	–50.3	–156.2	.13	–12.84	.68	—
1500.0	.66	–110.9	8.3	–121.6	–48.0	–175.5	.13	–22.94	.63	—
1600.0	.74	–129.2	6.3	–142.3	–44.9	170.0	.13	–33.89	.57	—
1700.0	.79	–144.8	4.1	–160.9	–41.4	156.4	.13	–44.42	.52	—
1800.0	.82	–158.0	1.8	–177.8	–37.8	142.6	.14	–54.31	.47	—
1900.0	.84	–169.5	–.4	167.0	–34.2	127.1	.15	–54.34	.42	—
2000.0	.85	–179.4	–2.6	153.5	–30.7	109.0	.17	–74.75	.38	—
2100.0	.85	–171.9	–4.9	141.5	–27.4	87.3	.20	–85.62	.33	—
2200.0	.85	164.6	–6.9	130.4	–24.7	61.4	.24	–100.51	.31	—
2300.0	.85	158.3	–8.8	118.6	–22.9	33.5	.27	–118.28	.33	—
2400.0	.86	152.1	–10.9	105.5	–22.1	7.1	.29	–135.45	.37	—
2500.0	.87	145.8	–13.3	91.6	–21.8	–15.4	.30	–150.69	.39	—

LINEARIZATION RANGE: 10.0 to 1000.0 MHz

AVANTEK

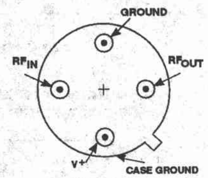
UTO/UTC 1501
Thin-Film Cascadable Amplifier
5 to 1500 MHz

FEATURES

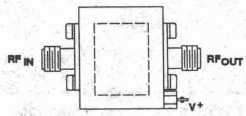
- Frequency Range: 5 to 1500 MHz
- Medium Gain: 10.0 dB (Typ)
- Low Supply Current

APPLICATIONS

- IF/RF Amplification
- Low Power Systems



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

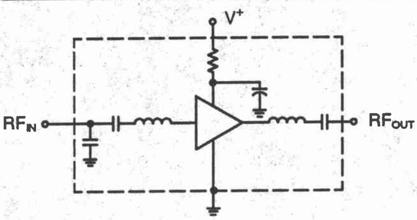
DESCRIPTION

The 1501 Series is a wideband, thin-film bipolar RF amplifier that incorporates resistive feedback and active bias to provide a stable and reliable gain stage. Inductively-coupled input and output networks provide good VSWR under all conditions. The 1501 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

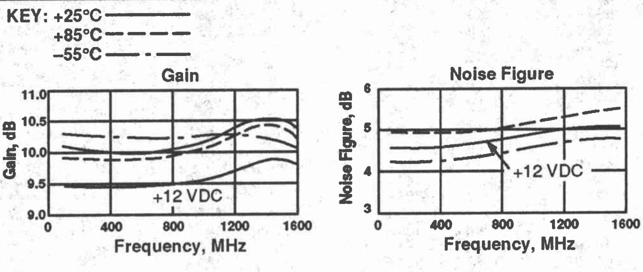
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-1500	5-1500	5-1500	MHz
GP	Small Signal Gain (Min.)	10.0	9.0	8.5	dB
—	Gain Flatness (Max.)	±0.3	±0.5	±1.0	dB
NF	Noise Figure (Max.)	4.5	5.5	6.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+0.0	–3.0	–4.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+10.0	—	—	dBm
I_D	DC Current	10	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

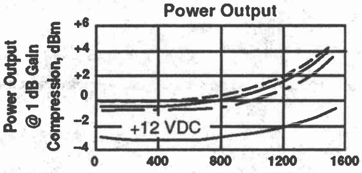
THERMAL CHARACTERISTICS*

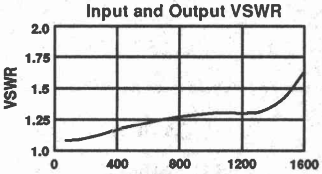
θ_{JC}	90°C/W
Active Transistor Power Dissipation	67 mW
Junction Temperature Above Case Temperature	6°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	1,228,000 Hrs.

*For further information, see High Reliability section, p. 17–2.

WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)





AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.10	10.19	164.95	–1.96	—	1.15	16.20
200.0	1.11	10.04	150.08	–2.11	.41	1.16	16.30
300.0	1.14	10.04	135.54	–1.94	.40	1.19	16.33
400.0	1.17	10.10	121.40	–1.36	.38	1.23	16.38
500.0	1.20	10.14	107.77	–.28	.38	1.26	16.39
600.0	1.24	10.13	94.43	1.08	.38	1.29	16.42
700.0	1.26	10.12	80.64	2.00	.39	1.32	16.45
800.0	1.31	10.16	66.67	2.74	.39	1.33	16.44
900.0	1.34	10.22	52.40	3.19	.41	1.35	16.43
1000.0	1.38	10.32	37.60	3.11	.42	1.35	16.42
1100.0	1.40	10.45	22.23	2.45	.43	1.36	16.40
1200.0	1.42	10.62	6.34	1.25	.46	1.36	16.38
1300.0	1.45	10.77	–10.21	–.58	.47	1.38	16.34
1400.0	1.51	10.89	–27.54	–3.20	.49	1.42	16.26
1500.0	1.64	10.87	–45.92	–6.86	.54	1.52	16.21
1600.0	1.89	10.74	–66.18	—	.57	1.67	16.28
1700.0	2.31	10.46	–86.81	—	.57	1.87	16.55
1800.0	2.91	9.77	–107.06	—	.56	2.10	17.04

LINEARIZATION RANGE: 100.0 to 1500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.076	–171.7	9.97	165.4	–16.19	–6.0	.094	157.3
200.00	.080	–170.0	9.91	151.9	–16.25	–11.5	.101	135.5
300.00	.089	–169.4	9.82	138.2	–16.25	–17.5	.113	116.1
400.00	.097	–169.5	9.85	124.3	–16.31	–23.1	.126	100.3
500.00	.108	–173.5	9.91	110.8	–16.42	–29.2	.137	87.2
600.00	.118	–177.6	9.92	97.9	–16.42	–35.7	.146	76.0
700.00	.128	177.6	9.91	84.8	–16.42	–42.0	.151	64.9
800.00	.138	171.1	9.92	71.4	–16.42	–48.3	.153	55.5
900.00	.144	162.6	9.98	57.8	–16.48	–54.7	.153	45.8
1000.00	.150	152.7	9.98	44.0	–16.42	–61.1	.148	38.2
1100.00	.150	142.1	10.10	29.7	–16.36	–67.3	.142	31.1
1200.00	.150	127.0	10.18	14.8	–16.36	–74.4	.137	27.3
1300.00	.155	108.3	10.28	–.8	–16.31	–81.8	.134	23.9
1400.00	.166	85.2	10.38	–17.0	–16.25	–89.7	.137	23.1
1500.00	.194	59.8	10.41	–33.5	–16.19	–98.5	.150	20.5
1600.00	.242	35.1	10.31	–51.1	–16.19	–107.6	.175	16.8
1700.00	.315	12.9	10.12	–70.3	–16.25	–116.9	.208	7.9

AVANTEK

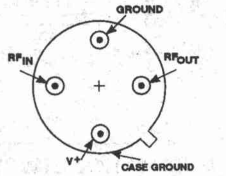
UTO/UTC 1502 Series
Thin-Film Cascadable Amplifier
5 to 1500 MHz

FEATURES

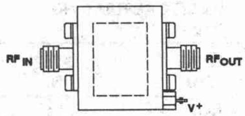
- Frequency Range: 5 to 1500 MHz
- Medium Gain: 10.5 dB (Typ)
- Low VSWR

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

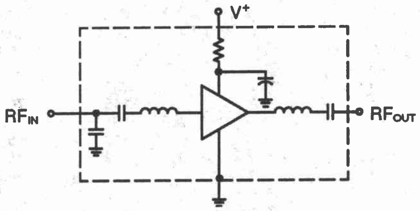
DESCRIPTION

The 1502 Series is a high-power, wideband thin-film bipolar RF amplifier that incorporates resistive feedback and active bias to provide a stable and reliable gain stage. Inductively coupled input and output networks provide good VSWR under all conditions. The 1052 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-1500	5-1500	5-1500	MHz
GP	Small Signal Gain (Min.)	10.5	9.0	8.5	dB
—	Gain Flatness (Max.)	±0.3	±0.5	±1.0	dB
NF	Noise Figure (Max.)	5.0	7.5	7.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+8.0	+6.0	+6.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+19.0	—	—	dBm
I_D	DC Current	23	—	—	mA

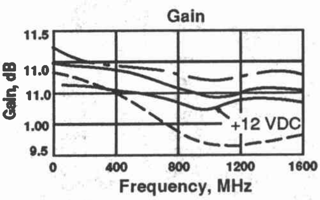
SCHEMATIC

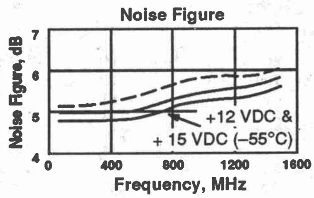


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C———— +85°C — — — — –55°C —·—





MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

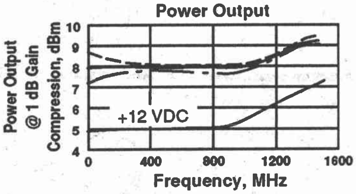
θ_{JC}	90°C/W
Active Transistor Power Dissipation	120 mW
Junction Temperature Above Case Temperature	11°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	1,363,000 Hrs.

*For further information, see High Reliability section, p. 17–2.

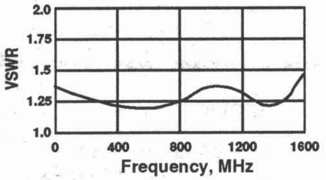
WEIGHT: (typical) UTO— 2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

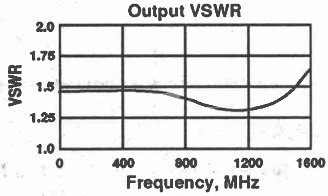
Power Output



Input VSWR



Output VSWR



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.25	11.04	164.12	–.48	—	1.45	17.16
200.0	1.22	10.88	148.78	–.91	.44	1.45	17.14
300.0	1.19	10.82	133.24	–1.55	.42	1.44	17.10
400.0	1.15	10.83	118.45	–1.43	.40	1.44	17.05
500.0	1.14	10.80	104.26	–.72	.40	1.43	16.95
600.0	1.14	10.72	90.23	.15	.39	1.42	16.85
700.0	1.16	10.60	76.47	1.29	.39	1.40	16.76
800.0	1.21	10.53	62.18	1.92	.39	1.39	16.67
900.0	1.25	10.46	47.76	2.42	.41	1.37	16.54
1000.0	1.29	10.42	32.74	2.31	.42	1.35	16.44
1100.0	1.31	10.44	17.54	2.01	.42	1.33	16.33
1200.0	1.29	10.48	1.76	1.14	.45	1.32	16.25
1300.0	1.25	10.54	–14.38	–.10	.46	1.32	16.11
1400.0	1.18	10.59	–31.37	–2.17	.48	1.38	15.91
1500.0	1.22	10.53	–49.48	–5.37	.53	1.49	15.78
1600.0	1.44	10.40	–69.57	—	.57	1.68	15.78
1700.0	1.86	10.11	–90.21	—	.57	1.94	16.01
1800.0	2.52	9.37	–110.81	—	.58	2.24	16.58

LINEARIZATION RANGE: 100.0 to 1500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.099	–177.6	10.78	162.8	–16.77	–4.1	.185	161.5
200.00	.088	174.3	10.64	149.9	–16.77	–9.0	.185	143.8
300.00	.073	172.8	10.59	134.9	–16.59	–14.7	.192	125.5
400.00	.057	–179.9	10.38	119.7	–16.71	–19.9	.194	109.1
500.00	.046	–161.8	10.40	105.9	–16.47	–27.1	.197	94.7
600.00	.051	–137.7	10.26	92.1	–16.42	–32.5	.195	80.7
700.00	.067	–124.6	10.19	77.4	–16.12	–38.4	.191	68.0
800.00	.088	–121.1	10.12	63.9	–16.31	–45.1	.184	57.3
900.00	.105	–124.1	10.11	48.9	–16.14	–53.2	.175	47.8
1000.00	.118	–128.3	10.03	35.2	–15.92	–59.3	.157	40.6
1100.00	.121	–134.9	10.14	20.1	–15.92	–66.0	.148	35.6
1200.00	.110	–141.4	10.05	5.8	–15.86	–74.0	.134	36.9
1300.00	.088	–150.1	10.10	–10.8	–15.65	–83.9	.136	38.7
1400.00	.044	–153.0	10.22	–27.1	–15.54	–90.9	.151	40.5
1500.00	.025	–14.4	10.16	–44.2	–15.49	–101.4	.189	37.6
1600.00	.121	–13.2	9.93	–62.7	–15.60	–112.1	.236	27.3
1700.00	.239	–27.3	9.72	–83.8	–15.65	–124.3	.293	12.3
1800.00	.373	–40.5	9.04	–103.5	–16.14	–137.2	.349	–4.4
1900.00	.503	–57.6	7.93	–124.6	–16.83	–150.4	.393	–25.4
2000.00	.605	–72.5	6.45	–144.5	–17.92	–161.3	.421	–44.5

AVANTEK

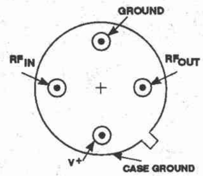
UTO/UTC 1511 Series
Thin-Film Cascadable Amplifier
5 to 1500 MHz

FEATURES

- Frequency Range: 5 to 1500 MHz
- Noise Figure: 3.5 dB (Typ)
- Low Power Consumption

APPLICATIONS

- System Front End
- Low Power Systems



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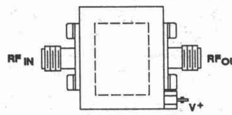


UTC—TC-1, p. 16–42

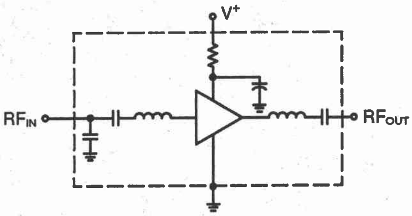
DESCRIPTION

The 1511 Series is a low-noise, wideband thin-film bipolar RF amplifier that incorporates resistive feedback and active bias to provide a stable and reliable gain stage. Inductively coupled input and output networks provide good VSWR under all conditions. The 1511 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-1500	5-1500	5-1500	MHz
GP	Small Signal Gain (Min.)	12.5	10.0	10	dB
—	Gain Flatness (Max.)	±05	±0.5	±1.0	dB
NF	Noise Figure (Max.)	3.5	4.5	5.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	–4.0	–9.0	–10.0	dBm
—	Input VSWR (Max.)	<1.7:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.7:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+1.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+10.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+16.0	—	—	dBm
I_D	DC Current	7	—	—	mA

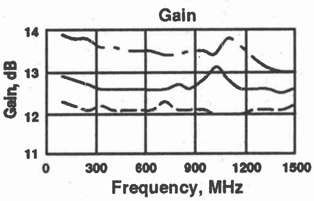
SCHEMATIC

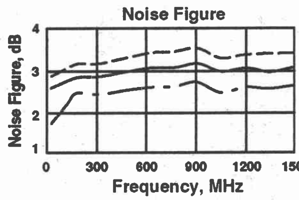


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ————
+85°C — — — —
–55°C —— - ——





MAXIMUM RATINGS

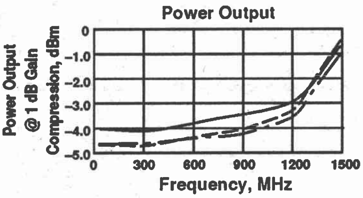
DC Voltage .... 17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

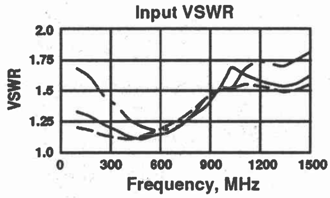
THERMAL CHARACTERISTICS*

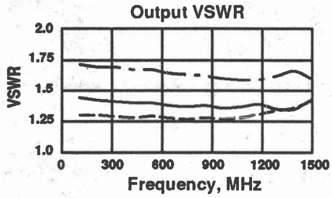
θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 43 mW
Junction Temperature Above Case Temperature .... 5°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 1,421,000 Hrs.
*For further information, see High Reliability section, p. 17–2.

WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)







AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.32	13.29	164.19	–1.70	—	1.33	18.08
200.0	1.31	13.42	147.04	–2.61	.40	1.36	18.08
300.0	1.30	13.31	132.72	–.72	.41	1.39	18.12
400.0	1.28	13.19	117.31	.08	.44	1.42	18.27
500.0	1.26	13.19	101.45	.45	.43	1.45	18.23
600.0	1.26	13.09	85.88	1.09	.45	1.48	18.43
700.0	1.25	13.18	70.14	1.57	.43	1.46	18.77
800.0	1.26	13.21	54.56	2.20	.44	1.44	18.89
900.0	1.29	13.21	38.15	2.00	.47	1.44	19.12
1000.0	1.34	13.31	21.65	1.71	.45	1.41	19.31
1100.0	1.41	13.34	4.29	.56	.48	1.40	19.56
1200.0	1.51	13.50	–12.07	.40	.45	1.39	19.96
1300.0	1.58	13.52	–28.52	.16	.48	1.40	20.28
1400.0	1.67	13.40	–46.35	–1.44	.53	1.40	20.58
1500.0	1.75	13.21	–66.43	–5.31	.57	1.39	20.91
1600.0	1.89	13.06	–88.23	—	.58	1.37	20.87
1700.0	2.11	12.76	–108.05	—	.56	1.33	20.98
1800.0	2.39	12.16	–128.34	—	.58	1.27	21.14
1900.0	2.85	11.35	–150.53	—	.00	1.21	21.41

LINEARIZATION RANGE: 100.0 to 1500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.130	171.2	12.15	162.7	–17.08	–4.7	.147	158.7
200.00	.125	162.1	12.05	150.0	17.14	–10.9	.150	138.9
300.00	.117	150.7	12.05	134.8	–17.02	–17.5	.158	118.6
400.00	.104	139.8	11.93	119.4	–17.26	–23.4	.161	99.8
500.00	.090	127.7	12.05	105.6	–17.14	–31.1	.163	83.1
600.00	.072	115.8	12.02	91.5	–17.26	–37.2	.158	66.4
700.00	.053	98.9	12.09	76.4	–17.20	–43.3	.152	49.1
800.00	.031	77.0	12.12	62.4	–17.45	–50.4	.136	33.5
900.00	.017	24.8	12.23	46.6	–17.52	–58.3	.119	15.4
1000.00	.021	–58.9	12.28	31.9	–17.52	–64.5	.095	–7.1
1100.00	.036	–92.8	12.50	16.2	–17.79	–71.1	.073	–34.1
1200.00	.049	–120.5	12.44	.9	–17.99	–77.9	.058	–76.1
1300.00	.060	–150.7	12.55	–16.9	–18.13	–86.7	.065	–125.8
1400.00	.068	176.6	12.69	–33.4	–18.34	–91.7	.087	–159.2
1500.00	.086	136.6	12.58	–50.8	–18.56	–98.6	.113	175.4
1600.00	.125	99.7	12.38	–69.2	–18.86	–104.5	.133	157.9
1700.00	.187	67.8	12.25	–89.3	–18.86	–112.7	.143	141.8
1800.00	.271	42.6	11.76	–107.7	–19.01	–120.7	.142	129.0
1900.00	.361	20.9	11.09	–128.2	–19.17	–129.1	.128	120.7
2000.00	.456	.2	10.25	–147.6	–19.49	–137.7	.105	120.8

AVANTEK

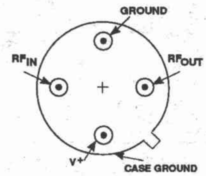
UTO/UTC 1522 Series
Thin-Film Cascadable Amplifier
5 to 1500 MHz

FEATURES

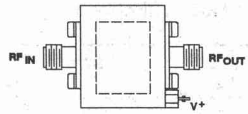
- Frequency Range: 5 to 1500 MHz
- High Gain: 20.0 dB (Typ)
- Medium Output Power: +13.0 dBm (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

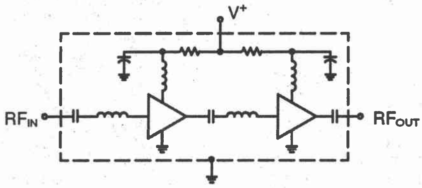
DESCRIPTION

The1522 Series is a two-stage bipolar RF amplifier built on a thin-film substrate. Active bias and resistive feedback provide stability over temperature and bias voltage variations. Input/output blocking capacitors couple the RF through the amplifier, and low VSWR is maintained through inductive tuning. The 1522 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

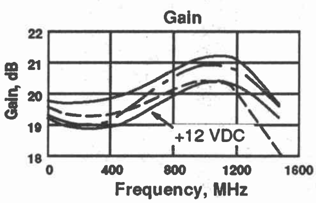
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			$T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	
BW	Frequency Range	5-1500	5-1500	5-1500	MHz
GP	Small Signal Gain (Min.)	20.0	18.0	17.0	dB
—	Gain Flatness (Max.)	±0.8	±1.5	±1.5	dB
NF	Noise Figure (Max.)	4.5	5.5	6.0	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+13.0	+11.0	+10.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+23.0	—	—	dBm
I_D	DC Current	85	—	—	mA

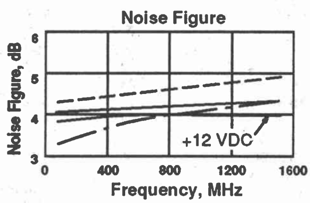
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ————
+85°C — — — —
–55°C —— - ——





MAXIMUM RATINGS

DC Voltage .... 17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +100°C

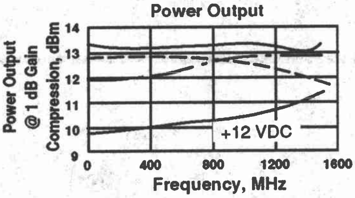
THERMAL CHARACTERISTICS*

θ_{JC} .... 105/75°C/W
Active Transistor Power Dissipation .... 187/460 mW
Junction Temperature Above Case Temperature ..... 20/34°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 550,200 Hrs.
*For further information, see High Reliability section, p. 17–2.

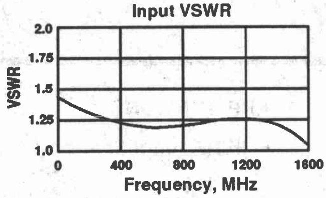
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

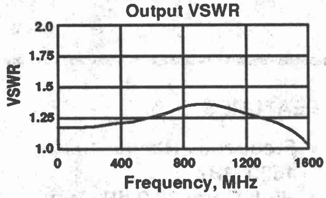
Power Output



Input VSWR



Output VSWR



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.64	20.92	–18.52	–4.62	.00	1.29	36.97
150.0	1.64	20.93	–27.57	–4.03	.47	1.29	36.44
200.0	1.66	20.90	–35.58	–2.40	.47	1.30	36.29
250.0	1.66	20.81	–44.65	–1.83	.50	1.31	36.42
300.0	1.67	20.84	–53.69	–1.22	.50	1.32	36.39
350.0	1.65	20.87	–$2.69	–.57	.50	1.32	36.65
400.0	1.65	20.95	–71.51	.25	.51	1.33	36.59
450.0	1.63	21.09	–81.10	.30	.51	1.34	36.57
500.0	1.60	21.22	–89.82	1.21	.49	1.36	36.74
600.0	1.54	21.38	–107.92	2.39	.52	1.39	37.16
700.0	1.46	21.47	–126.90	2.69	.55	1.43	37.43
800.0	1.39	21.38	–146.77	2.12	.54	1.48	37.86
900.0	1.34	21.28	–166.58	1.58	.54	1.52	38.81
1000.0	1.35	21.29	174.38	1.83	.54	1.54	39.98
1100.0	1.42	21.52	155.44	2.18	.53	1.52	41.44
1200.0	1.51	21.56	135.50	1.53	.59	1.43	41.94
1300.0	1.50	21.37	113.44	–1.24	.61	1.32	41.77
1400.0	1.43	20.83	91.85	–3.54	.58	1.25	41.86
1500.0	1.38	20.21	71.23	–4.87	.57	1.20	42.13
1600.0	1.43	19.66	50.56	—	.58	1.16	42.29
1700.0	1.52	19.01	30.82	—	.53	1.15	42.92
1800.0	1.57	17.98	12.32	—	.50	1.17	43.04
1900.0	1.59	16.94	–5.02	—	.46	1.20	42.17
2000.0	1.60	15.99	–20.87	—	.00	1.24	41.43

LINEARIZATION RANGE: 100.0 to 1500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.244	154.3	20.700	–18.2	–35.509	–1.9	.157	173.4
200.00	.250	137.0	20.669	–35.4	–35.329	–11.0	.165	170.5
300.00	.250	121.9	20.597	–53.1	–36.050	–18.0	.176	164.4
400.00	.250	107.9	20.719	–70.4	–36.091	–26.4	.184	155.3
500.00	.240	93.5	21.057	–88.4	–36.082	–33.3	.196	143.8
600.00	.218	76.2	21.280	–106.5	–36.594	–43.9	.211	130.4
700.00	.187	53.5	21.450	–125.4	–37.182	–52.2	.229	117.0
800.00	.160	23.9	21.441	–145.4	–37.887	–62.0	.248	103.8
900.00	.147	–10.7	21.388	–165.7	–38.653	–69.7	.265	91.7
1000.00	.157	–41.1	21.423	174.7	–39.998	–76.0	.274	80.3
1100.00	.179	–67.5	21.695	155.6	–41.777	–82.5	.266	66.4
1200.00	.199	–95.4	21.718	135.4	–42.936	–78.1	.238	51.3
1300.00	.188	–126.4	21.517	112.8	–42.193	–76.0	.196	36.5
1400.00	.154	–159.9	20.896	90.7	–40.949	–79.5	.158	22.7
1500.00	.130	160.2	20.249	70.3	–41.216	–88.3	.140	6.9
1600.00	.135	116.5	19.649	49.9	–41.271	–99.1	.134	–9.3
1700.00	.162	82.5	19.023	30.7	–41.843	–100.5	.142	–24.5
1800.00	.187	58.9	18.102	12.8	–41.828	–106.2	.163	–38.9
1900.00	.205	42.0	17.196	–4.9	–42.248	–109.0	.185	–52.3
2000.00	.219	29.0	16.360	–21.4	–42.362	–109.6	.205	–66.2

AVANTEK

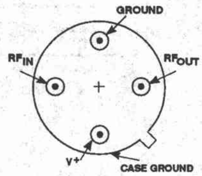
UTO/UTC 1524 Series
Thin-Film Cascadable Amplifier
10 to 1500 MHz

FEATURES

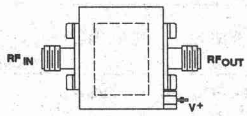
- Frequency Range: 10 to 1500 MHz
- High Gain: 22.0 dB (Typ)
- Medium Output Power: +10 dBm (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

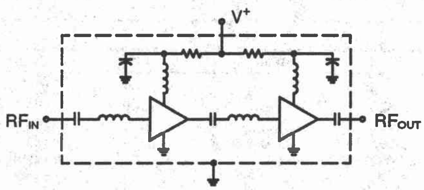
DESCRIPTION

The 1524 Series is a two-stage bipolar RF amplifier built on a thin-film substrate. Active bias and resistive feedback provide for stability over temperature and bias voltage variations. Input/output blocking capacitors couple the RF through the amplifier, and a low VSWR is maintained through inductive tuning. The 1524 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	10-1500	10-1500	10-1500	MHz
GP	Small Signal Gain (Min.)	22.0	21.0	20.0	dB
—	Gain Flatness (Max.)	±0.4	±1.5	±1.5	dB
NF	Noise Figure (Max.)	4.0	4.5	5.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+10.0	+7.0	+6.0	dBm
—	Input VSWR (Max.)	—	2.0:1	2.0:1	—
—	Output VSWR (Max.)	—	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+19.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+22.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+27.0	—	—	dBm
I_D	DC Current	60	—	—	mA

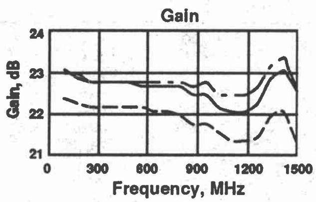
SCHEMATIC

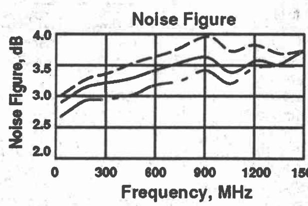


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
–55°C —·—





MAXIMUM RATINGS

DC Voltage .... 17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

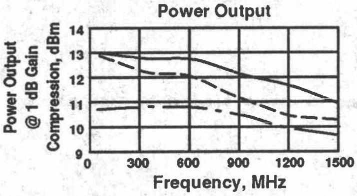
THERMAL CHARACTERISTICS*

θ_{JC} .... 105/75°C/W
Active Transistor Power Dissipation .... 102/340 mW
Junction Temperature Above Case Temperature .... 11/26°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 586,100 Hrs.
*For further information, see High Reliability section, p. 17–2.

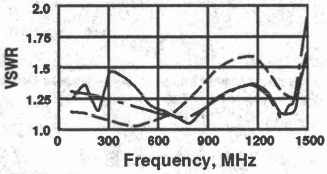
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

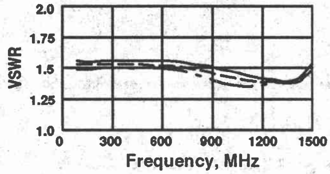
Power Output



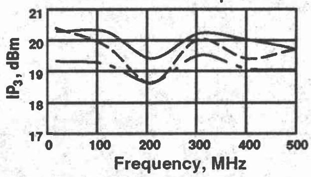
Input VSWR



Output VSWR



Third-Order Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.01	22.53	–15.01	–3.10	.00	1.58	36.39
200.0	1.02	22.48	–30.29	–2.39	.44	1.57	35.33
300.0	1.03	22.54	45.95	–2.02	.42	1.56	36.49
400.0	1.03	22.61	–60.93	–.99	.39	1.56	36.32
500.0	1.04	22.52	–74.88	1.07	.39	1.55	36.61
600.0	1.05	22.47	–89.61	2.35	.45	1.53	37.27
700.0	1.07	22.47	–105.97	2.00	.46	1.50	37.75
800.0	1.10	22.61	–122.32	1.66	.46	1.45	38.40
900.0	1.14	22.80	–138.12	1.85	.41	1.38	38.91
1000.0	1.18	22.80	–153.28	2.71	.43	1.30	39.35
1100.0	1.24	22.86	–169.08	2.91	.46	1.21	39.71
1200.0	1.30	22.84	173.66	1.66	.50	1.13	41.39
1300.0	1.37	22.79	155.74	–.23	.52	1.06	41.92
1400.0	1.48	22.85	136.39	–3.56	.52	1.00	43.37
1500.0	1.64	22.62	117.14	–6.80	.56	1.02	44.35

LINEARIZATION RANGE: 100.0 to 1500.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.019	–174.1	22.562	–15.2	–34.760	8.0	.226	172.6
200.00	.028	–124.8	22.576	–30.1	–35.860	.7	.222	169.1
300.00	.036	–116.0	22.522	–45.1	–35.616	–14.3	.219	161.8
400.00	.039	–108.4	22.496	–60.4	–35.936	–17.4	.219	155.1
500.00	.040	–95.5	22.486	–75.9	–36.753	–19.9	.215	147.4
600.00	.045	–86.1	22.593	–91.1	–36.615	–26.9	.207	140.0
700.00	.053	–78.8	22.690	–106.5	–37.868	–31.7	.195	130.8
800.00	.065	–82.3	22.812	–122.0	–38.339	–35.4	.178	121.8
900.00	.075	–91.4	22.902	–137.1	–38.262	–41.2	.156	109.7
1000.00	.085	–110.6	22.924	–153.1	–39.934	–39.0	.130	98.6
1100.00	.098	–135.6	22.974	–169.1	–40.571	–43.4	.098	84.6
1200.00	.121	–165.5	23.002	174.1	–41.071	–49.8	.064	71.3
1300.00	.154	164.4	23.033	156.4	–42.089	–52.1	.034	58.2
1400.00	.205	137.1	22.926	137.4	–42.274	–52.9	.007	87.3
1500.00	.264	109.5	22.734	117.8	–44.008	–65.3	.018	146.9
1600.00	.323	82.4	22.295	97.4	–46.629	–60.4	.026	109.8
1700.00	.372	56.6	21.600	77.3	–51.695	–32.0	.030	44.7
1800.00	.412	32.4	20.622	58.9	–45.624	–4.4	.050	–22.0

AVANTEK

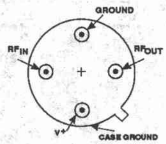
UTO/UTC/PPA 2012 Series
Thin-Film Cascadable Amplifier
500 to 2000 MHz

FEATURES

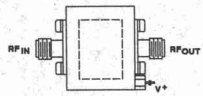
- Frequency Range: 500 to 2000 MHz
- High Dynamic Range
- Noise Figure: 3.0 dB (Typ)
- GaAs FET Technology
- Temperature Compensated
- Surface Mount Option

APPLICATIONS

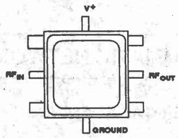
- System Front End
- Surface Mount Assembly



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42



PPA—PP-38, p. 16–35

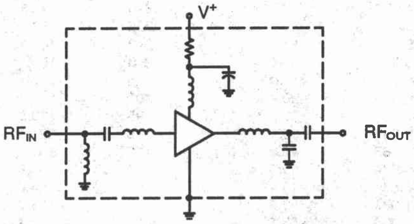
DESCRIPTION

The 2012 Series is a thin-film GaAs FET RF amplifier using active bias and resistive feedback for stability over temperature and bias voltage variations. Input/output blocking capacitors couple RF through the amplifier while a low VSWR is maintained through inductive tuning. The 2012 Series amplifiers are available in three packages: the surface mount PlanarPak PP-38 (.375 in. x .375 in.) case, the TO-8 hermetic case and the connectorized TC-1 case.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

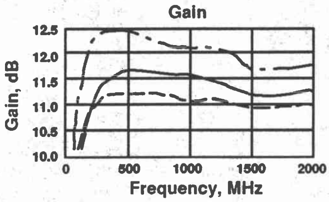
Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range	500-2000	500-2000	500-2000	MHz
GP	Small Signal Gain (Min.)	11.0	9.0	8.5	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	3.0	4.0	4.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+14.0	+12.0	+11.0	dBm
—	Input VSWR (Max.)	<1.6:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+23.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+33.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+39.0	—	—	dBm
I_D	DC Current	50	—	—	mA

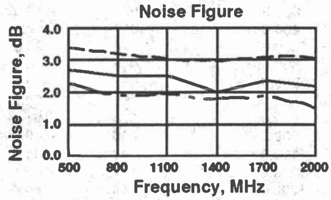
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C — — —
–55°C — · —





MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+15 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

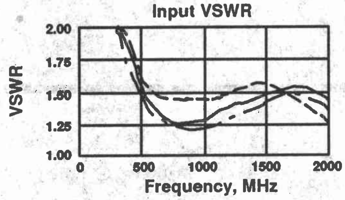
θ_{JC}	100°C/W
Active Transistor Power Dissipation	250 mW
Junction Temperature Above Case Temperature	25°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	299,200 Hrs.

*For further information, see High Reliability section, p. 17–2.

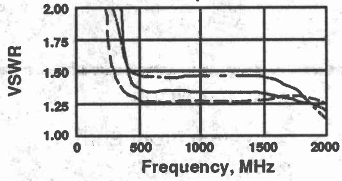
WEIGHT: (typical) PPA—0.5 grams; UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

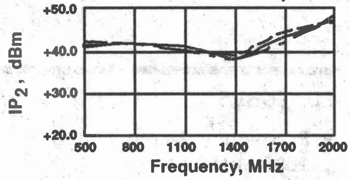
Input VSWR



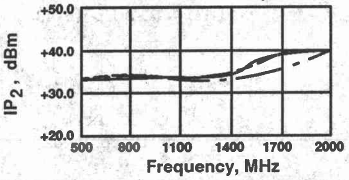
Output VSWR



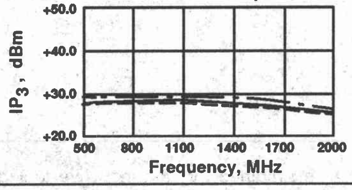
Second-Harmonic Intercept Point



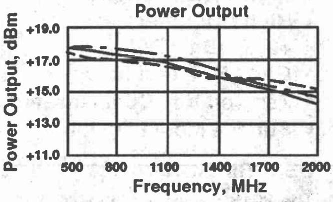
Second-Order Intercept Point



Third-Order Intercept Point



Power Output



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
500.0	1.32	10.66	170.30	9.46	.57	1.41	16.35
600.0	1.20	10.65	151.64	3.72	.49	1.45	16.60
700.0	1.11	10.59	134.99	–.02	.44	1.51	16.84
800.0	1.03	10.59	119.69	–2.41	.40	1.56	17.02
900.0	1.03	10.57	105.49	–3.71	.39	1.61	17.15
1000.0	1.06	10.67	92.93	–3.37	.33	1.62	17.34
1100.0	1.05	10.57	81.00	–2.40	.34	1.55	17.48
1200.0	1.05	10.54	68.30	–2.21	.34	1.46	17.57
1300.0	1.05	10.51	56.10	–1.51	.34	1.36	17.48
1400.0	1.06	10.49	43.58	–1.13	.34	1.30	17.46
1500.0	1.06	10.48	31.45	–.37	.35	1.30	17.44
1600.0	1.04	10.57	18.63	–.28	.33	1.35	17.35
1700.0	1.05	10.55	7.26	1.24	.33	1.44	17.36
1800.0	1.10	10.44	–5.17	1.71	.33	1.50	17.35
1900.0	1.15	10.44	–17.67	2.12	.36	1.47	17.40
2000.0	1.19	10.35	–30.49	2.19	.36	1.36	17.37

LINEARIZATION RANGE: 500.0 to 2000.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
500.00	.077	–21.4	10.225	172.3	–16.048	–27.4	.145	–129.7
600.00	.047	–6.7	10.208	152.5	–16.347	–39.1	.167	–155.5
700.00	.021	–17.1	10.256	136.3	–16.996	–51.0	.175	–179.4
800.00	.005	–162.4	10.250	120.6	–17.395	–62.1	.181	164.4
900.00	.028	–146.3	10.342	105.9	–17.191	–74.7	.202	148.8
1000.00	.016	128.8	10.366	93.5	–17.447	–86.4	.213	136.1
1100.00	.013	29.1	10.281	80.8	–18.202	–98.1	.189	130.2
1200.00	.030	–15.7	10.203	67.6	–17.753	–110.3	.172	118.9
1300.00	.056	–31.8	10.218	54.3	–17.535	–120.5	.133	112.4
1400.00	.046	–50.1	10.320	41.3	–17.343	–132.6	.098	98.8
1500.00	.034	–75.0	10.310	28.1	–17.653	–143.1	.079	68.0
1600.00	.020	75.8	10.573	15.8	–17.464	–158.5	.088	36.1
1700.00	.066	63.7	10.470	2.5	–17.371	–169.5	.119	10.7
1800.00	.111	80.6	10.448	–11.6	–17.828	176.7	.102	11.4
1900.00	.136	78.5	10.362	–26.9	–18.291	163.0	.202	29.2
2000.00	.103	81.1	10.227	–40.9	–17.434	149.7	.233	62.2

AVANTEK

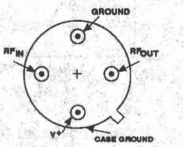
UTO/UTC/PPA 2013 Series
Thin-Film Cascadable Amplifier
500 to 2000 MHz

FEATURES

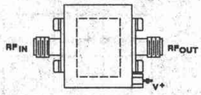
- Frequency Range: 500 to 2000 MHz
- High Dynamic Range
- High Output Power: +21.0 dBm (Typ)
- GaAs FET Technology
- Temperature Compensated
- Surface Mount Option

APPLICATIONS

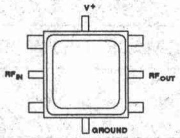
- System Front End
- Output Stage
- Surface Mount Assembly



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42



PPA—PP-38, p. 16–35

DESCRIPTION

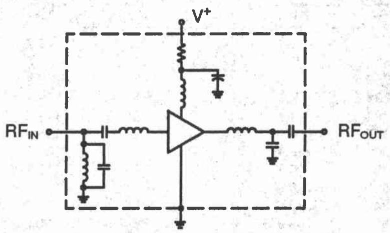
The 2013 Series is a thin-film high power GaAs FET RF amplifier using active bias and resistive feedback for stability over temperature and bias voltage variations. Input/output blocking capacitors couple RF through the amplifier, while a low VSWR is maintained through inductive tuning. The 2013 Series amplifiers are available in three packages: the surface mount Planar-Pak PP-38 (.375 in. x .375 in.) case, the TO-8 hermetic case and the connectorized TC- 1 case.

ELECTRICAL SPECIFICATIONS[1] (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	500-2000	500-2000	500-2000	MHz
GP	Small Signal Gain (Min.)	10.0	9.0 Min.	8.5 Min.	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	4.5	5.5	6.0	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+21.0	+19.0	+18.0	dBm
—	Input VSWR (Max.)	<1.7:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+33.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+45.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+50.0	—	—	dBm
I_D	DC Current	100	—	—	mA

NOTE: RF input pin is at DC ground—no input blocking capacitor.

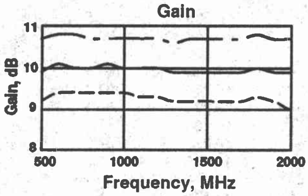
SCHEMATIC

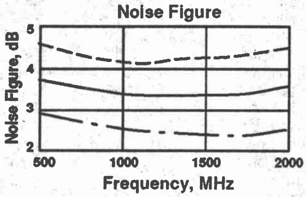


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ———— +85°C – – – – –55°C —·—





MAXIMUM RATINGS

DC Voltage .... 17 Volts
Continuous RF Input Power .... +17 dBm
Operating Case Temperature .... –55°C to +100°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +100°C

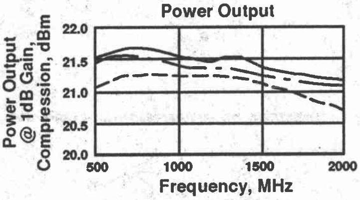
THERMAL CHARACTERISTICS*

θ_{JC} .... 60°C/W
Active Transistor Power Dissipation .... 900 mW
Junction Temperature Above Case Temperature .... 54°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 361,600 Hrs.
*For further information, see High Reliability section, p. 17–2.

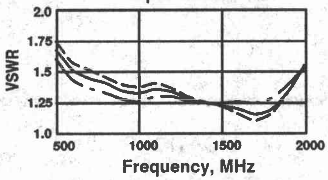
WEIGHT: (typical) PPA—0.5 grams; UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

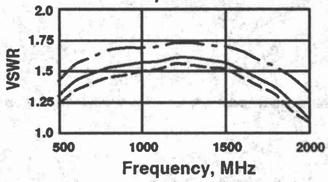
Power Output



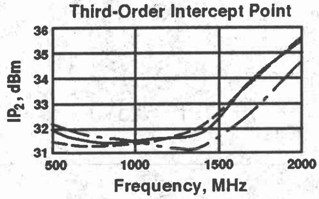
Input VSWR



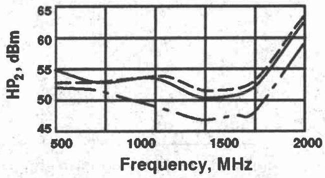
Output VSWR



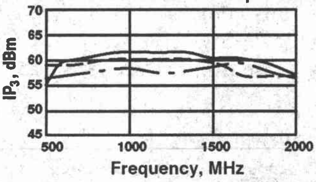
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
400.0	1.58	9.54	−160.92	—	.92	1.39	15.90
500.0	1.28	9.91	170.88	10.08	.69	1.36	16.01
600.0	1.15	10.02	148.57	3.28	.57	1.38	16.14
700.0	1.08	10.03	128.97	−.80	.52	1.42	16.35
800.0	1.09	10.04	111.27	−2.97	.47	1.44	16.53
900.0	1.11	10.13	94.80	−3.92	.43	1.46	16.68
1000.0	1.11	10.20	80.09	−3.11	.40	1.44	16.90
1100.0	1.07	10.20	65.49	−2.18	.42	1.39	17.03
1200.0	1.06	10.18	50.46	−1.70	.41	1.34	17.07
1300.0	1.07	10.15	35.55	−1.08	.42	1.32	17.01
1400.0	1.07	10.19	20.43	−.68	.41	1.32	17.02
1500.0	1.04	10.19	5.46	−.13	.43	1.38	17.00
1600.0	1.06	10.30	−9.46	.45	.39	1.51	17.05
1700.0	1.14	10.23	−23.97	1.46	.42	1.65	17.16
1800.0	1.24	10.16	−38.70	2.24	.43	1.74	17.32
1900.0	1.32	10.12	−55.02	1.45	.45	1.72	17.35
2000.0	1.40	10.21	−71.49	.51	.46	1.68	17.43
2100.0	1.44	10.29	−88.92	—	.52	1.66	17.28

LINEARIZATION RANGE: 500.0 to 2000.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
500.00	.199	32.7	10.097	178.2	−17.058	−14.6	.130	−72.6
600.00	.125	19.7	10.257	154.3	−16.560	−29.8	.111	−108.7
700.00	.069	−14.2	10.299	135.3	−16.848	−48.7	.094	−154.8
800.00	.053	−69.5	10.268	117.2	−17.316	−61.4	.093	166.5
900.00	.078	−111.6	10.385	100.5	−17.040	−77.9	.120	145.9
1000.00	.069	−111.9	10.375	86.4	−17.402	−91.4	.114	139.3
1100.00	.103	−109.0	10.296	71.4	−18.034	−105.3	.094	146.7
1200.00	.115	−116.0	10.205	56.0	−17.977	−119.2	.071	146.7
1300.00	.116	−120.1	10.078	40.9	−17.625	−131.8	.048	172.7
1400.00	.111	−135.0	10.045	26.8	−17.854	−143.2	.040	−171.3
1500.00	.098	−144.1	10.015	12.8	−18.129	−156.0	.025	−170.5
1600.00	.071	179.8	10.159	−.1	−17.931	−170.3	.018	115.7
1700.00	.068	134.5	10.142	−14.9	−17.947	177.3	.019	64.0
1800.00	.072	93.3	10.156	−30.8	−18.386	158.1	.013	−38.3
1900.00	.095	66.8	10.091	−47.6	−18.220	145.4	.032	−54.2
2000.00	.110	46.5	9.907	−63.4	−18.194	132.1	.068	−88.7

AVANTEK

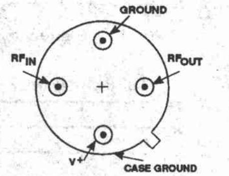
UTO/UTC 2021 Series
Thin-Film Cascadable Amplifier
10 to 2000 MHz

FEATURES

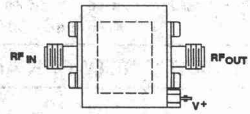
- Frequency Range: 10 to 2000 MHz
- Noise Figure: 3.7 dB (Typ)
- Low VSWR
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- System Front End



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

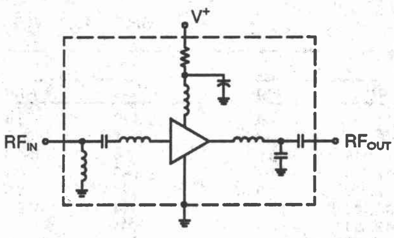
DESCRIPTION

The 2021 Series is a wideband thin-film bipolar RF amplifier with resistive feedback and active bias for temperature compensation and increased immunity to bias voltage variations. Input/output blocking capacitors couple the RF through the amplifier, while a low VSWR is maintained through inductive tuning. The 2021 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

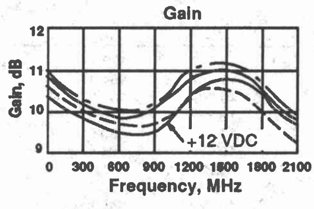
Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	10-2000	10-2000	10-2000	MHz
GP	Small Signal Gain (Min.)	10.0	9.0	8.5	dB
—	Gain Flatness (Max.)	±0.7	±1.0	±1.0	dB
NF	Noise Figure (Max.)	3.7	4.5	5.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+4.0	+2.0	+2.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+14.0	—	—	dBm
I_D	DC Current	16	—	—	mA

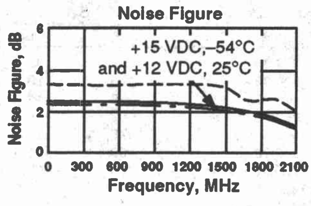
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – –
–55°C — - —





MAXIMUM RATINGS

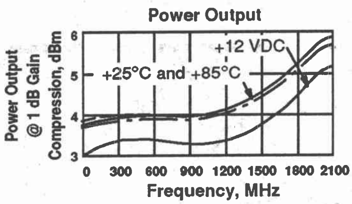
DC Voltage .... 17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

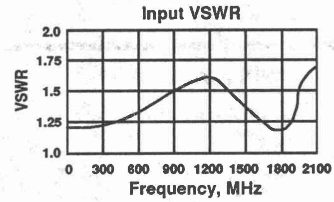
THERMAL CHARACTERISTICS*

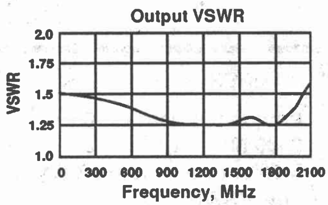
θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 126 mW
Junction Temperature Above Case Temperature .... 13°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 1,044,000 Hrs.
*For further information, see High Reliability section, p. 17–2.

WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)







AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.19	11.26	166.23	–6.03	.00	1.49	18.82
200.0	1.21	11.18	153.28	–5.27	.36	1.46	18.88
300.0	1.23	11.09	140.08	–4.74	.36	1.43	18.92
400.0	1.27	11.08	127.41	–3.69	.34	1.41	19.00
500.0	1.31	11.06	115.25	–2.14	.33	1.38	19.03
600.0	1.36	11.00	103.46	–.23	.33	1.35	19.08
700.0	1.42	10.96	91.63	1.64	.31	1.32	19.13
800.0	1.48	10.98	80.57	4.29	.33	1.30	19.20
900.0	1.54	11.04	68.43	5.88	.35	1.28	19.27
1000.0	1.59	11.14	55.49	6.63	.37	1.27	19.41
1100.0	1.61	11.31	41.97	6.81	.38	1.27	19.61
1200.0	1.60	11.44	27.77	6.31	.40	1.28	19.81
1300.0	1.55	11.50	12.82	5.07	.43	1.28	20.01
1400.0	1.47	11.53	–2.70	3.26	.43	1.29	20.08
1500.0	1.38	11.42	–18.15	1.53	.43	1.29	19.97
1600.0	1.29	11.24	–33.69	–.29	.44	1.28	19.77
1700.0	1.22	11.05	–49.74	–2.63	.44	1.25	19.50
1800.0	1.19	10.89	–65.46	–4.62	.44	1.24	19.23
1900.0	1.25	10.69	–81.19	–6.63	.45	1.25	18.93
2000.0	1.41	10.35	–97.89	–9.62	.48	1.35	18.78
2100.0	1.70	9.89	–115.76	—	.51	1.52	18.67
2200.0	2.15	9.24	–134.59	—	.54	1.76	18.82

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.088	–171.5	11.224	166.2	–18.937	–6.7	.191	166.7
200.00	.094	–162.9	11.157	153.0	–18.895	–13.7	.188	154.2
300.00	.104	–156.4	11.064	139.8	–19.000	–20.3	.179	141.5
400.00	.117	–151.1	11.057	126.8	–19.069	–26.6	.172	129.2
500.00	.136	–149.1	11.036	114.7	–19.059	–33.7	.162	119.0
600.00	.157	–148.2	10.993	102.7	–19.064	–40.5	.151	108.4
700.00	.183	–150.3	10.979	90.8	–19.144	–48.0	.137	98.6
800.00	.207	–154.1	10.988	79.5	–19.215	–54.7	.126	88.4
900.00	.231	–160.5	11.062	67.3	–19.276	–60.7	.115	77.5
1000.00	.252	–167.2	11.177	54.3	–19.411	–67.6	.107	64.1
1100.00	.261	–175.4	11.352	40.6	–19.593	–74.6	.104	48.3
1200.00	.259	175.7	11.502	26.3	–19.812	–81.1	.105	29.3
1300.00	.243	165.6	11.616	11.1	–19.975	–86.7	.110	9.7
1400.00	.210	154.9	11.659	–4.6	–20.031	–92.5	.116	–10.1
1500.00	.171	144.0	11.544	–20.4	–19.874	–98.0	.119	–26.6
1600.00	.124	130.1	11.363	–36.1	–19.667	–104.0	.120	–39.2
1700.00	.080	104.0	11.174	–52.5	–19.411	–110.1	.118	44.2
1800.00	.061	46.4	11.033	–68.6	–19.136	–117.3	.117	–41.6
1900.00	.108	–4.8	10.797	–84.6	–18.878	–125.9	.133	–34.1
2000.00	.192	–28.7	10.450	–101.6	–18.706	–135.7	.171	–29.2
2100.00	.299	–44.6	9.950	–119.5	–18.655	–146.5	.230	–31.7
2200.00	.415	–58.7	9.272	–138.4	–18.784	–158.3	.296	–39.5
2300.00	.521	–72.7	8.307	–157.7	–19.149	–170.6	.350	–49.4
2400.00	.615	–85.5	7.085	–176.6	–19.758	178.5	.388	–60.3
2500.00	.689	–97.2	5.641	165.3	–20.423	167.3	.402	–70.3

AVANTEK

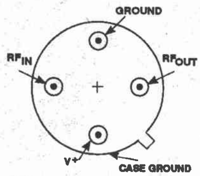
UTO/UTC 2022 Series
Thin-Film Cascadable Amplifier
10 to 2000 MHz

FEATURES

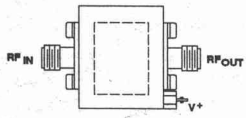
- Frequency Range: 10 to 2000 MHz
- Medium Gain: 10.0 dB (Typ)
- Low VSWR
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

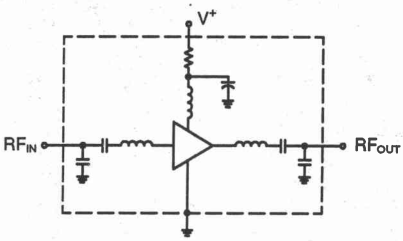
DESCRIPTION

The 2022 Series is a high-power wideband, thin-film bipolar RF amplifier with resistive feedback and active bias for temperature compensation and increased immunity to bias voltage variations. Input/output blocking capacitors couple the RF through the amplifier, while a low VSWR is maintained through inductive tuning. The 2022 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

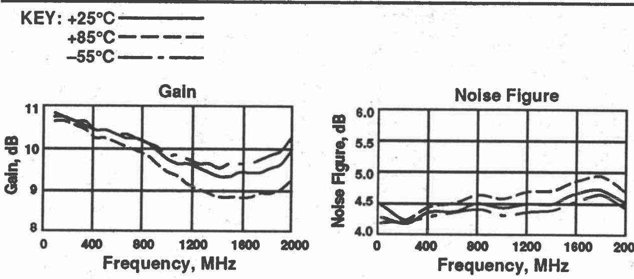
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	10-2000	10-2000	10-2000	MHz
GP	Small Signal Gain (Min.)	10.0	9.0	8.5	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	5.0	6.0	6.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+8.0	+7.0	+6.5	dBm
—	Input VSWR (Max.)	<1.7:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+17.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+30.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+35.0	—	—	dBm
I_D	DC Current	25	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage .... 17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

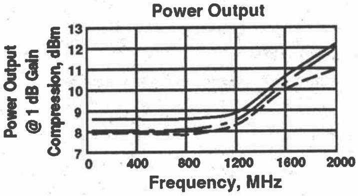
THERMAL CHARACTERISTICS*

θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 216 mW
Junction Temperature Above Case Temperature .... 23°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 814,700 Hrs.
*For further information, see High Reliability section, p. 17–2.

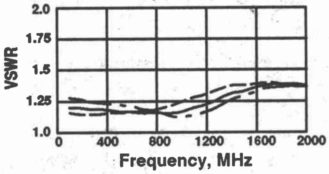
WEIGHT: (typical) UTO— 2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

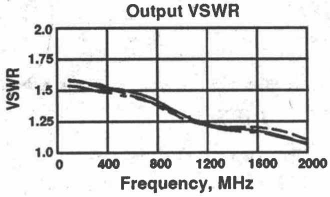
Power Output



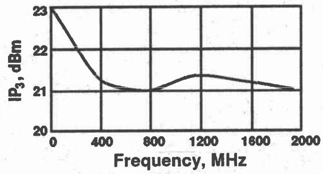
Input VSWR



Output VSWR



Third-Order Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.26	10.45	166.48	–7.64	.00	1.62	18.02
200.0	1.29	10.39	154.11	–6.19	.35	1.59	18.22
300.0	1.32	10.35	141.35	–5.12	.36	1.58	18.22
400.0	1.36	10.39	128.99	–3.66	.33	1.58	18.32
500.0	1.40	10.44	117.02	–1.80	.33	1.57	18.42
600.0	1.46	10.46	105.27	.25	.32	1.56	18.60
700.0	1.50	10.50	93.48	2.30	.31	1.55	18.69
800.0	1.56	10.57	82.37	5.01	.34	1.55	18.83
900.0	1.60	10.71	70.04	6.48	.35	1.55	19.00
1000.0	1.63	10.87	57.02	7.27	.37	1.55	19.24
1100.0	1.64	11.05	43.12	7.18	.39	1.56	19.50
1200.0	1.61	11.20	28.58	6.47	.41	1.56	19.76
1300.0	1.56	11.29	13.37	5.09	.43	1.55	19.95
1400.0	1.48	11.33	–2.31	3.23	.43	1.53	20.00
1500.0	1.40	11.26	–17.82	1.55	.43	1.48	19.84
1600.0	1.34	11.10	–33.49	–.28	.44	1.41	19.59
1700.0	1.29	10.95	–49.56	–2.52	.45	1.35	19.25
1800.0	1.31	10.89	–65.62	–4.75	.44	1.31	18.95
1900.0	1.38	10.76	–81.80	–7.11	.46	1.32	18.65
2000.0	1.55	10.46	–99.32	–10.81	.51	1.41	18.52
2100.0	1.86	10.00	–118.20	—	.54	1.57	18.44
2200.0	2.33	9.26	–138.11	—	.56	1.77	18.60

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.186	179.5	10.505	166.7	–18.576	–6.6	.268	166.3
200.00	.184	179.2	10.452	154.2	–18.519	–12.5	.261	153.2
300.00	.183	179.4	10.393	141.6	–18.585	–19.2	.254	139.8
400.00	.180	–179.5	10.405	129.1	–18.655	–25.5	.249	126.7
500.00	.185	–177.8	10.410	117.4	–18.645	–32.5	.239	115.3
600.00	.190	–175.8	10.410	105.9	–18.672	–39.2	.227	103.3
700.00	.204	–175.2	10.426	94.4	–18.801	–46.0	.212	91.3
800.00	.220	–175.7	10.456	83.7	–18.855	–52.7	.202	78.7
900.00	.239	–178.3	10.570	71.8	–18.982	–58.5	.190	65.0
1000.00	.257	178.2	10.723	59.5	–19.201	–64.8	.184	49.7
1100.00	.267	172.4	10.906	46.1	–19.411	–71.3	.183	32.4
1200.00	.268	165.7	11.096	32.3	–19.628	–76.8	.189	13.7
1300.00	.257	157.8	11.236	17.4	–19.762	–81.5	.199	–5.4
1400.00	.232	149.7	11.306	2.2	–19.845	–86.1	.209	–24.5
1500.00	.201	141.9	11.242	–13.1	–19.678	–91.0	.215	–42.0
1600.00	.165	134.8	11.088	–28.2	–19.386	–96.1	.213	–57.7
1700.00	.130	124.8	10.896	–43.7	–19.083	–101.6	.204	–69.8
1800.00	.096	109.6	10.809	–59.0	–18.775	–108.0	.184	–78.0
1900.00	.074	75.1	10.722	–73.9	–18.472	–114.9	.157	–80.1
2000.00	.085	23.5	10.576	–89.7	–18.191	–122.7	.132	–71.2
2100.00	.150	–12.3	10.340	–106.5	–17.919	–131.8	.139	–53.6
2200.00	.245	–34.2	10.002	–124.8	–17.733	–142.2	.188	–42.5
2300.00	.351	–51.3	9.410	–144.2	–17.726	–153.4	.257	–43.7
2400.00	.458	–67.1	8.497	–164.3	–17.862	–164.8	.327	–50.8
2500.00	.551	–81.4	7.273	176.0	–18.237	–176.1	.377	–59.9

AVANTEK

AKA R3711
56-61

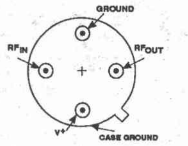
UTO/UTC/PPA 2023 Series
Thin-Film Cascadable Amplifier
10 to 2000 MHz

FEATURES

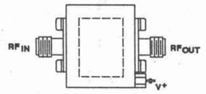
- Frequency Range: 10 to 2000 MHz
- Medium Output Power: +14.5 dBm (Typ)
- Medium Gain: 8.5 dB (Typ)
- Temperature Compensated
- Surface Mount Option

APPLICATIONS

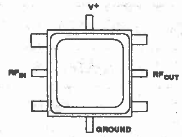
- IF/RF Amplification
- Surface Mount Assembly



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42



PPA—PP-38, p. 16–35

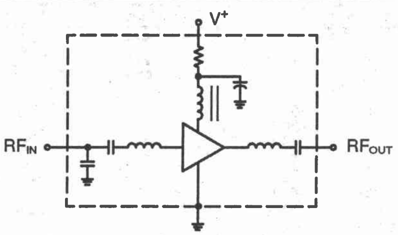
DESCRIPTION

The 2023 Series is a medium-power, wideband thin-film bipolar RF amplifier with resistive feedback and active bias for temperature compensation and increased immunity to bias voltage variations. Input/output blocking capacitors couple the RF through the amplifier, while a low VSWR is maintained through inductive tuning. The 2023 Series amplifiers are available in three packages: the surface mount PlanarPak PP-38 (.375 in. x .375 in.) case, the TO-8 hermetic case and the connectorized TC- 1 case.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

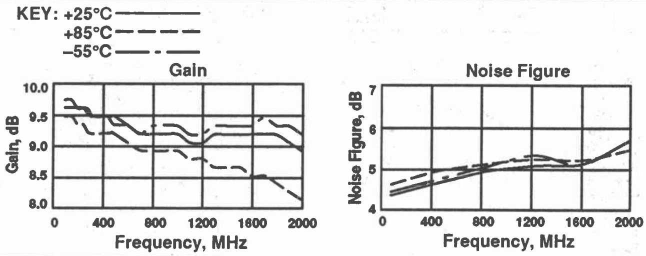
Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	10-2000	10-2000	10-2000	MHz
GP	Small Signal Gain (Min.)	8.5	8.0	7.5	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	6.5	8.5	9.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+14.5	+14.0	+14.0	dBm
—	Input VSWR (Max.)	<1.8:1	2.2:1	2.2:1	—
—	Output VSWR (Max.)	<1.5:1	2.2:1	2.2:1	—
IP_3	Two Tone 3rd Order Intercept Point	+25.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+40.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+46.0	—	—	dBm
I_D	DC Current	50	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +100°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+100°C

THERMAL CHARACTERISTICS*

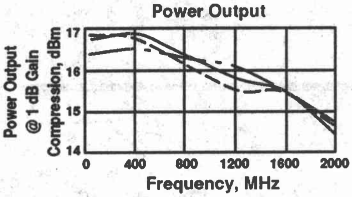
θ_{JC}	75°C/W
Active Transistor Power Dissipation	600 mW
Junction Temperature Above Case Temperature	45°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	664,200 Hrs.

*For further information, see High Reliability section, p. 17–2.

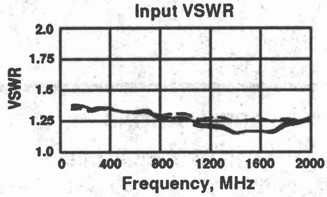
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

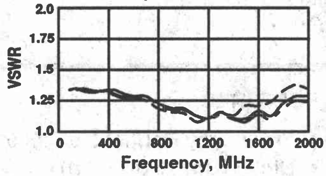
Power Output



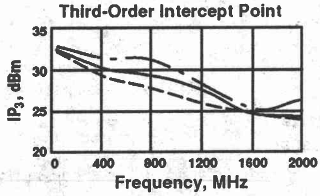
Input VSWR



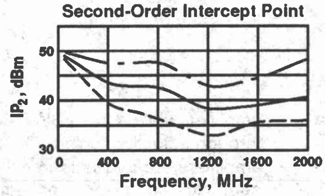
Output VSWR



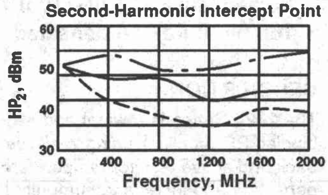
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.59	9.08	168.15	–1.16	.00	1.48	15.29
200.0	1.61	9.03	156.52	–1.27	.33	1.47	15.34
300.0	1.63	8.96	144.62	–1.67	.33	1.46	15.38
400.0	1.66	8.97	132.82	–1.96	.31	1.45	15.51
500.0	1.69	8.98	121.76	–1.51	.30	1.44	15.61
600.0	1.73	8.94	110.90	–.85	.30	1.42	15.72
700.0	1.75	8.86	100.15	–.10	.28	1.40	15.82
800.0	1.78	8.80	90.08	1.35	.31	1.37	15.92
900.0	1.78	8.75	79.14	1.92	.31	1.35	16.01
1000.0	1.79	8.71	68.05	2.34	.31	1.32	16.07
1200.0	1.76	8.67	45.08	2.40	.32	1.31	16.25
1400.0	1.69	8.63	21.55	1.91	.33	1.35	16.36
1600.0	1.58	8.65	–2.46	.94	.34	1.46	16.32
1800.0	1.43	8.59	–28.04	–1.60	.37	1.60	16.29
2000.0	1.23	8.56	–55.05	–5.57	.38	1.73	16.22
2200.0	1.14	8.14	–82.83	—	.40	1.79	16.21
2400.0	1.49	7.29	–112.71	—	.43	1.79	16.39

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.241	–178.1	8.611	168.7	–15.091	–6.1	.182	161.6
200.00	.242	–178.7	8.589	157.1	–15.207	–13.1	.179	147.1
300.00	.247	–179.7	8.543	145.5	–15.262	–19.4	.181	131.2
400.00	.250	179.3	8.575	133.8	–15.409	–25.3	.182	116.6
500.00	.258	178.0	8.614	122.9	–15.473	–31.7	.180	103.3
600.00	.263	176.9	8.613	112.3	–15.547	–38.0	.176	89.5
700.00	.272	175.1	8.621	101.7	–15.677	–44.3	.168	75.3
800.00	.277	172.8	8.619	91.6	–15.779	–50.1	.161	60.4
900.00	.282	170.3	8.630	80.7	–15.773	–55.0	.149	44.2
1000.00	.283	168.1	8.663	69.5	–15.849	–61.0	.139	25.0
1200.00	.275	162.2	8.758	46.2	–16.031	–73.1	.128	–18.9
1400.00	.249	154.1	8.886	22.2	–16.145	–85.6	.139	–85.7
1600.00	.200	143.2	9.013	–2.8	–16.116	–98.1	.167	–107.1
1800.00	.119	126.5	9.059	–29.8	–16.163	–110.6	.191	–143.6
2000.00	.026	27.6	9.063	–58.5	–16.245	–124.1	.209	–178.0
2200.00	.164	–60.6	8.539	–87.8	–16.442	–139.7	.219	144.2
2400.00	.330	–83.0	7.508	–118.7	–16.906	–156.7	.227	109.4

AVANTEK

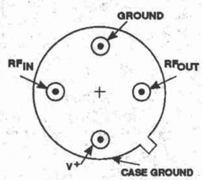
UTO/UTC 2024 Series
Thin-Film Cascadable Amplifier
5 to 2000 MHz

FEATURES

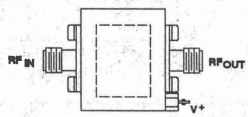
- Frequency Range: 5 to 2000 MHz
- High Gain: 16 dB (Typ)
- Noise Figure: 4.5 dB (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

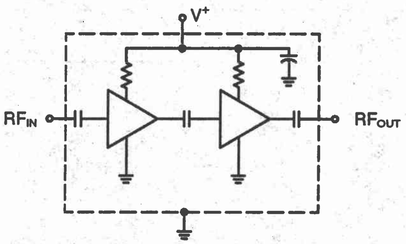
DESCRIPTION

The 2024 Series is a wideband two-stage bipolar RF amplifier using resistive feedback and active bias for temperature compensation and increased immunity to bias voltage variations. Input/output blocking capacitors couple the RF through the amplifier, while a low VSWR is maintained through inductive tuning. The 2024 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T = 25°C	Guaranteed Specifications		Unit
			T = 0° to 50°C	T = –55° to +85°C	
BW	Frequency Range	5-2000	5-2000	5-2000	MHz
GP	Small Signal Gain (Min.)	16.0	15.0 Min.	14.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	4.5	5.5	6.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+6.0	+5.0	+4.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.8:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+18.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+30.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+40.0	—	—	dBm
I_D	DC Current	38	—	—	mA

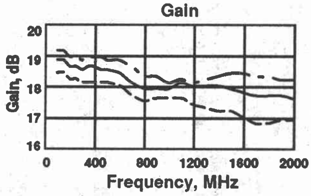
SCHEMATIC

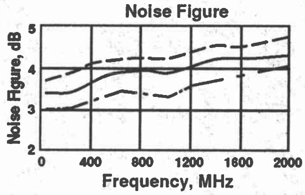


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
–55°C — · —





MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

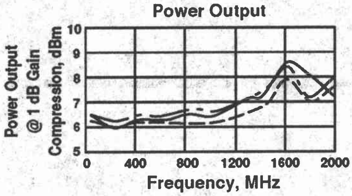
θ_{JC}	105/87°C/W
Active Transistor Power Dissipation	85/170 mW
Junction Temperature Above Case Temperature	9/15°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	741,300 Hrs.

*For further information, see High Reliability section, p. 17–2.

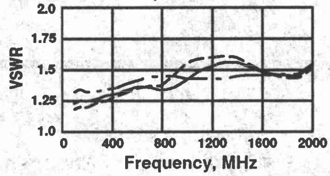
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

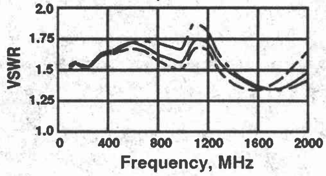
Power Output



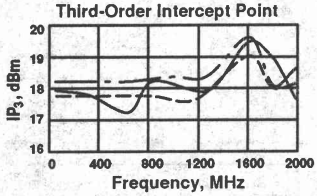
Input VSWR



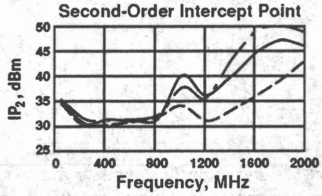
Output VSWR



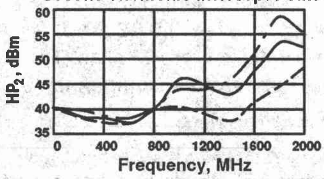
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.22	16.54	–10.39	–2.14	.00	1.51	30.62
200.0	1.22	16.46	–17.84	–.46	.22	1.55	30.48
300.0	1.22	16.29	–26.31	.19	.25	1.61	30.69
400.0	1.24	16.28	–35.94	–.29	.26	1.68	30.96
500.0	1.26	16.35	–44.87	–.08	.25	1.75	31.27
600.0	1.29	16.50	–53.95	–.02	.27	1.80	31.37
700.0	1.34	16.54	–64.05	–.99	.25	1.84	31.53
800.0	1.37	16.46	–72.05	.14	.23	1.88	31.81
900.0	1.40	16.50	–80.69	.62	.25	1.84	32.04
1000.0	1.43	16.51	–89.75	.70	.23	1.76	32.32
1100.0	1.44	16.54	–97.15	2.44	.22	1.66	32.67
1200.0	1.45	16.42	–105.87	2.85	.26	1.60	32.92
1300.0	1.43	16.26	–116.21	1.64	.29	1.50	33.23
1400.0	1.41	16.33	–126.79	.20	.28	1.50	33.39
1500.0	1.36	16.36	–136.11	.02	.27	1.49	33.63
1600.0	1.30	16.20	–146.31	–1.04	.27	1.54	33.63
1700.0	1.21	16.16	–155.22	–.82	.24	1.57	33.64
1800.0	1.13	16.11	–163.79	–.25	.26	1.60	33.26
1900.0	1.11	16.15	–173.75	–1.08	.27	1.62	32.79
2000.0	1.23	16.43	176.59	–1.62	.28	1.55	32.16

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.123	–171.3	16.410	–9.6	–30.503	1.1	.180	–177.0
200.00	.126	–166.6	16.256	–18.2	–30.551	.4	.189	–174.4
300.00	.130	–160.1	16.122	–26.8	–30.721	–1.1	.207	–173.7
400.00	.135	–152.7	16.170	–36.6	–31.091	–.9	.226	–173.5
500.00	.140	–147.9	16.329	–45.1	–31.167	–1.9	.246	–174.1
600.00	.151	–146.7	16.417	–54.0	–31.431	–2.5	.265	–176.2
700.00	.168	–146.2	16.614	–62.8	–31.537	–2.3	.286	–179.4
800.00	.188	–142.7	16.505	–71.3	–31.872	–2.6	.297	177.3
900.00	.193	–138.9	16.485	–79.2	–32.074	–2.2	.304	172.1
1000.00	.194	–139.5	16.545	–87.7	–32.430	–1.7	.299	164.8
1100.00	.210	–139.9	16.396	–96.2	–32.821	–3.4	.297	157.5
1200.00	.205	–138.4	16.142	–106.5	–33.044	–5.9	.280	148.3
1300.00	.192	–138.3	16.221	–116.4	–33.275	–5.9	.258	138.0
1400.00	.183	–138.4	16.366	–126.0	–33.473	–7.0	.225	124.2
1500.00	.163	–138.6	16.256	–134.5	–33.646	–11.1	.210	111.0
1600.00	.143	–138.3	16.162	–143.8	–33.738	–13.2	.193	92.9
1700.00	.115	–132.1	16.750	–153.4	–33.560	–15.6	.182	79.6
1800.00	.079	–112.0	16.180	–162.2	–33.228	–16.1	.185	59.6
1900.00	.072	–74.9	16.347	–171.8	–32.786	–19.4	.185	47.2
2000.00	.120	–48.1	16.386	–176.7	–32.129	–21.3	.206	28.3
2500.00	.509	–70.2	16.628	–115.1	–29.189	–45.7	.235	–48.4
3000.00	.406	–89.4	13.788	14.5	–31.971	–82.9	.491	–125.7
3500.00	.800	–124.5	–2.301	–51.6	–35.785	–45.9	.323	–148.9
4000.00	.918	–158.4	–21.583	–65.4	–39.128	–26.5	.310	–162.9

AVANTEK

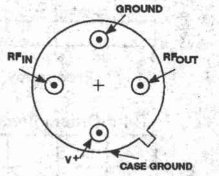
UTO/UTC 2025 Series
Thin-Film Cascadable Amplifier
100 to 2000 MHz

FEATURES

- **Frequency Range: 100 to 2000 MHz**
- **High Dynamic Range**
- **Medium Gain: 11.0 dB (Typ)**
- **Low Noise: 3.0 dB (Typ)**
- **High Power: +27 dBm (Typ)**
- **Temperature Compensated**

APPLICATIONS

- **Power AMP Driver**
- **High Intercept Requirements**



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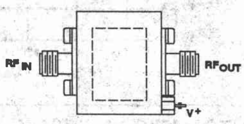


UTC—TC-1, p. 16–42

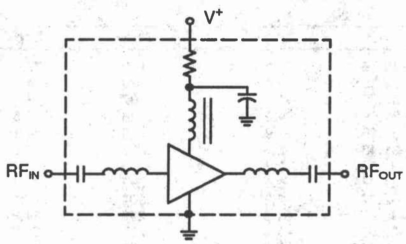
DESCRIPTION

The 2025 Series is a wideband, high-power GaAs FET RF amplifier. The combination of high output power and low noise figure provide a unit with very high dynamic range. Active bias and resistive feedback provide for stability over temperature and bias voltage variations. Input/output blocking capacitors couple the RF through the amplifier, while a low VSWR is maintained through inductive tuning. The 2025 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	100-2000	100-2000	100-2000	MHz
GP	Small Signal Gain (Min.)	11.0	9.5	9.0	dB
—	Gain Flatness (Max.)	±0.3	±1.0	±1.0	dB
NF	Noise Figure (Max.)	3.0	4.5	5.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+27.0	+25.0	+24.0	dBm
—	Input VSWR (Max.)	1.8:1	2.0:1	2.2:1	—
—	Output VSWR (Max.)	1.6:1	2.0:1	2.2:1	—
IP_3	Two Tone 3rd Order Intercept Point	+37.0	+33.0	+32.0	dBm
IP_2	Two Tone 2nd Order Intercept Point	+47.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+53.0	—	—	dBm
I_D	DC Current	175	—	—	mA

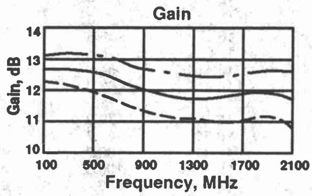
SCHEMATIC

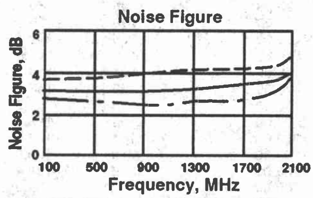


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – –
–55°C —·—





MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+19 dBm
Operating Case Temperature	–55°C to +100°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+100°C

THERMAL CHARACTERISTICS*

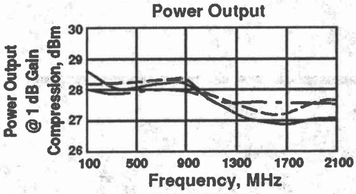
θ_{JC}	36°C/W
Active Transistor Power Dissipation	1280 mW
Junction Temperature Above Case Temperature	46°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	217,400 Hrs.

*For further information, see High Reliability section, p. 17–2.

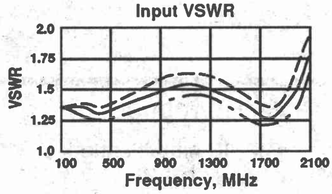
WEIGHT: (typical) UTO— 2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

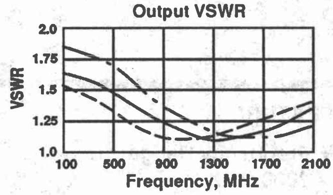
Power Output



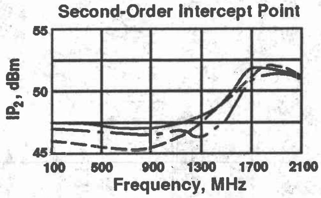
Input VSWR



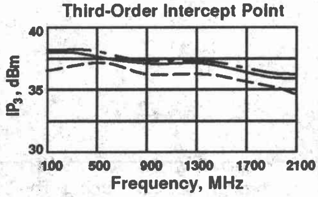
Output VSWR



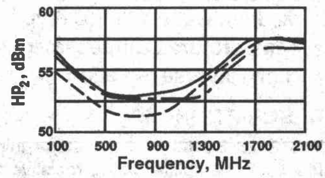
Second-Order Intercept Point



Third-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

BIAS = 15.00 VOLTS
CURRENT = 174.00 mA

FREQ	S_{11}		S_{21}		S_{12}		S_{22}			GPDEL	PHASE
GHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	K	ns	DEG
.100	.14	–84.7	12.4	178.2	–19.0	–16.1	.25	–154.60	1.19	.42	4.85
.200	.11	–98.5	12.5	163.1	–19.5	–19.9	.24	179.85	1.25	.42	.24
.300	.11	–106.2	12.4	151.2	–19.7	–25.6	.23	165.70	1.28	.33	–1.20
.400	.12	–113.1	12.4	140.2	–19.8	–32.2	.22	155.30	1.31	.31	–1.81
.500	.14	–119.1	12.3	129.4	–20.0	–38.9	.20	145.84	1.34	.30	–2.10
.600	.15	–126.1	12.2	119.0	–20.2	–46.0	.18	137.12	1.38	.29	–2.07
.700	.17	–131.9	12.0	108.8	–20.3	–52.5	.15	128.88	1.41	.28	–1.78
.800	.18	–138.3	11.9	98.6	–20.5	–59.9	.12	120.30	1.45	.28	–1.56
.900	.20	–144.4	11.8	88.7	–20.7	–67.5	.09	110.25	1.49	.27	–.91
1.000	.21	–151.2	11.7	79.0	–20.8	–75.1	.07	99.02	1.54	.27	–.15
1.100	.22	–158.8	11.6	69.4	–21.1	–83.0	.04	81.92	1.58	.27	.69
1.200	.22	–167.1	11.5	59.6	–21.3	–91.2	.03	47.01	1.63	.27	1.39
1.300	.21	–176.1	11.5	49.6	–21.6	–99.2	.03	5.14	1.68	.28	1.78
1.400	.19	175.1	11.5	39.3	–21.9	–107.6	.05	–20.27	1.74	.29	1.96
1.500	.17	164.3	11.5	28.9	–22.1	–116.2	.06	–33.91	1.79	.29	2.06
1.600	.15	149.9	11.5	18.7	–22.3	–125.5	.07	–42.38	1.84	.28	2.29
1.700	.13	125.3	11.6	8.1	–22.5	–136.7	.06	–41.62	1.87	.29	2.17
1.800	.11	83.3	11.7	–3.9	–23.0	–148.1	.07	–33.15	1.95	.33	.66
1.900	.13	36.2	11.7	–16.8	–23.6	–159.1	.09	–34.26	2.05	.36	–1.81
2.000	.19	3.8	11.7	–30.1	–24.3	–170.1	.11	–42.50	2.18	.37	–4.68
2.100	.27	–17.4	11.5	–44.2	–25.0	178.7	.12	–56.05	2.30		
2.200	.36	–33.7	11.2	–58.9	–25.8	166.6	.13	–74.23	2.43		
2.300	.45	–47.7	10.8	–74.0	–26.9	153.9	.15	–95.76	2.62		
2.400	.53	–60.3	10.1	–89.3	–28.2	141.3	.18	–119.16	2.91		
2.500	.61	–71.9	9.2	–104.3	–29.9	129.0	.22	–140.94	3.37		
2.600	.67	–82.8	8.1	–118.8	–31.9	117.0	.27	–159.57	4.07		
2.700	.72	–93.0	6.8	–132.2	–34.7	105.7	.32	–175.10	5.51		
2.800	.76	–102.5	5.4	–144.2	–38.5	97.0	.36	171.81	8.54		
2.900	.79	–111.7	3.9	–155.0	–45.5	98.9	.40	160.79	19.57		
3.000	.81	–120.4	2.4	–164.1	–50.0	170.3	.42	151.48	34.63		
3.100	.82	–129.1	.9	–171.2	–42.6	–160.6	.43	143.46	16.06		
3.200	.82	–137.8	–.4	–178.6	–38.7	–164.4	.43	136.41	11.60		
3.300	.82	–146.5	–1.6	175.7	–36.0	–172.8	.42	130.31	9.76		
3.400	.82	–155.2	–2.6	170.6	–34.5	179.1	.40	124.76	9.47		
3.500	.82	–164.0	–3.4	165.0	–33.4	169.0	.37	119.78	9.50		
3.600	.82	–173.2	–4.1	159.1	–32.7	159.5	.34	115.25	9.79		
3.700	.82	177.8	–4.7	152.5	–32.1	150.0	.31	111.05	10.15		
3.800	.82	168.4	–5.3	144.9	–31.9	139.3	.29	107.01	10.70		
3.900	.82	159.0	–5.9	136.7	–31.8	129.7	.26	102.96	11.42		
4.000	.83	149.6	–6.5	127.6	–31.9	118.1	.24	99.62	12.38		

LINEARIZATION RANGE: .10 to 2.00 GHz

AVANTEK

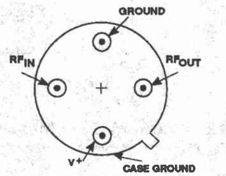
UTO/UTC 2026 Series
Thin-Film Cascadable Amplifier
10 to 2000 MHz

FEATURES

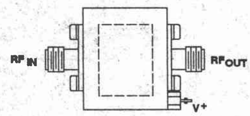
- **Frequency Range: 10 to 2000 MHz**
- **High Output Power: +19.0 dBm (Typ)**
- **Medium Gain: 15.0 dB (Typ)**
- **Temperature Compensated**
- **High Reverse Isolation**

APPLICATIONS

- **IF/RF Amplification**
- **Mixer Driver**



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

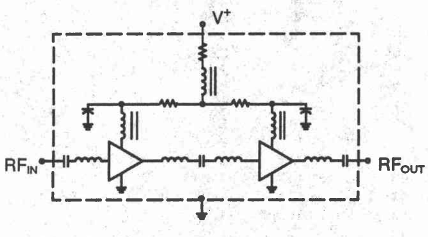
DESCRIPTION

The 2026 Series is a two-stage thin-film bipolar RF amplifier using resistive feedback and active bias for temperature compensation and increased immunity to bias voltage variations. Input/output blocking capacitors couple the RF through the amplifier, while a low VSWR is maintained through inductive tuning. The 2026 Series amplifiers are available in either the TO- 8 hermetic case or connectored TC-1 package.

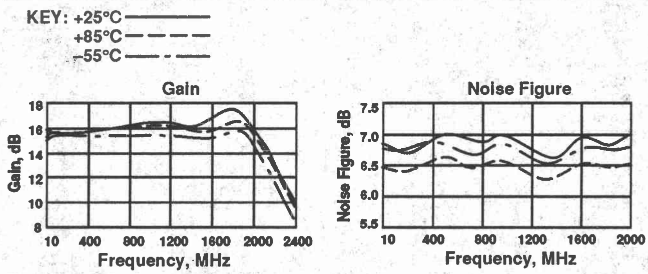
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	10-2000	10-2000	10-2000	MHz
GP	Small Signal Gain (Min.)	15.0	13.5	13.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.5	dB
NF	Noise Figure (Max.)	6.5	7.0	7.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+20.5	+19.0	+18.5	dBm
—	Input VSWR (Max.)	1.6:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.7:1	2.0:1	2.0:1	—
IP3	Two Tone 3rd Order Intercept Point	+31.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+45.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+51.0	—	—	dBm
I_D	DC Current	155	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage .... 17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +115°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +115°C

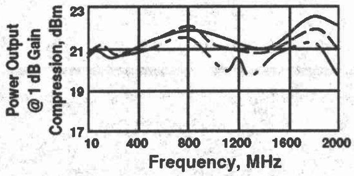
THERMAL CHARACTERISTICS*

θ_{JC} .... 75°C/W
Active Transistor Power Dissipation .... 459/429/429 mW
Junction Temperature Above Case Temperature .. 34/32/32°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 356,100 Hrs.
*For further information, see High Reliability section, p. 17–2.

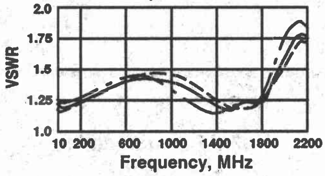
WEIGHT: (typical) UTO— 1.7 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

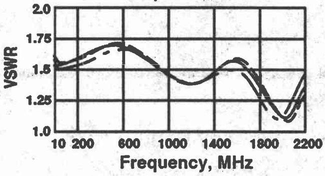
Power Output



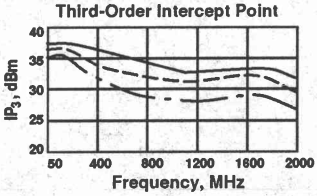
Input VSWR



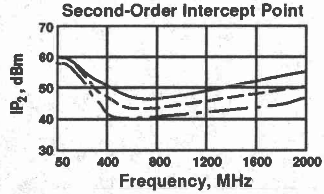
Output VSWR



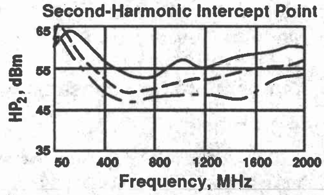
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS — **BIAS = 15.00 VOLTS**

FREQ	S_{11}		S_{21}		S_{12}		S_{22}			GPDEL	PHASE
GHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	K	ns	DEG
.005	.15	–159.0	14.6	39.6	–28.4	36.5	.33	151.85	2.23	12.83	
.010	.09	–170.2	14.9	16.5	–28.1	16.3	.24	162.27	2.23	12.83	9.67
.020	.08	–173.1	14.9	5.5	–28.0	6.7	.22	169.59	2.23	3.03	.87
.050	.08	–172.2	15.0	–5.7	–28.0	–1.4	.21	173.80	2.21	1.04	–4.03
.100	.09	–167.3	15.0	–17.6	–28.0	–8.2	.21	174.87	2.20	.66	–5.36
.150	.09	–163.3	15.0	–28.2	–28.0	–13.6	.21	174.56	2.20	.59	–5.42
.200	.10	–160.7	15.0	–38.5	–28.0	–18.7	.22	173.34	2.21	.57	–5.14
.250	.11	–159.4	15.0	–48.6	–28.1	–23.8	.22	171.33	2.23	.56	–4.63
.300	.12	–159.7	15.0	–58.6	–28.2	–28.9	.23	168.63	2.24	.55	–4.04
.350	.13	–161.0	15.0	–68.5	–28.3	–33.5	.24	165.33	2.25	.55	–3.38
.400	.14	–162.6	15.0	–78.3	–28.4	–38.3	.24	161.41	2.27	.55	–2.68
.450	.15	–164.9	15.0	–88.2	–28.5	–42.7	.25	157.34	2.28	.55	–1.98
.500	.15	–167.4	15.1	–98.0	–28.6	–47.5	.25	152.61	2.29	.55	–1.25
.550	.16	–170.3	15.1	–108.0	–28.6	–52.0	.25	147.22	2.29	.56	–.66
.600	.17	–173.3	15.1	–118.0	–28.7	–56.7	.26	141.36	2.31	.55	–.04
.650	.17	–176.3	15.2	–127.9	–28.8	–61.2	.25	135.06	2.32	.55	.57
.700	.17	–179.2	15.2	–138.0	–28.9	–65.7	.25	128.12	2.34	.56	1.00
.750	.17	178.0	15.2	–148.1	–29.0	–70.0	.24	120.83	2.36	.56	1.57
.800	.17	175.3	15.3	–158.1	–29.1	–74.7	.23	112.98	2.39	.56	2.09
.850	.17	172.7	15.3	–168.4	–29.1	–79.1	.22	104.19	2.41	.57	2.41
.900	.17	170.2	15.3	–178.7	–29.3	–83.6	.21	94.87	2.45	.57	2.70
.950	.17	167.8	15.3	171.1	–29.4	–88.0	.20	84.60	2.48	.57	3.01
1.000	.16	165.6	15.4	160.7	–29.4	–92.5	.19	73.05	2.50	.58	3.15
1.050	.16	163.4	15.4	150.3	–29.6	–97.1	.18	60.38	2.54	.58	3.35
1.100	.15	161.3	15.4	139.8	–29.7	–101.3	.17	46.63	2.59	.58	3.43
1.150	.15	159.2	15.4	129.3	–29.7	–105.5	.16	31.82	2.61	.58	3.48
1.200	.14	157.6	15.4	118.6	–29.9	–110.0	.16	16.17	2.64	.59	3.39
1.250	.13	156.3	15.4	107.9	–29.9	–113.9	.16	.08	2.67	.60	3.28
1.300	.12	155.7	15.4	97.3	–30.0	–118.6	.17	–15.42	2.70	.59	3.22
1.350	.11	156.6	15.3	86.6	–30.0	–122.6	.18	–30.11	2.72	.60	3.10
1.400	.09	160.2	15.2	76.0	–30.0	–126.8	.19	–44.32	2.73	.59	3.06
1.450	.08	167.6	15.2	65.4	–29.9	–131.4	.20	–57.88	2.72	.59	3.09
1.500	.08	178.7	15.1	55.0	–29.9	–135.8	.21	–70.34	2.73	.58	3.25
1.550	.08	–170.5	15.1	44.9	–29.7	–141.0	.22	–82.87	2.67	.56	3.70
1.600	.09	–164.2	15.1	34.8	–29.7	–146.8	.22	–95.19	2.63	.56	4.13
1.650	.10	–161.2	15.2	24.5	–29.6	–153.1	.21	–106.67	2.57	.57	4.38
1.700	.10	–157.9	15.5	13.3	–29.6	–159.5	.21	–117.92	2.52	.62	3.81
1.750	.10	–151.7	15.7	1.3	–29.6	–166.4	.19	–128.77	2.48	.67	2.35
1.800	.11	–142.4	15.9	–11.8	–29.8	–173.3	.17	–138.59	2.49	.73	–.19
1.850	.13	–133.7	15.9	–25.8	–30.0	179.1	.14	–147.28	2.52	.78	–3.62
1.900	.16	–129.9	15.8	–40.4	–30.3	171.8	.11	–153.61	2.63	.81	–7.63
1.950	.19	–130.5	15.6	–55.3	–30.0	164.7	.08	–152.97	2.82	.83	–11.95
2.000	.22	–134.1	15.2	–70.1	–31.4	158.6	.05	–135.66	3.11	.82	–16.15
2.050	.25	–138.8	14.6	–84.5	–31.9	152.3	.06	–100.99	3.46	.80	
2.100	.27	–143.7	13.9	–98.4	–32.6	147.0	.08	–83.99	4.00	.77	
2.150	.28	–148.1	13.2	–111.6	–33.3	143.5	.11	–81.10	4.71	.73	
2.200	.28	–151.6	12.3	–124.1	–33.8	140.1	.15	–83.09	5.43	.70	
2.250	.27	–153.9	11.5	–135.9	–34.5	138.6	.18	–86.55	6.39	.65	
2.300	.27	–154.9	10.6	–147.0	–35.0	137.4	.21	–89.98	7.47	.62	
2.350	.26	–154.0	9.8	–157.7	–35.2	137.4	.23	–93.30	8.23	.60	
2.400	.25	–150.7	9.0	–168.2	–34.9	136.6	.26	–96.82	8.67	.59	
2.450	.25	–145.7	8.3	–178.8	–34.7	133.6	.29	–100.30	9.10	.59	
2.500	.27	–140.1	7.5	170.7	–34.6	130.6	.31	–103.70	9.51	.59	
2.750	.46	–135.7	3.3	119.1	–34.0	101.7	.41	–117.10	11.31	.57	
3.000	.65	–151.3	–1.5	74.3	–34.7	71.1	.45	–124.62	14.87	.50	

LINEARIZATION RANGE: .010 to 2.00 GHz

AVANTEK

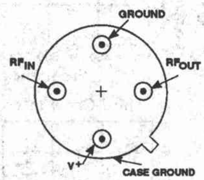
UTO/UTC 2027 Series Thin-Film Cascadable Amplifier 10 to 2000 MHz

FEATURES

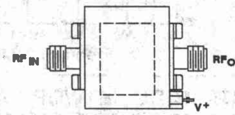
- **Frequency Range: 10 to 2000 MHz**
- **High Gain: +15.0 dB (Typ)**
- **Medium Output Power: +17.5 dBm (Typ)**
- **Temperature Compensated**

APPLICATIONS

- **IF/RF Amplification**



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

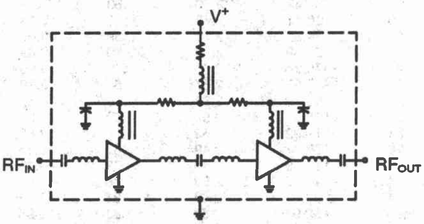
DESCRIPTION

The 2027 Series is a wideband, two-stage thin-film bipolar RF amplifier using resistive feedback and active bias for temperature compensation and increased immunity to bias voltage variations. Input/output blocking capacitors couple the RF through the amplifier while a low VSWR is maintained through inductive tuning. The 2027 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	10-2000	10-2000	10-2000	MHz
GP	Small Signal Gain (Min.)	15.0	13.5	12.5	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.5	dB
NF	Noise Figure (Max.)	6.3	7.0	7.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+17.5	+16.0	+16.0	dBm
—	Input VSWR (Max.)	1.6:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.7:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+30.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+45.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+51.0	—	—	dBm
I_D	DC Current	108	—	—	mA

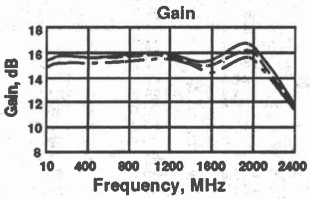
SCHEMATIC

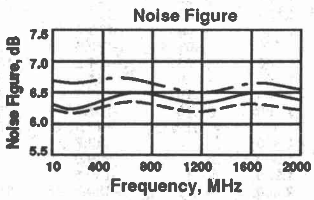


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
–55°C — - —





MAXIMUM RATINGS

DC Voltage .... 17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

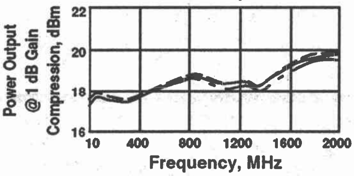
THERMAL CHARACTERISTICS*

θ_{JC} .... 75°C/W
Active Transistor Power Dissipation .... 300/317/317 mW
Junction Temperature Above Case Temperature .. 23/24/24°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 383,000 Hrs.
*For further information, see High Reliability section, p. 17–2.

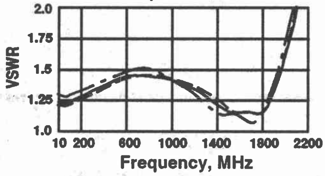
WEIGHT: (typical) UTO—1.7 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

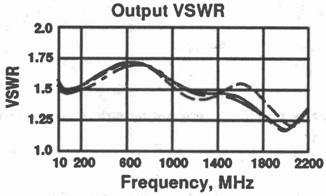
Power Output



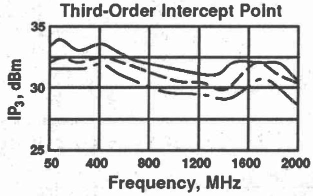
Input VSWR



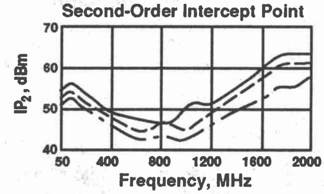
Output VSWR



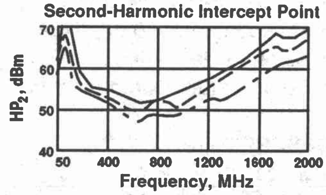
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS — **BIAS = 15.00 VOLTS**

FREQ	S_{11}		S_{21}		S_{12}		S_{22}			GPDEL	PHASE
GHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	K	ns	DEG
.005	.15	–158.9	14.4	35.7	–28.1	31.6	.30	151.71	2.24	11.71	
.010	.11	–169.5	14.5	14.6	–27.9	14.4	.22	162.86	2.27	11.71	10.27
.020	.10	–173.0	14.5	4.7	–27.8	5.7	.21	170.13	2.27	2.75	2.37
.050	.10	–173.1	14.6	–5.8	–27.7	–1.7	.20	174.20	2.24	.97	–2.07
.100	.10	–169.4	14.6	–17.2	–27.7	–8.3	.20	175.55	2.24	.63	–3.45
.150	.11	–166.1	14.6	–27.5	–27.8	–13.9	.20	175.52	2.24	.57	–3.71
.200	.12	–163.9	14.7	–37.5	–27.8	–18.9	.21	174.60	2.26	.55	–3.60
.250	.12	–162.8	14.6	–47.3	–27.9	–24.1	.21	172.75	2.27	.54	–3.35
.300	.13	–163.1	14.6	–57.0	–28.0	–29.0	.22	170.32	2.28	.54	–3.00
.350	.14	–164.1	14.6	–66.6	–28.1	–33.6	.23	167.18	2.30	.54	–2.58
.400	.15	–165.6	14.6	–76.2	–28.2	–38.3	.24	163.48	2.31	.53	–2.12
.450	.16	–167.7	14.6	–85.7	–28.3	–42.5	.25	159.40	2.32	.53	–1.60
.500	.17	–170.2	14.6	–95.2	–28.3	–47.3	.25	154.80	2.33	.53	–1.04
.550	.17	–172.9	14.7	–104.9	–28.4	–51.5	.26	149.58	2.33	.54	–.65
.600	.18	–175.9	14.7	–144.5	–28.5	–56.3	.26	143.95	2.36	.53	–.21
.650	.18	–178.8	14.7	–124.2	–28.6	–60.7	.26	137.94	2.37	.54	.21
.700	.18	178.5	14.7	–133.9	–28.7	–65.3	.26	131.28	2.40	.54	.52
.750	.18	175.7	14.7	–143.6	–28.8	–69.8	.26	124.29	2.41	.54	.85
.800	.18	173.0	14.8	–153.4	–28.9	–74.1	.25	116.80	2.43	.54	1.14
.850	.18	170.5	14.8	–163.3	–29.0	–78.5	.25	108.57	2.46	.55	1.30
.900	.18	168.1	14.8	–173.2	–29.0	–83.0	.24	99.95	2.48	.55	1.43
.950	.17	165.8	14.8	176.9	–29.1	–87.1	.23	90.81	2.52	.55	1.55
1.100	.17	163.7	14.8	166.8	–29.2	–91.3	.22	80.85	2.55	.56	1.55
1.050	.17	161.7	14.8	156.8	–29.3	–95.9	.21	70.42	2.58	.56	1.59
1.100	.16	159.5	14.8	146.7	–29.5	–100.5	.21	59.44	2.64	.56	1.55
1.150	.16	157.5	14.8	136.6	–29.5	–104.1	.20	48.07	2.66	.56	1.49
1.200	.15	155.7	14.8	126.3	–29.5	–108.6	.20	36.31	2.69	.57	1.32
1.250	.14	153.8	14.8	116.1	–29.6	–112.5	.19	24.25	2.73	.57	1.18
1.300	.13	152.1	14.7	106.0	–29.8	–116.8	.19	12.17	2.79	.56	1.11
1.350	.12	151.2	14.7	95.8	–29.7	–120.6	.19	.10	2.81	.56	.97
1.400	.10	151.8	14.6	85.8	–29.8	–124.4	.19	–12.11	2.85	.56	.96
1.450	.09	154.7	14.5	75.7	–29.7	–128.7	.19	–24.36	2.85	.56	.95
1.500	.08	162.0	14.4	65.8	–29.6	–132.6	.19	–36.29	2.86	.55	1.12
1.550	.07	173.4	14.4	56.2	–29.4	–137.4	.19	–48.75	2.82	.53	1.59
1.600	.07	–175.6	14.3	46.8	–29.2	–142.5	.18	–61.11	2.78	.53	2.18
1.650	.07	–167.9	14.4	37.4	–29.1	–148.7	.17	–72.47	2.72	.52	2.90
1.700	.07	–161.7	14.6	27.7	–29.1	–155.0	.16	–83.31	2.67	.54	3.18
1.750	.07	–151.3	14.8	17.3	–29.0	–161.6	.15	–93.25	2.60	.58	2.86
1.800	.07	–132.5	15.0	6.0	–29.1	–168.5	.13	–101.16	2.57	.63	1.68
1.850	.08	–112.2	15.2	–6.1	–29.2	–175.5	.12	–106.97	2.53	.67	–.37
1.900	.12	–102.2	15.3	–18.9	–29.3	178.1	.10	–110.29	2.51	.71	–3.16
1.950	.17	–100.8	15.4	–32.3	–29.6	170.7	.09	–108.39	2.56	.75	–6.54
2.000	.22	–104.3	15.3	–46.2	–29.9	164.3	.08	–100.52	2.61	.77	–10.36
2.050	.27	–110.0	15.1	–60.3	–30.2	157.5	.08	–89.19	2.69	.79	
2.100	.32	–116.8	14.7	–74.5	–30.6	151.4	.10	–80.23	2.85	.78	
2.150	.36	–124.0	14.3	–88.4	–31.2	145.7	.12	–76.07	3.11	.77	
2.200	.38	–131.0	13.7	–101.9	–31.6	141.2	.15	–76.08	3.38	.75	
2.250	.40	–137.4	13.0	–114.7	–32.1	136.3	.17	–77.69	3.75	.71	
2.300	.41	–143.0	12.3	–127.1	–32.6	132.8	.20	–79.96	4.23	.69	
2.350	.40	–147.4	11.6	–139.0	–32.9	128.9	.23	–82.69	4.69	.66	
2.400	.0	–150.4	10.9	–150.5	–33.1	125.6	.26	–86.08	5.20	.64	
2.500	.38	–152.0	9.5	–172.9	–33.4	118.2	.31	–92.57	6.27	.62	
3.000	.62	–150.2	1.0	82.5	–34.8	61.7	.44	–110.50	12.07	.56	

LINEARIZATION RANGE: .01 to 2.00 GHz

AVANTEK

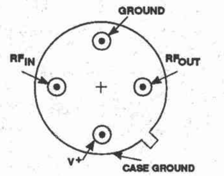
UTO/UTC 2031 Series
Thin-Film Cascadable Amplifier
1 to 2000 MHz

FEATURES

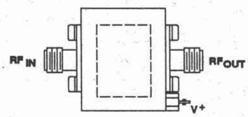
- Frequency Range: 1 to 2000 MHz
- Noise Figure: 4.0 dB (Typ)
- Medium Gain: 10.5 dB (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

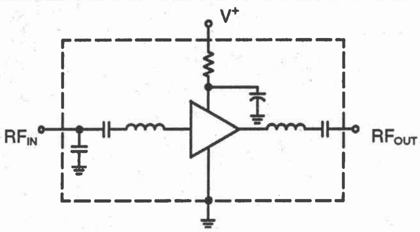
DESCRIPTION

The 2031 Series is a wideband thin-film bipolar RF amplifier using resistive feedback and active bias for temperature compensation and increased immunity to bias voltage variations. Low input/output VSWR is maintained by inductive tuning, and internal blocking capacitors couple the RF through the amplifier. The 2031 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	1-2000	1-2000	1-2000	MHz
GP	Small Signal Gain (Min.)	10.5	9.0 Min.	8.5	dB
—	Gain Flatness (Max.)	±0.6	±1.0	±1.0	dB
NF	Noise Figure (Max.)	4.0	5.5	5.5	dB
$P_{1 dB}$	Power Output @ +1 dB Compression (Min.)	+3.0	+2.0	+2.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+14.0	—	—	dBm
I_D	DC Current	16	—	—	mA

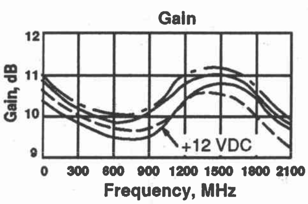
SCHEMATIC

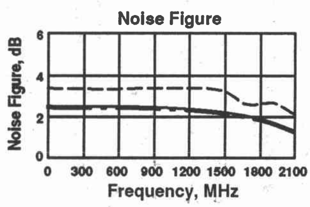


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ————
+85°C — — — —
–55°C —— - ——





MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

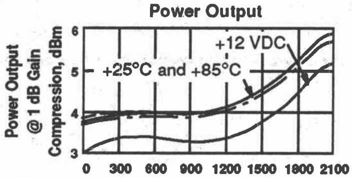
θ_{JC}	105°C/W
Active Transistor Power Dissipation	126 mW
Junction Temperature Above Case Temperature	13°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	685,900 Hrs.

*For further information, see High Reliability section, p. 17–2.

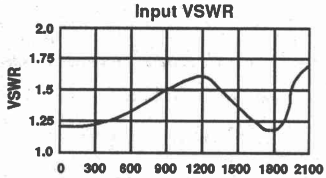
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

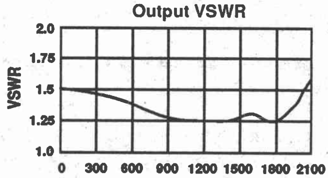
Power Output



Input VSWR



Output VSWR



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.19	11.26	166.23	–6.03	.00	1.49	18.82
200.0	1.21	11.18	153.28	–5.27	.36	1.46	18.88
300.0	1.23	11.09	140.08	–4.74	.36	1.43	18.92
400.0	1.27	11.08	127.41	–3.69	.34	1.41	19.00
500.0	1.31	11.06	115.25	–2.14	.33	1.38	19.03
600.0	1.36	11.00	103.46	–.23	.33	1.35	19.08
700.0	1.42	10.96	91.63	1.64	.31	1.32	19.13
800.0	1.48	10.98	80.57	4.29	.33	1.30	19.20
900.0	1.54	11.04	68.43	5.88	.35	1.28	19.27
1000.0	1.59	11.14	55.49	6.63	.37	1.27	19.41
1100.0	1.61	11.31	41.97	6.81	.38	1.27	19.61
1200.0	1.60	11.44	27.77	6.31	.40	1.28	19.81
1300.0	1.55	11.50	12.82	5.07	.43	1.28	20.01
1400.0	1.47	11.53	–2.70	3.26	.43	1.29	20.08
1500.0	1.38	11.42	–18.15	1.53	.43	1.29	19.97
1600.0	1.29	11.24	–33.69	–.29	.44	1.28	19.77
1700.0	1.22	11.05	–49.74	–2.63	.44	1.25	19.50
1800.0	1.19	10.89	–65.46	–4.62	.44	1.24	19.23
1900.0	1.25	10.69	–81.19	–6.63	.45	1.25	18.93
2000.0	1.41	10.35	–97.89	–9.62	.48	1.35	18.78
2100.0	1.70	9.89	–115.76	—	.51	1.52	18.67
2200.0	2.15	9.24	–134.59	—	.54	1.76	18.82

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.088	–171.5	11.224	186.2	–18.937	–6.7	.191	166.7
200.00	.094	–162.9	11.157	153.0	–18.895	–13.7	.188	154.2
300.00	.104	–156.4	11.064	139.8	–19.000	–20.3	.179	141.5
400.00	.117	–151.1	11.057	126.8	–19.069	–26.6	.172	129.2
500.00	.136	–149.1	11.036	114.7	–19.059	–33.7	.162	119.0
600.00	.157	–148.2	10.993	102.7	–19.064	–40.5	.151	108.4
700.00	.183	–150.3	10.979	90.8	–19.144	–48.0	.137	98.6
800.00	.207	–154.1	10.988	79.5	–19.215	–54.7	.126	88.4
900.00	.231	–160.5	11.062	67.3	–19.276	–60.7	.115	77.5
1000.00	.252	–167.2	11.177	54.3	–19.411	–67.6	.107	64.1
1100.00	.261	–175.4	11.352	40.6	–19.593	–74.6	.104	48.3
1200.00	.259	175.7	11.502	26.3	–19.812	–81.1	.105	29.3
1300.00	.243	165.6	11.616	11.1	–19.975	–86.7	.110	9.7
1400.00	.210	154.9	11.659	–4.6	–20.031	–92.5	.116	–10.1
1500.00	.171	144.0	11.544	–20.4	–19.874	–98.0	.119	–26.6
1600.00	.124	130.1	11.363	–36.1	–19.667	–104.0	.120	–39.2
1700.00	.080	104.0	11.174	–52.5	–19.411	–110.1	.118	–44.2
1800.00	.061	46.4	11.033	–68.6	–19.136	–117.3	.117	–41.6
1900.00	.108	–4.8	10.797	–84.6	–18.878	–125.9	.133	–34.1
2000.00	.192	–28.7	10.450	–101.6	–18.706	–135.7	.171	–29.2
2100.00	.299	–44.6	9.950	–119.5	–18.655	–146.5	.230	–31.7
2200.00	.415	–58.7	9.272	–138.4	–18.784	–158.3	.296	–39.5
2300.00	.521	–72.7	8.307	–157.7	–19.149	–170.6	.350	–49.4
2400.00	.615	–85.5	7.085	–176.6	–19.758	178.5	.386	–60.3
2500.00	.689	–97.2	5.641	165.3	–20.423	167.3	.402	–70.3

AVANTEK

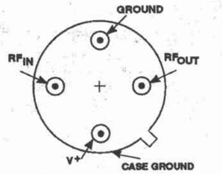
UTO/UTC 2032 Series
Thin-Film Cascadable Amplifier
1 to 2000 MHz

FEATURES

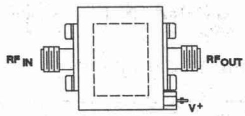
- Frequency Range: 1 to 2000 MHz
- Medium Gain: 10.0 dB (Typ)
- Low VSWR
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



UTO—TO-8U, p. 16–48



UTC—TC-1, p. 16–42

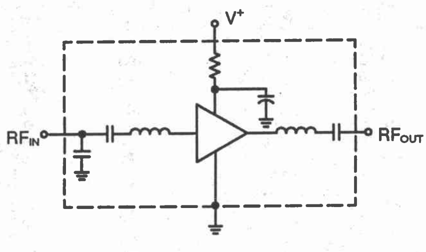
DESCRIPTION

The 2032 Series is a wideband thin-film bipolar RF amplifier using resistive feedback and active bias for temperature compensation and increased immunity to bias voltage variations. Low input/output VSWR is maintained by inductive tuning, and internal blocking capacitors couple the RF through the amplifier. The 2032 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	1-2000	1-2000	1-2000	MHz
GP	Small Signal Gain (Min.)	10.0	9.0	8.5	dB
—	Gain Flatness (Max.)	±0.6	±1.0	±1.0	dB
NF	Noise Figure (Max.)	5.0	6.0	6.0	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+7.50	+7.0	+6.5	dBm
—	Input VSWR (Max.)	<1.8:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.4:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+17.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+23.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+28.0	—	—	dBm
I_D	DC Current	25	—	—	mA

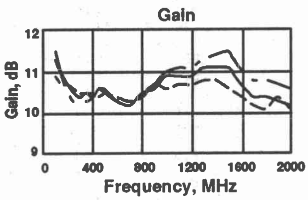
SCHEMATIC

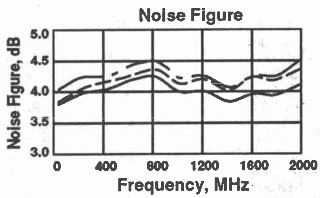


TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C — — —
−55°C —·—





MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	−55°C to +125°C
Storage Temperature	−62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

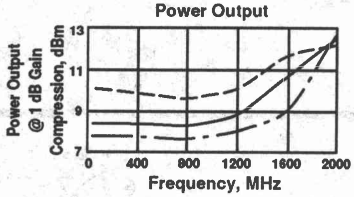
θ_{JC}	105°C/W
Active Transistor Power Dissipation	216 mW
Junction Temperature Above Case Temperature	23°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	797,500 Hrs.

*For further information, see High Reliability section, p. 17–2.

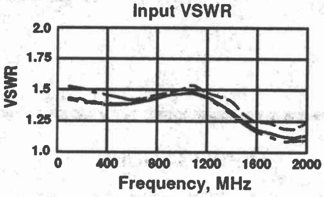
WEIGHT: (typical) UTO — 2.1 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

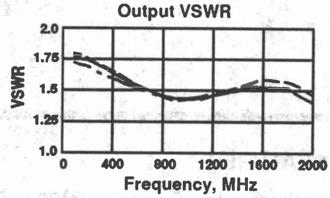
Power Output



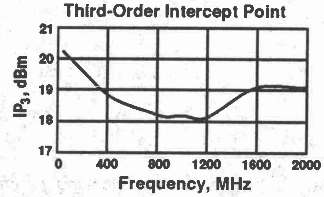
Input VSWR



Output VSWR



Third-Order Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.26	10.45	166.48	–7.64	.00	1.62	18.02
200.0	1.29	10.39	154.11	–6.19	.35	1.59	18.22
300.0	1.32	10.35	141.35	–5.12	.36	1.58	18.22
400.0	1.36	10.39	128.99	–3.66	.33	1.58	18.32
500.0	1.40	10.44	117.02	–1.80	.33	1.57	18.42
600.0	1.46	10.46	105.27	.25	.32	1.56	18.60
700.0	1.50	10.50	93.48	2.30	.31	1.55	18.69
800.0	1.56	10.57	82.37	5.01	.34	1.55	18.83
900.0	1.60	10.71	70.04	6.48	.35	1.55	19.00
1000.0	1.63	10.87	57.02	7.27	.37	1.55	19.24
1100.0	1.64	11.05	43.12	7.18	.39	1.56	19.50
1200.0	1.61	11.20	28.58	6.47	.41	1.56	19.76
1300.0	1.56	11.29	13.37	5.09	.43	1.55	19.95
1400.0	1.48	11.33	–2.31	3.23	.43	1.53	20.00
1500.0	1.40	11.26	17.82	1.55	.43	1.48	19.84
1600.0	1.34	11.10	–33.49	–.28	.44	1.41	19.59
1700.0	1.29	10.95	–49.56	–2.52	.45	1.35	19.25
1800.0	1.31	10.89	65.62	–4.75	.44	1.31	18.95
1900.0	1.38	10.76	–81.80	–7.11	.46	1.32	18.65
2000.0	1.55	10.46	–99.32	–10.81	.51	1.41	18.52
2100.0	1.86	10.00	–118.20	—	.54	1.57	18.44
2200.0	2.33	9.26	–138.11	—	.56	1.77	18.60

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.186	179.5	10.505	166.7	–18.576	–6.6	.268	166.3
200.00	.184	179.2	10.452	154.2	–18.519	–12.5	.261	153.2
300.00	.183	179.4	10.393	141.6	–18.585	–19.2	.254	139.8
400.00	.180	–179.5	10.405	129.1	–18.655	–25.5	.249	126.7
500.00	.185	–177.8	10.410	117.4	–18.645	–32.5	.239	115.3
600.00	.190	–175.8	10.410	105.9	–18.672	–39.2	.227	103.3
700.00	.204	–175.2	10.426	94.4	–18.801	–46.0	.212	91.3
800.00	.220	–175.7	10.456	83.7	–18.855	–52.7	.202	78.7
900.00	.239	–178.3	10.570	71.8	–18.982	–58.5	.190	65.0
1000.00	.257	178.2	10.723	59.5	–19.201	–64.8	.184	49.7
1100.00	.267	172.4	10.906	46.1	–19.411	–71.3	.183	32.4
1200.00	.268	165.7	11.096	32.3	–19.628	–76.8	.189	13.7
1300.00	.257	157.8	11.236	17.4	–19.762	–81.5	.199	–5.4
1400.00	.232	149.7	11.306	2.2	–19.845	–86.1	.209	–24.5
1500.00	.201	141.9	11.242	13.1	–19.678	–91.0	.215	–42.0
1600.00	.165	134.8	11.088	–28.2	–19.386	–96.1	.213	–57.7
1700.00	.130	124.8	10.896	–43.7	–19.083	–101.6	.204	–69.8
1800.00	.096	109.6	10.809	–59.0	–18.775	–108.0	.184	–78.0
1900.00	.074	75.1	10.722	–73.9	–18.472	–114.9	.157	–80.1
2000.00	.085	23.5	10.576	–89.7	–18.191	–122.7	.132	–71.2
2100.00	.150	–12.3	10.340	–106.5	–17.919	–131.8	.139	–53.6
2200.00	.245	–34.2	10.002	–124.8	–17.733	–142.2	.188	–42.5
2300.00	.351	–51.3	9.410	–144.2	–17.726	–153.4	.257	–43.7
2400.00	.458	–67.1	8.497	–164.3	–17.862	–164.8	.327	–50.8
2500.00	.551	–81.4	7.273	176.0	–18.237	–176.1	.377	–59.9

AVANTEK

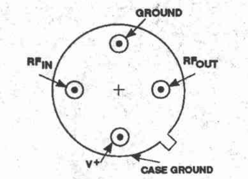
UTO/UTC 2033 Series
Thin-Film Cascadable Amplifier
1 to 2000 MHz

FEATURES

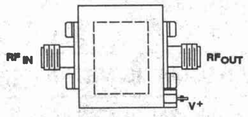
- Frequency Range: 1 to 2000 MHz
- Medium Output Power: +16.0 dBm (Typ)
- Low VSWR
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

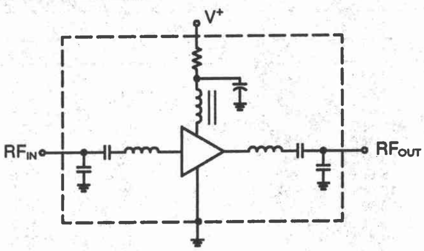
DESCRIPTION

The 2033 Series is a wideband thin-film bipolar RF amplifier using resistive feedback and active bias for temperature compensation and increased immunity to bias voltage variations. Low input/output VSWR is maintained by inductive tuning, while internal blocking capacitors couple the RF through the amplifier. The 2033 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

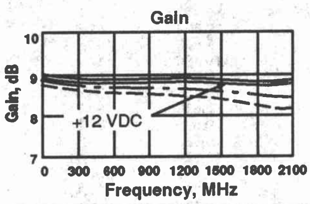
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range	1-2000	1-2000	1-2000	MHz
GP	Small Signal Gain (Min.)	8.5	8.0	7.5	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	6.5	8.5	9.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+16.0	+14.0	+14.0	dBm
—	Input VSWR (Max.)	<1.8:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+30.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+41.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+46.0	—	—	dBm
I_D	DC Current	50	—	—	mA

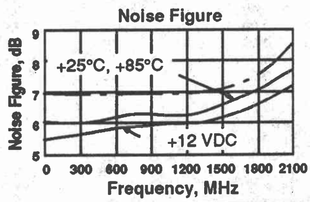
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
–55°C —— - ——





MAXIMUM RATINGS

DC Voltage .... 17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +100°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +100°C

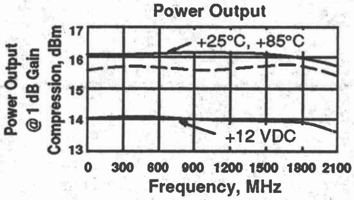
THERMAL CHARACTERISTICS*

θ_{JC} .... 75°C/W
Active Transistor Power Dissipation .... 600 mW
Junction Temperature Above Case Temperature .... 45°C
MTBF (MIL-HDBK-217E, A_{UF} W 90°C) .... 701,700 Hrs.
*For further information, see High Reliability section, p. 17–2.

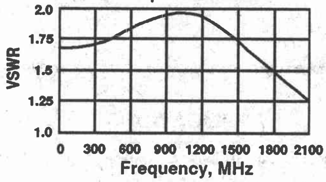
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

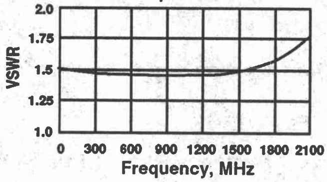
Power Output



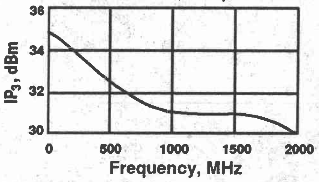
Input VSWR



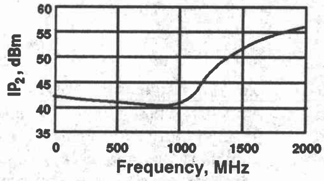
Output VSWR



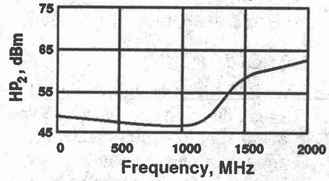
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.59	9.08	168.15	–1.16	.00	1.48	15.29
200.0	1.61	9.03	156.52	–1.27	.33	1.47	15.34
300.0	1.63	8.96	144.62	–1.67	.33	1.46	15.38
400.0	1.66	8.97	132.82	–1.96	.31	1.45	15.51
500.0	1.69	8.98	121.76	–1.51	.30	1.44	15.61
600.0	1.73	8.94	110.90	–.85	.30	1.42	15.72
700.0	1.75	8.86	100.15	–.10	.28	1.40	15.82
800.0	1.78	8.80	90.08	1.35	.31	1.37	15.92
900.0	1.78	8.75	79.14	1.92	.31	1.35	16.01
1000.0	1.79	8.71	68.05	2.34	.31	1.32	16.07
1200.0	1.76	8.67	45.08	2.40	.32	1.31	16.25
1400.0	1.69	8.63	21.55	1.91	.33	1.35	16.36
1600.0	1.58	8.65	–2.46	.94	.34	1.46	16.32
1800.0	1.43	8.59	–28.04	–1.60	.37	1.60	16.29
2000.0	1.23	8.56	–55.05	–5.57	.38	1.73	16.22
2200.0	1.14	8.14	–82.83	—	.40	1.79	16.21
2400.0	1.49	7.29	–112.71	—	.43	1.79	16.39

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.241	–178.1	8.611	168.7	–15.091	–6.1	.182	161.6
200.00	.242	–178.7	8.589	157.1	–15.207	–13.1	.179	147.1
300.00	.247	–179.7	8.543	145.5	–15.262	–19.4	.181	131.2
400.00	.250	179.3	8.575	133.8	–15.409	–25.3	.182	116.6
500.00	.258	178.0	8.614	122.9	–15.473	–31.7	.180	103.3
600.00	.263	176.9	8.613	112.3	–15.547	–38.0	.176	89.5
700.00	.272	175.1	8.621	101.7	–15.677	–44.3	.168	75.3
800.00	.277	172.8	8.619	91.6	–15.779	–50.1	.161	60.4
900.00	.282	170.3	8.630	80.7	–15.773	–55.0	.149	44.2
1000.00	.283	168.1	8.663	69.5	–15.849	–61.0	.139	25.0
1200.00	.275	162.2	8.758	46.2	–16.031	–73.1	.128	–18.9
1400.00	.249	154.1	8.886	22.2	–16.145	–85.6	.139	–65.7
1600.00	.200	143.2	9.013	–2.8	–16.116	–98.1	.167	–107.1
1800.00	.119	126.5	9.059	–29.8	–16.163	–110.6	.191	–143.6
2000.00	.026	27.6	9.063	–58.5	–16.245	–124.1	.209	–178.0
2200.00	.164	–60.6	8.539	–87.8	–16.442	–139.7	.219	144.2
2400.00	.330	–83.1	7.508	–118.7	–16.906	–156.7	.227	109.4

AVANTEK

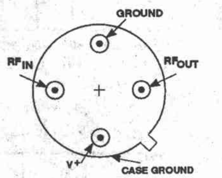
UTO/UTC 2052 Series
Thin-Film Cascadable Amplifier
5 to 2000 MHz

FEATURES

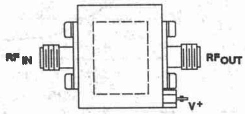
- Frequency Range: 5 to 2000 MHz
- 5 Volt Supply
- Low Supply Current: 18 mA (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- 5 Volt Systems



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

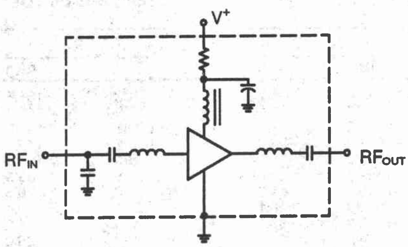
DESCRIPTION

The 2052 Series is a thin-film bipolar RF amplifier that operates on 5-volt bias to provide medium output power. Resistive feedback and active bias assure temperature compensation and immunity to bias voltage variation. Input/output blocking capacitors couple RF through the amplifier, while a low VSWR is maintained through inductive tuning. The 2052 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

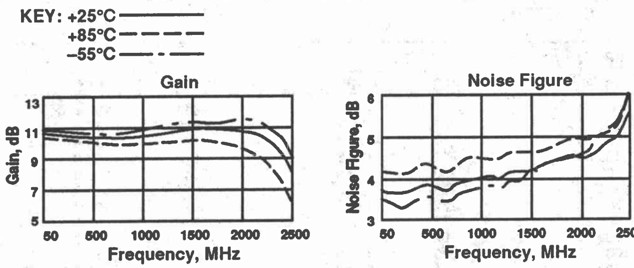
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-2000	5-2000	5-2000	MHz
GP	Small Signal Gain (Min.)	10.0	9.0	8.0	dB
—	Gain Flatness (Max.)	±0.2	±0.7	±1.0	dB
NF	Noise Figure (Max.)	4.5	5.0	5.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+7.0	+5.5	+4.5	dBm
—	Input VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.7:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+16.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+28.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+33.0	—	—	dBm
I_D	DC Current	18.0	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +5 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	+8.5 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

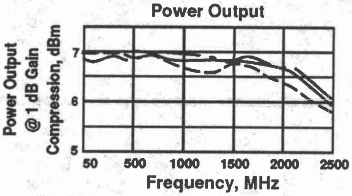
θ_{JC}	105°C/W
Active Transistor Power Dissipation	65 mW
Junction Temperature Above Case Temperature	7.0°C

*For further information, see High Reliability section, p. 17–2.

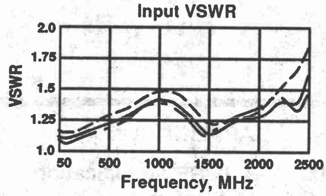
WEIGHT: (typical) UTO—1.7 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

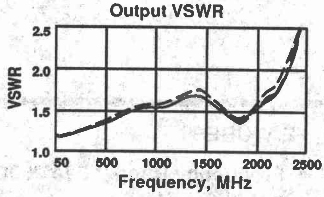
Power Output



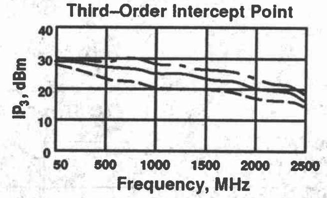
Input VSWR



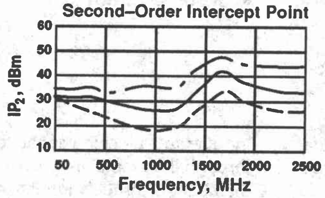
Output VSWR



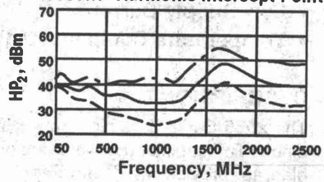
Third–Order Intercept Point



Second–Order Intercept Point



Second–Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

BIAS = 5 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}		GPDEL	PHASE
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	ns	DEG
.005	.09	–61.2	10.2	–170.5	–15.3	11.4	.10	48.53		
.010	.06	–40.9	10.1	–176.6	–15.4	4.7	.08	23.40		
.020	.05	–28.5	10.1	–179.8	–15.4	1.0	.07	15.24		
.050	.05	–28.8	10.1	174.5	–15.4	–3.5	.08	13.08	.39	–4.24
.100	.05	–41.5	10.1	167.5	–15.4	–8.7	.08	15.42	.39	–4.46
.150	.06	–55.0	10.1	160.8	–15.4	–13.5	.09	17.97	.37	–4.25
.200	.06	–67.2	10.1	154.3	–15.4	–18.1	.10	19.89	.36	–3.94
.250	.07	–78.2	10.0	147.9	–15.5	–22.7	.11	20.94	.35	–3.51
.300	.07	–89.0	10.0	141.5	–15.5	–27.2	.12	21.01	.35	–3.01
.350	.08	–98.7	10.0	135.2	–15.6	–31.6	.13	20.30	.35	–2.53
.400	.09	–107.5	10.0	128.8	–15.6	–36.1	.14	18.99	.35	–2.04
.450	.09	–115.6	10.0	122.5	–15.6	–40.5	.15	16.97	.35	–1.53
.500	.10	–123.3	9.9	116.3	–15.7	–44.8	.16	14.41	.35	–.96
.550	.11	–130.8	9.9	110.0	–15.7	–49.2	.16	11.38	.35	–.38
.600	.11	–138.2	9.9	103.8	–15.8	–53.5	.17	8.03	.35	.20
.650	.12	–145.4	9.9	97.5	–15.8	–57.8	.18	4.34	.35	.81
.700	.12	–152.5	9.9	91.3	–15.8	–62.1	.19	.35	.35	1.39
.750	.13	–159.6	9.9	85.0	–15.9	–66.4	.20	–3.85	.35	1.90
.800	.13	–166.7	9.9	78.7	–15.9	–70.7	.20	–8.28	.35	2.46
.850	.14	–173.8	10.0	72.3	–15.9	–75.0	.21	–13.01	.35	2.96
.900	.14	179.2	10.0	66.0	–15.9	–79.3	.21	–17.91	.35	3.47
.950	.14	171.9	10.0	59.6	–16.0	–83.7	.21	–22.96	.36	3.90
1.000	.14	164.6	10.0	53.1	–16.0	–88.0	.22	–28.22	.36	4.27
1.050	.14	157.2	10.1	46.8	–16.0	–92.4	.22	–33.68	.36	4.59
1.100	.14	149.5	10.1	40.1	–16.0	–96.9	.22	–39.43	.36	4.87
1.150	.13	141.6	10.2	33.4	–16.0	–101.4	.22	–45.38	.37	5.07
1.200	.13	133.2	10.2	26.7	–16.0	–106.0	.22	–51.47	.38	5.12
1.250	.13	124.3	10.3	19.8	–16.0	–110.6	.21	–57.88	.38	5.07
1.300	.12	114.8	10.4	12.8	–15.9	–115.3	.21	–64.71	.39	4.89
1.350	.11	104.1	10.5	5.7	–15.9	–120.1	.21	–71.65	.39	4.68
1.400	.11	92.2	10.5	–1.5	–15.9	–124.9	.20	–78.91	.40	4.23
1.450	.10	78.7	10.6	–9.0	–15.9	–129.9	.20	–86.64	.41	3.64
1.500	.09	63.2	10.6	–16.6	–15.9	–134.9	.19	–94.79	.43	2.81
1.550	.08	45.0	10.7	–24.4	–15.9	–140.0	.18	103.26	.43	1.84
1.600	.08	24.8	10.7	–32.5	–15.9	–145.2	.18	–112.45	.45	.63
1.650	.07	2.4	10.7	–40.3	–16.0	–150.4	.17	–122.53	.44	–.40
1.700	.07	–19.5	10.6	–48.3	–16.0	–155.5	.17	–133.39	.44	–1.50
1.750	.07	–39.1	10.6	–56.2	–16.0	–160.7	.17	–145.35	.44	–2.59
1.800	.08	–55.1	10.5	–64.2	–15.9	–166.1	.18	–158.70	.44	–3.74
1.850	.08	–68.5	10.5	–72.2	–15.9	–171.5	.18	–172.81	.45	–4.98
1.900	.09	–78.9	10.5	–80.6	–15.9	–177.3	.19	172.90	.46	–6.50
1.950	.10	–87.9	10.4	–89.1	–15.9	176.7	.21	158.52	.47	–8.17
2.000	.10	–96.1	10.4	–97.8	–15.9	170.4	.22	144.56	.49	–10.08
2.050	.10	–103.5	10.3	–106.8	–15.9	164.0	.25	131.65	.50	
2.100	.10	–109.5	10.2	–116.1	–15.9	157.3	.27	119.45	.52	
2.150	.10	–114.3	10.1	–125.6	–16.0	150.5	.30	107.91	.53	
2.200	.09	–116.5	9.9	–135.3	–16.1	143.4	.33	97.27	.54	
2.250	.08	–114.1	9.6	–145.2	–16.3	136.2	.37	87.23	.55	
2.300	.07	–105.6	9.4	–155.2	–16.5	128.8	.41	77.80	.56	
2.350	.07	–90.0	9.0	–165.5	–16.7	121.3	.45	68.49	.57	
2.400	.09	–73.8	8.6	–175.8	–17.0	113.6	.49	59.72	.58	
2.450	.12	–65.0	8.2	173.8	–17.4	106.0	.53	51.20	.58	
2.500	.16	–63.2	7.6	163.5	–17.9	98.3	.57	42.86	.57	
3.000	.64	–121.8	–1.5	76.0	–25.6	38.2	.82	–27.25	.49	

LINEARIZATION RANGE: .050 to 2.000 GHz

AVANTEK

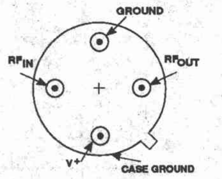
UTO/UTC 2055 Series
Thin-Film Cascadable Amplifier
5 to 2000 MHz

FEATURES

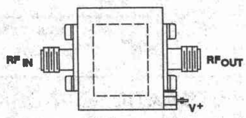
- Frequency Range: 5 to 2000 MHz
- 5-Volt Supply
- Low Supply Current
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- 5-Volt System



UTO—TO-8T, p. 16–48



UTC—TC-1, p. 16–42

DESCRIPTION

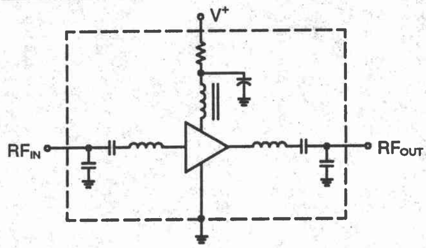
The 2055 Series is a high power thin-film bipolar RF amplifier that operates on 5-volt bias to provide medium output power. Resistive feedback and active bias assure temperature compensation and increased immunity to bias voltage variations.

Input/output blocking capacitors couple RF through the amplifier, while a low VSWR is maintained through inductive tuning. The 2055 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	5-2000	5-2000	5-2000	MHz
GP	Small Signal Gain (Min.)	9.5	8.5	7.5	dB
—	Gain Flatness (Max.)	±0.3	±0.7	±1.0	dB
NF	Noise Figure (Max.)	5	6.0	6.5	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression (Min.)	+11.5	+10.0	+9.0	dBm
—	Input VSWR (Max.)	1.6:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.7:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+22.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+30.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+36.0	—	—	dBm
I_D	DC Current	32	—	—	mA

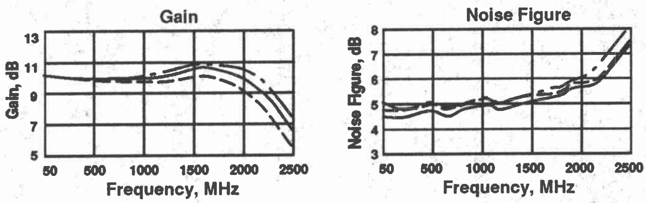
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +5 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
–55°C — - —



MAXIMUM RATINGS

DC Voltage .... +8.0 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

THERMAL CHARACTERISTICS*

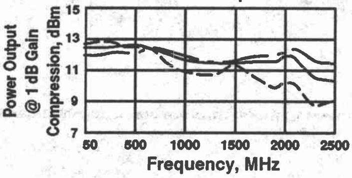
θ_{JC} .... 87°C/W
Active Transistor Power Dissipation .... 115 mW
Junction Temperature Above Case Temperature .... 10°C

*For further information, see High Reliability section, p. 17–2.

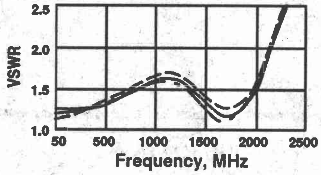
WEIGHT: (typical) UTO — 1.7 grams; UTC — 21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

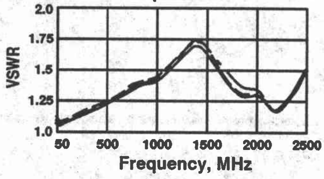
Power Output



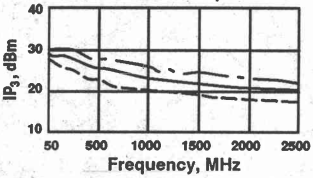
Input VSWR



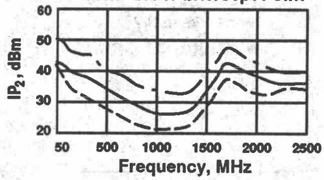
Output VSWR



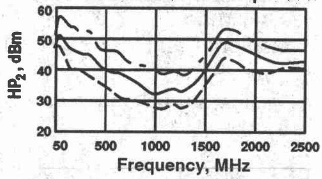
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

BIAS = 5 VOLTS
CURRENT = 32 mA

Freq MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang	GPDEL ns	PHASE DEG
.005	.12	–117.0	9.7	–168.9	–15.1	13.1	.07	119.33		
.010	.08	–138.2	9.7	–175.9	–15.1	5.6	.04	128.45		
.020	.06	–153.1	9.7	–179.9	–15.2	1.4	.03	138.60		
.050	.06	–161.3	9.7	174.5	–15.1	–3.0	.03	128.76	.40	–5.44
.100	.07	–160.2	9.7	167.4	–15.2	–8.0	.03	109.14	.40	–5.51
.150	.07	–157.5	9.7	160.6	–15.2	–12.5	.04	94.61	.38	–5.17
.200	.08	–155.6	9.7	154.0	–15.2	–16.9	.05	83.21	.37	–4.69
.250	.09	–154.0	9.6	147.5	–15.2	–21.2	.06	73.59	.36	–4.09
.300	.10	–153.7	9.6	141.0	–15.3	–25.4	.07	65.41	.36	–3.44
.350	.11	–154.5	9.6	134.5	–15.3	–29.6	.08	57.67	.36	–2.83
.400	.12	–155.9	9.6	128.0	–15.3	–33.8	.09	50.24	.36	–2.22
.450	.13	–157.7	9.6	121.5	–15.3	–38.0	.10	42.96	.36	–1.60
.500	.14	–159.8	9.6	115.1	–15.4	–42.1	.11	35.74	.36	–.94
.550	.15	–162.2	9.6	108.7	–15.4	–46.2	.12	28.48	.36	–.28
.600	.15	–164.9	9.6	102.2	–15.4	–50.3	.13	21.38	.36	.40
.650	.16	–168.0	9.6	95.8	–15.4	–54.3	.13	14.25	.36	1.07
.700	.17	–171.2	9.6	89.3	–15.5	–58.4	.14	7.09	.36	1.71
.750	.18	–174.8	9.6	82.8	–15.5	–62.5	.15	–.10	.36	2.31
.800	.19	–178.6	9.6	76.3	–15.5	–66.6	.15	–7.34	.36	2.91
.850	.19	177.4	9.7	69.8	–15.5	–70.6	.16	–14.67	.36	3.45
.900	.20	173.3	9.7	63.2	–15.5	–74.8	.17	–22.11	.36	4.03
.950	.20	168.9	9.7	56.6	–15.5	–78.8	.17	–29.49	.37	4.52
1.000	.21	164.3	9.8	49.9	–15.5	–82.9	.18	–37.03	.37	4.95
1.050	.21	159.6	9.8	43.2	–15.5	–87.1	.18	–44.69	.37	5.32
1.100	.21	154.6	9.9	36.4	–15.5	–91.3	.19	–52.42	.38	5.63
1.150	.21	149.4	9.9	29.6	–15.4	–95.5	.19	–60.21	.38	5.87
1.200	.21	143.9	10.0	22.6	–15.4	–99.8	.19	–68.05	.39	5.98
1.250	.20	138.0	10.0	15.5	–15.4	104.1	.20	–76.00	.40	5.97
1.300	.20	131.7	10.1	8.2	–15.3	–108.5	.20	–84.15	.40	5.82
1.350	.19	124.7	10.2	.9	–15.3	–113.0	.20	–92.24	.41	5.57
1.400	.18	116.9	10.3	–6.7	–15.3	–117.6	.20	–100.37	.42	5.10
1.450	.16	108.2	10.3	–14.4	–15.2	–122.2	.20	–108.66	.43	4.44
1.500	.14	98.1	10.4	–22.5	–15.2	–127.0	.19	–116.98	.44	3.51
1.550	.12	85.8	10.5	–30.7	–15.2	–131.8	.19	–125.16	.46	2.34
1.600	.10	70.3	10.5	–39.2	–15.2	–136.6	.18	–133.35	.47	.91
1.650	.08	49.7	10.4	–47.8	–15.2	–141.3	.18	–141.69	.47	–.53
1.700	.06	20.8	10.4	–56.4	–15.2	–146.0	.18	–150.24	.48	–2.06
1.750	.06	–14.5	10.3	–65.0	–15.1	–150.6	.17	–159.60	.47	–3.50
1.800	.07	–43.9	10.1	–73.5	–15.0	–155.4	.17	–170.25	.47	–4.89
1.850	.09	–63.1	10.0	–81.9	–14.9	–160.4	.16	177.77	.47	–6.27
1.900	.12	–75.5	9.9	–90.5	–14.8	–165.8	.16	164.59	.48	–7.76
1.950	.15	–84.8	9.8	–99.3	–14.7	–171.4	.15	150.13	.48	–9.39
2.000	.18	–92.5	9.7	–108.2	–14.6	–177.4	.14	134.47	.49	–11.19
2.050	.21	–99.5	9.5	–117.3	–14.6	176.4	.14	118.05	.51	
2.100	.25	–106.0	9.3	–126.7	–14.6	170.1	.13	101.01	.52	
2.150	.28	–112.3	9.1	–136.1	–14.6	163.6	.13	83.87	.52	
2.000	.32	–118.3	8.9	–145.7	–14.6	156.9	.13	67.66	.53	
2.250	.35	–124.0	8.6	–155.4	–14.6	150.1	.14	52.78	.53	
2.300	.38	–129.5	8.2	–165.1	–14.7	143.3	.14	39.44	.54	
2.350	.41	–134.8	7.9	–174.9	–14.8	136.4	.15	28.06	.54	
2.400	.44	–139.7	7.4	175.3	–15.0	129.3	.15	18.94	.55	
2.450	.46	–144.2	7.0	165.4	–15.2	122.2	.16	11.94	.55	
2.500	.48	–148.4	6.5	155.6	–15.4	114.9	.17	6.82	.55	
3.000	.72	178.8	–1.8	55.0	–20.6	37.0	.55	–43.02	.56	

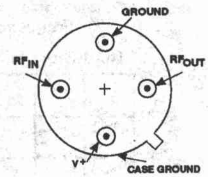
LINEARIZATION RANGE: .10 to 2.00 GHz

![AVANTEK]

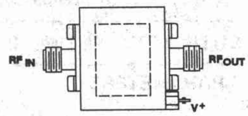
UTO/UTC 2302 Series
Thin-Film Cascadable Amplifier
1700 to 2300 MHz

FEATURES
- Frequency Range: 1700 to 2300 MHz
- Medium Gain: 10.5 dB (Typ)
- Low VSWR
- Temperature Compensated

APPLICATIONS
- IF/RF Amplification
- Telemetry
- Military Communications



UTO—TO-8U, p. 16–48



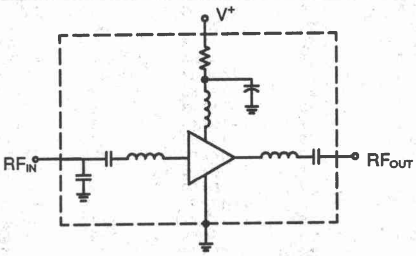
UTC—TC-1, p. 16–42

DESCRIPTION
The 2302 Series is a thin-film bipolar RF amplifier that incorporates resistive feedback and active bias for temperature compensation and increased immunity to bias voltage variations. Tuned inductive coupling maintains low VSWR over all conditions, while blocking capacitors couple RF through the amplifier. The 2302 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

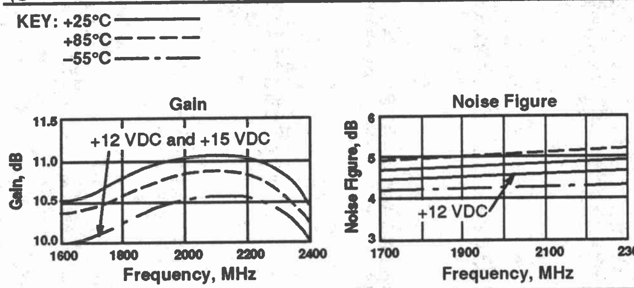
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range	1700-2300	1700-2300	1700-2300	MHz
GP	Small Signal Gain (Min.)	10.5	8.0	8.0	dB
—	Gain Flatness (Max.)	±0.3	±0.5	±1.0	dB
NF	Noise Figure (Max.)	5.0	6.5	7.0	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+8.0	+3.0	+2.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+13.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+23.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+27.0	—	—	dBm
I_D	DC Current	18	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

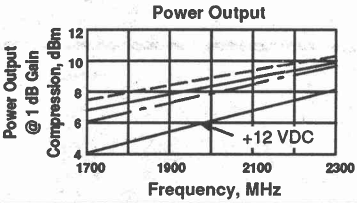
THERMAL CHARACTERISTICS*

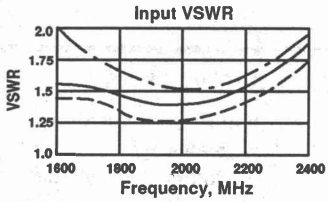
θ_{JC}	105°C/W
Active Transistor Power Dissipation	130 mW
Junction Temperature Above Case Temperature	13°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	752,100 Hrs.

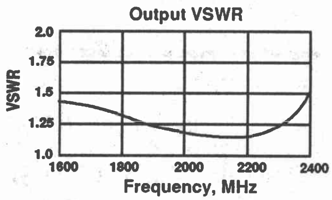
*For further information, see High Reliability section, p. 17–2.

WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)







AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
400.0	4.43	8.86	–156.61	—	.98	2.04	28.14
500.0	2.46	10.44	171.17	—	.80	1.85	26.08
600.0	1.91	10.94	145.35	—	.62	1.69	25.26
700.0	1.77	10.97	125.73	—	.49	1.61	24.76
800.0	1.76	10.74	109.58	—	.43	1.56	24.39
900.0	1.81	10.57	94.94	—	.39	1.54	24.04
1000.0	1.84	10.42	81.39	—	.36	1.51	23.61
1100.0	1.86	10.34	68.28	—	.36	1.50	23.22
1200.0	1.88	10.26	55.71	—	.35	1.49	22.75
1300.0	1.88	10.24	43.20	—	.35	1.48	22.27
1400.0	1.85	10.28	30.46	—	.35	1.46	21.75
1500.0	1.83	10.35	17.82	—	.35	1.45	21.31
1600.0	1.79	10.48	5.16	—	.36	1.43	20.82
1700.0	1.75	10.56	–7.87	–1.72	.37	1.40	20.39
1800.0	1.70	10.70	–21.84	–.14	.40	1.36	19.91
1900.0	1.66	10.83	–36.58	.64	.42	1.31	19.44
2000.0	1.61	11.01	–51.85	.89	.42	1.23	19.06
2100.0	1.60	11.08	–67.17	1.12	.44	1.13	18.79
2200.0	1.67	11.00	–83.76	.09	.48	1.07	18.68
2300.0	1.82	10.77	–101.62	–2.21	.50	1.19	18.78
2400.0	2.15	10.37	–119.98	—	.53	1.39	19.11
2500.0	2.63	9.70	–139.72	—	.55	1.65	19.83

LINEARIZATION RANGE: 1700 to 2300 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
300.00	.861	–152.9	3.553	–121.6	–34.830	104.4	.385	–101.6
400.00	.646	172.4	9.381	–162.3	–27.922	71.3	.371	–133.9
500.00	.473	154.6	10.645	168.1	–26.023	49.1	.343	–162.7
600.00	.376	146.4	11.003	143.8	–24.958	35.8	.316	171.8
700.00	.334	143.1	10.994	125.5	–24.390	25.2	.306	150.1
800.00	.315	142.1	10.845	111.4	–24.007	19.9	.297	134.1
900.00	.309	138.9	10.660	96.8	–23.482	12.3	.292	118.1
1000.00	.308	135.0	10.532	82.9	–22.964	5.9	.282	102.9
1100.00	.308	129.8	10.448	69.9	–22.519	–1.5	.273	88.6
1200.00	.311	125.4	10.387	58.7	–22.030	–6.6	.261	77.6
3400.00	.306	118.5	10.370	44.9	–21.646	–13.7	.246	61.9
1400.00	.300	110.4	10.385	30.9	–21.169	–20.8	.228	46.3
1500.00	.289	102.8	10.464	18.3	–20.586	–27.9	.210	30.8
1600.00	.277	94.1	10.570	6.4	–20.267	–34.5	.191	15.0
1700.00	.260	83.9	10.651	–5.5	–19.850	–40.9	.175	–1.8
1800.00	.237	69.0	10.722	–21.6	–19.375	–50.8	.152	–25.2
1900.00	.212	53.5	10.779	–35.5	–18.936	–59.8	.134	–46.3
2000.00	.189	36.9	10.933	–46.8	–18.575	–66.2	.120	–65.4
2100.00	.168	7.1	10.967	–63.1	–18.248	–77.0	.095	–93.3
2200.00	.179	–31.4	10.927	–80.3	–18.106	–88.6	.067	–132.0
2300.00	.224	–64.6	10.682	–96.8	–18.000	–100.7	.051	161.5
2400.00	.297	–90.2	10.376	–113.5	–18.096	–113.4	.083	99.2
2500.00	.390	–112.3	9.817	–131.6	–18.622	–126.6	.146	60.3
2600.00	.490	–132.8	8.981	–151.6	–19.486	–142.1	.226	32.3
2700.00	.604	–155.1	7.713	–175.9	–20.859	–163.0	.319	5.6
2800.00	.672	–168.4	6.382	169.4	–22.149	–173.9	.377	–10.5
2900.00	.751	171.9	4.344	145.9	–24.913	167.6	.440	–33.2
3000.00	.792	161.5	2.636	132.5	–27.657	154.4	.467	–46.3

AVANTEK

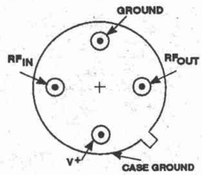
UTO/UTC 2303 Series
Thin-Film Cascadable Amplifier
1700 to 2300 MHz

FEATURES

- Frequency Range: 1700 to 2300 MHz
- Medium Gain: 10.0 dB (Typ)
- Medium Output Power: +12.0 dBm (Typ)
- Low Noise Figure: 6.5 dB (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- Telemetry
- Military Communications



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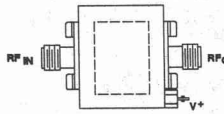


UTC—TC-1, p. 16–42

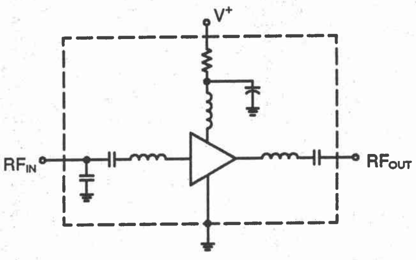
DESCRIPTION

The 2303 Series is a thin-film bipolar RF amplifier that incorporates resistive feedback and active bias for temperature compensation and increased immunity to bias voltage variations. Tuned inductive coupling maintains low VSWR over all conditions, while blocking capacitors couple RF through the amplifier. The 2303 Series is available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

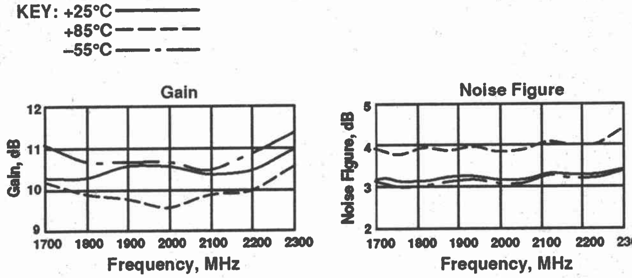
Symbol	Characteristic	Typical $T_c = 25°C$	Guaranteed Specifications $T_c = 0°$ to $50°C$	$T_c = -55°$ to $+85°C$	Unit
BW	Frequency Range	1700-2300	1700-2300	1700-2300	MHz
GP	Small Signal Gain (Min.)	10.0	8.0	8.0	dB
—	Gain Flatness (Max.)	±0.4	±0.5	±1.0	dB
NF	Noise Figure (Max.)	6.5	8.0	8.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+12.0	+10.0	+9.0	dBm
—	Input VSWR (Max.)	<1.8:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+20.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+31.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+40.0	—	—	dBm
I_D	DC Current	30	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

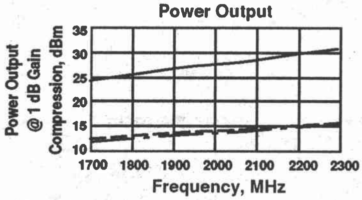
THERMAL CHARACTERISTICS*

θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 250 mW
Junction Temperature Above Case Temperature .... 27°C
MTBF (MIL-HDBK-217E, A_{UF} 90°C) .... 691,800 Hrs.
*For further information, see High Reliability section, p. 17–2.

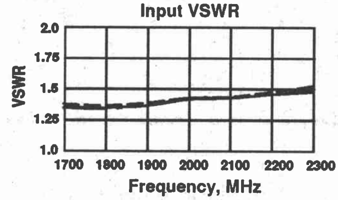
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

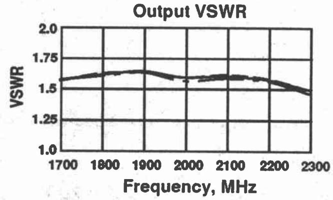
Power Output



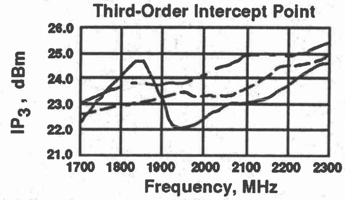
Input VSWR



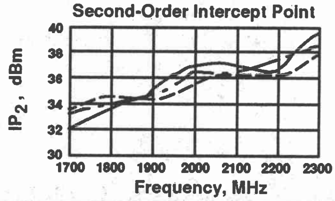
Output VSWR



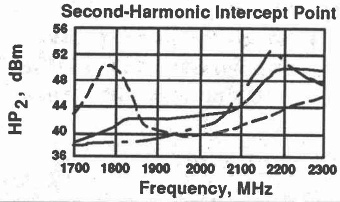
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL nsec	VSWR OUT	ISOL dB
400.0	4.88	8.30	–156.19	—	.93	2.39	29.60
500.0	2.78	9.81	174.10	—	.73	2.24	26.92
600.0	2.11	10.15	151.18	—	.55	2.14	26.13
700.0	1.86	10.14	133.71	—	.43	2.09	25.47
800.0	1.78	9.93	119.37	—	.37	2.04	25.03
900.0	1.77	9.67	106.47	—	.34	1.99	24.51
1000.0	1.78	9.45	94.59	—	.32	1.94	24.13
1100.0	1.81	9.27	83.58	—	.30	1.89	23.61
1200.0	1.83	9.13	72.70	—	.30	1.84	23.01
1300.0	1.85	9.05	61.94	—	.29	1.77	22.40
1400.0	1.84	8.98	51.35	—	.29	1.73	21.94
1500.0	1.86	8.99	40.98	—	.29	1.67	21.39
1600.0	1.83	9.01	30.65	—	.29	1.60	21.09
1700.0	1.79	9.08	20.28	–1.01	.28	1.55	20.67
1800.0	1.73	9.13	9.93	.01	.29	1.49	20.13
1900.0	1.68	9.19	–.70	.69	.31	1.44	19.82
2000.0	1.59	9.32	–12.56	.29	.33	1.39	19.31
2100.0	1.49	9.50	–24.02	.21	.32	1.35	18.88
2200.0	1.37	9.64	–35.61	.00	.32	1.34	18.55
2300.0	1.24	9.74	–47.67	–.69	.34	1.34	18.37
2400.0	1.09	9.74	–60.33	—	.35	1.36	18.25
2500.0	1.05	9.78	–73.64	—	.39	1.47	18.27

LINEARIATION RANGE: 1700 to 2300 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
300.00	.874	–149.6	1.299	–114.5	–36.858	105.8	.367	–95.8
400.00	.673	173.5	8.183	–152.5	–28.607	74.6	.353	–124.3
500.00	.478	152.4	9.931	177.8	–26.231	53.0	.330	–151.3
600.00	.346	143.6	10.436	152.3	–24.947	37.6	.304	–176.0
700.00	.275	144.9	10.454	133.3	–24.613	26.3	.293	162.4
800.00	.253	150.4	10.229	119.1	–24.369	20.1	.288	147.6
900.00	.258	153.4	9.899	104.8	–24.020	12.0	.284	132.9
1000.00	.274	153.5	9.571	91.6	–23.613	6.2	.275	120.1
1100.00	.290	151.3	9.316	79.8	–23.307	.6	.270	109.0
1200.00	.307	148.4	9.090	70.0	–22.921	–3.0	.258	100.5
1300.00	.321	143.4	8.869	58.0	–22.456	–9.9	.246	89.2
1400.00	.329	137.6	8.722	46.3	–22.147	–15.2	.226	78.7
1500.00	.334	132.3	8.630	36.0	–21.730	–20.3	.208	68.0
1600.00	.333	127.6	8.616	26.7	–21.451	–24.8	.184	57.5
1700.00	.327	122.0	8.600	17.5	–21.048	–29.9	.162	45.6
1800.00	.318	114.1	8.648	5.2	–20.507	–36.6	.133	27.9
1900.00	.303	107.8	8.636	–4.5	–20.163	–42.3	.109	8.1
2000.00	.282	104.0	8.747	–12.3	–19.747	–46.3	.093	–14.7
2100.00	.252	96.3	8.856	–24.9	–19.150	–54.4	.088	–48.8
2200.00	.211	87.2	9.025	–37.5	–18.799	–62.9	.096	–86.0
2300.00	.161	82.0	9.089	–48.8	–18.454	–70.6	.119	–113.7
2400.00	.102	77.1	9.168	–60.1	–18.148	–79.2	.148	–136.1
2500.00	.036	90.2	9.167	–72.5	–18.040	–88.1	.177	–157.6
2600.00	.058	–154.7	9.115	–86.5	–17.893	–98.9	.215	–179.3
2700.00	.164	–156.2	8.939	–104.9	–18.140	–114.2	.256	155.7
2800.00	.252	–162.1	8.659	–116.9	–18.374	–123.8	.289	138.8
2900.00	.382	–176.0	8.160	–138.6	–19.004	–141.8	.329	112.4
3000.00	.474	175.5	7.656	–152.1	–19.945	–153.4	.356	94.8

AVANTEK

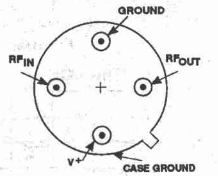
UTO/UTC 2311 Series
Thin-Film Cascadable Amplifier
1700 to 2300 MHz

FEATURES

- Frequency Range: 1700 to 2300 MHz
- Noise Figure: 4.5 dB (Typ)
- Medium Gain: 10.0 dB (Typ)
- Temperature Compensated

APPLICATIONS

- IF/RF Amplification
- Telemetry
- Military Communications



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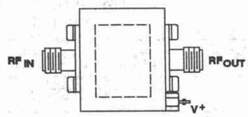


UTC—TC-1, p. 16–42

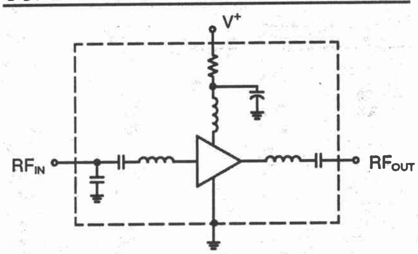
DESCRIPTION

The 2311 Series is a low-power thin-film bipolar RF amplifier that incorporates resistive feedback and active bias for temperature compensation and increased immunity to bias voltage variations. Tuned inductive coupling maintains low VSWR over all conditions, while blocking capacitors couple RF through the amplifier. The 2311 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

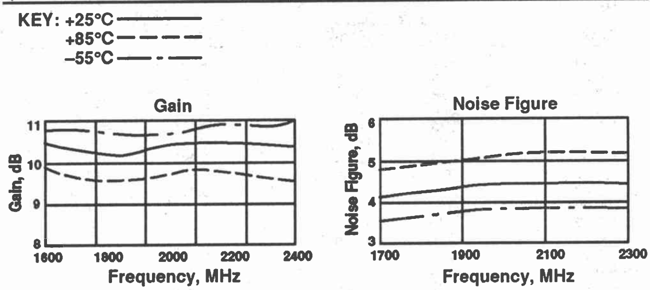
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	1700-2300	1700-2300	1700-2300	MHz
GP	Small Signal Gain (Min.)	10.0	8.0	8.0	dB
—	Gain Flatness (Max.)	±0.2	±0.5	±1.0	dB
NF	Noise Figure (Max.)	4.5	5.0	5.5	dB
$P_{1 dB}$	Power Output @ +1 dB Compression (Min.)	+1.0	–3.0	–4.0	dBm
—	Input VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+10.0	—	—	dBm
I_D	DC Current	15	—	—	mA

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE

(@ +15 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

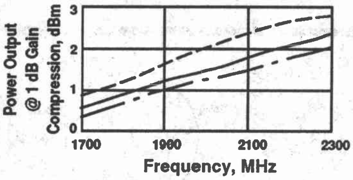
THERMAL CHARACTERISTICS*

θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 70 mW
Junction Temperature Above Case Temperature .... 7°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 1,282,000 Hrs.
*For further information, see High Reliability section, p. 17–2.

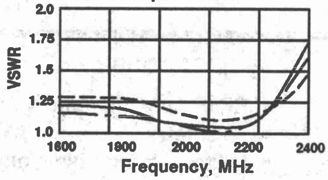
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

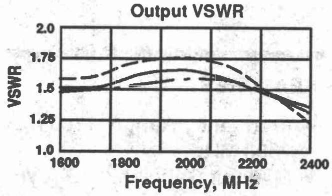
Power Output



Input VSWR



Output VSWR



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
400.0	5.41	8.91	–151.85	—	.95	2.21	27.73
500.0	3.09	10.67	177.69	—	.76	2.07	25.25
600.0	2.32	11.19	153.51	—	.59	1.99	24.19
700.0	2.00	11.33	134.79	—	.46	1.94	23.54
800.0	1.05	11.23	119.30	—	.41	1.92	22.98
900.0	1.79	11.05	105.11	—	.38	1.90	22.42
1000.0	1.76	10.89	91.93	—	.35	1.88	21.99
1100.0	1.75	10.75	79.72	—	.33	1.85	21.62
1200.0	1.75	10.65	67.57	—	.34	1.81	20.92
1300.0	1.74	10.58	55.63	—	.33	1.74	20.32
1400.0	1.72	10.54	43.73	—	.33	1.68	19.92
1500.0	1.69	10.58	31.97	—	.33	1.61	19.47
1600.0	1.63	10.63	20.30	—	.33	1.51	19.16
1700.0	1.56	10.70	8.49	–1.24	.33	1.41	18.67
1800.0	1.47	10.73	–3.60	.14	.35	1.30	18.27
1900.0	1.39	10.78	–16.61	.60	.37	1.18	17.85
2000.0	1.29	10.88	–30.42	.26	.38	1.06	17.58
2100.0	1.22	10.95	–43.74	.41	.37	1.09	17.29
2200.0	1.26	10.90	–57.49	.15	.39	1.25	17.18
2300.0	1.40	10.72	–72.30	–1.17	.42	1.48	17.37
2400.0	1.63	10.27	–88.13	—	.38	1.75	18.00
2500.0	1.92	10.01	–101.60	—	.46	1.93	17.86

LINEARIZATION RANGE: 1700 to 2300 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

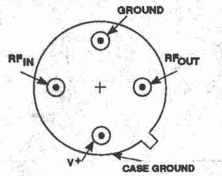
FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.818	–54.5	6.990	–153.5	–34.123	46.2	.604	–62.1
200.00	.931	–101.5	–2.432	140.8	–41.928	–12.8	.415	–78.3
300.00	.870	–147.9	3.407	–118.4	–35.814	113.4	.398	–101.3
400.00	.682	176.9	9.329	–157.3	–28.334	80.6	.380	–131.7
500.00	.522	155.8	10.785	174.5	–26.158	59.2	.359	–158.7
600.00	.418	142.8	11.314	150.4	–24.844	45.4	.339	177.2
700.00	.350	135.4	11.461	132.2	–23.862	35.4	.331	156.7
800.00	.311	132.8	11.381	118.1	–23.278	28.9	.328	141.9
900.00	.285	129.7	11.239	103.5	–22.606	21.7	.322	127.3
1000.00	.271	127.4	11.073	89.5	–21.803	13.5	.311	113.9
1100.00	.263	123.7	10.969	76.7	–21.405	5.6	.301	101.8
1200.00	.259	120.6	10.845	65.8	–20.783	1.1	.285	92.0
1300.00	.252	115.8	10.754	52.3	–20.251	–7.2	.263	79.9
1400.00	.241	108.9	10.696	39.0	–19.793	–15.2	.236	67.4
1500.00	.228	102.8	10.670	27.0	–19.158	–22.0	.207	55.0
1600.00	.212	95.4	10.689	16.0	–18.838	–29.3	.174	41.8
1700.00	.190	86.7	10.684	5.0	–18.341	–36.1	.142	26.5
1800.00	.156	73.7	10.664	–9.5	–17.978	–46.4	.100	.4
1900.00	.119	59.5	10.599	–21.6	–17.490	–54.6	.071	–33.3
2000.00	.082	40.1	10.643	–31.5	–17.207	–60.5	.070	–77.9
2100.00	.052	–15.7	10.626	–45.8	–16.854	–71.1	.090	–124.5
2200.00	.085	–79.3	10.563	–60.2	–16.890	–82.4	.126	–156.3
2300.00	.146	–107.6	10.369	–73.3	–16.807	–92.5	.169	–179.6
2400.00	.218	–123.1	10.135	–86.3	–16.906	–102.6	.209	160.5
2500.00	.298	–136.1	9.861	–100.4	–17.251	–114.6	.247	139.7
2700.00	.491	–164.7	8.887	–136.1	–18.667	–145.3	.325	91.6
2900.00	.666	170.3	7.252	–171.8	–21.845	–174.8	.380	43.9
3000.00	.795	153.7	5.277	162.5	–26.883	159.8	.397	7.1

AVANTEK

UTO/UTC 2321 Series
Thin-Film Cascadable Amplifier
1700 to 2300 MHz

FEATURES
- Frequency Range: 1700 to 2300 MHz
- Medium Gain: 15.0 dB (Typ)
- Medium Output Power: +12.0 dBm (Typ)
- Temperature Compensated

APPLICATIONS
- RF/IF Amplification
- Telemetry
- Military Communications



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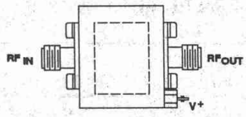


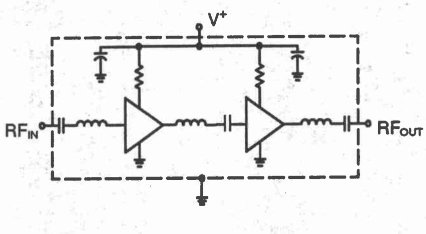
UTC—TC-1, p. 16–42

DESCRIPTION
The 2321 Series is a two-stage thin-film bipolar RF amplifier using resistive feedback and active bias for temperature compensation and increased immunity to bias voltage variations. Input/output blocking capacitors couple RF through the amplifier, while a low VSWR is maintained through inductive tuning. The 2321 Series amplifiers are available in either the TO-8 hermetic case or connectored TC-1 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

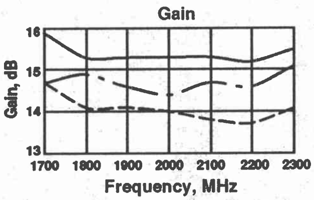
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range	1700-2300	1700-2300	1700-2300	MHz
GP	Small Signal Gain (Min.)	15.0	14.0	13.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.0	dB
NF	Noise Figure (Max.)	7.0	8.0	8.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+12.0	+10.0	+9.0	dBm
—	Input VSWR (Max.)	<1.8:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	<1.6:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+20.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+35.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+41.0	—	—	dBm
I_D	DC Current	70	—	—	mA

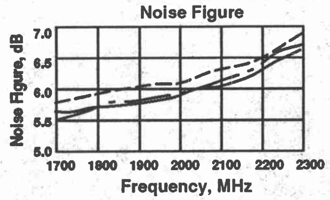
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
–55°C — · —





MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+18 dBm
Operating Case Temperature	–55°C to +115°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+115°C

THERMAL CHARACTERISTICS*

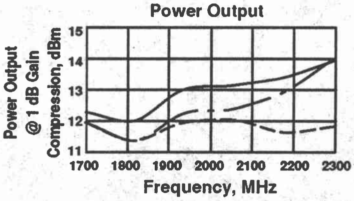
θ_{JC}	105/75°C/W
Active Transistor Power Dissipation	180/450 mW
Junction Temperature Above Case Temperature	19/34°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C)	366,000 Hrs.

*For further information, see High Reliability section, p. 17–2.

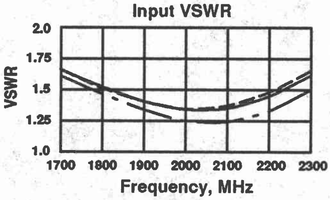
WEIGHT: (typical) UTO—2.1 grams; UTC—21.5 grams

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

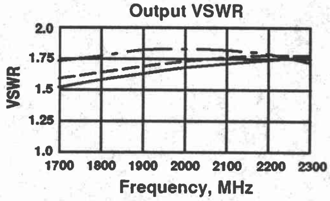
Power Output



Input VSWR



Output VSWR



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

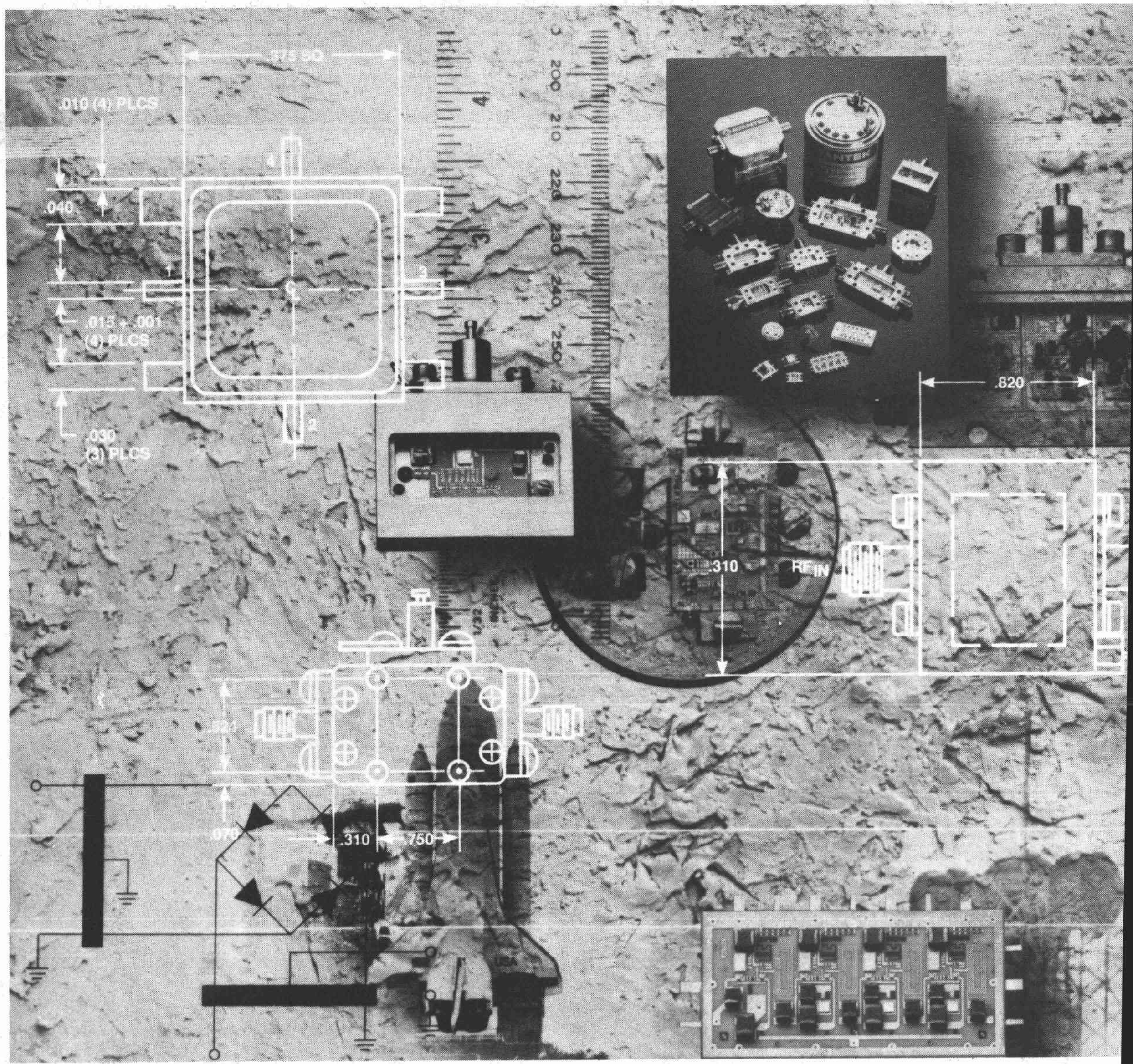
FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
500.0	2.53	14.27	54.15	—	1.01	3.86	42.19
600.0	2.05	15.40	20.93	—	.85	3.00	40.12
700.0	2.01	15.93	−7.33	—	.73	2.46	39.51
800.0	2.08	16.27	−31.37	—	.62	2.06	38.85
900.0	2.21	16.21	−52.07	—	.54	1.76	38.36
1000.0	2.27	16.06	−69.93	—	.48	1.53	38.49
1100.0	2.30	15.76	−86.55	—	.44	1.35	38.20
1200.0	2.29	15.60	−101.64	—	.40	1.24	37.76
1300.0	2.19	15.32	−115.02	—	.37	1.18	37.69
1400.0	2.13	15.01	−128.55	—	.37	1.19	38.03
1500.0	2.00	14.80	−141.86	—	.38	1.25	37.94
1600.0	1.88	14.76	−155.69	—	.37	1.34	37.77
1700.0	1.72	14.80	−168.27	−1.95	.34	1.43	37.71
1800.0	1.58	14.52	179.58	.04	.35	1.57	36.65
1900.0	1.49	15.00	166.56	1.17	.37	1.56	38.68
2000.0	1.40	15.05	152.69	1.46	.39	1.64	38.57
2100.0	1.41	14.98	138.50	1.43	.42	1.67	38.64
2200.0	1.56	15.10	122.45	−.45	.44	1.67	38.95
2300.0	1.82	15.12	107.05	−1.70	.47	1.66	39.53
2400.0	2.21	14.67	88.70	—	.52	1.61	39.45
2500.0	2.66	13.97	69.28	—	.50	1.55	39.21
2600.0	3.09	13.37	52.57	—	.48	1.48	40.23
2700.0	3.55	12.22	34.59	—	.48	1.43	40.52
2800.0	4.06	10.99	17.92	—	.46	1.43	40.94
2900.0	4.70	9.38	1.18	—	.44	1.49	40.95
3000.0	5.33	7.77	−13.79	—	.00	1.60	40.96

LINEARIZATION RANGE: 1700 to 2300 MHz

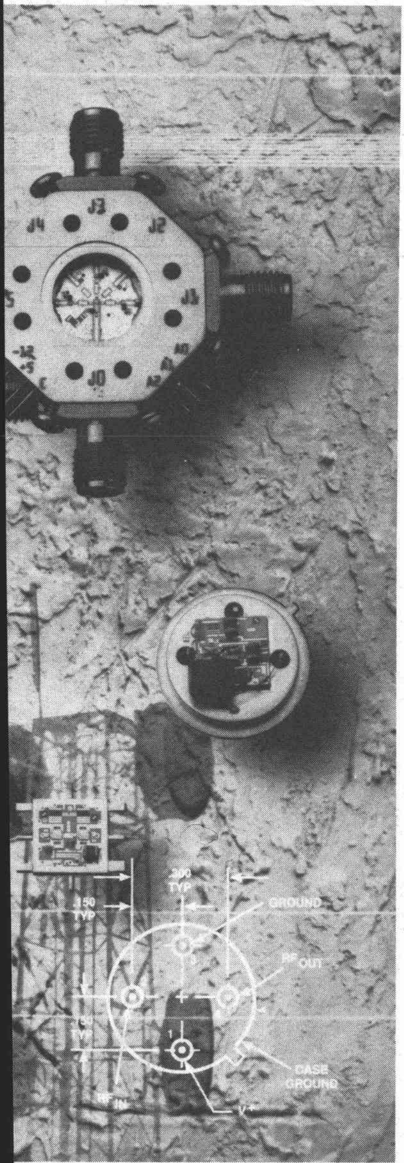
S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
500.00	.437	−73.5	13.952	53.4	−42.019	134.1	.580	−72.0
600.00	.345	−67.1	15.169	21.3	−40.348	119.9	.490	−82.5
700.00	.328	−60.8	15.698	−6.4	−39.169	110.8	.410	−91.8
800.00	.363	−57.9	16.075	−30.5	−38.765	107.2	.328	−99.6
900.00	.371	−59.1	16.066	−50.9	−38.267	103.3	.246	−106.8
1000.00	.398	−67.1	15.983	−68.5	−38.026	99.8	.179	−112.1
1100.00	.411	−71.3	15.653	−85.2	−38.166	98.3	.123	−111.9
1200.00	.400	−78.6	15.569	−100.2	−37.669	98.9	.080	−99.9
1300.00	.400	−84.8	15.309	−113.8	−37.939	96.8	.062	−68.1
1400.00	.378	−91.3	15.062	−127.4	−37.710	95.8	.075	−40.3
1500.00	.363	−98.9	14.850	−141.0	−37.955	96.6	.103	−32.4
1600.00	.332	−104.7	14.837	−154.9	−37.930	97.0	.136	−31.2
1700.00	.290	−115.0	14.881	−167.8	−37.876	97.1	.165	−33.2
1800.00	.248	−119.4	14.601	−179.9	−36.654	85.3	.202	−43.6
1900.00	.207	−141.5	15.025	166.9	−38.709	91.2	.197	−44.0
2000.00	.169	−169.3	15.065	152.9	−38.586	91.4	.222	−50.7
2100.00	.148	152.0	15.016	138.7	−38.698	89.0	.229	−54.8
2200.00	.186	113.9	15.133	122.9	−38.997	87.7	.226	−59.9
2300.00	.259	85.4	15.155	107.5	−39.194	83.2	.225	−64.5
2400.00	.356	68.3	14.712	89.1	−39.515	81.7	.211	−67.6
2500.00	.440	54.2	14.071	69.7	−39.410	72.8	.192	−68.9
2600.00	.511	43.3	13.453	52.9	−40.173	69.1	.168	−66.4
2700.00	.566	34.5	12.331	34.8	−40.402	62.8	.149	−59.0
2800.00	.621	27.6	11.064	17.8	−40.704	62.7	.150	−47.2
2900.00	.665	23.1	9.439	1.2	−40.619	56.0	.172	−37.2
3000.00	.704	18.6	7.761	−14.1	−40.887	56.3	.204	−33.2


.375 SQ.
.010 (4) PLCS
.040
.015 ± .001
(4) PLCS
.030
(3) PLCS
.820
.310
RF IN
.070
.310
.750

AGC SERIES



PRODUCT DESCRIPTION

The AGC Series combines amplification and voltage-controlled attenuation functions in one package, providing an easy-to-use complete AGC function. The AGC-330 covers 5-300 MHz, the AGC-553 covers 10-500 MHz and the AGC-1053 covers 10-1000 MHz. Typical applications are IF gain control, signal source leveling or, with use of a D/A circuit, digital controlled gain switching. The products are designed with temperature compensation and have internal power supply filtering circuitry. The AGC-330 is packaged in a TO-3 package and the AGC-553/1053 are packaged in TO-8 packages.

AGC SELECTION GUIDE

AGC SERIES

Typical Specifications at 25°C Case Temperature

Model	Frequency Range (MHz)	Gain[1] (dB) Typ./Min.	AGC Range (dB) Typical	AGC Voltage Range (Volts)	AGC Current Range (mA)	Maximum[1] Noise Figure (dB) Typ./Max.	Power Output[1] at 1 dB Gain Compression (dBm) Minimum	Typical Response Time (µsec)	Bias Voltage (VDC)	Bias Current (mA)	Typical VSWR	Case Type	Page Number
AGC-330	5-300	22/20	36	0 to 5	0 to 60	4.0/5.0	0	1.5	+15	25	<2.0	TO-3	3–199
AGC-553	10-500	44/40	45	0 to 5	0 to 12	6.0/8.0	–4	25	+15	50	<2.0	TO-8F	3–200
AGC-1053	10-1000	22/18	35	0 to 5	0 to 12	11.0/12.0	+5	25	+15	90	<2.0	TO-8F	3–203

NOTE 1: At 0 AGC.

AVANTEK

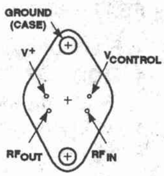
AGC-330
Voltage-Controlled AGC Amplifier
5 to 300 MHz

FEATURES

- Frequency Range: 5 to 300 MHz
- Single Package
- Wide AGC Range: 36 dB (Typ)
- Provides Gain: 22 dB (Typ)

APPLICATIONS

- Open or Closed Loop Gain Control
- Receiver Output Gain Control
- Transmitter Output Levelling Control



TO-3, p. 16–46

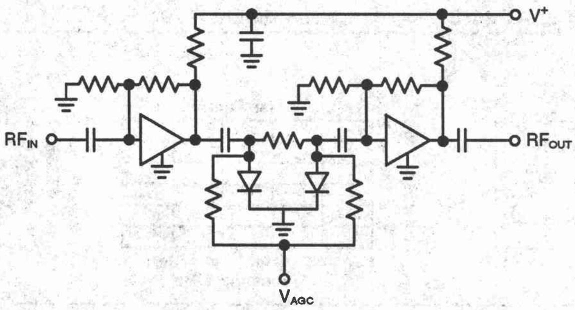
DESCRIPTION

The AGC-330 combines two-stage thin-film bipolar RF amplifier using Avantek® transistors, and PIN diodes with 0 to 5-volts DC control to allow over 36 dB gain variation. Resistive feedback assures gain compensation over temperature, and the bias input voltage is RF protected through the use of bypass capacitors and choke decoupling. Blocking capacitors couple the RF signal through the amplifier which is housed in a small TO-3 hermetic package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to 50°C	Unit
BW	Frequency Range	5-300	5-300	MHz
GP	Small Signal Gain @ 0 V_C (Min.)	22	20	dB
—	Gain Flatness (Max.)	±0.7	±1.0	dB
—	AGC Range (Min.)	36	30	dB
NF	Noise Figure — no AGC (Max.)	4.0	5.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression— $V_{AGC} = 0$ (Min.)	+1.0	0	dBm
—	Input VSWR (Max.)	1.7:1	2.0:1	—
—	Output VSWR (Max.)	1.5:1	2.0:1	—
—	Response Time (10 to 90%)	1.5	2.0	µsec
VDC	Bias Voltage	+15		Volts
I_D	Bias Current	25	30	mA
V_{AGC}	AGC Voltage	0-5		Volts
I_{AGC}	AGC Current	0-60		mA

SCHEMATIC



MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+13 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

θ_{JC}	105/105°C/W
Active Transistor Power Dissipation	105/180 mW
Junction Temperature Above Case Temperature	11/19°C

*For further information, see High Reliability section, p. 17–2.

WEIGHT: (typical) 14.5 grams

AVANTEK

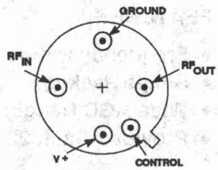
AGC-553
Voltage-Controlled AGC Amplifier
10 to 500 MHz

FEATURES

- Frequency Range: 10 to 500 MHz
- MODAMP Silicon Monolithic Gain Stages
- AGC Range: 45 dB (Typ)
- 0 to 5 V Control Voltage

APPLICATIONS

- Open or Closed Loop Gain Control
- Receiver Output Gain Control
- Transmitter Output Levelling Control



TO-8F, p. 16–47

DESCRIPTION

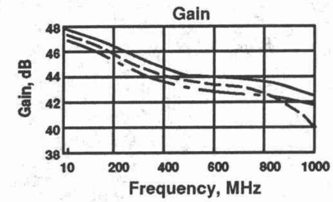
The AGC-553 combines three-stage MMIC RF amplifier with 44 dB (typ) gain, and PIN diodes with 0 to +5 VDC control voltage for gain control. The 553 has blocking capacitors which couple the RF signal through the amplifier, and bypass capacitors to filter the bias voltage line.

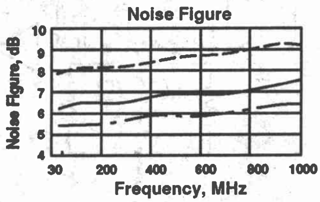
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

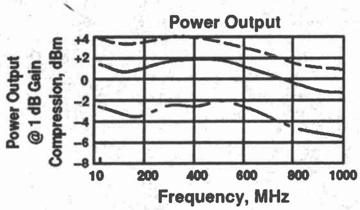
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	10-500	10-500	10-500	MHz
GP	Small Signal Gain (Min.)	44	40	40	dB
—	Gain Flatness, V_{AGC} = 0 to +5 Volts (Max.)	±2.0	±3.0	±3.0	dB
—	AGC Range	45			dB
NF	Noise Figure, V_{AGC} = 0 (Max.)	6.0	8.0	9.0	dB
$P_{1\,dB}$	Power Output @ +1 dB Compression V_{AGC} = 0 (Min.)	0	–4.0	–6.0	dBm
—	Input VSWR, V_{AGC} = 0 to +5 Volts (Max.)	1.5:1	2.0:1	2.0:1	—
—	Output VSWR, V_{AGC} = 0 to +5 Volts (Max.)	1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+12.0			dBm
IP_2	Two Tone 2nd Order Intercept Point	+12.0			dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+32.0			dBm
—	Response Time	25			µsec
VDC	Bias Voltage	+15			Volts
I_D	Bias Current	50			mA
V_{AGC}	AGC Voltage	0 to +5			Volts
I_{AGC}	AGC Current	0 to 12			mA

TYPICAL PERFORMANCE AT 25°C (@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C — — — —
–55°C —— - ——







MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +17 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

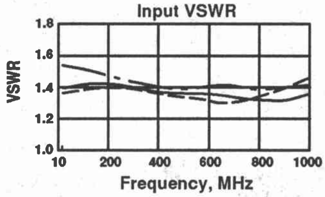
THERMAL CHARACTERISTICS*

θ_{JC} .... 135/135/135°C/W
Active Transistor Power Dissipation .... 85/85/85 mW
Junction Temperature Above Case Temperature .. 12/12/12°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 413,834 Hrs.
*For further information, see High Reliability section, p. 17–2.

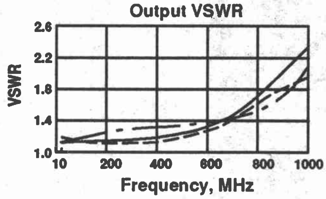
WEIGHT: (typical) 2.1 grams

TYPICAL PERFORMANCE AT 25°C (continued)

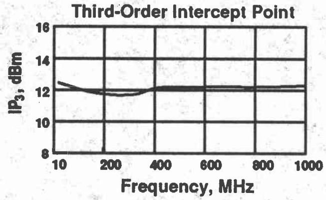
Input VSWR



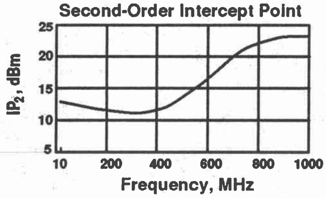
Output VSWR



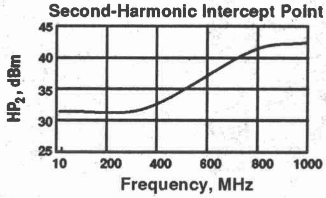
Third-Order Intercept Point



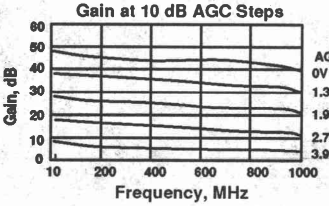
Second-Order Intercept Point



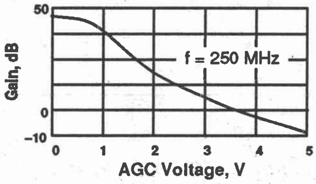
Second-Harmonic Intercept Point



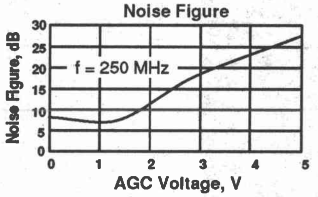
Gain at 10 dB AGC Steps



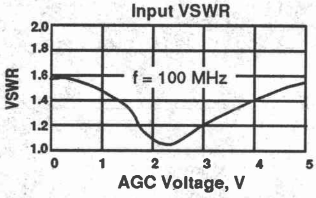
Gain



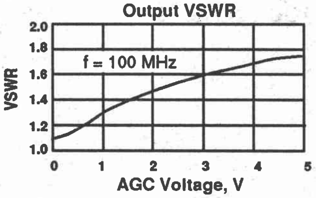
Noise Figure



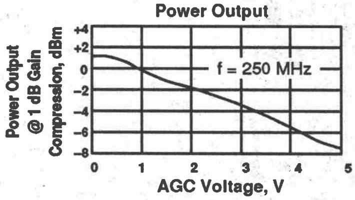
Input VSWR



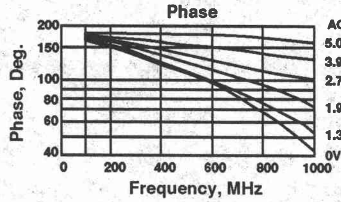
Output VSWR



Power Output



Phase

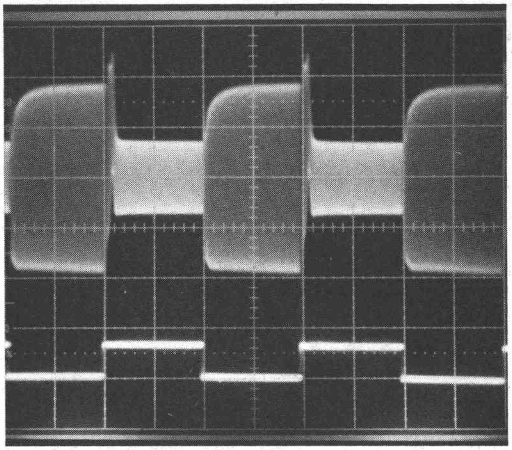


AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

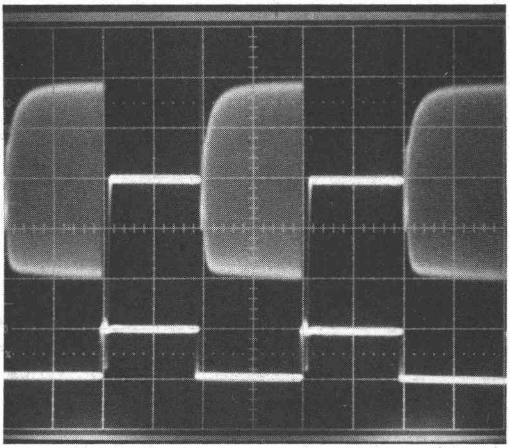
S-PARAMETERS

BIAS = 15.00 VOLTS
CURRENT = 47 mA

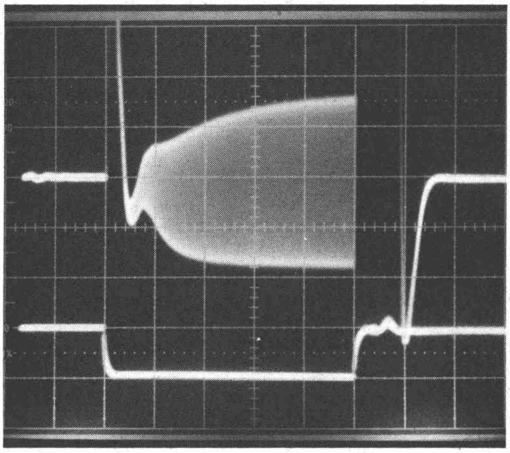
FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.170	–1.5	46.381	150.7	–77.830	–77.9	.051	74.7
150.00	.178	–3.0	46.125	135.3	–70.117	104.4	.060	50.5
200.00	.172	–3.6	45.486	122.7	–67.013	77.2	.070	33.4
250.00	.171	–5.3	44.935	110.9	–65.898	93.5	.074	8.2
300.00	.157	–5.6	44.021	100.4	–60.433	96.5	.035	–2.4
350.00	.157	–7.1	43.933	91.9	–61.634	79.5	.092	–2.1
400.00	.157	–11.7	43.735	80.9	–61.614	89.5	.095	–29.8
450.00	.155	–11.5	43.520	70.4	–60.694	88.1	.097	–48.9
500.00	.155	–13.0	43.379	60.3	–61.248	100.0	.123	–92.3
550.00	.156	–14.4	43.217	50.2	–58.353	100.2	.123	–92.3
600.00	.151	–11.8	43.058	39.8	–58.173	104.1	.136	–110.4
650.00	.143	–6.5	42.897	29.4	–57.308	113.5	.161	–127.6
700.00	.132	–4.0	42.824	18.9	–56.308	112.0	.196	–145.2
750.00	.122	–6.2	42.785	6.6	–55.176	115.3	.221	–162.5
800.00	.130	–7.6	42.875	–6.2	–53.638	116.1	.245	–176.0
850.00	.128	–8.5	42.766	–20.3	–53.403	115.0	.298	168.8
900.00	.131	–10.0	42.617	–33.6	–52.473	115.8	.335	152.4
950.00	.140	–14.0	42.155	–47.2	–50.734	112.8	.352	136.5
1000.00	.157	–14.0	41.886	–61.1	–51.425	115.7	.386	122.0



Frequency = 100 MHz
50 μSec./Div.
10 dB Gain Change



Frequency = 100 MHz
50 μSec./Div.
Full AGC Voltage



Frequency = 100 MHz
5 μSec./Div.
Full AGC Voltage

AVANTEK

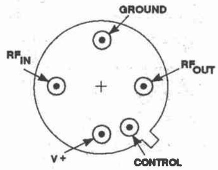
AGC-1053
Voltage-Controlled AGC Amplifier
10 to 1000 MHz

FEATURES

- Frequency Range: 10 to 1000 MHz
- MODAMP Silicon Monolithic Gain Stages
- AGC Range: 35 dB (Typ)
- 0 to 5 V Control Voltage

APPLICATIONS

- Open or Closed Loop Gain Control
- Receiver Output Gain Control
- Transmitter Output Levelling Control



TO-8F, p. 16–47

DESCRIPTION

The AGC-1053 combines three-stage MMIC RF amplifier with 22 dB (typ) gain, and PIN diodes with 0 to +5 VDC control voltage for gain control. The 1053 has blocking capacitors which couple the RF signal through the amplifier, and bypass capacitors to filter the bias voltage line.

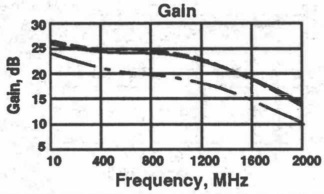
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	10-1000	10-1000	10-1000	MHz
GP	Small Signal Gain (Min.)	22	18	17	dB
—	Gain Flatness, V_{AGC} = 0 to +3 Volts (Max.)	±1.0	±2.0	±2.5	dB
—	AGC Range, V_{AGC} = +5 Volts	35			dB
NF	Noise Figure, V_{AGC} = 0 (Max.)	11.0	12.0	13.0	dB
$P_{1 dB}$	Power Output @ +1 dB Compression V_{AGC} = 0 (Min.)	+8.0	+5.0	+3.0	dBm
—	Input VSWR, V_{AGC} = 0 to +5 Volts (Max.)	1.5:1	2.0:1	2.0:1	—
—	Output VSWR, V_{AGC} = 0 to +5 Volts (Max.)	1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+20.0			dBm
IP_2	Two Tone 2nd Order Intercept Point	+40.0			dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+50.0			dBm
—	Response Time (10 to 90%)	25			µsec
VDC	Bias Voltage	+15			Volts
I_D	Bias Current	90			mA
V_{AGC}	AGC Voltage	0 to +5			Volts
I_{AGC}	AGC Current	0 to 12			mA

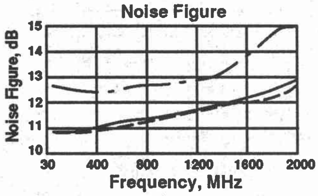
TYPICAL PERFORMANCE AT 25°C (@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
–55°C —— - ——

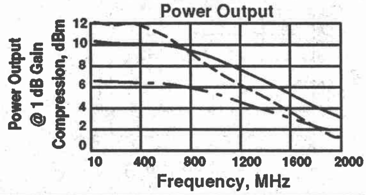
Gain



Noise Figure



Power Output



MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +17 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

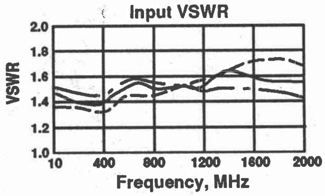
THERMAL CHARACTERISTICS*

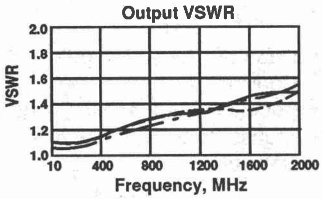
θ_{JC} .... 130/130/130°C/W
Active Transistor Power Dissipation .... 125/125/175 mW
Junction Temperature Above Case Temperature .. 16/16/24°C
MTBF (MIL-HDBK-217E, A_{UF} @ 90°C) .... 378,652 Hrs.
*For further information, see High Reliability section, p. 17–2.

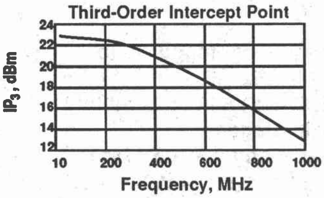
WEIGHT: (typical) 2.1 grams

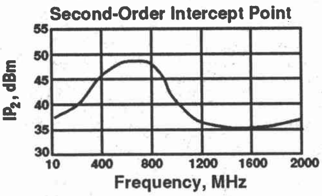
TYPICAL PERFORMANCE AT 25°C (continued)

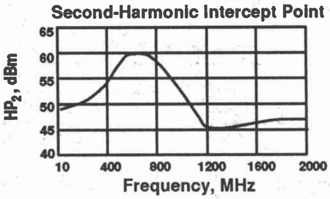
KEY: +25°C ————
+85°C – – – –
–55°C —- · —

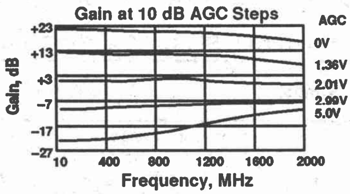


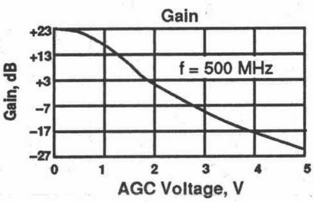


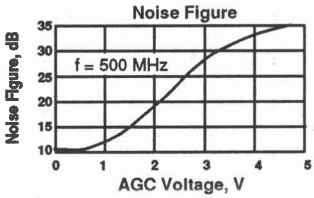


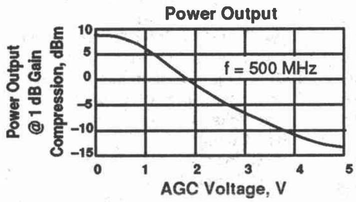


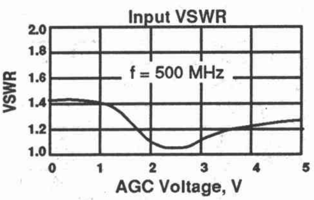


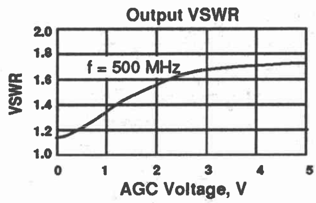


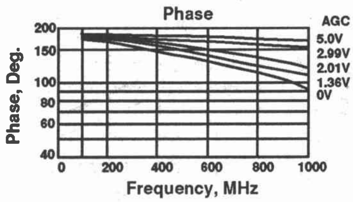










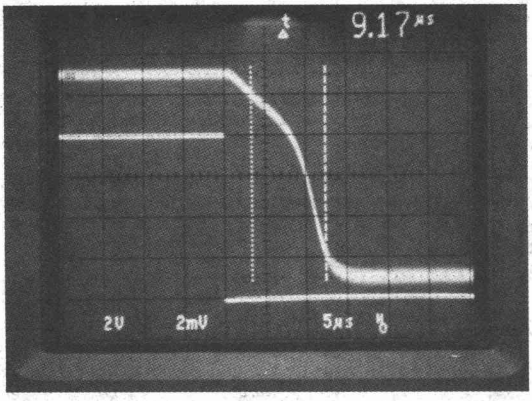


AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

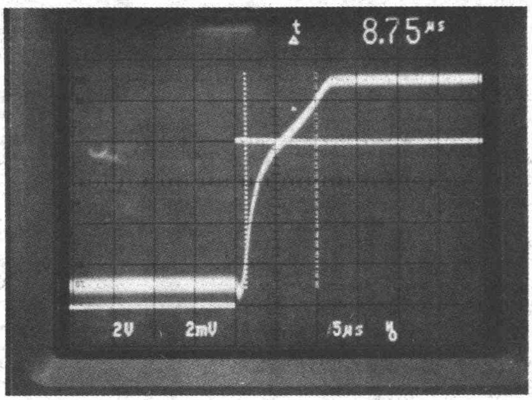
S-PARAMETERS

BIAS = 15.00 VOLTS
CURRENT = 86 mA

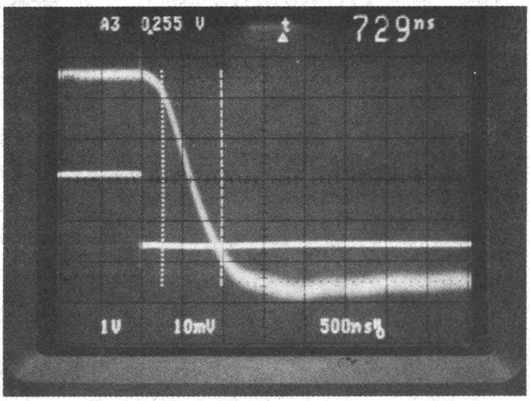
FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.168	3.3	23.100	160.4	–35.047	–177.0	.010	8.2
150.00	.160	–.8	22.828	149.5	–37.208	–3.0	.019	–119.0
200.00	.156	–6.1	22.744	140.0	–45.836	66.7	.034	–98.4
250.00	.152	10.8	22.704	129.6	–51.764	–18.7	.032	–95.8
300.00	.151	–14.5	22.600	120.0	–48.073	–38.4	.057	–80.3
350.00	.156	–14.1	22.320	110.4	–54.909	–171.3	.064	–101.6
400.00	.158	–18.4	22.243	101.3	–45.695	40.0	.065	–97.3
450.00	.171	–22.4	22.115	92.3	–50.204	20.9	.075	–96.9
500.00	.185	–23.0	22.112	82.9	–53.132	145.6	.078	–96.6
550.00	.193	–23.5	22.092	73.7	–52.702	68.7	.090	–98.0
600.00	.195	–23.5	22.027	64.5	–52.354	98.2	.097	–99.4
650.00	.195	–23.9	21.960	55.0	–53.418	146.8	.106	–100.5
700.00	.185	–26.6	21.893	45.4	–60.145	162.5	.112	–102.5
750.00	.177	–31.5	21.784	36.3	–55.039	71.8	.121	–104.3
800.00	.174	–36.6	21.720	26.3	–47.281	51.9	.127	–106.2
850.00	.182	–41.2	21.571	15.7	–47.371	49.8	.129	–108.4
900.00	.183	–44.9	21.450	4.9	–56.316	75.2	.132	–113.0
950.00	.189	–49.0	21.291	–5.6	–50.851	112.3	.140	–115.5
1000.00	.194	–49.8	21.113	–16.5	–48.514	75.1	.141	–114.5
1050.00	.195	–47.2	20.897	–26.6	–49.027	80.0	.137	–115.7
1100.00	.192	–44.9	20.699	–36.6	–47.141	74.4	.132	–119.4
1150.00	.193	–43.9	20.454	–46.6	–47.842	81.1	.137	–118.8
1200.00	.197	–45.2	20.181	–56.5	–54.577	110.8	.136	–115.1
1250.00	.204	–47.4	19.852	–65.7	–48.801	78.9	.126	–110.9
1300.00	.218	–50.3	19.508	–75.0	–50.134	59.9	.121	–107.2
1350.00	.238	56.2	19.256	–84.3	–54.313	93.9	.139	–105.3
1400.00	.245	–59.4	19.032	–94.2	–61.674	110.8	.162	–101.8
1450.00	.240	–61.3	18.695	–104.3	–48.073	131.5	.165	–101.0
1500.00	.231	–64.2	18.389	–114.0	–52.090	123.2	.156	–104.0
1550.00	.228	–65.3	17.998	–123.8	–46.604	136.4	.163	–110.3
1600.00	.228	–65.2	17.527	–133.1	–50.210	116.1	.177	–108.5
1650.00	.228	–66.3	17.069	–142.6	–46.314	152.4	.176	–102.7
1700.00	.224	–68.5	16.509	–151.7	–45.587	138.9	.164	–103.3
1750.00	.224	–70.4	15.967	–160.6	–47.299	140.9	.169	–108.1
1800.00	.223	–72.4	15.427	–169.7	–49.243	164.2	.186	–107.9
1850.00	.225	–73.7	14.855	–179.1	–45.932	159.3	.186	–103.2
1900.00	.226	–73.8	14.335	172.5	–48.546	148.4	.173	–103.5
1950.00	.224	–74.1	13.847	164.0	–44.024	146.4	.173	–108.1
2000.00	.224	–74.5	13.294	156.2	–44.810	154.0	.188	–107.2



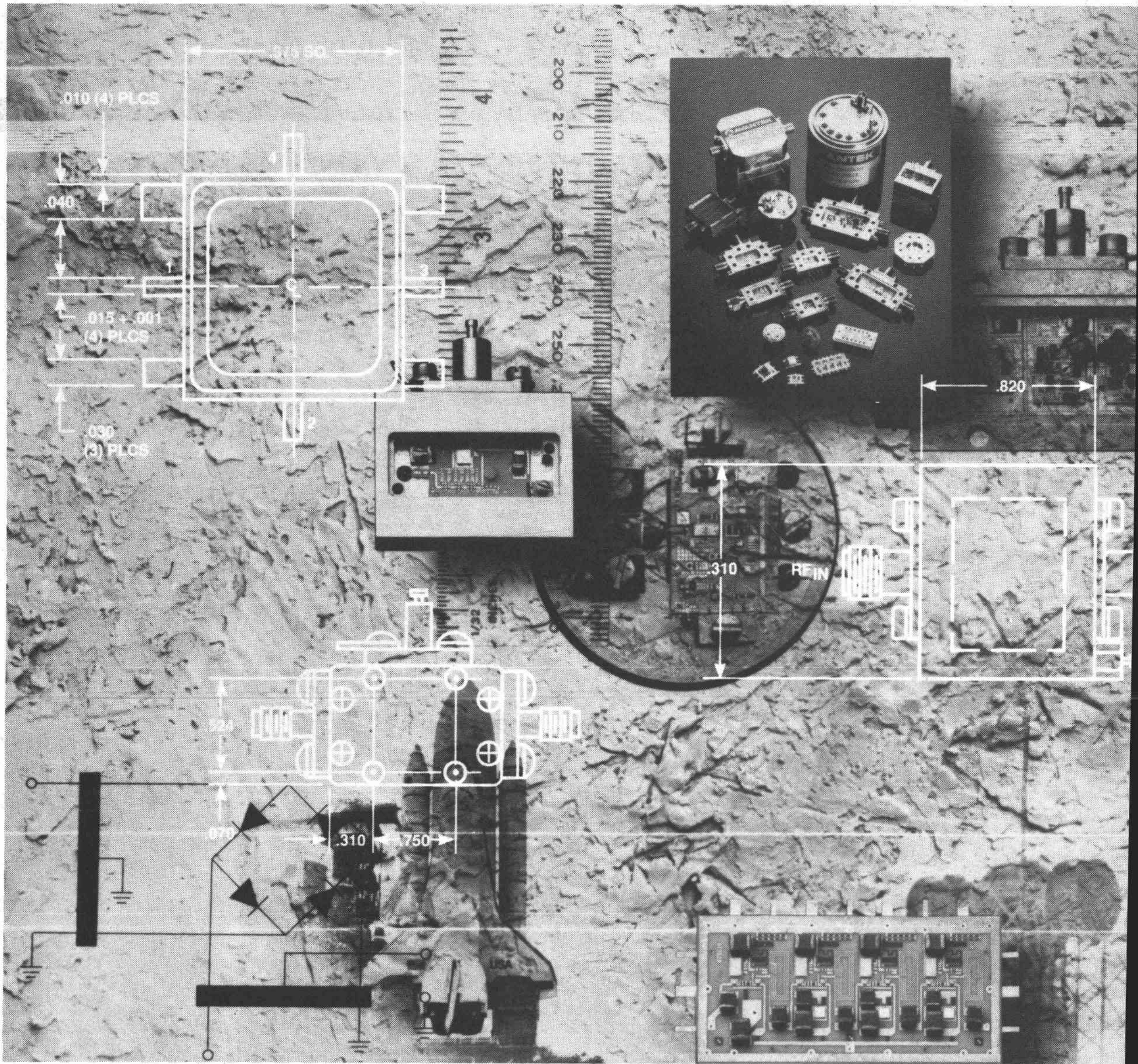
Frequency = 100 MHz
50 µSec./Div.
10 dB Gain Change



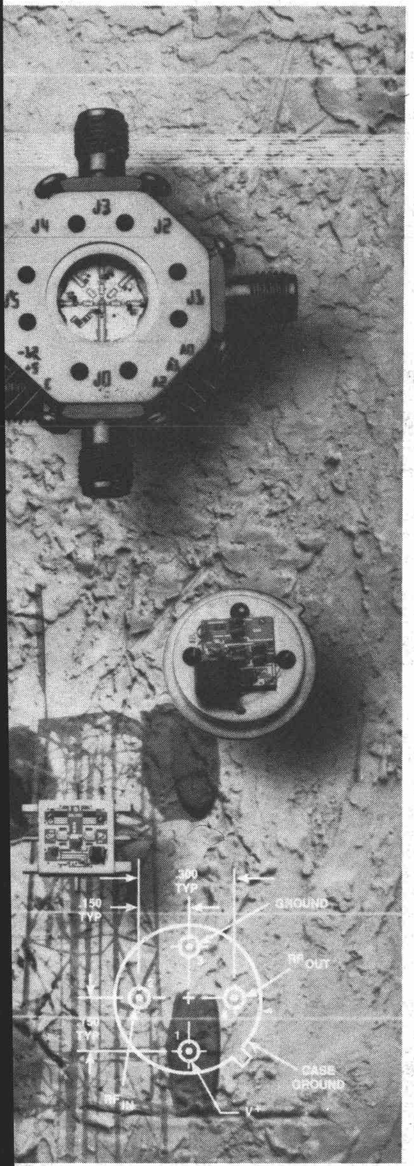
Frequency = 100 MHz
50 µSec./Div.
Full AGC Voltage



Frequency = 100 MHz
5 µSec./Div.
Full AGC Voltage


.010 (4) PLCS
.040
(4) PLCS
.030
(3) PLCS
.820
.310
RF IN
.524
.070
.310
.750
USA

LIMITING AMPLIFIERS



PRODUCT DESCRIPTION

Avantek® limiting amplifiers, available in TO-8, dual-inline and surface-mount PlanarPak™ packages, are excellent for applications in ECM, radar and instrumentation, or communication systems. Some complex systems require some method of either removing amplitude modulation from an FM signal or preventing the overdrive of a detection circuit. Avantek limiting amplifiers are ideal for these types of applications—especially when wide input range and fast limiting recovery is required.

UDL/UTL SERIES THIN-FILM LIMITING AMPLIFIERS

Guaranteed Specifications @ 0° to 50°C Case Temperature

Model	Frequency Range (MHz)	Input Power Limiting Range (dBm) Minimum	Saturated Output Power (dBm) Minimum	Output Power Flatness (dB) Maximum	Noise Figure (dB) Maximum	Operating Bias (VDC)	Case Type	Page Number
UTL-502	5-500	–3 to +7	–4.0	±0.5	11.0	+15, –15	TO-8F	3–213
UTL-503	5-500	–6 to +7	–4.0	±1.0	10.0	+15	TO-8U	3–214
UDL-502	5-500	–23 to +7	–4.0	±0.5	11.0	+15, –15	DIP	3–211
UDL-503	5-500	–30 to +10	–2.0	±1.0	10.0	+15	DIP	3–212

PPL-504, PLANARPAK™, SURFACE MOUNTED LIMITING AMPLIFIER

Guaranteed Specifications @ 0° to 50°C Case Temperature

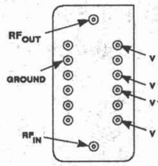
Model	Frequency Range (MHz)	Input Power Limiting Range (dBm) Minimum	Saturated Output Power (dBm) Minimum	Output Power Flatness (dB) Maximum	Noise Figure (dB) Maximum	Operating Bias (VDC)	Case Type	Page Number
PPL-504	10-1000	–25 to +10	–4.0	±0.8	10.0	+15	PP-48	3–215

![AVANTEK]

UDL-502
Thin-Film Limiting Amplifier
5 to 500 MHz

FEATURES
- Frequency Range: 5 to 500 MHz
- Output Power Flatness: ±0.5 dB (Max.)
- Input Power Range: 30.0 dB
- Low Phase Shift Variation
- High Even-Harmonic Suppression

APPLICATIONS
- All FM Systems
- Communications
- Telemetry
- Radar Warning
- Measurement Systems



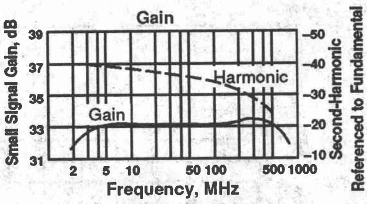
DIP Case, p. 16–14

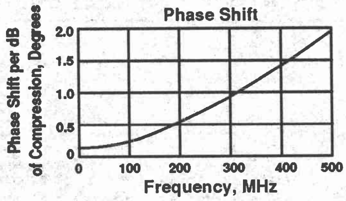
DESCRIPTION
The UDL-502 is a three-stage bipolar RF limiting amplifier with 32 dB (typ) of small signal gain. Emitter-coupled pair design provides for even-harmonic suppression and low AM-to-PM conversion. The RF signal is coupled through the amplifier by means of internal blocking capacitors.

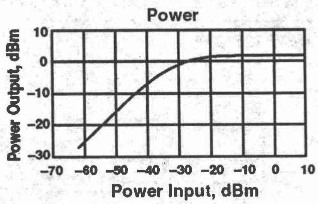
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ ±15 VDC and –15 VDC nominal)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	32.0	30.0	—	dB
—	Saturated Output Power (Min.)	–2.0	–4.0	—	dBm
—	Saturated Flatness (Max.)	—	±0.5	—	dB
—	VSWR Input/Output (Max.)	—	2.0:1	—	—
—	Even-Harmonic Suppression @ P_{IN} = –50 to +7 dBm	—	15.0	—	dBc
NF	Noise Figure (Max.)	—	11.0	—	dB
I_D	Bias Current				
	+15 VDC	60	—	—	mA
	–15 VDC	60	—	—	mA

TYPICAL PERFORMANCE AT 25°C TEMPERATURE (@ ±15 VDC unless otherwise noted)



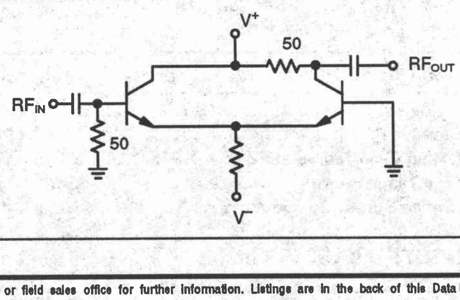




MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +15 dBm
Operating Case Temperature .... –55°C to +85°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +85°C

SCHEMATIC (1 of 3 identical stages shown)



WEIGHT: (typical) 5.7 grams

AVANTEK

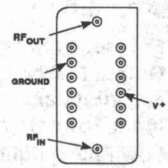
UDL-503
Thin-Film Limiting Amplifier
5 to 500 MHz

FEATURES

- Frequency Range: 5 to 500 MHz
- Output Power Flatness: ±0.8 dB (Typ)
- Input Power Range: 40.0 dB
- Low Phase Shift Variation
- High Even-Harmonic Suppression

APPLICATIONS

- All FM Systems
- Communications
- Telemetry
- Radar Warning
- Measurement Systems



DIP Case, p. 16–14

DESCRIPTION

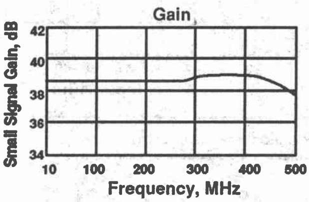
The UDL-503 is a three-stage bipolar RF limiting amplifier having 38 dB (typ) of small signal gain. Emitter-coupled pair design provides even-harmonic suppression and low AM-to-PM conversion. The RF signal is coupled through the amplifier by means of internal blocking capacitors.

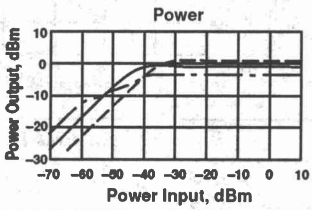
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal)

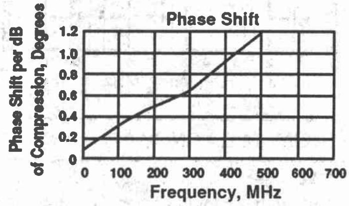
Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	38.0	30.0	30.0	dB
—	Saturated Output Power (Min.) P_{IN} = 0 dBm	–0.5	–2.0	–4.0	dBm
—	Saturated Flatness (Max.) P_{IN} = 0 dBm	±0.8	±1.0	±1.7	dB
—	VSWR Input (Max.)	1.5:1	2.0:1	2.0:1	—
—	VSWR Output (Max.)	1.2:1	2.0:1	2.0:1	—
—	Phase Shift per dB of Compression per MHz	0.0023	—	—	degree/ dB MHz
—	Even Harmonic Suppression @ P_{IN} = –33 to +10 dBm	20	15.0	15	dBc
NF	Noise Figure (Max.)	9.0	10.0	11.0	dB
I_D	DC Current	70	—	—	mA

TYPICAL PERFORMANCE AT 25°C TEMPERATURE (@ +15 VDC unless otherwise noted)

KEY: +25°C ——————
+85°C — — — —
–55°C —— - ——







MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +13 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

THERMAL CHARACTERISTICS*

θ_{JC} 240C/W
Active Transistor Power Dissipation .... 100 mW
Junction Temperature Above Case Temperature .... 24°C

*For further information, see High Reliability section, p. 17–2.

WEIGHT: (typical) 5.7 grams

AVANTEK

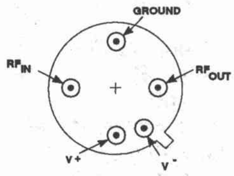
UTL-502
Thin-Film Limiting Amplifier
5 to 500 MHz

FEATURES

- Frequency Range: 5 to 500 MHz
- Output Power Flatness: ±0.5 dB (Max.)
- Input Power Range: 10.0 dB
- Low Phase Shift Variation
- High Even Harmonic Suppression

APPLICATIONS

- All FM Systems
- Communications
- Telemetry
- Radar Warning
- Measurement Systems



TO-8F, p. 16–47

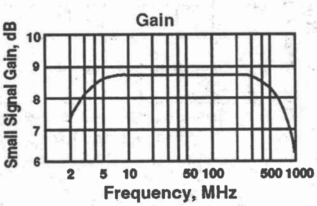
DESCRIPTION

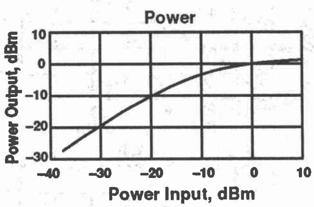
The UTL-502 is a single-stage bipolar RF limiting amplifier with 8.5 dB (typ) of small signal gain. Emitter-coupled pair design provides even-harmonic suppression and low AM-to-PM conversion. The RF signal is coupled through the amplifier by means of internal blocking capacitors.

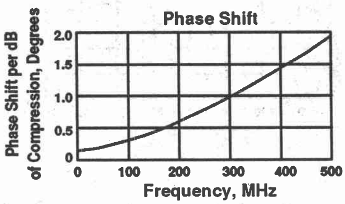
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ ±15 VDC nominal)

Symbol	Characteristic	Typical T_c = 25°C	Guaranteed Specifications T_c = 0° to 50°C	Guaranteed Specifications T_c = –55° to +85°C	Unit
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	8.5	7.0	—	dB
—	Saturated Output Power (Min.)	–2.0	–4.0	—	dBm
—	Saturated Flatness (Max.)	—	±0.5	—	dB
—	VSWR Input/Output (Max.)	—	2.0:1	—	—
—	Even-Harmonic Suppression @ P_{IN} = –50 to +7 dBm	—	15.0	—	dBc
NF	Noise Figure (Max.)	—	11.0	—	dB
I_D	Bias Current				
	+15 VDC	20	—	—	mA
	–15 VDC	20	—	—	mA

TYPICAL PERFORMANCE AT 25°C TEMPERATURE (@ ±15 VDC unless otherwise noted)



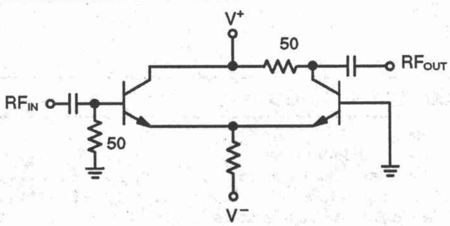




MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +15 dBm
Operating Case Temperature .... –55°C to +100°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +100°C

SCHEMATIC



WEIGHT: (typical) 2.1 grams

AVANTEK

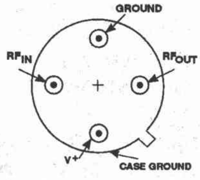
UTL-503
Thin-Film Limiting Amplifier
5 to 500 MHz

FEATURES

- Frequency Range: 5 to 500 MHz
- Output Power Flatness: ±0.3 dB (Typ)
- Input Power Range: 13.0 dB
- Low Phase Shift Variation
- High Even-Harmonic Suppression

APPLICATIONS

- All FM Systems
- Communications
- Telemetry
- Radar Warning
- Measurement Systems



TO-8U, p. 16–48

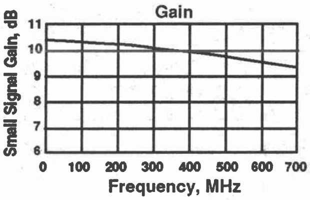
DESCRIPTION

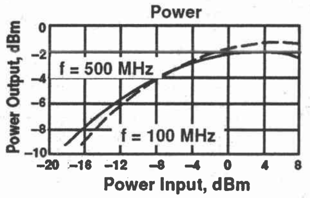
The UTL-503 is a single-stage bipolar RF limiting amplifier using a single polarity supply with 9.5 dB (typ) of small signal gain. Emitter-coupled pair design provides even-harmonic suppression and low AM-to-PM conversion. The RF signal is coupled through the amplifier by means of internal blocking capacitors.

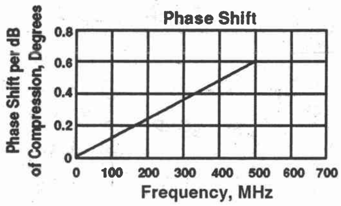
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range	5-500	5-500	5-500	MHz
GP	Small Signal Gain (Min.)	9.5	8.0	7.0	dB
—	Saturated Output Power (Min.) P_{IN} = 0 dBm	–2.0	–4.0	–4.0	dBm
—	Saturated Flatness (Max.) P_{IN} = 0 dBm	±0.3	±1.0	±1.0	dB
—	VSWR Input (Max.)	1.3:1	1.5:1	1.5:1	—
—	VSWR Output (Max.)	1.2:1	1.5:1	1.5:1	—
—	Even Harmonic Suppression (Min.) @ P_{IN} = 7 dBm	30.0	20.0.	20.0	dBc
NF	Noise Figure (Max.)	8.6	10.0	10.5	dB
I_D	Bias Current @ +15 VDC	20	—	—	mA

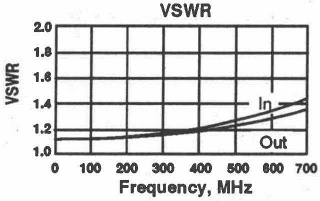
TYPICAL PERFORMANCE AT 25°C TEMPERATURE (@+15 VDC unless otherwise noted)







KEY: +25°C ————
+85°C — — — —
–55°C —— - ——



MAXIMUM RATINGS

DC Voltage	+17 Volts
Continuous RF Input Power	+15 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

THERMAL CHARACTERISTICS*

θ_{JC}	240°C/W
Active Transistor Power Dissipation	100 mW
Junction Temperature Above Case Temperature	24°C

*For further information, see High Reliability section, p. 17–2.

WEIGHT: (typical) 2.1 grams

AVANTEK

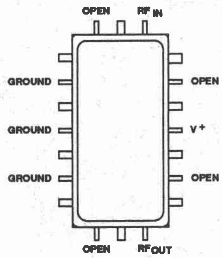
PPL-504
Surface-Mount Limiting Amplifier
10 to 1000 MHz

FEATURES

- Frequency Range: 10 to 1000 MHz
- Up to 55 dB Compression Range
- Low Phase Shift
- Surface Mount Package

APPLICATIONS

- All FM Systems
- Communications
- Telemetry
- Radar Warning
- Measurement Systems



PP-48, p. 16–36

DESCRIPTION

The PPL-504 is a four-stage bipolar RF limiting amplifier in a PlanarPak surface mount package using a single polarity supply with a compression range of up to 55 dB. Emitter-coupled pair design provides for even-harmonic suppression and low AM-to-PM conversion. The RF signal is coupled through the amplifier by means of internal blocking capacitors.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal)

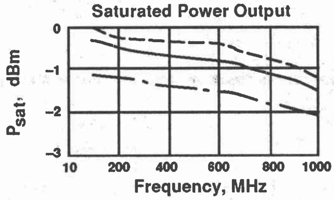
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	10-1000	10-1000	10-1000	MHz
—	Compression Range @ $P_{OUT} = \pm 0.5$ dB				
	10-250 MHz	–52 to +10	–45 to +10	–45 to +10	dBm
	250-500 MHz	–48 to +10	–40 to +10	–40 to +10	
	500-1000 MHz	–32 to +10	–25 to +10	–25 to +10	
—	Saturated Power @ $P_{IN} = 0$ dBm				
	10-1000 MHz (Min.)	0	–4	–4	dBm
—	Saturated Flatness @ $P_{IN} = 0$ dBm				
	10-500 MHz (Max.)	±0.2	±0.4	±0.5	dB
	10–1000 MHz (Max.)	±0.6	±0.8	±1.0	
—	VSWR Input/Output				
	10-500 MHz (Max.)	1.3/1.3:1	1.5/1.5:1	2.0/2.0:1	—
	500-1000 MHz (Max.)	1.6/2.0:1	2.0/2.2:1	2.0/2.5:1	
—	Output Noise Power, 1 MHz BW				
	10-250 MHz (Max.)	–43	–41	–38	dBm
	250-500 MHz (Max.)	–48	–44	–42	
	500-1000 MHz (Max.)	–57	–46	–48	
—	Phase Shift per dB of Compression per MHz, deg.				
	10-1000 MHz	0.0035	—	—	
—	Even Harmonic Suppression @ $P_{IN} = 0$ dBm				
	250 MHz (Min.)	–26	–20	–20	dBc
	500 MHz (Min.)	–18	–13	–13	
	1000 MHz (Min.)	–10	–7	–6	
—	Odd Harmonic Suppression, @ $P_{IN} = 0$ dBm				
	250 MHz (Min.)	–10	–8	–7	dBc
	500 MHz (Min.)	–12	–10	–8	
NF	Noise Figure				
	250 MHz	8	—	—	dB
	500 MHz	9	—	—	
	1000 MHz	10	—	—	
I_D	DC Current (@ Rated Voltage)	+80	—	—	mA

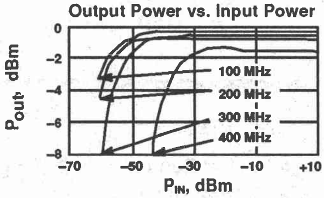
MAXIMUM RATINGS

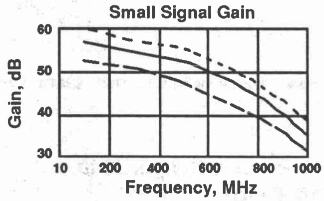
DC Voltage .... +17 Volts
Continuous RF Input Power .... +15 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +125°C
"R" Series Burn-In Temperature .... +125°C
Temperature Rise (Junction Above Case) .... 20°C
Thermal Resistance (Junction-Case) .... 225°C/W
Transistor Power Dissipation .... 90 mW

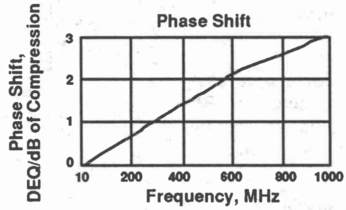
WEIGHT: (typical) 1.1 grams

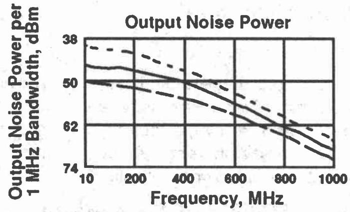
TYPICAL PERFORMANCE OVER TEMPERATURE (@+15 VDC unless otherwise noted)

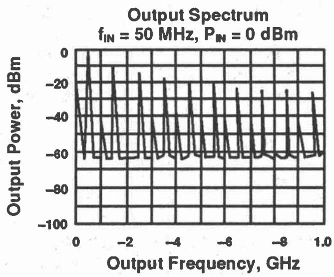


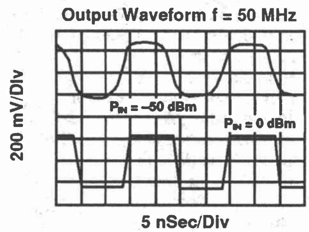


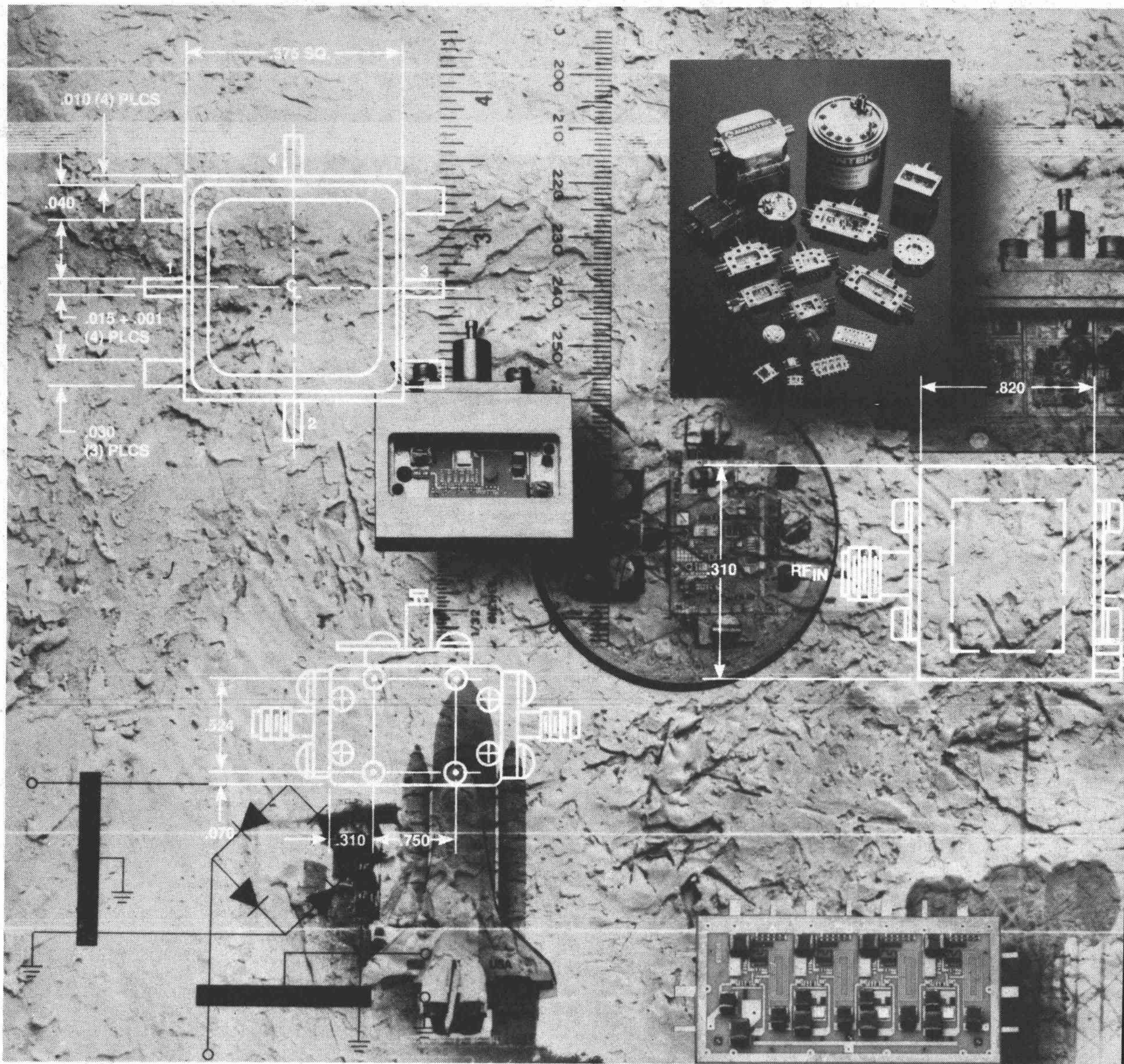






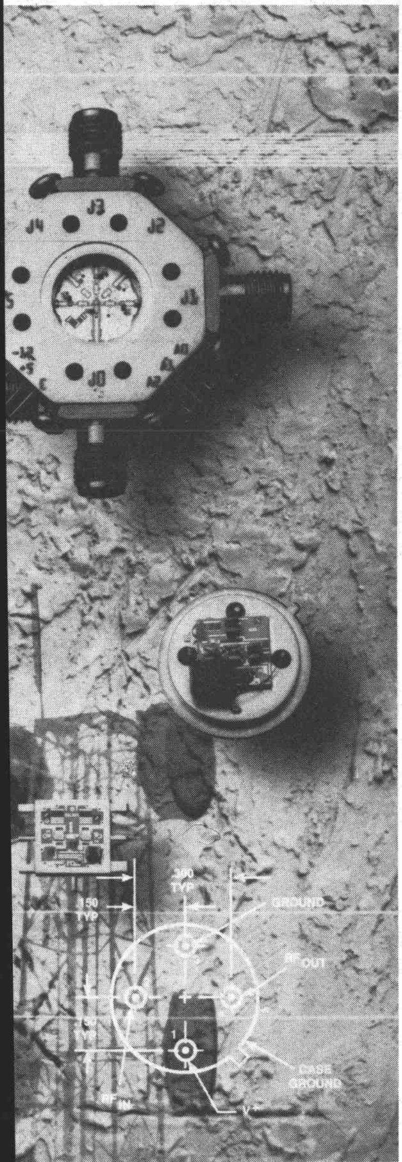






.010 (4) PLCS
.040
.015 + .001
(4) PLCS
.030
(3) PLCS
200
210
220
230
240
250
.820
.310
RF IN
.524
.070
.310
.750

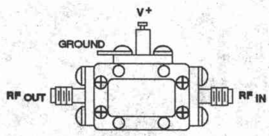
ACT SERIES



[1]For information on other ACT Series and UTC Series products not discussed in this data book in detail, please contact your nearest Avantek distributor, representative, or sales office (see page 18–21 for complete list of addresses.)

PRODUCT DESCRIPTION

Avantek's ACT Series are multi-stage, high performance amplifiers packaged in a hermetic stainless steel Avanpak™ package with removable connectors for SMA connections or drop-in assembly. The 5 to 2000 MHz part of the line uses some of Avantek's most popular UTO type devices cascaded in substrate form. This permits the cascades to be factory-tuned to provide a wide selection of low NF, high gain, flat frequency response and moderate output power products. Other parts in the line are a 0.1 to 4000 MHz extremely broadband unit, and several narrowband ultra-low-NF amplifiers. The ACT line is recommended for use as instrumentation amplifiers, LNAs, Fiber optic system amplifiers or any other application where performance plays a major role.



AS-2, p. 16–8

ACT SERIES CASCADED AMPLIFIERS

(Guaranteed Specifications @ 0° to 50°C Case Temperature, V = 15 VDC)

Model	Frequency Range MHz	Gain (dB) Typ./Min.	Noise Figure (dB) Maximum	Power Output for 1 dB Gain Compression (dBm) Minimum	Gain Flatness (dB) Maximum	Intercept Point for IM Products (dBm) Typical	VSWR 50 Ohms In/Out Maximum	Input Bias Current (mA) Typical
10 to 500 MHz								
ACT5-200	10-500	26.5/25	2.7	+6	±1.5	+22	2.0:1	35
ACT5-201	10-500	37/35	2.7	+7	±1.5	+20	2.0:1	33
ACT5-202	10-500	51.5/49	2.7	+6	±1.5	+18	2.0:1	60
ACT5-203	10-500	64.5/62	2.7	+6	±2.0	+18	2.0:1	70
ACT5-210	10-500	27.5/26	3.0	+14	±1.5	+30	2.0:1	78
ACT5-211	10-500	38/36	3.5	+14	±1.5	+30	2.0:1	76
ACT5-212	10-500	47/45	2.7	+14	±1.5	+27	2.0:1	80
ACT5-213	10-500	54/52	2.7	+14	±2.0	+27	2.0:1	92
ACT5-214	10-500	67/65	2.7	+14	±2.0	+27	2.0:1	103
ACT5-220	10-500	24.5/23	3.5	+23	±1.5	+35	2.0:1	165
ACT5-221	10-500	35/33	3.0	+23	±2.0	+35	2.0:1	190
ACT5-222	10-500	46/44	3.0	+23	±2.0	+35	2.0:1	193
ACT5-223	10-500	60.5/58	3.0	+23	±2.0	+35	2.0:1	210
10 to 1000 MHz								
ACT10-210	10-1000	21.5/20	4.5	+11	±2.0	+28	2.0:1	60
ACT10-211	10-1000	31/29	3.7	+9	±1.5	+20	2.0:1	37
ACT10-212	10-1000	41/39	3.7	+9	±2.0	+20	2.0:1	62
ACT10-213	10-1000	52/50	3.7	+12	±1.5	+27	2.0:1	101
ACT10-220	10-1000	22.5/21	5.0	+20	±2.0	+35	2.0:1	125
ACT10-221	10-1000	33/31	4.5	+20	±2.0	+35	2.0:1	150
ACT10-222	10-1000	42/40	3.7	+20	±2.0	+35	2.0:1	127
ACT10-223	10-1000	49/47	3.7	+20	±2.0	+35	2.0:1	163
10 to 2000 MHz								
ACT20-210	10-2000	19.5/18	5.0	+7	±1.5	+17	2.2:1	41
ACT20-211	10-2000	28/26	5.0	+14	±2.0	+29	2.2:1	91
ACT20-212	10-2000	34/32	6.0	+14	±2.0	+29	2.2:1	104
ACT20-213	10-2000	40/38	6.0	+12	±2.0	+29	2.2:1	126

ACT SERIES SELECTION GUIDE (continued)

AVANPAK CASCADED AMPLIFIER

(Guaranteed Specifications @ 0° to 50°C Case Temperature)

Model	Frequency Range (MHz)	Gain (dB) Typ./Min.	Noise Figure (dB) Maximum 0.1 to 2000 (MHz)	Noise Figure (dB) Maximum >2000 to 4000 (MHz)	Power Output @ 1.0 dB Comp. (dBm), Min. 0.1 to 2000 (MHz)	Power Output @ 1.0 dB Comp. (dBm), Min. >2000 to 4000 (MHz)	Gain Flatness (dB) Maximum	Third-Order Intercept Point (dBm) Typ. 0.1 to 2000 (MHz)	Third-Order Intercept Point (dBm) Typ. >2000 to 4000 (MHz)	Input Power Voltage (VDC)	Current (mA) Typ.	Page Number
ACT-4032	0.1-4000	19/18	7.5	9.0	7.5	2.0	±1.0	19.0	10.0	15	105	3–222

ACT SERIES ULTRA LOW NOISE, NARROWBAND AMPLIFIER

(Guaranteed Specifications @ 0° to 50°C Case Temperature, V = 15 VDC)

Model	Frequency Range (MHz) Min.	Gain (dB) Min.	Noise Figure (dB) Max.	Power Output @ 1 dB Gain Compression (dBm) Min.	Gain Flatness (dB) Max.	Third-Order Intercept Point (dBm) Typ.	Input Power Voltage (VDC)	Input Power Current (mA) Typ.	Page Number
ACT-120923	950-1250	35.5	1.5	+14	±0.5	26	12-15	95	3–224
ACT-141223	1200-1400	35	1.5	+13	±0.5	25	12-15	95	3–226
ACT-161223	1200-1600	34	1.5	+15	±0.7	24	12-15	90	3–228

AVANTEK

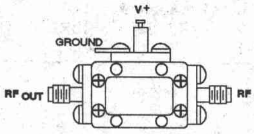
ACT-4032
Avanpak™ Cascaded Amplifier
0.1 to 4000 MHz

FEATURES

- Wide Frequency Range: 0.1 to 4000 MHz
- Moderate Gain: 19.0 dB (Typ)
- Flat Gain Response: ±0.5 dB (Typ)
- Low Pulse Overshoot: < 15%
- Low VSWR: < 1.8:1 (Typ)

APPLICATIONS

- Fiber Optic System Amplifier
- Pulse Amplifier
- Instrumentation
- Broadband Bench Amplifier



AS-2, p. 16–8

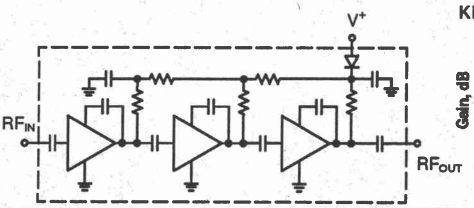
DESCRIPTION

The ACT-4032 utilizes three monolithic silicon ICs on a thin-film substrate containing interstage tuning, input/output matching and internal blocking capacitors. This provides excellent wideband response over the range of 100 kHz to 4 GHz with a gain variation of only ±0.5 dB. It is packaged in a laser-welded, hermetically-sealed case weighing only 40 grams with field replaceable/removable SMA connectors. Without connectors, the unit weighs only 31 grams and is suitable for microstrip mounting.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

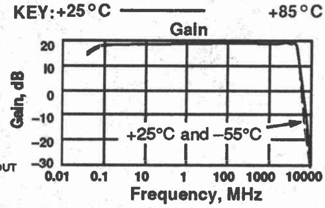
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			$T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	
BW	Frequency Range	0.1-4000	0.1-4000	0.1-4000	MHz
GP	Small Signal Gain (Min.)	19.0	18.0	17.0	dB
—	Gain Flatness (Max.)	±0.5	±1.0	±1.25	dB
NF	Noise Figure				
	0.1-2000 MHz (Max.)	7.0	7.5	8.0	dB
	>2000-4000 MHz (Max.)	8.5	9.0	9.5	dB
P_{1dB}	Power Output @ +1 dB Compression				
	0.1-2000 (Min.)	9.0	7.5	7.0	dBm
	>2000-4000 MHz (Min.)	3.0	2.0	0.0	dBm
—	Input VSWR (Max.)	1.8:1	2.0:1	2.2:1	—
—	Output VSWR (Max.)	1.8:1	2.0:1	2.2:1	—
IP_3	Two Tone 3rd Order Intercept Point				
	0.1-2000 MHz	+19.0	—	—	dBm
	>2000-4000 MHz	+10.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+35.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+40.0	—	—	dBm
—	Pulse Overshoot	<15%	—	—	nsec
—	DC Voltage	15	—	—	Volts
GD	Group Delay	.71	—	—	ns
I_D	DC Current	105	—	—	mA

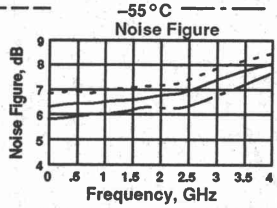
SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE
(@ +15 VDC unless otherwise noted)

KEY: +25°C ———— +85°C – – – – –55°C – · –





MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+17 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

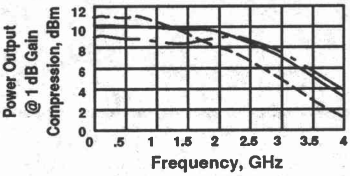
THERMAL CHARACTERISTICS

θ_{JC}	80°C/W
Active Transistor Power Dissipation	280 mW
Junction Temperature Above Case Temperature	22°C

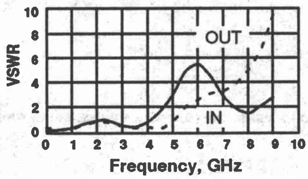
*For further information, see High Reliability section, p. 17–2.

WEIGHT: 40 grams (with connectors)

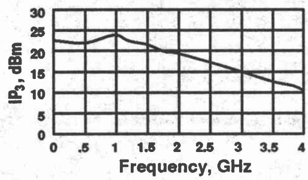
Power Output



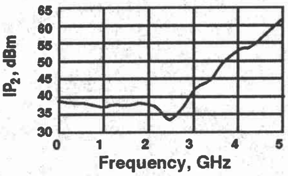
VSWR



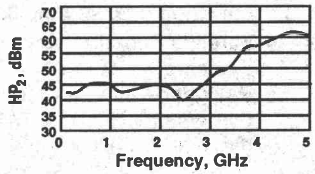
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

BIAS = 15 VOLTS
CURRENT = 104 mA

FREQ	S_{11}		S_{21}		S_{12}		S_{22}		
GHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	K
.050	–35.30	–14.92	19.33	168.35	–42.06	–2.44	–21.25	179.83	6.83
.100	–35.85	29.60	19.27	158.11	–43.34	–17.23	–21.31	177.96	7.96
.150	–34.35	25.00	19.27	146.87	–43.99	–26.16	–21.09	176.52	8.56
.200	–32.98	30.70	19.20	135.92	–43.90	–34.37	–21.25	173.45	8.55
.250	–31.36	25.19	19.20	125.17	–44.13	–37.87	–21.48	174.09	8.79
.300	–29.96	27.14	19.15	113.71	–43.88	–52.45	–21.61	175.19	8.59
.350	–27.63	13.66	19.14	102.50	–45.44	–58.95	–21.52	174.14	10.26
.400	–27.32	12.61	19.20	91.81	–42.35	–64.01	–21.30	174.66	7.16
.450	–25.89	–1.12	19.14	80.84	–43.29	–76.96	–21.28	173.96	8.01
.500	–24.84	–4.40	19.17	70.01	–43.98	–78.79	–21.15	174.70	8.64
.600	–23.98	–15.21	19.12	48.26	–43.49	–92.25	–20.52	173.20	8.20
.700	–22.71	–28.71	19.17	26.44	–44.13	–108.76	–19.84	172.54	8.74
.800	–21.21	–39.14	19.17	4.45	–42.38	–131.97	–19.05	169.89	7.13
.900	–20.11	–52.42	19.20	–18.13	–43.12	–138.83	–18.05	165.54	7.68
1.000	–19.32	–60.31	19.13	–39.77	–44.34	–160.02	–17.17	160.77	8.86
1.100	–18.14	–70.60	19.13	–61.48	–47.48	170.89	–16.25	153.39	12.57
1.200	–17.01	–83.44	19.17	–83.85	–45.26	168.88	–15.48	145.53	9.60
1.300	–15.99	–94.82	19.17	–105.73	–48.77	154.79	–14.69	136.93	14.21
1.400	–14.85	–106.58	19.25	–127.16	–48.25	133.19	–14.10	128.28	13.08
1.500	–13.88	–118.84	19.21	–149.56	–45.01	122.43	–13.44	118.43	8.92
1.600	–13.13	–133.10	19.26	–171.39	–45.46	114.50	–13.03	108.07	9.21
1.700	–12.57	–145.80	19.30	166.90	–47.62	106.63	–12.62	97.41	11.60
1.800	–11.97	–158.74	19.32	145.01	–47.29	101.56	–12.37	86.03	11.01
1.900	–11.85	–170.37	19.40	122.33	–45.65	58.09	–12.20	74.52	9.03
2.000	–11.28	173.44	19.46	100.44	–45.84	47.10	–11.89	62.58	9.05
2.100	–11.01	160.48	19.55	78.43	–46.79	34.52	–11.93	51.03	9.95
2.200	–10.90	147.57	19.56	56.28	–46.11	23.13	–12.03	40.42	9.20
2.300	–10.92	134.50	19.64	33.37	–46.91	–12.03	–12.23	28.42	10.05
2.400	–11.28	121.74	19.67	10.84	–45.66	–15.27	–12.51	15.10	8.78
2.500	–11.70	111.50	19.67	–6.46	–48.34	–43.30	–12.77	5.47	12.05
2.600	–11.89	100.21	19.60	–29.26	–48.67	–67.55	–13.18	–7.44	12.73
2.700	–12.45	90.08	19.68	–51.73	–47.15	–108.68	–13.82	–21.06	10.72
2.800	–13.22	80.72	19.60	–74.51	–44.73	–89.89	–14.34	–34.79	8.34
2.900	–13.94	72.84	19.49	–96.90	–48.04	–123.01	–14.85	–46.81	12.46
3.000	–14.09	65.60	19.44	–119.34	–47.28	–124.20	–15.35	–59.57	11.53
3.100	–14.44	59.05	19.31	–141.49	–45.71	–149.91	–15.76	–73.30	9.83
3.200	–14.65	51.91	19.25	–163.97	–46.78	–136.20	–16.12	–87.37	11.22
3.300	–14.97	42.93	19.35	173.96	–49.38	172.78	–16.36	–102.19	14.99
3.400	–14.70	34.35	19.39	151.40	–51.50	171.28	–16.58	–117.05	19.05
3.500	–14.55	25.20	19.52	128.20	–45.98	153.50	–16.61	–130.64	9.92
3.600	–14.47	16.06	19.70	104.66	–58.37	145.35	–16.70	–145.43	40.46
3.700	–14.10	3.62	19.77	80.37	–50.30	106.63	–16.58	–158.97	15.78
3.800	–13.37	–10.40	19.99	55.31	–49.75	89.69	–16.18	–172.24	14.30
3.900	–12.69	–23.90	19.96	29.94	–52.82	84.46	–16.04	174.55	20.26
4.000	–12.19	–40.03	19.84	4.15	–50.98	68.46	–16.06	161.09	16.52
4.250	–10.01	–82.93	19.26	–62.74	–53.67	24.14	–16.78	134.01	23.15
4.500	–7.94	–126.30	17.76	–130.01	–68.90	–34.84	–17.13	124.96	99.99
4.750	–5.78	–166.36	15.80	164.04	–57.62	–1.71	–15.10	120.92	44.06
5.000	–4.27	155.73	12.87	99.54	–51.89	–8.00	–11.22	104.00	26.00
5.250	–3.52	121.84	9.43	41.99	–53.61	–162.19	–8.76	73.69	38.79
5.500	–3.06	92.42	6.23	–10.69	–56.84	127.95	–7.34	43.56	69.69
5.750	–2.87	65.08	3.12	–61.45	–52.27	–117.82	–6.23	12.73	52.83
6.000	–2.85	39.13	.28	–109.34	–52.06	10.70	–5.56	–18.89	67.67
6.250	–3.18	14.38	–2.49	–155.71	–58.17	137.71	–4.96	–51.59	99.99
6.500	–3.37	–10.36	–4.77	158.73	–58.03	–167.71	–4.52	–84.89	99.99
6.750	–3.89	–37.18	–7.29	114.14	–66.57	152.89	–4.04	–117.83	99.99
7.000	–4.60	–65.14	–9.65	71.17	–59.67	143.70	–3.56	–149.89	99.99
7.250	–5.39	–91.90	–11.05	32.11	–53.43	115.06	–3.17	–176.79	99.99
7.500	–6.61	–128.19	–13.08	–10.52	–52.50	80.03	–2.66	154.27	99.99
7.750	–8.02	–171.35	–14.42	–54.15	–56.17	–122.94	–2.32	127.08	99.99
8.000	–8.67	139.19	–16.49	–104.59	–60.51	18.17	–1.95	101.59	99.99
8.250	–8.24	89.38	–18.17	–150.65	–51.81	–43.70	–1.68	77.92	99.99
8.500	–7.01	40.26	–20.44	162.79	–65.98	112.20	–1.42	55.66	99.99
8.750	–6.17	1.59	–24.47	110.94	–52.06	179.52	–1.24	34.25	99.99
9.000	–5.46	–33.82	–27.64	51.74	–57.46	133.48	–1.08	13.53	99.99
9.250	–4.83	–67.45	–31.55	16.77	–51.01	–97.87	–1.02	–6.41	99.99
9.500	–4.79	–98.88	–31.89	–11.62	–46.23	–179.90	–.95	–26.26	99.99
9.750	–5.06	–128.94	–35.11	–127.70	–47.38	106.40	–.87	–44.56	99.99
10.000	–5.67	–158.02	–48.88	127.19	–57.68	141.48	–.86	–63.01	99.99

![AVANTEK]

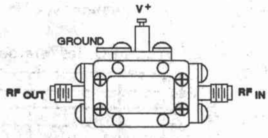
ACT-120923
Ultra Low Noise Narrowband Amplifier
950 to 1250 MHz

FEATURES

- Ultra Low Noise Figure: 1.2 dB (Typ)
- Narrow Frequency Range: 950 to 1250 MHz
- Internal Voltage Regulator
- Available With High Reliability Screening
- Removable Connectors

APPLICATIONS

- RF/IF Front Ends
- Low Signal Level Amplification
- Satellite Communications Systems
- Navigation and Avionics Systems (GPS, DME, TACAN, IFF, JTIDS, ...)



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DESCRIPTION

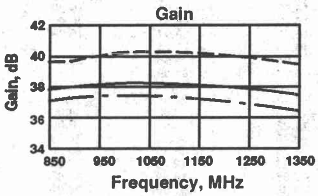
The ACT-120923 is a GaAs FET input, ultra low noise, narrowband amplifier using a single-ended, multi-stage design with lossless feedback and an internal voltage regulator. A custom thin-film matching network provides optimum performance over the 950 to 1250 MHz frequency range. It is packaged in a laser-welded, hermetically-sealed case weighing only 35 grams with field-replaceable SMA connectors. Without connectors it weighs only 28 grams and is suitable for microstrip mounting.

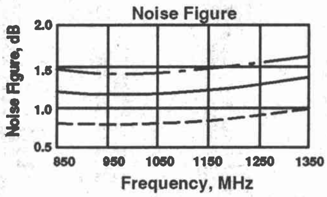
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +12 VDC nominal unless otherwise noted)

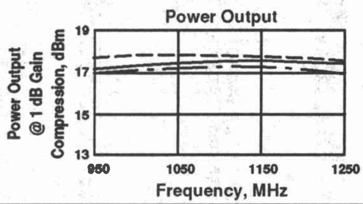
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	950-1250	950-1250	950-1250	MHz
GP	Small Signal Gain (Min.)	37.0	35.5	35.0	dB
—	Gain Flatness (Max.)	±0.3	±0.5	±0.7	dB
NF	Noise Figure (Max.)	1.2	1.5	1.7	dB
$P_{1 dB}$	Power Output @ + 1 dB Compression (Min.)	+16.0	+14.0	+13.0	dBm
—	Input VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.5:1	2.0:1	2.0:1	—
IP_3	Two Tone 3rd Order Intercept Point	+26.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+26.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+32.0	—	—	dBm
—	Operating Voltage	+12 to +15	—	—	V
I_D	DC Current	95	—	—	mA

TYPICAL PERFORMANCE OVER TEMPERATURE (@ +12 VDC unless otherwise noted)

KEY: +25°C ————
+85°C — — — —
–55°C —— - ——







MAXIMUM RATINGS

DC Voltage	17 Volts
Continuous RF Input Power	+15 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

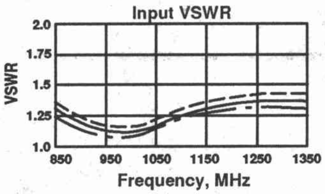
THERMAL CHARACTERISTICS*

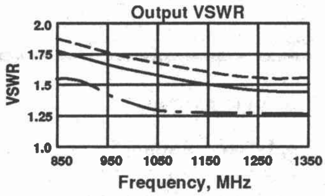
θ_{JC}	105°C/W
Active Transistor Power Dissipation	250 mW
Junction Temperature Above Case Temperature	27°C

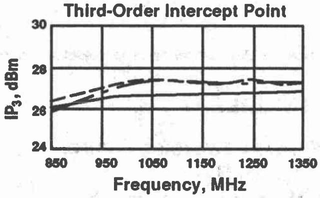
*For further information, see High Reliability section, p. 17–2.

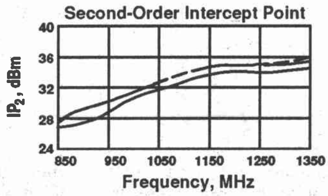
WEIGHT: (typical) 35 grams (with connectors)

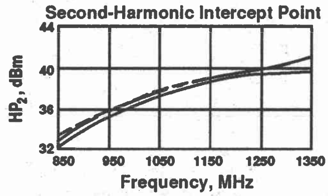
TYPICAL PERFORMANCE OVER TEMPERATURE (continued)











AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

BIAS = 12 VOLTS
CURRENT = 98 mA

FREQ	S_{11}		S_{21}		S_{12}		S_{22}			GPDEL	PHASE
GHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	K	nS	DEG
.40	.91	119.35	20.58	8.95	–47.21	159.02	.72	148.55	1.01	1.94	
.50	.80	98.39	27.79	–51.32	–47.49	81.74	.57	119.38	1.71	1.73	
.60	.66	67.03	33.14	–115.96	–44.48	–178.41	.46	96.34	1.10	2.42	
.70	.40	37.13	35.76	–173.33	–53.88	–172.99	.37	76.63	5.31	1.42	
.80	.19	18.48	36.74	135.53	–51.84	120.98	.29	60.75	2.65	1.23	
.90	.11	137.19	37.72	92.06	–48.33	–69.98	.24	51.26	2.56	1.16	2.96
1.00	.02	176.28	37.54	49.48	–55.95	–61.92	.20	40.30	4.34	1.38	–1.36
1.10	.07	–169.19	38.12	9.25	–49.10	48.66	.18	35.26	2.29	1.26	–3.34
1.20	.11	158.53	37.81	–26.74	–44.05	175.09	.17	28.15	1.21	1.05	–1.08
1.30	.14	170.11	37.66	–61.10	–47.29	16.31	.16	17.63	1.63	.76	2.82
1.40	.15	168.62	37.49	–95.98	–48.90	–79.06	.14	8.01	2.13	1.12	
1.50	.12	169.84	36.93	–127.52	–54.65	–94.87	.13	5.00	28.82	.63	
1.60	.16	176.33	36.51	–163.89	–47.32	–75.77	.11	4.95	1.93	.96	
1.70	.23	178.95	35.89	165.77	–46.19	140.61	.13	8.50	1.96	.56	
1.80	.29	168.14	34.87	130.88	–56.36	–154.43	.16	4.96	7.79	.90	
1.90	.34	157.31	33.13	99.55	–52.23	140.36	.18	–4.16	3.95	.63	
2.00	.37	148.54	32.39	69.29	–53.98	–164.83	.20	–17.10	5.60	.99	
2.10	.36	137.59	30.95	40.71	–47.02	–99.84	.23	–31.19	3.33	.83	
2.20	.37	128.25	29.17	14.70	–50.38	–119.76	.24	–45.43	4.96	.52	
2.30	.36	119.25	27.23	–10.00	–48.14	–144.94	.25	–59.87	4.66	.26	
2.40	.40	115.28	25.96	–29.16	–55.28	–155.78	.26	–68.98	11.99	–.11	
2.50	.38	112.74	24.61	–54.64	–54.82	–179.45	.26	–78.48	14.58	1.60	
2.60	.38	95.14	23.33	–70.54	–49.51	124.84	.26	–91.21	8.58	.55	
2.70	.44	91.80	22.52	–92.11	–44.98	–51.16	.26	–101.78	5.12	.99	
2.80	.38	69.39	20.69	–113.66	–58.66	140.02	.26	–110.99	56.69	.18	
2.90	.41	60.48	19.63	–138.44	–41.51	89.47	.26	–122.48	4.75	.90	
3.00	.39	47.47	18.45	–159.89	–64.53	99.09	.27	–131.81	78.93	.23	
3.10	.39	12.93	16.30	174.05	–40.84	50.10	.27	–139.43	8.14	1.29	
3.20	.41	–30.24	12.87	173.66	–42.93	–71.11	.26	–150.67	17.29	–1.13	
3.30	.19	–39.26	18.41	144.44	–45.53	–76.14	.26	–161.64	10.71	1.30	
3.40	.30	–68.34	14.64	109.53	–55.94	108.38	.26	–170.49	58.18	.93	
3.50	.38	–88.10	12.73	86.65	–53.28	33.85	.24	–179.90	46.26	.73	
3.60	.47	–114.15	10.45	64.88	–60.46	–38.25	.23	169.94	90.26	.31	
3.70	.56	–132.73	7.91	48.42	–52.57	49.77	.22	158.07	57.20	.18	
3.80	.61	–155.40	6.56	25.44	–57.46	–46.56	.21	151.81	83.45	1.15	
3.90	.73	–178.24	3.90	7.06	–43.62	35.47	.19	142.53	21.63	.40	
4.00	.71	171.41	1.95	–7.20	–50.11	127.20	.19	133.72	67.02		

![AVANTEK]

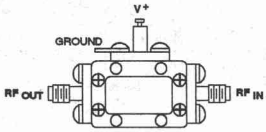
ACT-141223
Ultra Low Noise Narrowband Amplifier
1.2 to 1.4 GHz

FEATURES

- Ultra Low Noise Figure: 1.1 dB (Typ)
- Narrow Frequency Range: 1.2 to 1.4 GHz
- Internal Voltage Regulator
- Available With High Reliability Screening
- Removable Connectors

APPLICATIONS

- L Band Radar
- RF/IF Front Ends
- Low Signal Level Amplification



AX-2, p. 16–8

DESCRIPTION

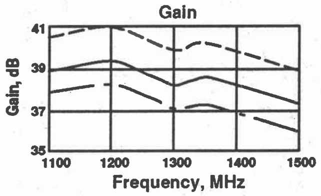
The ACT-141223 is a GaAs FET input, ultra low noise, narrowband amplifier using a single-ended, multi-stage design with lossless feedback and an internal voltage regulator. A custom thin-film matching network provides optimum performance over the 1.2 to 1.4 GHz frequency range. It is packaged in a laser welded, hermetically sealed case weighing only 35 grams with field replaceable SMA connectors. Without connectors it weighs only 28 grams and is suitable for microstrip mounting.

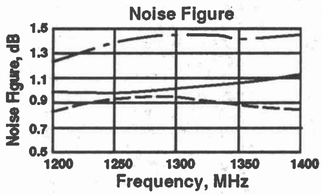
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +12 VDC nominal unless otherwise noted)

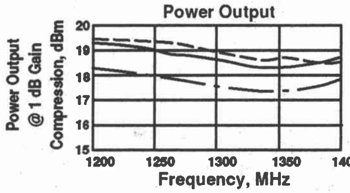
Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	T_C = –55° to +85°C	Unit
BW	Frequency Range	1.2-1.4	1.2-1.4	1.2-1.4	GHz
GP	Small Signal Gain (Min.)	38.0	35	35	dB
—	Gain Flatness (Max.)	±0.3	±0.5	±0.5	dB
NF	Noise Figure (Max.)	1.1	1.5	1.5	dB
$P_{1\,dB}$	Power Output @ + 1 dB Compression (Min.)	+16.0	13	13	dBm
—	Input VSWR (Max.)	1.1:1	1.5:1	1.5:1	—
—	Output VSWR (Max.)	1.1:1	1.5:1	1.5:1	—
IP_3	Two Tone 3rd Order Intercept Point	+25.0	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+32.0	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+38.0	—	—	dBm
—	Operating Voltage	+12 to +15	—	—	V
I_D	DC Current	95	—	—	mA

TYPICAL PERFORMANCE OVER TEMPERATURE (@ +12 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
–55°C —— - ——







MAXIMUM RATINGS

DC Voltage .... 17 Volts
Continuous RF Input Power .... +15 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

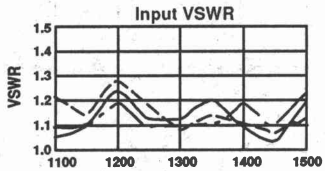
THERMAL CHARACTERISTICS*

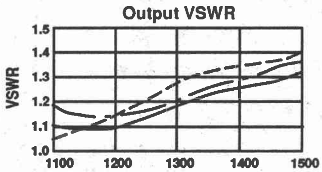
θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 250 mW
Junction Temperature Above Case Temperature .... 27°C

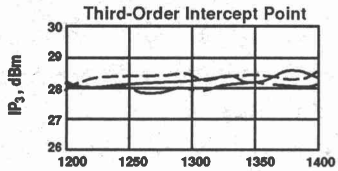
*For further information, see High Reliability section, p. 17–2.

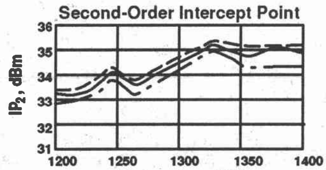
WEIGHT: (typical) 35 grams (with connectors)

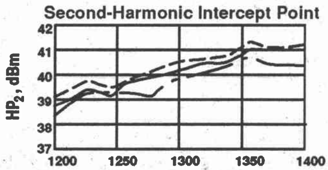
TYPICAL PERFORMANCE OVER TEMPERATURE (continued)











AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

BIAS = 12 VOLTS
CURRENT = 98 mA

FREQ	S_{11}		S_{21}		S_{12}		S_{22}			GPDEL	PHASE
GHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	K	nS	DEG
.50	.87	93.79	28.38	–61.79	–49.52	20.64	.49	98.99	1.33		
.55	.70	82.43	31.17	–88.80	–51.43	124.38	.45	86.19	2.51	1.61	
.60	.63	63.54	33.30	–119.83	–45.87	–114.10	.40	73.98	1.35	1.68	
.65	.48	50.72	34.89	–149.36	–50.30	142.45	.36	62.53	2.10	1.63	
.70	.31	38.42	35.91	–178.32	–49.11	–149.76	.31	51.69	2.02	1.52	
.75	.25	41.93	36.87	155.92	–50.32	88.09	.28	42.12	2.29	1.43	
.80	.17	46.74	37.23	130.39	–51.24	111.79	.25	31.70	2.78	1.34	
.85	.16	60.24	37.81	107.62	–47.06	152.92	.21	19.75	1.57	1.22	
.90	.14	101.17	37.64	86.64	–47.17	–157.41	.17	15.26	1.84	1.20	
.95	.06	157.33	38.09	64.45	–41.19	–34.30	.15	9.06	1.05	1.21	
1.00	.14	100.11	38.35	43.05	–46.61	–144.98	.11	–2.19	1.52	1.06	
1.05	.15	104.62	38.07	26.18	–48.93	–150.10	.10	–5.35	1.85	1.06	
1.10	.14	87.30	38.24	4.91	–47.63	–161.95	.06	–151.53	1.68	0.98	
1.15	.16	110.63	38.91	–9.26	–49.80	14.60	.04	15.93	2.03	0.99	
1.20	.12	84.65	38.25	–30.58	–45.58	143.46	.05	45.04	1.63	1.13	+1.08
1.25	.12	71.67	38.33	–50.10	–40.67	116.52	.06	55.33	1.08	1.06	–0.55
1.30	.12	86.47	38.04	–68.75	–47.06	–112.03	.09	55.88	2.16	0.98	–1.31
1.35	.09	64.24	37.93	–85.37	–47.44	–171.77	.11	55.35	1.71	0.94	–0.04
1.40	.07	52.61	37.56	–102.41	–55.30	–106.75	.13	43.39	4.03	0.96	+0.82
1.45	.05	–32.00	37.50	–119.99	–60.69	74.38	.15	38.92	7.45	1.03	
1.50	.04	–96.65	37.13	–139.32	–41.49	–2.84	.16	30.22	1.10	0.88	
1.55	.07	–64.24	36.58	–151.65	–48.37	–173.34	.17	24.18	2.00	0.85	
1.60	.10	–100.28	36.26	–169.82	–49.21	–47.78	.18	18.44	2.25	0.96	
1.65	.17	–146.70	36.09	173.97	–56.58	49.59	.18	8.88	6.43	0.89	
1.70	.21	–150.77	35.58	158.23	–53.12	–175.37	.20	–58.38	3.63	0.84	
1.75	.17	–165.18	35.15	143.85	–44.84	–97.25	.20	–6.17	1.66	0.76	
1.80	.25	–169.85	34.33	131.04	–55.10	118.54	.19	–12.58	6.20	0.86	
1.85	.29	179.08	34.54	113.20	–49.63	–70.73	.19	–21.94	2.69	0.93	
1.90	.36	167.52	33.93	97.56	–46.63	42.15	.19	–28.63	1.93	0.81	
1.95	.37	158.03	33.72	84.22	–47.18	55.29	.19	–31.42	2.43	0.88	
2.00	.38	144.67	33.51	65.95	–48.55	132.84	.19	–38.82	3.61		

AVANTEK

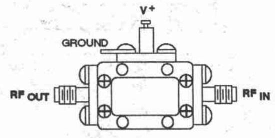
ACT-161223
Ultra Low Noise Narrowband Amplifier
1.2 to 1.6 GHz

FEATURES

- Ultra Low Noise Figure: 1.1 dB (Typ)
- Narrow Frequency Range: 1.2 to 1.6 GHz
- Internal Voltage Regulator
- Available with High-Reliability Screening
- Removable Connectors

APPLICATIONS

- L Band Telemetry
- Satellite Downlinks (GPS, Marisat, etc...)
- RF/IF Front Ends
- Low Signal Level Amplification



AX-2 , p. 16–8

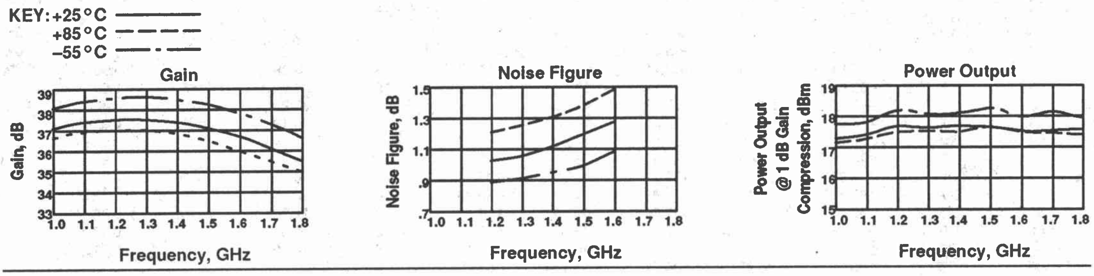
DESCRIPTION

The ACT-161223 is a GaAs FET input, ultra low noise, narrowband amplifier using a single ended, multi-stage design with lossless feedback and an internal voltage regulator. Thin-film matching elements provide optimum performance over the 1.2 to 1.6 GHz frequency range. It has a noise figure of only 1.1 dB (typ), gain of 36 dB (typ) and power output of +16 dBm (typ). The ACT-161223 is packaged in a laser-welded, hermetically sealed case weighing only 35 grams with field-replaceable SMA connectors. Without connectors it weighs only 28 grams and is suitable for microstrip mounting.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +12 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range	1.2-1.6	1.2-1.6	1.2-1.6	GHz
GP	Small Signal Gain (Min.)	36.0	34.0	34.0	dB
—	Gain Flatness (Max.)	±0.3	±0.7	±1.0	dB
NF	Noise Figure (Max.)	1.1	1.5	1.5	dB
P_{1dB}	Power Output @ +1 dB Compression (Min.)	+16.0	+15.0	+15.0	dBm
—	Input VSWR (Max.)	1.4	1.7	1.7	—
—	Output VSWR (Max.)	1.2	1.7	1.7	—
IP_3	Two Tone 3rd Order Intercept Point	+24	—	—	dBm
IP_2	Two Tone 2nd Order Intercept Point	+31	—	—	dBm
HP_2	One Tone 2nd Harmonic Intercept Point	+34	—	—	dBm
I_D	DC Current	90	110	110	mA
—	DC Voltage	12 to 15	—	—	V

TYPICAL PERFORMANCE OVER TEMPERATURE (@ +12 VDC unless otherwise noted)



MAXIMUM RATINGS

DC Voltage .... +17 Volts
Continuous RF Input Power .... +15 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –65°C to +150°C
"R" Series Burn-In Temperature .... +125°C

THERMAL CHARACTERISTICS

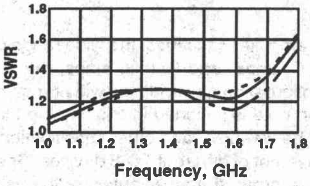
θ_{JC} .... 105°C/W
Active Transistor Power Dissipation .... 250 mW
Junction Temperature Above Case Temperature .... 27°C

*For further information, see High Reliability section, p. 17–2.

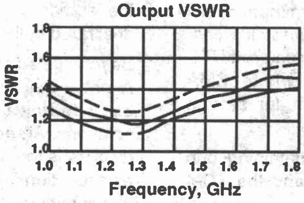
WEIGHT: (typical) 35 grams (with connectors)

TYPICAL PERFORMANCE OVER TEMPERATURE (continued)

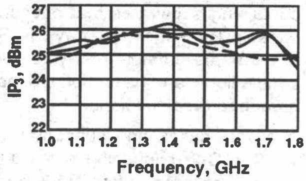
Input VSWR



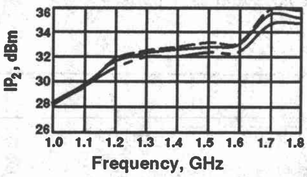
Output VSWR



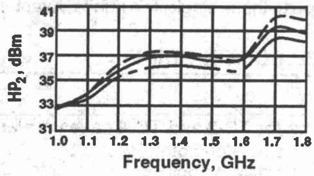
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

BIAS = 12 VOLTS
CURRENT = 90 mA

FREQ	S_{11}		S_{21}		S_{12}		S_{22}		GPDEL	PHASE
GHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	ns	DEG
0.100	–0.31	166.73	–25.73	90.38	–54.73	31.27	–0.41	–34.96		
0.200	–0.34	153.55	–16.35	157.43	–64.68	–140.68	–0.31	–73.05		
0.300	–0.43	138.74	5.97	107.66	–57.93	–18.43	–0.89	–119.23		
0.400	–0.64	121.87	18.27	33.76	–61.05	35.94	–2.88	–166.17		
0.500	–1.12	100.69	25.88	–31.54	–68.98	82.84	–5.78	152.59		
0.600	–2.72	75.28	31.05	–93.38	–62.89	103.06	–8.46	118.41		
0.700	–5.99	47.97	34.17	–152.23	–68.70	114.19	–10.69	87.96		
0.800	–11.54	27.49	35.62	155.01	–61.19	59.46	–12.56	60.82		
0.900	–19.96	20.52	36.29	107.66	–59.70	106.83	–14.42	35.05		
1.000	–32.35	72.56	36.65	67.41	–60.32	99.42	–16.54	18.48		
1.100	–24.15	142.49	36.97	29.69	–59.46	–125.37	–19.16	7.42		
1.200	–20.40	144.21	37.10	–6.70	–57.91	38.99	–21.39	11.34	0.81	0.99
1.300	–18.21	139.00	37.13	–41.76	–54.00	179.57	–21.62	24.29	–0.16	0.94
1.400	–18.55	134.57	37.00	–76.76	–58.66	–61.92	–19.11	27.25	–1.07	0.97
1.500	–19.43	139.28	36.70	–110.39	–60.79	163.16	–17.00	19.63	–0.61	0.94
1.600	–19.82	155.74	36.26	–142.84	–55.54	–143.55	–15.72	7.69	1.03	0.90
1.700	–16.75	175.64	35.73	–174.96	–58.02	–126.72	–14.63	–5.00		
1.800	–12.95	170.97	35.11	153.97	–56.88	–159.38	–14.28	–16.69		
1.900	–10.56	156.91	34.39	122.67	–58.26	169.03	–13.69	–27.33		
2.000	–9.03	143.44	33.58	91.48	–59.74	156.90	–13.11	–37.51		
2.200	–8.55	113.85	31.23	29.43	–66.23	–96.57	–11.84	–55.70		
2.400	–8.67	94.83	27.96	–25.92	–66.82	160.46	–10.80	–78.31		
2.600	–8.30	80.20	25.00	–64.92	–51.30	82.31	–10.52	–95.86		
2.800	–7.29	53.87	22.14	–109.48	–59.49	–104.59	–10.49	–115.28		
3.000	–6.39	21.79	19.45	–154.19	–59.94	171.69	–10.50	–135.43		
3.500	–5.73	–69.01	14.37	95.14	–61.44	–151.68	–10.93	170.27		
4.000	–2.65	–171.03	4.89	–155.22	–54.56	139.08	–12.12	115.56		
4.500	–1.68	86.05	–10.03	–2.17	–62.38	–167.12	–11.83	64.71		
5.000	–7.47	–37.28	–0.37	–120.17	–55.98	–148.79	–11.14	21.09		

PRODUCT DESCRIPTION

The UTC Series is made up of connectored, aluminum cases containing substrates that accept 1 to 4 of Avantek's cascadable TO-8 packaged devices. Rugged, connectored UTC devices are useful for system applications where SMA connections are used, for lab gain blocks, or for system breadboard applications.

Available cases and substrates are TC-1 (containing one TO-8), TC-2 (containing two TO-8 modules) and the TC-4 (containing three or four TO-8 modules).

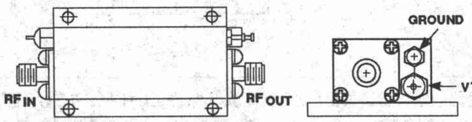
All of Avantek's TO-8 UTO amplifiers are available in the TC-1 package. In addition to these single TC-1 units, Avantek offers the standard line of cascaded TC-2 and TC-4 products described in this section.

Beyond these standard amplifier cascades, the wide range of Avantek amplifiers, AGC amps, and limiting amps, can be cascaded in various configurations, providing a wide range of solutions. An application note is included in this catalog that discusses the tradeoffs between NF and other specifications as a function of the placement of different TO-8 devices. Special configurations can be ordered from Avantek, or the user may assemble an application specific cascade with individual TO-8 devices and case parts.

UTC SERIES SELECTION GUIDE

Connector options for TC-2 and TC-4 cases are as follows:

–1	SMA	Female on both
–2	N	Female on both
–3	BNC	Female on both
–4	TNC	Female on both
–5	SMA	Male on both
–6	SMA	Male on input/Female on output
–7	SMA	Female on input/Male on output

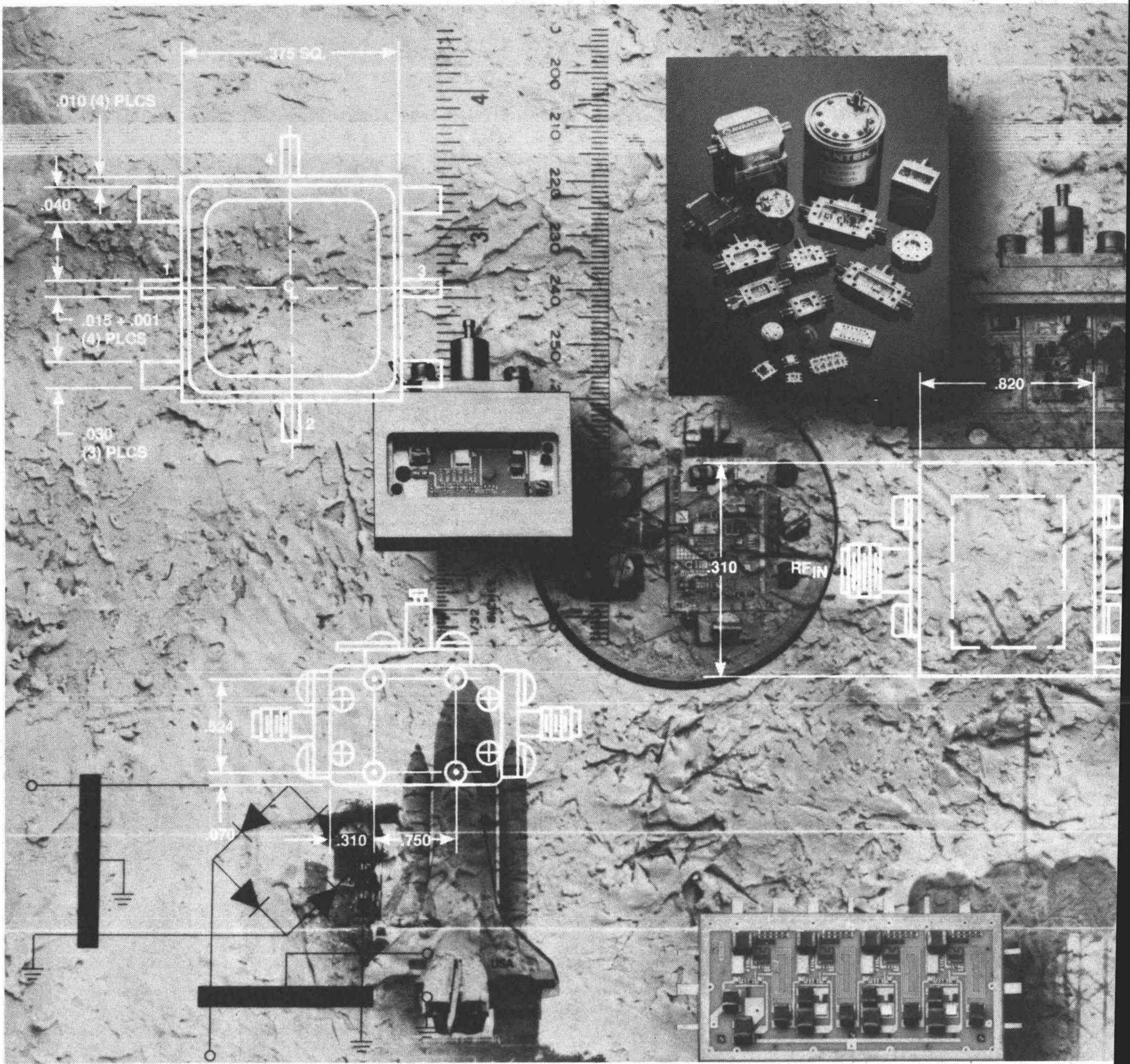


TC2, p. 16–43
TC4, p. 16–43

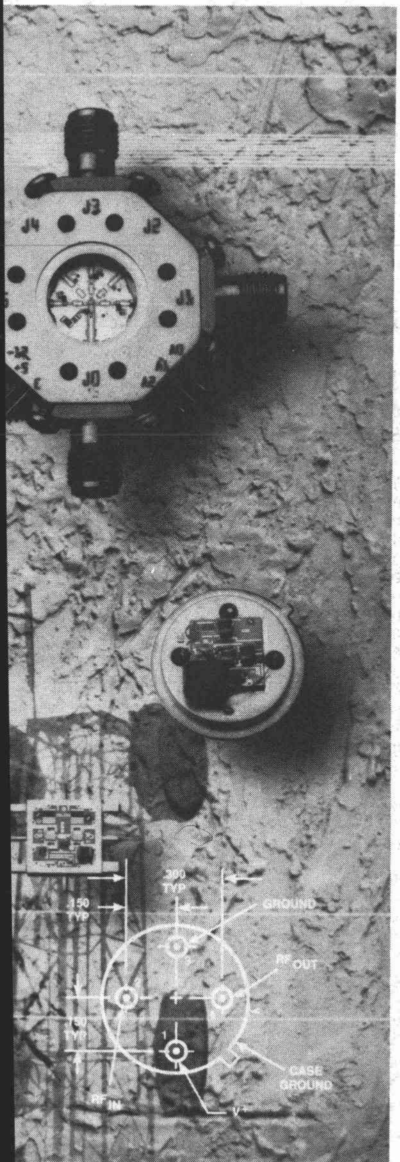
UTC SERIES MODULAR CASCADED AMPLIFIERS (Guaranteed Specifications @ 0° to 50°C Case Temperature, V = 15 VDC)

Model	Frequency Range MHz	Gain (dB) Typ./Min.	Noise Figure (dB) Max.	Power Output for 1 dB Gain Compression (dBm) Min.	Flatness (dB) Max.	3rd-Order Intercept Point (dBm) Typ.	VSWR 50 ohms Max. :1 In/Out	Input Bias Current (mA) Typ.	Case Type
10 to 500 MHz									
UTC5-200	10-500	26.5/25	2.7	+6	±1.5	+22	2.0:1	35	TC2
UTC5-201	10-500	37/35	2.7	+7	±1.5	+20	2.0:1	33	TC2
UTC5-202	10-500	51.5/49	2.7	+6	±1.5	+18	2.0:1	60	TC2
UTC5-203	10-500	64.5/62	2.7	+6	±2.0	+18	2.0:1	70	TC4
UTC5-210	10-500	27.5/26	3.0	+14	±1.5	+30	2.0:1	78	TC2
UTC5-211	10-500	38/36	3.5	+14	±1.5	+30	2.0:1	76	TC2
UTC5-212	10-500	47/45	2.7	+14	±1.5	+27	2.0:1	80	TC2
UTC5-213	10-500	54/52	2.7	+14	±2.0	+27	2.0:1	92	TC2
UTC5-214	10-500	67/65	2.7	+14	±2.0	+27	2.0:1	103	TC4
UTC5-220	10-500	24.5/23	3.5	+23	±1.5	+35	2.0:1	165	TC2
UTC5-221	10-500	35/33	3.0	+23	±2.0	+35	2.0:1	190	TC4
UTC5-222	10-500	46/44	3.0	+23	±2.0	+35	2.0:1	193	TC4
UTC5-223	10-500	60.5/58	3.0	+23	±2.0	+35	2.0:1	210	TC4
10 to 1000 MHz									
UTC10-210	10-1000	21.5/20	4.5	+11	±2.0	+28	2.0:1	60	TC2
UTC10-211	10-1000	31/29	3.7	+9	±1.5	+20	2.0:1	37	TC2
UTC10-212	10-1000	41/39	3.7	+9	±2.0	+20	2.0:1	62	TC4
UTC10-213	10-1000	52/50	3.7	+12	±1.5	+27	2.0:1	101	TC4
UTC10-220	10-1000	22.5/21	5.0	+20	±2.0	+35	2.0:1	125	TC2
UTC10-221	10-1000	33/31	4.5	+20	±2.0	+35	2.0:1	150	TC2
UTC10-222	10-1000	42/40	3.7	+20	±2.0	+35	2.0:1	127	TC4
UTC10-223	10-1000	49/47	3.7	+20	±2.0	+35	2.0:1	163	TC4
10 to 2000 MHz									
UTC20-210	10-2000	19.5/18	5.0	+7	±1.5	+17	2.2:1	41	TC2
UTC20-211	10-2000	28/26	5.0	+14	±2.0	+29	2.2:1	91	TC4
UTC20-212	10-2000	34/32	6.0	+14	±2.0	+29	2.2:1	104	TC4
UTC20-213	10-2000	40/38	6.0	+12	±2.0	+29	2.2:1	126	TC4

WEIGHT: (typical) TC2 = 57 grams; TC4 = 114 grams


.375 SQ.
.010 (4) PLCS
.040
.015 ± .001
(4) PLCS
.030
(3) PLCS
.820
.310
RF IN
.524
.070
.310
.750
USA

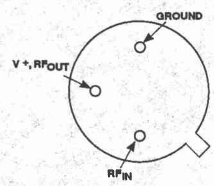
GPD SERIES



[1]GPD Series products are not discussed in this data book in detail. Please contact your nearest Avantek distributor, representative, or sales office for full details on these products. (See page 18–21 or complete list of addresses.)

PRODUCT DESCRIPTION

The GPD and GPM amplifiers, available in TO-12 (4-pin) and TO-39 (3-pin) packages, are designed for applications which require the highest performance-to-cost ratio or where size is an important factor. Some versions are equipped with internal coupling and bypass capacitors, however the "60" Series uses external coupling and bypass capacitors. This gives the user freedom to set the low frequency roll-off as needed. The GPM modules contain Si MMICs, while the GPD modules are discrete hybrid devices. These amplifiers are excellent for IF amplification purposes such as mixer postamps.



TO-39, p. 16–50

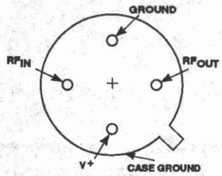
GPD SERIES LOW COST AMPLIFIERS, TO-39 PACKAGE[1]

Guaranteed Specifications at 0° to 50°C Case Temperature

Model	Frequency Response (MHz) Minimum	Gain over 0° to 50°C (dB) Minimum	Gain[2] over –55° to +85°C (dB) Minimum	Noise Figure (dB) Typical	Power Output at 1 dB Gain Compression (dBm) Typical	Gain Flatness (±dB) Typical	3rd-Order Intercept Point (dBm) Typical	Input Power (±1% Reg.) Voltage (VDC) Typical	Input Power (±1% Reg.) Current (mA) Typical
GPD-110	0.1-400	—	12	4.0	–2.0	1.0	+12	2.5	10
GPD-120	0.1-400	—	13	5.5	+8.0	1.0	+24	5.5	25
GPD-130	0.1-400	—	12	7.0	+17.0	1.0	+27	6.0	60
GPD-310	0.1-1000	8	7	5.0	–1.0	1.0	+11	2.3	10
GPD-320	0.1-1000	8	7	5.0	+8.0	1.0	+18	3.0	25
GPD-330	0.1-1000	7	6	6.5	+16.0	1.0	+26	4.5	60
GPD-311	0.1-1000	12	11	4.5	+3.0	1.0	+15	2.7	15
GPD-321	0.1-1000	12	11	4.7	+8.0	1.0	+20	3.5	25
GPD-331	0.1-1000	10	9	6.0	+16.0	1.0	+28	5.5	60
GPD-410	0.1-1500	12	11	4.2	+2.5	1.0	+15	2.5	15
GPD-420	0.1-1500	11	10	4.7	+8.0	1.0	+20	2.8	25
GPD-430	0.1-1500	10	9	6.3	+16.0	1.0	+28	5.0	60

NOTES: 1. Three external capacitors (input, output coupling and RF bypass) are required to establish low frequency roll-off. An external bias resistor, with a value determined by the available bias voltage ($R_D = [V_{CC} - V_D] \div I_D$, where R_D is the value of the bias resistor (Ohms), V_{CC} is the available source voltage, V_D is the required device bias voltage (per specification) and I_D is the device current (per specification), is also required.

2. Military temperature conditions: –55° to +85°C



GPD SERIES LOW COST AMPLIFIERS, TO-12 PACKAGE

TO-12, p. 16–50

Guaranteed Specifications at 0° to 50°C Case Temperature

Model	Frequency Response (MHz) Minimum	Gain (dB) Minimum	Gain[2] (dB) Minimim	Noise Figure (dB) Typical	Power Output for 1 dB Gain Compression (dBm) Typical	Gain Flatness (±dB) Typical	3rd-Order Intercept Point (dBm) Typical	Input Power (±1% Reg.) Voltage (VDC)	Input Power (±1% Reg.) Current (mA) Typical	Page Number
GPD-201	5-200	30	26	3.0	+5	1.0	+13	+15	30	3–236
GPD-202	5-200	25	23	5.5	+11	1.0	+18	+15	60	3–237
GPM-552	5-500	33	32	4.5	0	0.2	+14	+15	34	3–246
GPM-1052	5-1000	20	20	7.0	+8	0.3	+20	+15	60	3–250
GPD-251	5-200	25	23	4.0	+1	1.0	+10	+5	30	3–238
GPD-252	5-200	15	14	4.0	0	1.0	+12	+5	11	3–239
GPD-401/-461[1]	5-400	13	12	4.0	–2	1.0	+9	+15	10	3–240
GPD-411	5-400	12	11	3.0	–6	1.0	+4	+15	7	3–245
GPD-402/-462[1]	5-400	13	12	8.0	+8	1.0	+18	+15	24	3–241
GPD-403/-463[1]	5-400	9	8	7.5	+16	1.0	+25	+24	65	3–242
GPD-404/-464[1]	5-400	9	8	7.5	+17	1.0	+26	+15	70	3–243
GPD-405	10-400	13	12	5.0	+24	1.0	+36	+15	90	3–244
GPD-1001/-1061[1]	5-1000	12	11	6.0	0	1.0	+12	+15	15	3–247
GPD-1002/-1062[1]	5-1000	12	11	7.0	+6	1.0	+16	+15	27	3–248
GPD-1003/-1063[1]	5-1000	10	9	7.0	+14	1.0	+25	+15	55	3–249

NOTES: 1. The 60 Series is the same as the standard series except that three external capacitors are required to establish low frequency roll-off.
2. Military temperature conditions: –55° to +85°C

MAXIMUM RATINGS AND THERMAL CHARACTERISTICS TABLE

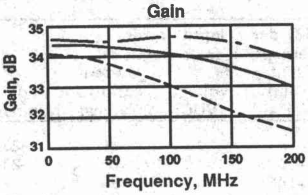
	Maximum Ratings					Thermal Characteristics[1]				
Model	DC Voltage (Volts)	Continuous RF Input Power (dBm)	Operating Case Temperature (°C)	Storage Temperature (°C)	"R" Series Burn-In Temperature (°C)	θ_{JC} (°C/W)	Active Transistor Power Dissipation (mW)	Junction Temperature Above Case Temperature (°C)	MTBF MIL-HDBK-217E, A_{UF} @ 90°C (Hrs)	Weight (Grams)
GPD-201	+17	+13	–55 to +125	–62 to +150	+125	105	33	3	1,678,671	1.5
GPD-202	+17	+13	–55 to +125	–62 to +150	+125	105	117	12	1,621,478	1.5
GPD-251	+12	+13	–55 to +125	–62 to +150	+125	105/105	23/43	2/5	1,678,323	1.5
GPD-252	+12	+13	–55 to +125	–62 to +150	+125	105	20	2	2,000,740	1.5
GPD-401/461	+17	+13	–55 to +125	–62 to +150	+125	90	14	2	2,045,316 (401) 2,388,527 (461)	1.5
GPD-402/-462	+17	+13	–55 to +125	–62 to +150	+125	90	82	7	2,325,901 (402) 2,640,329 (462)	1.5
GPD-403/-463	+25	+13	–55 to +125	–62 to +150	+125	85	275	23	3,058,127 (403) 3,602,215 (463)	1.5
GPD-404/-464	+17	+13	–55 to +115	–62 to +150	+115	85	330	28	2,435,672 (404) 2,512,908 (464)	1.5
GPD-405	+17	+13	–55 to +100	–62 to +150	+100	55	750	41	1,607,022	1.5
GPD-411	+17	+13	–55 to +125	–62 to +150	+125	105[2]	24[2]	4[2]	1,608,303	1.5
GPM-552	+17	+17	–55 to +125	–62 to +150	+125	135/135	85/85	12/12	—	1.5
GPD-1001/-1061	+17	+13	–55 to +125	–62 to +150	+125	105	37	4	1,639,228 (1001) 1,910,397 (1061)	1.5
GPD-1002/-1062	+17	+13	–55 to +125	–62 to +150	+125	105	81.6	9	1,639,228 (1002) 1,882,476 (1062)	1.5
GPD-1003/-1063	+17	+13	–55 to +125	–62 to +150	+125	75	185	14	869,341 (1003) 2,101,101 (1063)	1.5
GPM-1052	+17	+17	–55 to +125	–62 to +150	+125	130/130	125/175	16/23	—	1.5

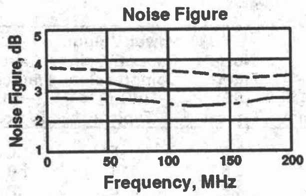
NOTES 1. Values refer to 1st and 2nd stage transistors respectively.
2. For further information, see High Reliability section.

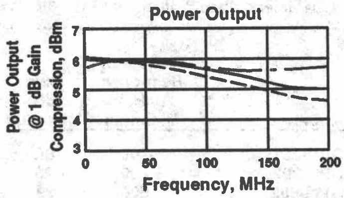
AVANTEK

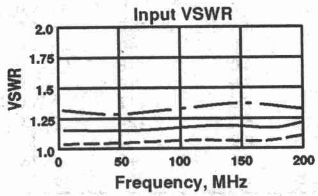
GPD-201
Thin-Film Cascadable Amplifier Module
5 to 200 MHz

TYPICAL PERFORMANCE OVER TEMPERATURE (@ +15 VDC unless otherwise noted)

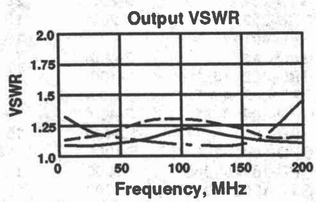


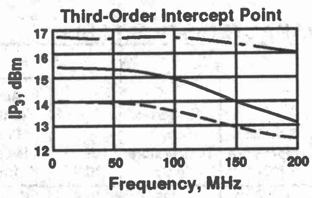


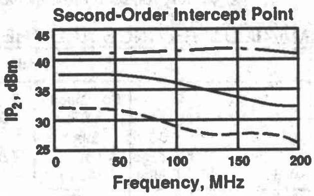




KEY: +25°C ———
+85°C – – –
–55°C — · —







AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.22	34.08	–21.48	.03	.00	1.38	45.05
150.0	1.24	33.63	–31.73	–.07	.56	1.35	42.53
200.0	1.30	33.06	–41.78	.03	.55	1.35	45.17
250.0	1.33	32.23	–51.68		.52	1.35	44.14
300.0	1.39	31.33	–60.39		.46	1.37	45.09
350.0	1.42	30.34	–68.41		.40	1.41	42.90
400.0	1.46	29.22	–74.90		.33	1.46	45.16
450.0	1.49	28.20	–80.20		.28	1.51	42.67
500.0	1.51	27.05	–84.95		.21	1.55	42.98
550.0	1.54	25.98	–87.93		.18	1.59	43.16
600.0	1.56	25.02	–91.38		.15	1.61	42.20
650.0	1.57	23.93	–93.28		.08	1.64	41.70

S-PARAMETERS

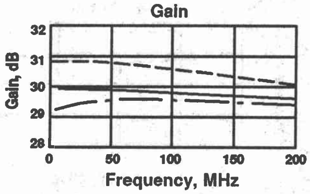
BIAS = 15.00 VOLTS

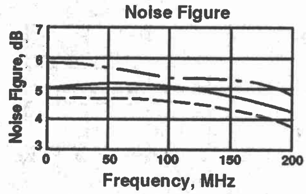
FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.089	–160.6	34.037	–21.5	–42.671	20.2	.172	–.6
150.00	.105	–151.2	33.599	–31.7	–45.997	38.9	.153	.8
200.00	.128	–152.6	33.063	–41.6	–45.886	28.4	.150	6.5
250.00	.144	–153.4	32.220	–51.6	–44.026	30.1	.148	13.7
300.00	.162	–156.8	31.300	–60.1	–43.385	56.6	.159	19.6
350.00	.173	–159.8	30.270	–68.4	–43.056	76.0	.171	22.6
400.00	.187	–163.6	29.200	–74.7	–41.723	80.0	.186	22.8
450.00	.199	–167.2	28.195	–80.2	–43.575	79.7	.204	21.9
500.00	.206	–170.2	27.005	–84.7	–43.475	100.7	.216	20.4
550.00	.214	–174.7	25.949	–87.7	–42.361	109.1	.227	17.7
600.00	.218	–177.3	24.986	–91.3	–41.674	113.8	.235	15.0
650.00	.224	–179.3	23.911	–93.2	–41.737	124.4	.242	11.7

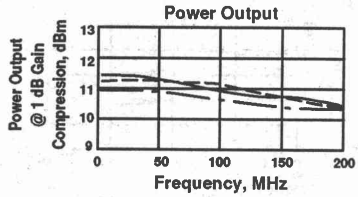
![AVANTEK]

GPD-202
Thin-Film Cascadable Amplifier Module
5 to 200 MHz

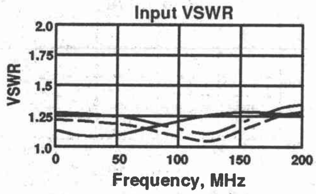
TYPICAL PERFORMANCE OVER TEMPERATURE (@ +15 VDC unless otherwise noted)

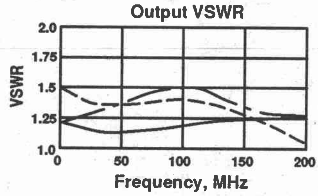


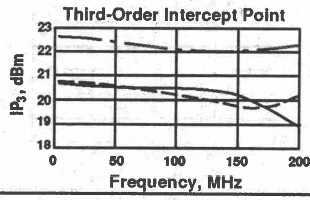


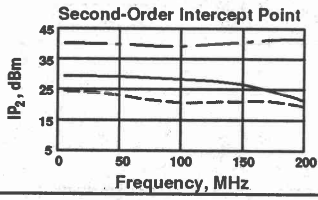


KEY: +25°C ——
+85°C – – –
−55°C —·—









AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.12	30.00	−16.42	.10	.00	1.17	58.12
150.0	1.17	29.68	−24.50	−.20	.43	1.22	46.81
200.0	1.23	29.27	−31.95	.10	.42	1.25	46.32
250.0	1.29	28.71	−39.74		.40	1.30	47.00
300.0	1.34	28.08	−46.54		.38	1.35	48.35
350.0	1.40	27.43	−53.39		.35	1.39	45.49
400.0	1.45	26.61	−59.25		.30	1.43	48.21
450.0	1.50	25.89	−64.05		.26	1.47	46.06
500.0	1.53	25.03	−68.45		.21	1.49	46.03
550.0	1.57	24.18	−71.53		.19	1.51	44.99
600.0	1.61	23.41	−75.32		.18	1.53	45.06
650.0	1.63	22.52	−77.92		.11	1.54	44.21
700.0	1.65	21.77	−79.36		.07	1.55	43.24
750.0	1.68	21.03	−80.55		.07	1.55	43.10

S-PARAMETERS

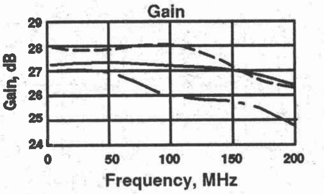
BIAS = 15.00 VOLTS

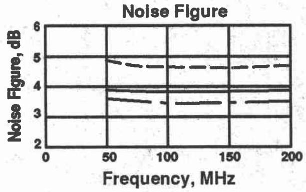
FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.053	−93.5	29.974	−16.5	−47.603	33.3	.087	22.5
150.00	.078	−97.9	29.675	−24.5	−45.367	7.5	.101	32.5
200.00	.103	−105.1	29.286	−31.8	−46.409	14.1	.118	36.0
250.00	.127	−114.3	28.726	−39.8	−47.945	63.9	.130	38.2
300.00	.150	−120.9	28.084	−46.4	−45.731	52.9	.150	38.0
350.00	.168	−126.8	27.376	−53.5	−45.001	66.9	.163	37.4
400.00	.186	−133.4	26.609	−59.1	−44.254	77.6	.175	35.8
450.00	.201	−139.3	25.889	−64.1	−45.714	91.1	.188	33.7
500.00	.214	−144.3	25.004	−68.2	−46.501	95.0	.197	31.3
550.00	.224	−149.3	24.177	−71.4	−44.719	109.6	.205	27.9
600.00	.234	−153.8	23.397	−75.3	−43.458	112.8	.211	25.3
650.00	.244	−157.0	22.526	−77.9	−43.576	129.7	.213	21.7
700.00	.252	−161.3	21.772	−79.2	−44.257	145.0	.216	18.8
750.00	.260	−165.0	21.026	−80.4	−42.019	148.5	.217	14.8

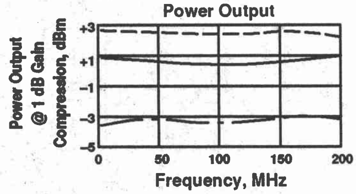
AVANTEK

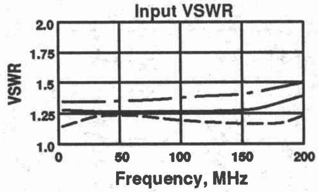
GPD-251
Thin-Film Cascadable Amplifier Module
5 to 200 MHz

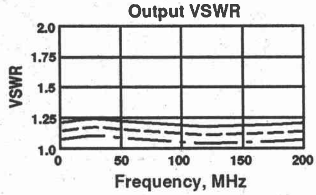
TYPICAL PERFORMANCE OVER TEMPERATURE (@ +15 VDC unless otherwise noted)



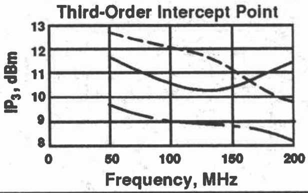


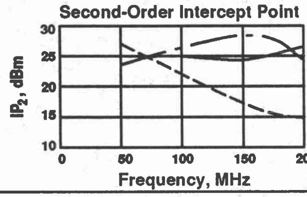






KEY: +25°C ———
+85°C – – – –
–55°C — · —





AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS — BIAS = 5.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.30	26.85	–18.13	.11	.00	1.12	49.96
150.0	1.34	26.52	–27.54	–.23	.50	1.12	49.00
200.0	1.43	26.01	–36.25	.11	.47	1.14	44.42
250.0	1.50	25.41	–44.49		.44	1.15	47.30
300.0	1.57	24.63	–51.92		.40	1.16	48.12
350.0	1.63	23.87	–58.94		.38	1.18	44.41
400.0	1.68	22.97	–65.67		.32	1.19	47.34
450.0	1.73	22.04	–70.41		.26	1.19	48.00
500.0	1.76	21.18	–74.90		.23	1.19	49.28
550.0	1.79	20.19	–78.51		.19	1.19	45.90
600.0	1.82	19.32	–81.65		.15	1.18	46.52
650.0	1.83	18.46	–83.95		.11	1.17	45.45
700.0	1.85	17.61	–85.55		.07	1.17	46.48
750.0	1.87	16.81	–86.49		.04	1.16	45.87

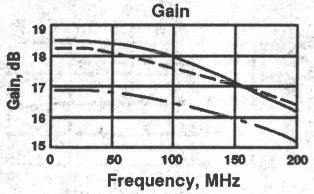
S-PARAMETERS — BIAS = 5.00 VOLTS

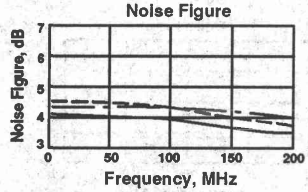
FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.139	–162.5	27.137	–18.5	–44.479	38.4	.050	175.0
150.00	.159	–154.9	26.804	–28.2	–47.583	20.7	.058	170.5
200.00	.185	–156.6	26.299	–36.7	–48.131	16.6	.066	161.4
250.00	.206	–159.2	25.656	–45.2	–47.285	55.0	.073	152.3
300.00	.227	–162.4	24.852	–52.4	–44.079	39.6	.079	142.0
350.00	.249	–166.4	24.046	–59.7	–46.115	68.9	.085	133.8
400.00	.264	–170.0	23.168	–66.3	–44.291	66.4	.089	125.7
450.00	.271	–173.8	22.228	–71.2	–47.319	68.9	.086	117.8
500.00	.278	–178.1	21.313	–75.4	–47.221	82.0	.089	110.9
550.00	.288	177.5	20.337	–79.1	–47.594	104.2	.087	104.6
600.00	.297	175.1	19.458	–82.2	–44.654	101.1	.086	98.6
650.00	.298	173.5	18.598	–84.7	–45.687	129.1	.082	92.7
700.00	.290	170.1	17.711	–85.9	–45.548	123.8	.078	86.8
750.00	.296	165.8	16.899	–86.8	–44.792	138.8	.075	81.3

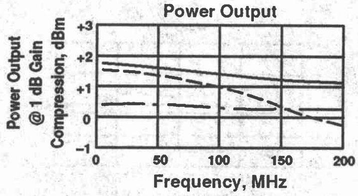
AVANTEK

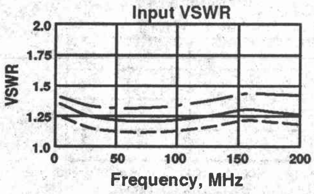
GPD-252
Thin-Film Cascadable Amplifier Module
5 to 200 MHz

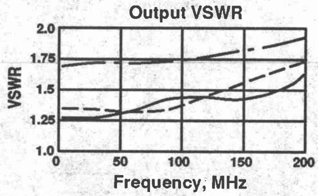
TYPICAL PERFORMANCE OVER TEMPERATURE (@ +5 VDC unless otherwise noted)



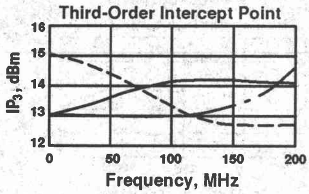


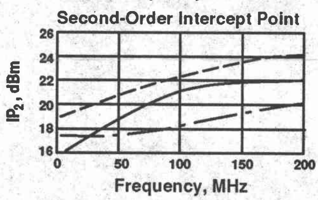






KEY: +25°C ————
+85°C — — — —
−55°C —— · ——





AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 5.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.17	17.72	170.96	.21	.00	1.48	45.93
150.0	1.27	17.11	167.48	−.43	.16	1.44	37.18
200.0	1.24	16.47	165.32	.21	.08	1.59	38.02
250.0	1.24	15.74	164.43		10.00	1.65	34.80
300.0	1.23	15.14	165.41		19.95	1.73	34.26
350.0	1.24	14.43	166.16		19.90	1.80	29.16
400.0	1.27	13.78	169.08		19.88	1.84	27.98
450.0	1.30	13.23	170.54		19.88	1.88	27.23
500.0	1.33	12.53	173.43		19.83	1.92	26.82
550.0	1.35	12.11	176.61		19.85	1.94	26.84
600.0	1.38	11.62	178.84		19.82	1.98	26.63
650.0	1.43	11.06	−176.94		19.81	2.02	26.40
700.0	1.47	10.73	−174.33		19.85	2.06	26.18
750.0	1.51	10.33	−171.41		19.83	2.09	26.13

S-PARAMETERS

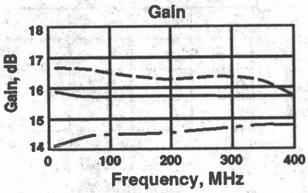
BIAS = 5.00 VOLTS

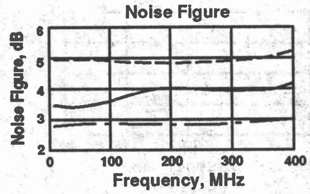
FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.095	174.6	17.662	170.2	−26.104	21.1	.163	28.8
150.0	.095	177.6	17.021	167.3	−25.690	29.1	.204	26.8
200.0	.093	−178.2	16.449	165.7	−25.590	36.2	.228	22.4
250.0	.097	−174.3	15.644	164.8	−25.752	44.2	.250	19.1
300.0	.107	−175.0	15.066	165.5	−25.551	51.8	.269	14.8
350.0	.121	−171.0	14.409	166.3	−25.690	60.5	.288	11.5
400.0	.130	−171.4	13.793	169.3	−25.566	69.6	.297	7.8
450.0	.136	−171.8	13.213	170.4	−25.902	79.1	.307	4.1
500.0	.146	−174.8	12.501	173.2	−25.790	86.4	.315	.8
550.0	.163	−179.2	12.106	176.3	−25.933	96.0	.322	−2.6
600.0	.180	−178.7	11.591	178.7	−25.795	106.1	.328	−6.5
650.0	.188	−178.3	11.007	−177.2	−25.731	115.1	.338	−10.0
700.0	.191	178.8	10.668	−174.9	−25.587	125.0	.347	−12.7
750.0	.202	175.5	10.246	−171.8	−25.558	134.1	.352	−16.1

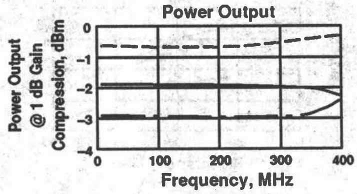
AVANTEK

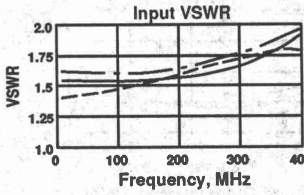
GPD-401/461 Thin-Film Cascadable Amplifier Module 5 to 400 MHz

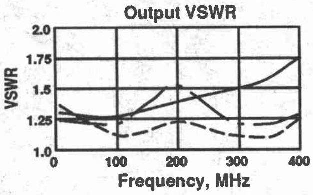
TYPICAL PERFORMANCE OVER TEMPERATURE (@ +15 VDC unless otherwise noted)



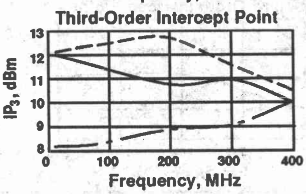


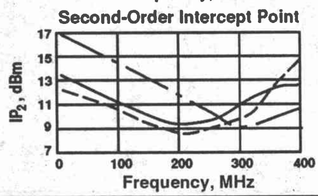






KEY: +25°C ———
+85°C — — —
−55°C — · —





AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.52	15.67	173.87	−.28	.00	1.29	21.66
150.0	1.53	15.59	170.27	−.06	.19	1.33	21.44
200.0	1.56	15.63	167.02	.51	.22	1.38	21.20
250.0	1.61	15.64	162.47	−.20	.22	1.44	21.21
300.0	1.68	15.71	159.15	.30	.21	1.53	20.98
350.0	1.79	15.81	154.98	−.04	.23	1.63	20.79
400.0	1.93	15.68	150.97	−.22	.21	1.76	20.73
450.0	2.13	15.70	147.51		.25	1.92	20.67
500.0	2.39	15.56	141.80		.27	2.12	20.47
550.0	2.70	15.33	137.78		.27	2.33	20.28
600.0	3.08	15.26	132.21		.33	2.60	20.44
650.0	3.52	14.74	126.06		.29	2.91	20.34
700.0	3.99	14.25	121.67		.25	3.26	20.34
750.0	4.48	13.80	117.03		.28	3.59	20.42

S-PARAMETERS

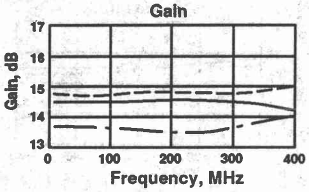
BIAS = 15.00 VOLTS

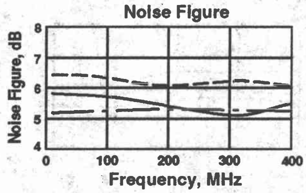
FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.202	−170.8	15.633	173.7	−21.532	14.5	.128	20.6
150.00	.210	−166.4	15.577	170.1	−21.411	16.8	.139	33.2
200.00	.218	−163.9	15.614	167.1	−21.411	22.1	.161	41.4
250.00	.229	−159.3	15.620	162.4	−21.236	28.0	.182	47.3
300.00	.252	−156.3	15.674	159.2	−20.928	32.5	.210	49.9
350.00	.283	−153.6	15.743	154.9	−20.848	38.3	.239	52.8
400.00	.319	−152.7	15.647	151.1	−20.562	42.9	.273	55.1
450.00	.361	−153.5	15.694	147.4	−20.685	46.0	.310	55.2
500.00	.408	−155.5	15.502	142.0	−20.475	50.7	.355	54.6
550.00	.456	−159.0	15.279	137.8	−20.305	54.1	.398	52.9
600.00	.510	−163.6	15.203	132.2	−20.351	57.7	.441	50.3
650.00	.558	−168.7	14.701	126.1	−20.361	62.4	.487	46.7
700.00	.594	−174.6	14.199	121.8	−20.367	65.4	.528	42.7
750.00	.633	179.5	13.755	117.2	−20.424	68.8	.565	37.8

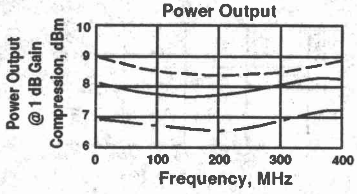
AVANTEK

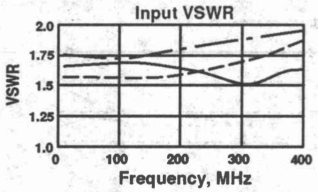
GPD-402/462
Thin-Film Cascadable Amplifier Module
5 to 400 MHz

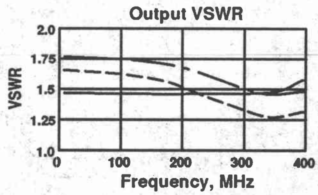
TYPICAL PERFORMANCE OVER TEMPERATURE (@ +15 VDC unless otherwise noted)



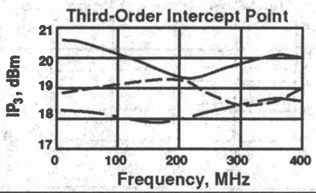


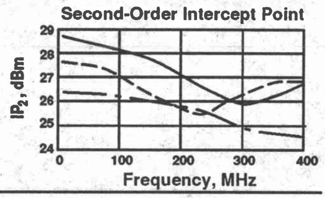






KEY: +25°C ———
+85°C — — —
–55°C — · —





AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS — BIAS = 15.00 VOLTS

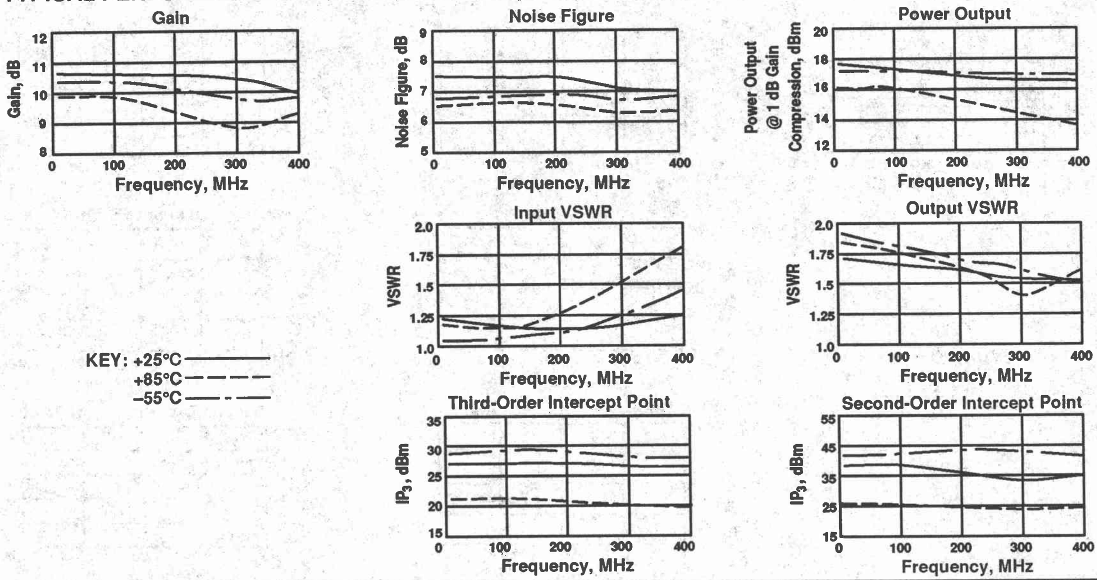
FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.63	14.33	174.29	.02	.00	1.45	23.70
150.0	1.60	14.23	170.90	.05	.18	1.46	23.27
200.0	1.56	14.24	167.76	.33	.20	1.45	22.92
250.0	1.53	14.17	163.59	–.40	.20	1.45	22.76
300.0	1.53	14.23	160.48	–.11	.19	1.45	22.49
350.0	1.55	14.22	156.84	–.32	.18	1.47	22.00
400.0	1.58	14.09	154.18	.43	.17	1.51	21.79
450.0	1.68	14.11	150.88		.21	1.54	21.28
500.0	1.83	13.97	146.56		.21	1.61	21.01
550.0	2.06	13.81	143.23		.22	1.70	20.54
600.0	2.33	13.76	138.65		.26	1.82	20.37
650.0	2.67	13.38	133.97		.24	1.97	20.05
700.0	3.08	13.05	130.10		.22	2.15	19.79
750.0	3.60	12.74	126.17		.24	2.35	19.62
800.0	4.17	12.36	121.50		.22	2.58	19.88

S-PARAMETERS — BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.235	–179.6	14.333	174.0	–23.399	15.6	.183	3.2
150.00	.230	–178.7	14.267	170.8	–23.288	23.6	.181	8.7
200.00	.221	–177.6	14.297	167.9	–23.158	28.4	.183	11.3
250.00	.209	–173.3	14.225	163.6	–22.753	36.3	.181	14.4
300.00	.207	–168.0	14.267	160.7	–22.286	42.9	.185	18.2
350.00	.212	–160.8	14.253	156.9	–22.099	49.7	.187	24.2
400.00	.228	–154.2	14.179	154.0	–21.392	55.4	.196	29.4
450.00	.258	–148.9	14.178	150.5	–21.186	58.8	.209	34.4
500.00	.298	–146.4	13.985	146.4	–20.985	64.6	.231	38.2
550.00	.346	–145.8	13.839	142.9	–20.484	67.1	.259	41.0
600.00	.400	–147.2	13.746	138.4	–20.250	71.3	.292	41.7
650.00	.457	–150.1	13.382	133.7	–20.036	75.1	.329	41.1
700.00	.512	–154.7	13.047	130.0	–19.837	77.9	.366	39.4
750.00	.569	–159.7	12.735	126.1	–19.672	79.9	.406	36.7
800.00	.617	–164.5	12.341	121.4	–19.820	81.9	.441	32.8

GPD-403/463
Thin-Film Cascadable Amplifier Module
5 to 400 MHz

TYPICAL PERFORMANCE OVER TEMPERATURE (@ +24 VDC unless otherwise noted)



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 24.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.07	10.50	176.22	.39	.00	1.65	20.66
150.0	1.10	10.37	174.17	.56	.15	1.63	20.24
200.0	1.12	10.33	170.97	–.40	.16	1.62	20.03
250.0	1.16	10.14	168.32	–.83	.13	1.60	19.76
300.0	1.19	10.14	166.45	–.47	.10	1.57	19.52
350.0	1.24	10.04	164.55	–.13	.09	1.55	19.09
400.0	1.28	9.95	163.35	.88	.08	1.51	18.72
450.0	1.33	9.79	161.56		.08	1.48	18.40
500.0	1.38	9.59	160.50		.07	1.45	18.10
550.0	1.45	9.46	158.96		.10	1.41	17.64
600.0	1.52	9.24	156.90		.08	1.39	17.26
650.0	1.61	9.05	155.95		.07	1.35	16.95
700.0	1.70	8.89	154.22		.10	1.32	16.50
750.0	1.81	8.64	152.36		.10	1.29	16.19
800.0	1.95	8.31	150.69		.08	1.28	16.00

S-PARAMETERS

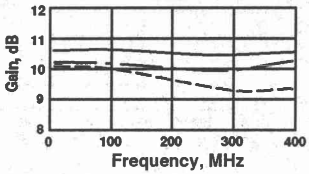
BIAS = 24.00 VOLTS

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.033	–121.8	10.482	176.1	–20.574	17.0	.248	–11.4
150.00	.049	–116.6	10.369	174.0	–20.272	24.0	.242	–16.0
200.00	.059	–115.5	10.352	171.1	–20.208	30.4	.236	–20.6
250.00	.075	–115.0	10.160	168.3	–19.797	38.1	.231	–26.7
300.00	.089	–117.5	10.149	166.6	–19.324	44.8	.226	–31.3
350.00	.105	–119.1	10.018	164.4	–19.131	51.8	.215	–37.4
400.00	.126	–121.5	9.947	163.4	–18.672	58.1	.204	–43.6
450.00	.144	–123.9	9.812	161.4	–18.416	63.5	.193	–50.0
500.00	.162	–126.4	9.572	160.6	–18.125	69.5	.183	–56.3
550.00	.182	–130.4	9.470	158.9	–17.575	74.6	.173	–63.3
600.00	.209	–133.6	9.238	156.9	–17.317	78.9	.162	–70.1
650.00	.237	–136.8	9.045	155.9	–16.931	84.5	.150	–76.9
700.00	.262	–141.5	8.896	154.2	–16.538	88.7	.140	–82.6
750.00	.291	–146.6	8.638	152.4	–16.183	93.1	.127	–89.8
800.00	.323	–151.3	8.281	150.7	–16.035	96.6	.120	–96.3

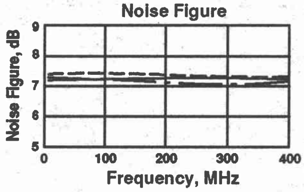
GPD-404/464
Thin-Film Cascadable Amplifier Module
5 to 400 MHz

TYPICAL PERFORMANCE OVER TEMPERATURE (@ +15 VDC unless otherwise noted)

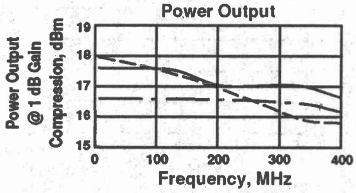
Gain



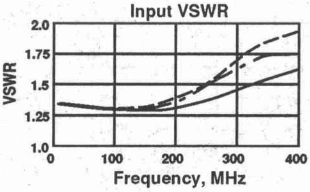
Noise Figure



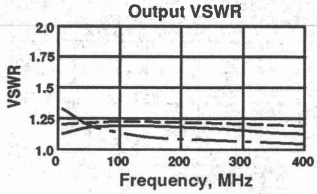
Power Output



Input VSWR

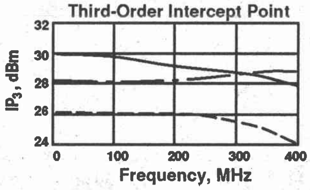


Output VSWR

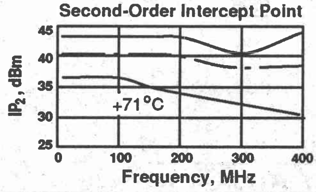


KEY: +25°C ———
+85°C — — —
−55°C — - —

Third-Order Intercept Point



Second-Order Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS — BIAS = 15.00 VOLTS

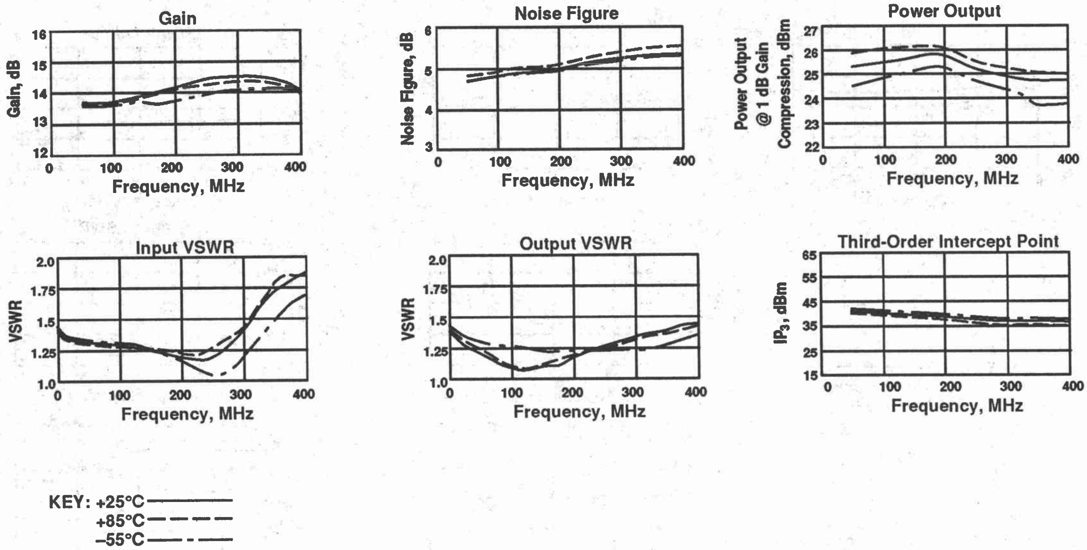
FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.32	10.54	178.94	.07	.00	1.11	22.94
150.0	1.33	10.48	177.20	−.07	.07	1.10	22.53
200.0	1.36	10.48	176.26	.55	.10	1.09	22.11
250.0	1.40	10.44	173.60	−.53	.11	1.10	22.07
300.0	1.44	10.49	172.17	−.39	.07	1.08	21.80
350.0	1.50	10.56	171.03	.04	.07	1.09	21.43
400.0	1.57	10.59	169.72	.31	.07	1.10	21.09
450.0	1.66	10.55	168.68		.06	1.12	20.76
500.0	1.75	10.56	167.56		.08	1.14	20.52
550.0	1.90	10.46	165.67		.10	1.18	20.09
600.0	2.05	10.38	163.83		.11	1.22	19.87
650.0	2.23	10.32	161.76		.13	1.25	19.52
700.0	2.44	10.17	159.27		.13	1.28	19.16
750.0	2.72	9.94	156.96		.13	1.31	18.89

S-PARAMETERS — BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.134	−164.2	10.510	178.5	−22.866	13.7	.053	−22.2
150.00	.142	−158.3	10.495	176.9	−22.529	21.5	.051	−32.2
200.00	.153	−155.0	10.485	176.3	−22.392	28.5	.044	−42.6
250.00	.163	−150.7	10.466	173.4	−21.934	35.5	.043	−60.8
300.00	.181	−147.2	10.488	172.1	−21.655	41.8	.043	−76.1
350.00	.199	−144.4	10.519	170.9	−21.382	47.4	.042	−100.2
400.00	.222	−142.7	10.578	169.8	−20.861	54.1	.046	−123.8
450.00	.247	−142.3	10.548	168.6	−20.826	58.2	.056	−141.5
500.00	.277	−142.3	10.518	167.6	−20.497	64.2	.065	−156.4
550.00	.308	−143.0	10.458	165.6	−19.989	68.7	.081	−170.0
600.00	.343	−144.5	10.363	163.8	−19.753	73.0	.096	179.2
650.00	.381	−146.5	10.318	161.7	−19.460	78.4	.110	170.6
700.00	.421	−149.8	10.161	159.3	−19.193	81.3	.124	161.3
750.00	.465	−153.5	9.929	157.0	−18.834	84.9	.133	154.1

GPD-405
Thin-Film Cascadable Amplifier Module
10 to 400 MHz

TYPICAL PERFORMANCE OVER TEMPERATURE (@ +15 VDC unless otherwise noted)



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

S-PARAMETERS

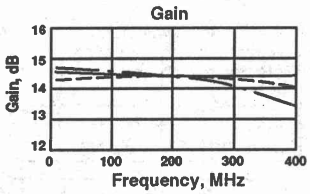
BIAS = 15.00 VOLTS

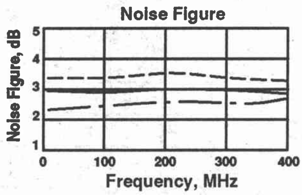
FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.177	177.7	13.5	146.1	–19.5	–18.7	.069	–51.5
120.00	.179	174.0	13.5	138.2	–19.4	–23.9	.064	–54.0
140.00	.182	170.8	13.5	130.5	–19.4	–29.2	.059	–56.6
160.00	.185	167.7	13.4	123.1	–19.5	–34.1	.054	–59.6
180.00	.190	164.5	13.4	115.7	–19.5	–38.3	.048	–62.8
200.00	.194	161.4	13.4	108.3	–19.4	–42.5	.042	–66.8
220.00	.198	158.5	13.5	100.8	–19.4	–47.2	.036	–70.1
240.00	.203	155.5	13.4	93.2	–19.3	–51.8	.030	–72.3
260.00	.208	152.5	13.4	85.5	–19.3	–56.7	.024	–73.0
280.00	.213	149.5	13.4	77.9	–19.2	–61.8	.017	–69.2
300.00	.218	146.8	13.4	70.4	–19.3	–67.1	.010	–43.5
320.00	.225	143.6	13.4	62.7	–19.4	–71.7	.011	+7.2
340.00	.232	140.5	13.3	55.0	–19.4	–75.5	.019	+32.5
360.00	.240	137.2	13.3	47.2	–19.4	–80.1	.030	+37.5
380.00	.249	133.8	13.2	39.6	–19.3	–84.9	.042	+35.6
400.00	.258	130.6	13.2	31.7	–19.3	–90.0	.055	+31.3
500.00	.317	111.4	12.6	–9.0	–19.9	–113.6	.145	–4.6
600.00	.394	87.7	11.5	–50.2	–20.6	–135.9	.246	–49.2
700.00	.476	63.3	9.8	–87.2	–21.1	–134.0	.343	–92.4

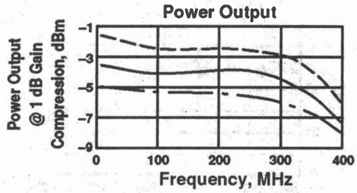
AVANTEK

GPD-411
Thin-Film Cascadable Amplifier Module
5 to 400 MHz

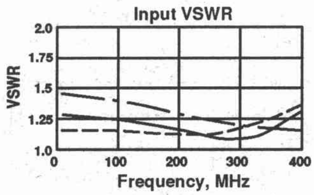
TYPICAL PERFORMANCE OVER TEMPERATURE (@ +15 VDC unless otherwise noted)

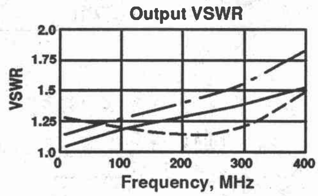


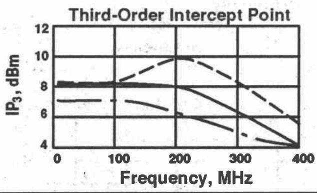


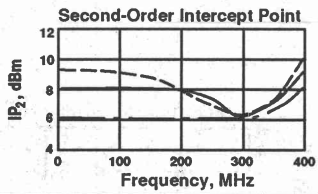


KEY: +25°C ———
+85°C — — —
−55°C — - —









AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS — BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.16	14.43	175.96	.45	.00	1.07	18.89
150.0	1.13	14.41	173.40	.16	.15	1.10	19.16
200.0	1.10	14.29	170.52	−.44	.14	1.15	19.03
250.0	1.10	14.28	168.36	−.33	.13	1.20	18.85
300.0	1.12	14.23	165.99	−.43	.11	1.28	18.88
350.0	1.19	14.20	164.26	.11	.10	1.37	18.59
400.0	1.32	14.25	162.37	.48	.16	1.48	18.42
450.0	1.52	14.18	158.38		.20	1.64	18.18
500.0	1.81	14.18	155.28		.25	1.87	18.08
550.0	2.30	14.30	149.36		.36	2.19	17.81
600.0	3.29	14.01	142.52		.42	2.64	18.00
650.0	5.62	13.78	134.30		.57	3.31	18.38
700.0	11.68	12.74	122.18		.64	4.43	19.33
750.0	33.90	10.82	111.34		.43	5.77	21.27

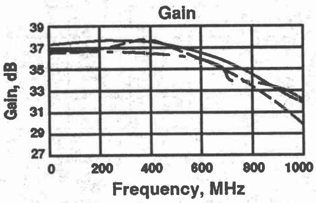
S-PARAMETERS — BIAS = 15.00 VOLTS

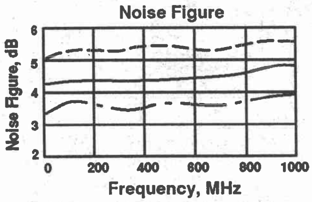
FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.115	161.8	14.519	175.6	−19.416	9.5	.077	3.7
150.00	.103	148.8	14.369	173.3	−19.099	13.9	.087	−4.6
200.00	.080	138.6	14.309	170.8	−19.092	16.5	.104	−14.0
250.00	.058	119.0	14.233	168.2	−18.857	20.5	.129	−20.5
300.00	.039	77.3	14.239	166.1	−18.869	24.2	.150	−30.7
350.00	.055	10.4	14.208	163.9	−18.565	26.4	.180	−40.9
400.00	.104	−18.9	14.240	161.7	−18.388	28.8	.214	−51.0
450.00	.175	−35.7	14.104	157.7	−18.086	29.4	.252	−62.4
500.00	.266	−49.1	14.058	154.7	−17.961	28.8	.304	−72.5
550.00	.387	−61.9	14.128	148.9	−17.553	26.1	.368	−83.2
600.00	.528	−75.7	13.762	142.3	−17.693	19.0	.442	−94.6
650.00	.696	−91.4	13.447	135.0	−18.240	12.3	.523	−106.1
700.00	.855	−108.8	12.485	124.3	−19.094	1.4	.610	−119.7
750.00	.979	−127.6	10.764	114.0	−21.247	−12.1	.681	−133.0

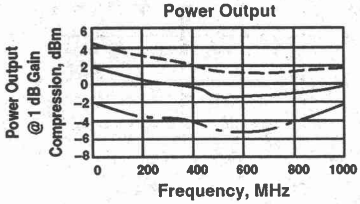
AVANTEK

GPM-552
High-Gain Amplifier Module
5 to 500 MHz

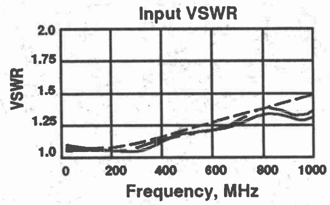
TYPICAL PERFORMANCE OVER TEMPERATURE (@ +15 VDC unless otherwise noted)

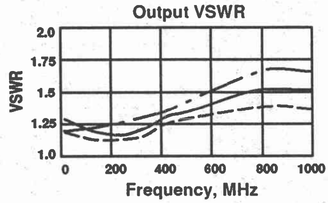


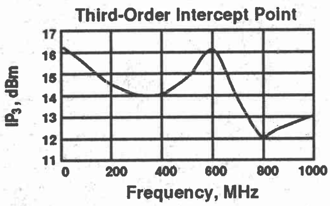


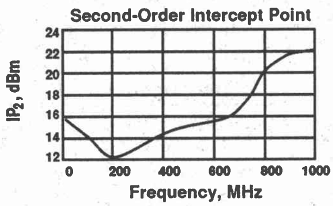


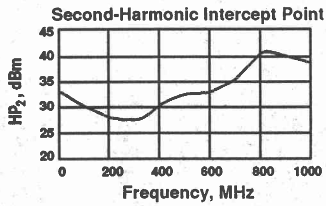
KEY: +25°C ———
+85°C – – – –
−55°C —·—











AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.06	37.36	−2.73	.00	1.13	46.24
150.0	1.06	37.39	−.81	.52	1.18	46.82
200.0	1.01	37.48	.99	.56	1.18	42.08
250.0	1.04	37.54	1.50	.59	1.19	49.53
350.0	1.09	37.55	1.75	.67	1.26	42.90
400.0	1.08	37.53	.46	.69	1.31	46.05
450.0	1.12	37.58	−.54	.71	1.33	44.11
500.0	1.14	37.58	−2.72	.73	1.36	43.15

LINEARIZATION RANGE: 100.0 to 500.0 MHz

S-PARAMETERS

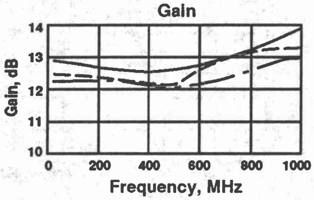
BIAS = 15.00 VOLTS
31.80 mA

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.023	−45.3	38.196	−13.4	−43.252	9.0	.092	−17.3
150.00	.041	−20.9	38.216	−21.2	−44.382	34.7	.075	−23.9
200.00	.022	−28.8	38.317	−28.5	−46.343	22.8	.076	−22.7
250.00	.041	−17.8	38.378	−36.1	−47.346	35.2	.080	−21.0
300.00	.023	16.3	38.387	−44.4	−45.052	36.7	.086	−21.8
350.00	.045	7.1	38.338	−53.1	−45.824	42.7	.103	−28.9
400.00	.048	−3.8	38.267	−62.4	−43.623	56.2	.120	−33.1
450.00	.061	19.3	38.156	−72.0	−44.366	45.5	.135	−41.0
500.00	.075	23.3	38.074	−81.7	−43.714	51.5	.145	−46.5
550.00	.080	17.2	37.911	−91.7	−43.756	48.8	.156	−52.7

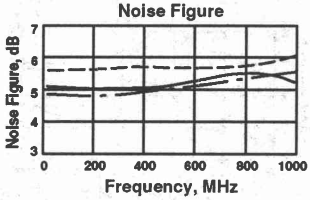
GPD-1001/1061
Thin-Film Cascadable Amplifier Module
5 to 1000 MHz

TYPICAL PERFORMANCE OVER TEMPERATURE (@ +15 VDC unless otherwise noted)

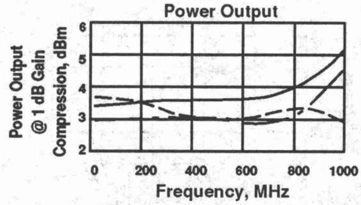
Gain



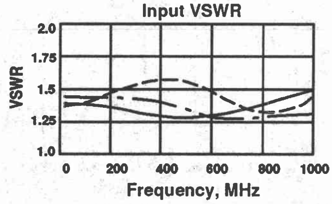
Noise Figure



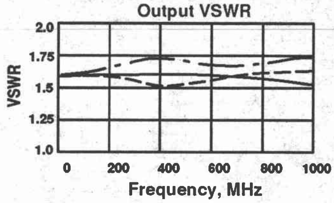
Power Output



Input VSWR

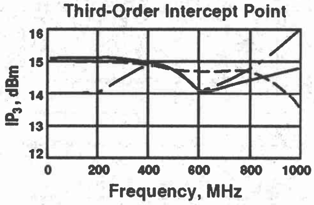


Output VSWR

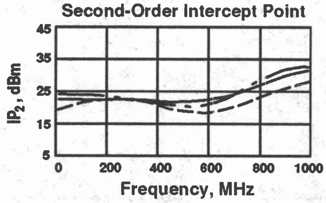


KEY: +25°C ———
+85°C — — —
−55°C — · —

Third-Order Intercept Point



Second-Order Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.29	12.80	175.00	−1.27	.00	1.55	21.19
200.0	1.25	12.70	171.12	−.70	.15	1.57	20.80
300.0	1.20	12.70	165.90	−.76	.13	1.59	20.73
400.0	1.15	12.68	161.70	.19	.10	1.59	20.57
500.0	1.11	12.69	157.36	.98	.11	1.60	20.31
600.0	1.13	12.82	152.75	1.51	.14	1.58	20.06
700.0	1.18	12.91	148.43	2.34	.14	1.57	19.83
800.0	1.26	13.20	142.15	1.21	.17	1.54	19.55
900.0	1.33	13.44	135.24	−.56	.25	1.48	19.29
1000.0	1.40	13.89	125.84	−4.81	.33	1.48	18.85
1100.0	1.66	14.25	110.43		.49	1.60	18.52
1200.0	2.65	14.09	88.12		.66	1.95	19.60
1300.0	5.16	11.75	67.01		.53	2.26	21.99

S-PARAMETERS

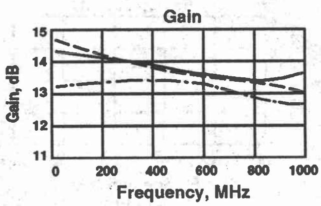
BIAS = 15.00 VOLTS

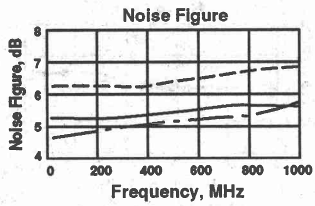
FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.126	176.0	12.781	175.4	−20.769	6.5	.216	.8
200.00	.109	170.2	12.735	171.2	−20.961	11.4	.222	3.4
300.00	.090	167.9	12.693	165.9	−20.665	18.5	.228	3.6
400.00	.070	176.0	12.683	161.8	−20.550	24.4	.229	3.1
500.00	.051	−165.9	12.662	157.5	−20.195	28.3	.232	.6
600.00	.059	−137.8	12.787	152.8	−20.108	32.5	.228	−2.0
700.00	.084	−125.1	12.899	148.5	−19.851	36.3	.224	−4.7
800.00	.115	−134.4	13.175	142.2	−19.505	38.1	.213	−8.0
900.00	.145	−153.4	13.447	135.5	−19.210	38.4	.198	−6.6
1000.00	.170	169.8	13.865	126.0	−18.813	37.5	.195	−.2
1100.00	.247	112.2	14.251	110.7	−18.550	32.7	.234	7.1
1200.00	.450	52.0	14.090	88.5	−19.649	25.2	.322	−.4
1300.00	.675	2.7	11.730	67.1	−21.993	21.1	.390	−19.1
1400.00	.789	−33.2	7.973	53.1	−23.851	29.5	.364	−40.5
1500.00	.831	−54.8	4.163	50.8	−24.626	37.0	.302	−53.1

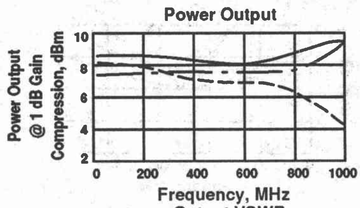
AVANTEK

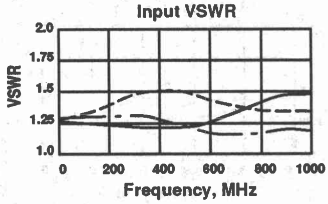
GPD-1002/1062
Thin-Film Cascadable Amplifier Module
5 to 1000 MHz

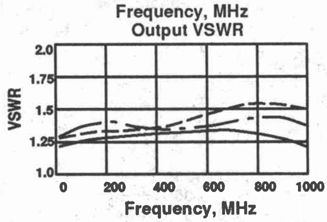
TYPICAL PERFORMANCE OVER TEMPERATURE (@ +15 VDC unless otherwise noted)



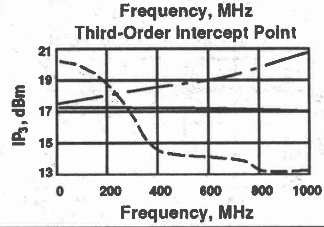


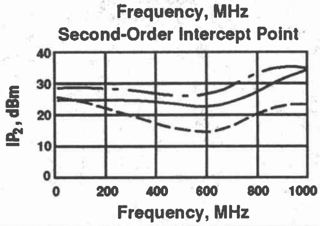






KEY: +25°C ———
+85°C – – –
–55°C — · —





AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS — **BIAS = 15.00 VOLTS**

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.29	14.23	174.38	–.16	.00	1.26	24.09
200.0	1.26	14.06	167.94	–.52	.19	1.27	23.33
300.0	1.21	13.97	161.47	–.93	.16	1.29	23.49
400.0	1.17	13.83	156.06	–.27	.14	1.30	23.05
500.0	1.18	13.67	150.80	.53	.14	1.31	22.61
600.0	1.23	13.57	145.27	1.08	.16	1.30	22.14
700.0	1.30	13.44	139.93	1.82	.17	1.29	21.64
800.0	1.39	13.43	133.32	1.29	.18	1.26	21.23
900.0	1.44	13.41	125.77	–.18	.26	1.20	20.79
1000.0	1.49	13.53	115.90	–3.99	.33	1.18	19.94
1100.0	1.76	13.51	100.99		.48	1.25	19.43
1200.0	2.74	12.87	80.86		.59	1.43	19.96
1300.0	5.08	10.21	60.92		.44	1.57	21.81

S-PARAMETERS — **BIAS = 15.00 VOLTS**

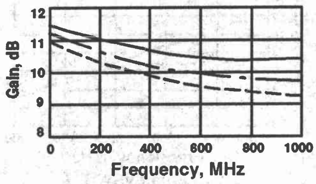
FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.130	177.2	14.212	174.2	–23.883	10.1	.114	1.0
200.00	.115	174.5	14.090	168.1	–23.830	14.4	.118	9.1
300.00	.094	177.6	13.974	161.6	–23.220	23.4	.127	9.4
400.00	.081	–168.4	13.831	156.2	–22.778	31.2	.130	9.0
500.00	.081	–150.6	13.638	150.9	–22.618	36.0	.134	6.5
600.00	.102	–139.1	13.535	145.2	–22.092	41.8	.132	3.1
700.00	.131	–138.6	13.423	139.9	–21.605	45.5	.127	–1.0
800.00	.162	–150.9	13.412	133.3	–21.127	48.1	.115	–6.2
900.00	.178	–171.3	13.416	126.0	–20.662	48.3	.097	–5.4
1000.00	.197	151.2	13.496	116.0	–19.983	47.6	.084	10.0
1100.00	.272	95.7	13.510	101.1	–19.447	42.2	.112	29.1
1200.00	.462	40.7	12.865	81.0	–20.066	34.7	.175	19.4
1300.00	.668	–4.2	10.191	60.9	–21.823	26.8	.225	–4.7
1400.00	.793	–37.1	6.343	51.1	–24.091	28.3	.213	–28.4
1500.00	.837	–58.2	2.570	50.1	–25.353	36.2	.174	–48.3

AVANTEK

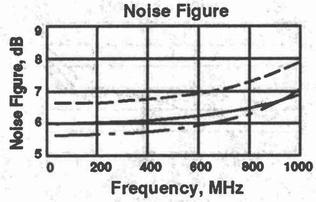
GPD-1003/1063
Thin-Film Cascadable Amplifier Module
5 to 1000 MHz

TYPICAL PERFORMANCE OVER TEMPERATURE (@ +15 VDC unless otherwise noted)

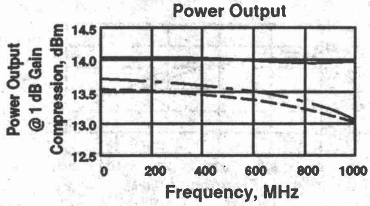
Gain



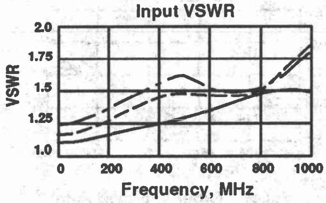
Noise Figure



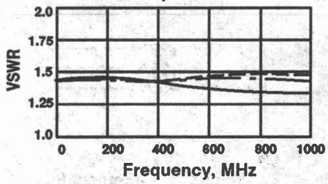
Power Output



Input VSWR

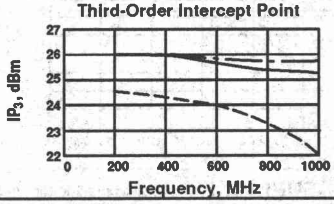


Output VSWR

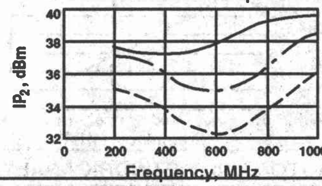


KEY: +25°C ———
+85°C — — —
–55°C —·—

Third-Order Intercept Point



Second-Order Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.13	11.32	161.40	–.60	.00	1.46	22.29
200.0	1.17	11.18	141.34	–1.28	.54	1.43	22.12
300.0	1.23	11.14	122.54	–.68	.51	1.39	21.89
400.0	1.27	10.98	104.21	.36	.51	1.34	21.62
500.0	1.31	10.84	86.05	1.58	.53	1.29	21.29
600.0	1.36	10.72	66.56	1.47	.52	1.26	21.00
700.0	1.41	10.74	47.59	1.88	.57	1.26	21.02
800.0	1.53	10.67	26.70	.38	.56	1.22	19.34
900.0	1.50	10.75	6.68	–.23	.59	1.24	18.98
1000.0	1.54	10.88	–16.41	–3.94	.00	1.28	18.61

LINEARIZATION RANGE: 100.0 to 1000.0 MHz

S-PARAMETERS

BIAS = 15.00 VOLTS

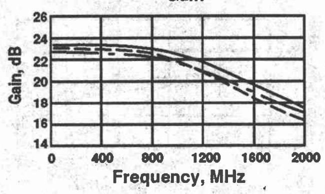
FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.053	–123.2	11.016	171.9	–21.498	11.5	.149	–9.5
200.00	.086	–119.4	11.120	167.0	–22.503	5.8	.125	–16.6
300.00	.082	–127.5	11.249	160.5	–20.865	25.2	.148	–22.0
400.00	.104	–130.2	10.924	154.6	–21.173	25.7	.139	–38.5
500.00	.113	–132.5	10.857	148.1	–21.142	33.8	.141	–49.3
600.00	.137	–146.1	10.755	141.8	–21.214	33.8	.136	–64.1
700.00	.144	–157.4	10.768	135.9	–20.690	39.1	.147	–77.9
800.00	.153	–169.4	10.778	127.8	–20.598	43.3	.156	–93.9
900.00	.186	169.2	10.973	120.2	–19.731	40.8	.157	–109.0
1000.00	.207	136.3	11.218	109.3	–18.887	36.1	.160	–128.3
1100.00	.293	88.5	11.458	95.4	–20.163	40.2	.165	–152.0
1200.00	.455	32.3	10.592	76.2	–19.339	31.5	.144	–175.6
1300.00	.646	–15.4	8.449	55.5	–19.985	24.1	.132	169.3
1400.00	.763	–50.0	5.442	43.9	–21.462	20.9	.133	154.4
1500.00	.820	–75.6	2.652	39.0	–22.083	25.1	.133	138.6
1800.00	.862	–94.2	.174	37.8	–22.710	30.6	.145	117.1
1700.00	.892	–109.5	–2.115	35.7	–24.469	22.8	.163	102.4

AVANTEK

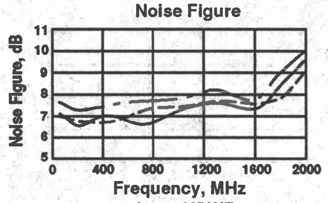
GPM-1052
High Gain Amplifier Module
5 to 1000 MHz

TYPICAL PERFORMANCE OVER TEMPERATURE (@ +15 VDC unless otherwise noted)

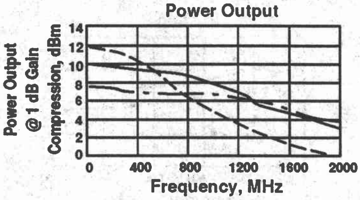
Gain



Noise Figure

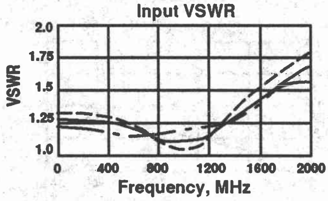


Power Output

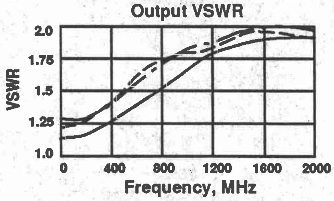


KEY: +25°C ———
+85°C — — —
–55°C — - —

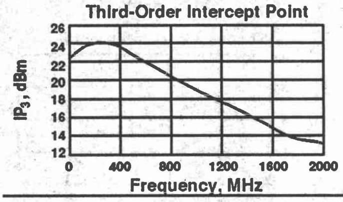
Input VSWR



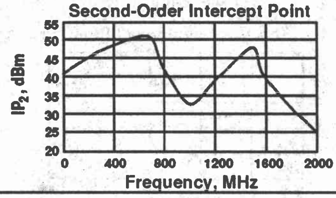
Output VSWR



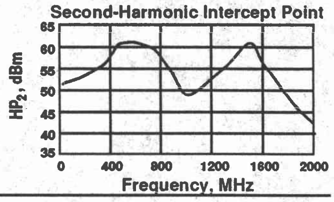
Third-Order Intercept Point



Second-Order Intercept Point



Second-Harmonic Intercept Point



AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

NUMERICAL READINGS

BIAS = 15.00 VOLTS

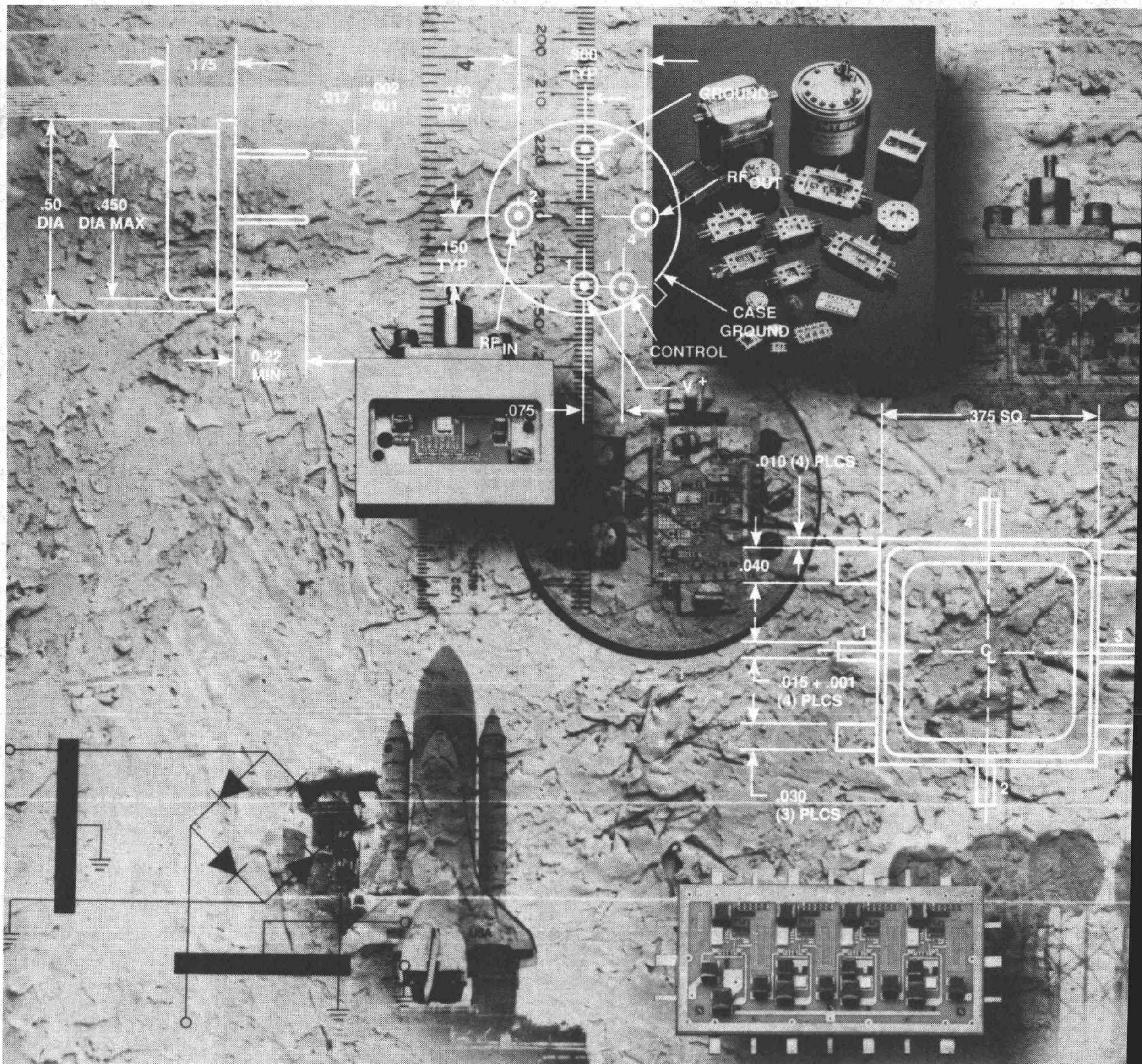
FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	GPDEL ns	VSWR OUT	ISOL dB
100.0	1.27	23.10	–1.06	.26	.00	1.29	37.74
200.0	1.28	23.22	–.53	.05	.91	1.34	38.26
300.0	1.26	23.26	.50	–.08	.88	1.38	40.19
400.0	1.23	23.15	.65	–.04	.91	1.45	37.94
500.0	1.20	23.07	.27	–.05	.93	1.51	39.22
600.0	1.17	23.06	.08	–.12	.91	1.57	38.89
700.0	1.14	22.95	.18	–.10	.91	1.62	37.90
800.0	1.11	22.84	.02	–.08	.92	1.68	37.89
900.0	1.10	22.66	–.35	.01	.91	1.75	38.38
1000.0	1.08	22.29	–.49	.29	.92	1.80	38.80

S-PARAMETERS

BIAS = 15.00 VOLTS

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang
100.00	.120	174.2	23.188	–10.3	–36.001	.5	.138	–21.9
150.00	.122	178.8	23.284	–16.1	–41.210	3.6	.137	–30.0
200.00	.125	–179.1	23.211	–21.3	–38.986	–1.5	.148	–32.1
250.00	.120	–179.4	23.233	–26.5	–37.965	22.7	.150	–36.4
300.00	.112	–179.5	23.231	–32.0	–41.795	9.6	.160	–41.9
350.00	.108	–179.7	23.161	–37.7	–38.308	16.8	.164	–46.9
400.00	.110	–167.9	23.149	–42.1	–40.926	18.2	.195	–55.3
450.00	.101	–176.9	23.117	–49.1	–38.585	11.8	.193	–58.0
500.00	.093	–178.9	23.107	–55.2	–39.673	17.6	.207	–59.7
550.00	.086	–177.4	23.091	–61.5	–38.490	13.9	.219	–62.7
600.00	.083	–178.9	23.104	–67.3	–37.638	11.4	.230	–66.0
650.00	.075	–174.4	23.111	–73.7	–38.089	23.6	.237	–68.5
700.00	.069	–175.7	23.088	–79.6	–38.919	16.3	.238	–72.7
750.00	.061	–174.3	23.024	–85.5	–38.214	18.2	.248	–78.4
800.00	.054	–169.5	22.927	–91.9	–40.107	25.0	.262	–82.0
850.00	.047	–162.8	22.841	–98.1	–38.402	21.8	.270	–84.7
900.00	.043	–149.6	22.708	–104.6	–40.210	17.2	.277	–86.8
950.00	.042	–142.4	22.484	–110.7	–39.685	20.7	.283	–90.2
1000.00	.042	–134.0	22.286	–116.3	–37.621	38.5	.291	–91.8

REFERENCE PLANES = 8.70 8.70 11.40



.175
.317
+.002
-.001
.50
DIA
.450
DIA MAX
0.22
MIN
.150
TYP
.300
TYP
GROUND
RF OUT
.150
TYP
RF IN
CASE
GROUND
CONTROL
V +
.075
.375 SQ.
.010 (4) PLCS
.040
.015 ± .001
(4) PLCS
.030
(3) PLCS

ATTENUATORS

PRODUCT DESCRIPTION

Avantek's UTF and PPF Series of thin-film precision, broadband voltage-controlled attenuators are specifically designed to provide flexible gain control in a cascade of modular amplifiers such as the UTO Series. With a frequency response of 5 to 2000 MHz they may be placed in any position in an amplifier cascade. Consistent input and output impedance allows several UTF modules to be cascaded for an even wider attenuation range. The designer can elect to install one near the input (for widest control range) or near the output (for best noise figure). Long-term stability of the thin-film attenuator means that a UTF attenuator can be used as a "trimmer" to precisely match the performance of two or more amplifier cascades and, with a well-regulated control voltage source, will maintain their gain match without constant adjustment. The new UTF-035 contains an internal linearizer to provide linear control over the complete range of attenuation. The PPF-030 surface mount attenuator provides small package size for new surface mount assembly techniques.

UTF SELECTION GUIDE

UTF SERIES SIGNAL ATTENUATORS

Guaranteed Specifications at 0° to 50°C Case Temperature[1]

Model	Frequency Range (MHz)	Insertion Loss, Maximum (dB)	Attenuation Minimum (dB)	Typical Switching Speed 10 to 90%	VSWR Maximum	Control Power Typical	Input Power Typical	Case Type	Page Number
UTF-015	5-1000	2.0, 5-500 MHz 2.5, 500-1000 MHz	15	.5 msec	2.0	0 to – 10 VDC, 0 to 7 mA	+15 VDC, 7 mA	TO-8F	4–3
UTF-025	5-500 5–1000 5-2000	2.5 2.5 3.3	30 25 20	75 µsec 75 µsec 75 µsec	2.0 2.0 2.5	0 to +15 VDC, 0 to 7 mA	+15 VDC, 15 mA	TO-8F	4–5
UTF-030	100-500 500-1000 1000-2000	2.5 3.0 3.5	40 35 25	.5 µsec .5 µsec .5 µsec	2.0 2.0 2.0	0 to +15 VDC 0 to 10 mA	+15 VDC, 8 mA	TO-8F	4–7
UTF-035[1]	50-2000	2.5, 50-1000 MHz 3.0, 1000-2000 MHz	23.5	5 µsec	2.1	–2 to –10 VDC, 10 to 35 mA	+15 VDC, 45 mA	TO-8F	4–9
UTF-040	10-1000	2.2, 5-500 MHz 2.5, 500-1000 MHz	40, 30-250 MHz 35, 10-500 MHz 30, 10-1000 MHz	.4 msec	2.0, 10-500 MHz 2.5, 10-1000 MHz	0 to –12 VDC, 0 to 75 mA	+15 VDC, 10 mA	TO-8F	4–16

NOTE 1: The factory can guarantee operation over –55° to +105°C if required.

PPF-030, PLANARPAK™ SURFACE MOUNTED ATTENUATOR

Guaranteed Specifications at 0° to 50°C Case Temperature

Model	Frequency Range (MHz)	Insertion Loss (dB) Maximum	Attenuation (dB) Minimum	VSWR (50Ω) Maximum	Switching Speed (µsec) Typical	Control Voltage (V)	Case Type	Page Number
PPF-030	100-500 500-1000 1000-2000	2.5 3.0 3.5	40 35 25	2.0 2.0 2.0	.5 .5 .5	0 to +15	PP-25F	4–7

AVANTEK

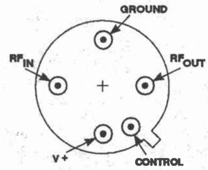
UTF-015
Attenuator
5 to 1000 MHz

FEATURES

- < 1.6:1 VSWR
- 20 dB of Attenuation
- Negative Control Voltage

APPLICATIONS

- Open and Closed Loop Gain Compensation



TO-8F, p. 16–47

DESCRIPTION

The UTF-015 is a thin-film voltage-controlled RF attenuator that offers a continuously-variable attenuation of up to 20 dB from 5 to 1000 MHz. Utilizing PIN diodes, attenuation over frequency is typically ±0.5 dB flat over the complete control voltage range. On the average, the attenuation will change roughly 5 dB per 2-volt increment. The UTF-015 comes hermetically sealed in a TO-8 case.

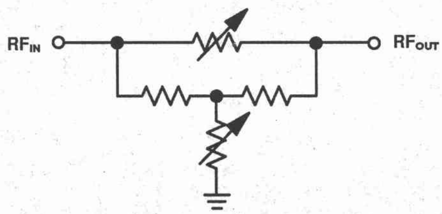
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC and –15 VDC nominal)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	5-1000	5-1000	5-1000	MHz
—	Attenuation, Min. ($V_C = -10$ V)	20.0	15.0	—	dB
—	Insertion Loss, Max. ($V_C = 0$ V)				
	5-500 MHz	1.5	2.0	—	dB
	500-1000 MHz	2.0	2.5	—	dB
—	VSWR				
	(Worst Case In Attenuation Range)	1.5:1	2.0:1	—	—
—	Flatness Over Frequency	±.5	—	—	dB
—	Switching Speed (10% to 90%)	.5	—	—	ms
—	Bias Current	7	—	—	mA
—	Control Voltage	0 to –10	0 to –10	—	VDC
—	Control Current	0 to 7	—	—	mA

MAXIMUM RATINGS

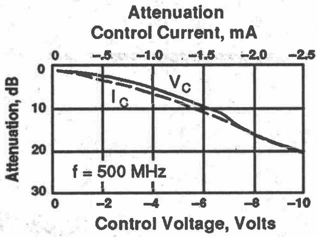
DC Voltage .... +17/–15 Volts
Continuous RF Input Power .... +23.0 dBm
Operating Case Temperature .... –55°C to 125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

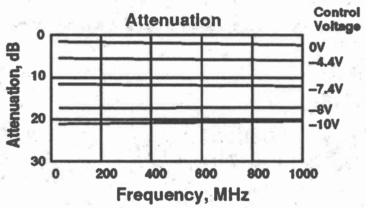
SCHEMATIC

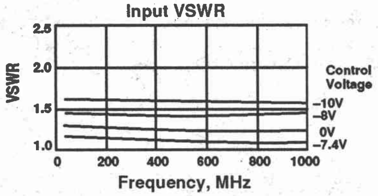


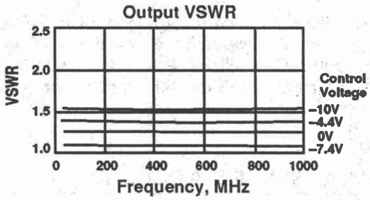
WEIGHT: (typical) 2.1 grams

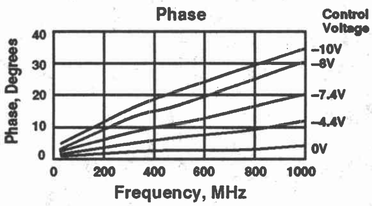
TYPICAL PERFORMANCE AT 25°C

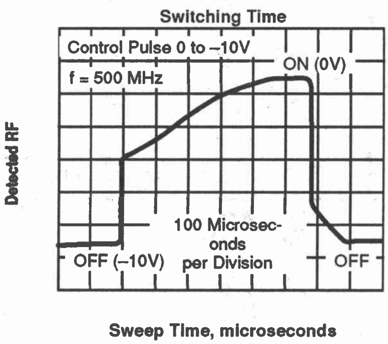












AVANTEK

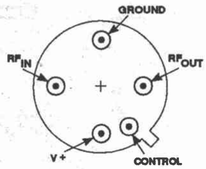
UTF-025
Attenuator
5 to 2500 MHz

FEATURES

- 35 dB Attenuation Range
- < 1.5:1 VSWR

APPLICATIONS

- Open and Closed Loop Gain Compensation



TO-8F, p. 16–47

DESCRIPTION

The UTF-025 is a thin-film voltage controlled RF attenuator that offers a continuously-variable 17 to 33 dB from 5 to 2500 MHz. Utilizing PIN diodes, attenuation over frequency is typically ±0.4 to ±0.6 dB flat over the complete control voltage range. On the average, the attenuation will change roughly 5 dB per 2-volt increment. The UTF-025 comes hermetically sealed in a TO-8 case.

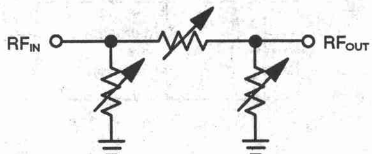
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			$T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	
BW	Frequency Range	5-2500	5-2000	5-2000	MHz
—	Attenuation, Min. ($V_C = 0$ V)				
	5-500 MHz	33.0	—	30.0	dB
	500-1000 MHz	28.0	—	25.0	dB
	1000-2000 MHz	23.0	—	20.0	dB
	2000-2500 MHz	17.0	—	—	dB
—	Insertion Loss, Max ($V_C = +15$ V)				
	5-1000 MHz	2.0	—	2.5	dB
	1000-2000 MHz	2.8	—	3.3	dB
	2000-2500 MHz	3.5	—	—	dB
—	VSWR (Worst Case in Attenuation Range)				
	5-1000 MHz	1.5:1	—	2.0:1	—
	1000-2000 MHz	1.8:1	—	2.5:1	—
—	Intercept Point	+30	—	—	dBm
—	Flatness Over Frequency (Min. to 15 dB)				
	5-1000 MHz	±0.4	—	±0.75	dB
	1000-2000 MHz	+0.6	—	±1.00	dB
	(Min to 20 dB)				
	5-1000 MHz	±0.8	—	±1.2	dB
—	Switching Speed (10% to 90%) (ON to OFF or OFF to ON)	75	—	—	µs
—	Bias Voltage	+15	—	—	VDC
—	Bias Current	15	—	—	mA
—	Control Voltage	1 to +15	—	—	VDC
—	Control Current	0 to 7	—	—	mA

MAXIMUM RATINGS

DC Voltage	+18 Volts
Continuous RF Input Power	+23.0 dBm
Operating Case Temperature	−55°C to +125°C
Storage Temperature	−62°C to +150°C
"R" Series Burn-In Temperature	+125°C

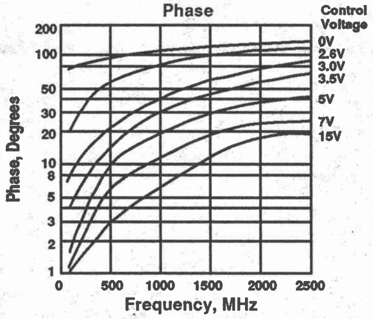
SCHEMATIC



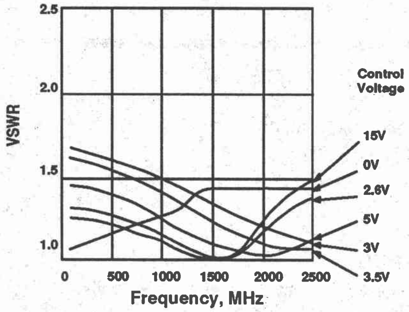
WEIGHT: (typical) 2.1 grams

TYPICAL PERFORMANCE AT 25°C TEMPERATURE (at +15 VDC unless otherwise noted)

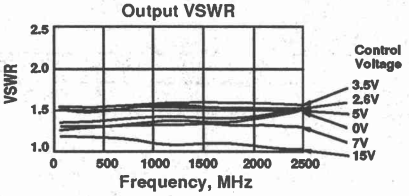
Phase



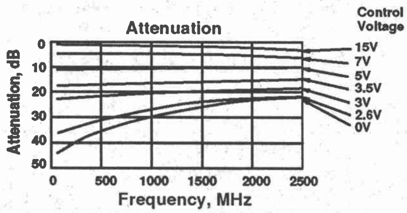
Input VSWR



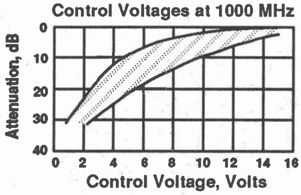
Output VSWR



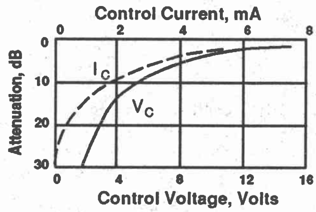
Attenuation



Variations of Attenuation From Unit–to–Unit at Various Control Voltages at 1000 MHz

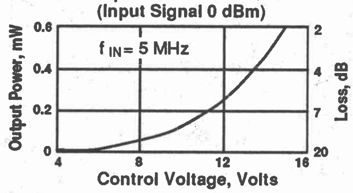


Attenuation

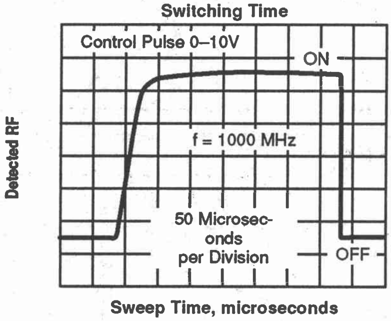


Due to R_s vs. I_F differences in pin diodes used in this product, internal drive compensation is done to optimize VSWR. This correction can affect the Attenuation vs. Control Voltage from unit to unit to the extent shown in the graph.

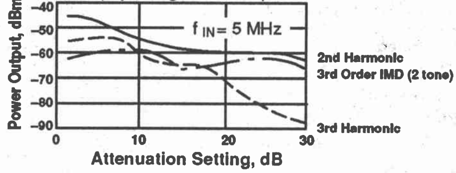
Output Power and Loss (Input Signal 0 dBm)



Switching Time



Distortion Products (Input Signal 0 dBm)



AVANTEK

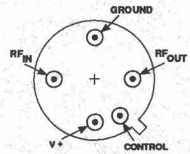
UTF/PPF-030
Attenuator
100 to 2000 MHz

FEATURES

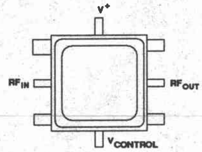
- 40 dB Attenuation Range
- 1 Microsecond Response Time
- Wideband Frequency Response
- Surface Mount Package

APPLICATIONS

- Open and Closed Loop Gain Compensation



UTF-030—TO-8F, p. 16–47



PPF-030—PP-25F, p. 16–34

DESCRIPTION

The UTF-030 is a thin-film voltage controlled RF attenuator that offers a continuously-variable attenuation of up to 30 to 45 dB from 100 to 2000 MHz. Utilizing PIN diodes, attenuation over frequency is typically ±0.5 to ±1.0 dB flat over the complete control voltage range. The UTF-030 comes hermetically sealed in a TO-8 case or in a surface mount PlanarPak.

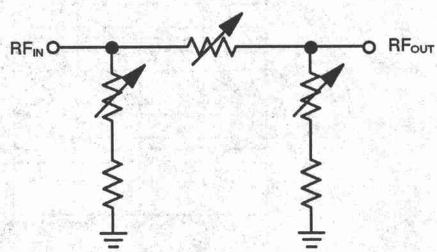
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	$T_C = -55°$ to $+85°C$	Unit
BW	Frequency Range	100-2300	100-2000	100-2000	MHz
—	Attenuation, Min. ($V_C = 0$ V)				
	100-500 MHz	45	40	30.0	dB
	500-1000 MHz	40	35	25.0	dB
	1000-2000 MHz	30	25	20.0	dB
—	Insertion Loss, Max ($V_C = +15$ V)				
	100-500 MHz	2.0	2.5	3.0	dB
	500-1000 MHz	2.5	3.0	3.5	dB
	1000-2000 MHz	3.0	3.5	4.0	dB
—	VSWR 100-2000 MHz (Worst Case in Attenuation Range)	1.7:1	2.0:1	2.0:1	—
—	Flatness Over Frequency (to 25 dB)				
	100-1000 MHz	±0.5	±1.0	±1.0	dB
	1000-2000 MHz	±1.0	±1.5	±1.5	dB
—	Switching Speed (10% to 90%) (ON to OFF or OFF to ON)	.5	1	1	μs
—	Bias Current	8.0	—	—	mA
—	Control Voltage	0 to +15	—	—	VDC
—	Control Current	0 to 10	—	—	mA

MAXIMUM RATINGS

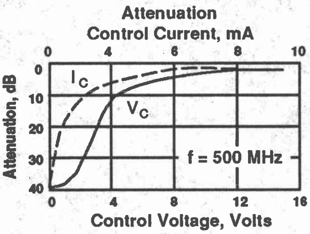
DC Voltage .... +17 Volts
Continuous RF Input Power .... +23.0 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

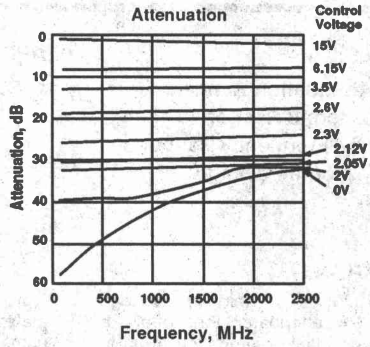
SCHEMATIC

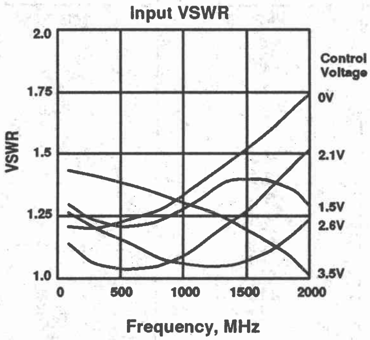


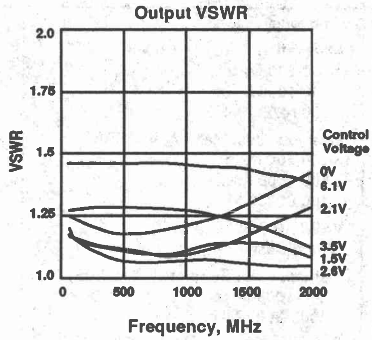
WEIGHT: (typical) PPF — 0.15 grams; UTF — 2.1 grams

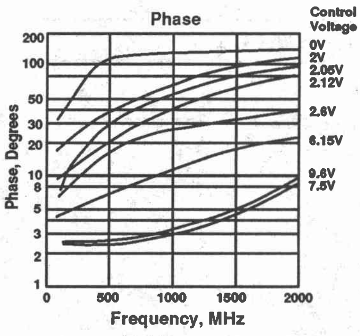
TYPICAL PERFORMANCE AT 25°C TEMPERATURE (at +15 VDC unless otherwise noted)

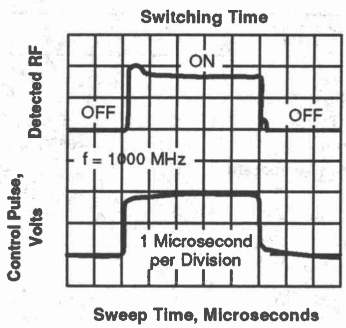












AVANTEK

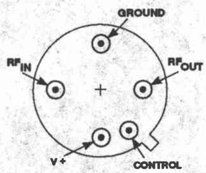
UTF-035
Attenuator
50 to 2000 MHz

FEATURES

- Frequency Range: 50 to 2000 MHz
- Attenuation Range: 2 to 25 dB (Typ)
- Linearity: ±0.6 dB (Typ)
- 5 μsec Switching Speed
- Linearizer and Attenuator in One Package

APPLICATIONS

- Open and Closed Loop Gain Compensation
- AGC Circuits
- Temperature Compensation Control



TO-8F, p. 16–47

DESCRIPTION

The UTF-035 is a linearized thin-film voltage-controlled RF attenuator that offers a continuously-variable attenuation of up to 25 dB attenuation, from 50 to 2000 MHz. The RF attenuation will change a fixed increment of nearly 3 dB per volt, over the full control voltage range. Utilizing PIN diodes, device attenuation vs. voltage linearity is typically ±0.6 dB over the complete control voltage range. The UTF-035 is only unique because the linearizer is housed in the same single TO-8 package weighing 2.1 grams.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	50–2000	50–2000	50–2000	MHz
—	Attenuation				
	Min. Insert. Loss, V_C = –10 V				
	50 to 1000 MHz (Max.)	2.0	2.5	3.0	dB
	1000 to 2000 MHz (Max.)	2.5	3.0	3.5	dB
	Max. Attenuation Loss, V_C = –2 V				
	50 to 2000 MHz (Min.)	25.5	23.5	20.0	dB
—	Gain Flatness (Max.)	±0.7	±1.5	±2.0	dB
—	Attenuation vs. Voltage Linearity				
	V_C = –2 to –10 V	±0.6	±1.5	±2.0	dB
—	Input VSWR (Max.)	1.5:1	2.1:1	2.2:1	—
—	Output VSWR (Max.)	1.5:1	2.1:1	2.2:1	—
IP_3	Two Tone 3rd Order Intercept Point	+45.0	—	—	dBm
—	Switching Speed	5	—	—	μs
—	Phase Shift	.002/dB	—	—	Deg/MHz
—	Supply Voltage/Current	15/45	—	—	V/mA
—	Control Voltage/Current	–10/35	—	—	V/mA

MAXIMUM RATINGS

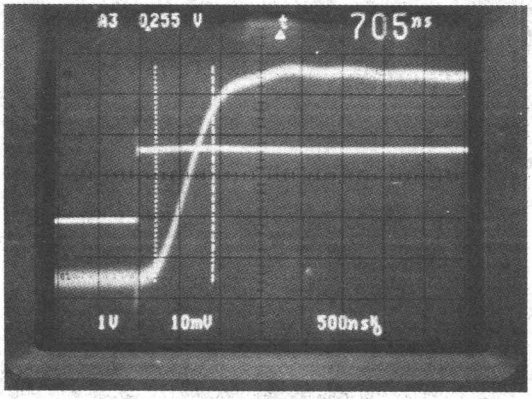
Continuous Voltage (V_{CC}/V_{cont}) .... +17/–15 Volts
Continuous RF Power (CW or Pulse) .... +23 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

THERMAL CHARACTERISTICS

θ_{JC} .... 100°C/W
Active Transistor Power Dissipation .... 185/145/190 mW
Junction Temp. Above Case Temp. .... 18.5/14.5/19.0°C

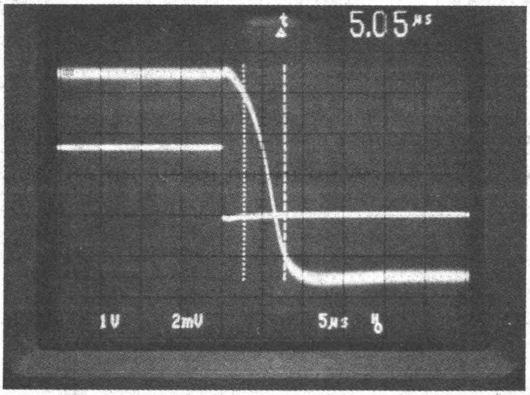
WEIGHT: (typical) 2.1 grams

UTF SWITCHING SPEED (continued)



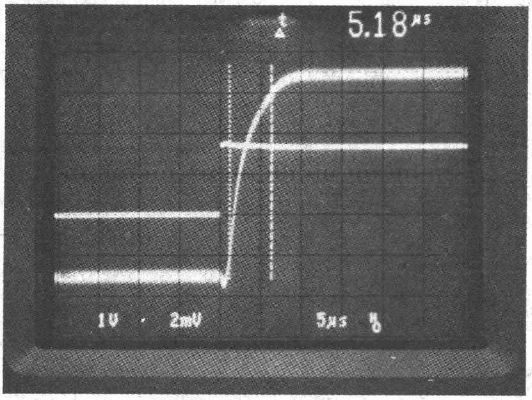
Control Voltage	Attenuation
–4.1 to – 2.4 Volts	–20 to – 25 dB

5 dB Step at Maximum Attenuation



–8.3 to –10 Volts	–7 to – 2 dB

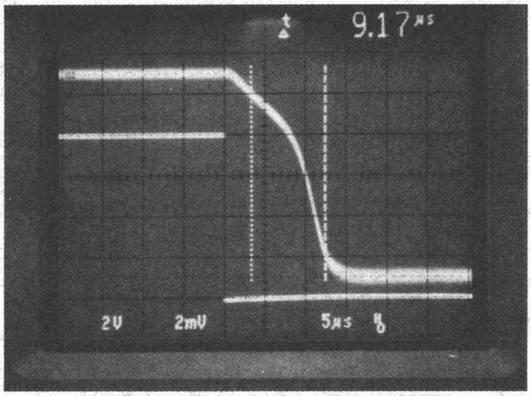
5 dB Step at Minimum Attenuation



–10 to – 8.3 Volts	–2 to – 7 dB

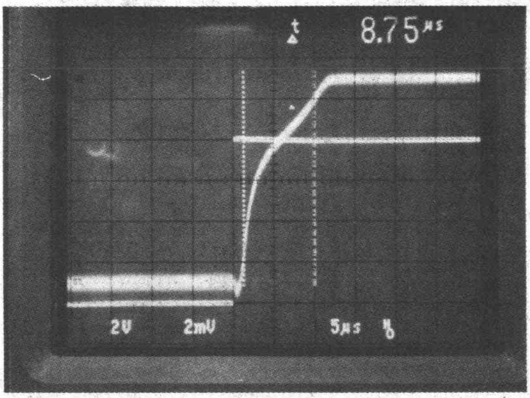
5 dB Step at Minimum Attenuation

UTF SWITCHING SPEED



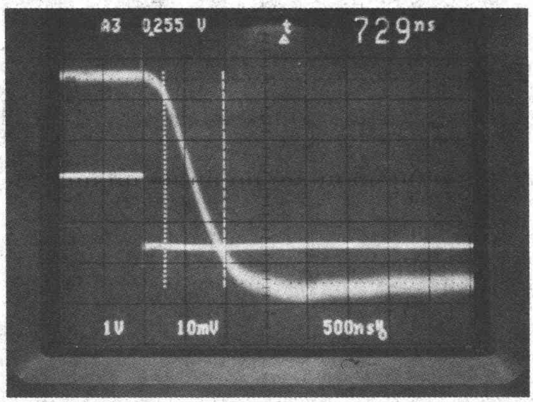
Control Voltage	Attenuation
–2 to – 10 Volts	–26 to – 2 dB

Step through full Attenuation range. Maximum to Minimum



–10 to –2 Volts	–2 to – 26 dB

Step through full Attenuation range. Minimum to Maximum

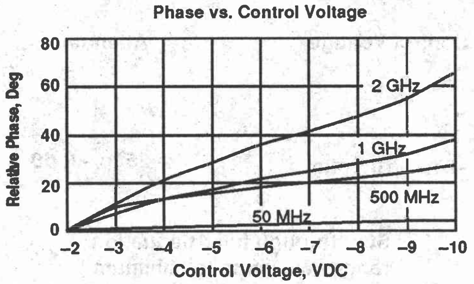


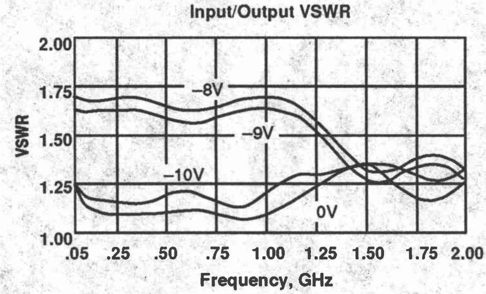
–2.4 to – 4.1 Volts	–25 to – 20 dB

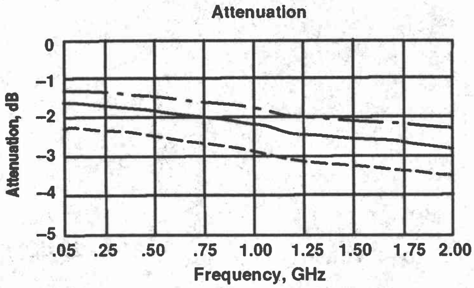
5 dB step at Maximum Attenuation

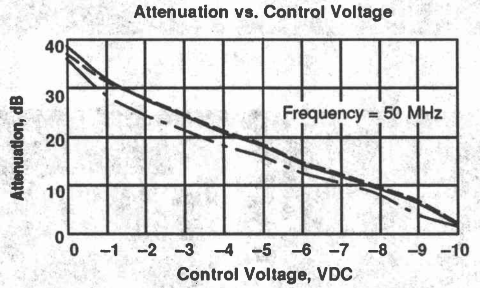
TYPICAL PERFORMANCE AT 25°C TEMPERATURE (at +15 VDC unless otherwise noted)

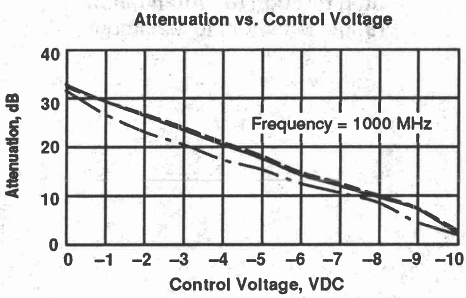
KEY: +25°C ———
+85°C – – – –
–55°C —·—

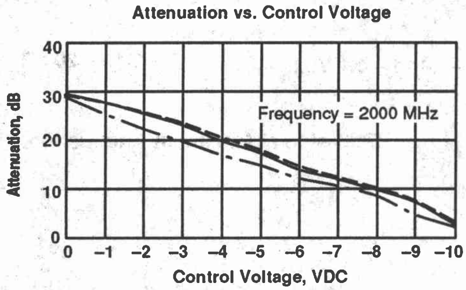


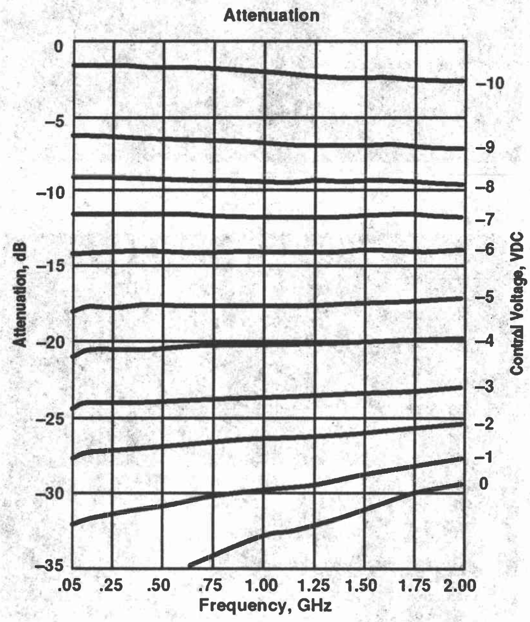










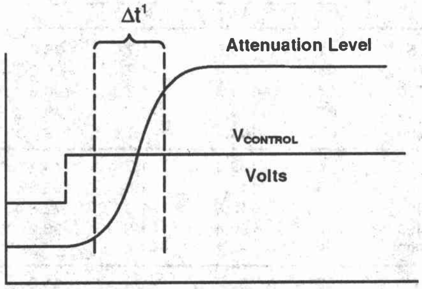


ATTENUATION VS. CONTROL VOLTAGE

$V_{CONTROL}$ Volts	Attenuation dB
–2.0	27.5
–4.0	20.8
–6.0	14.7
–8.0	8.6
–10.0	2.5

@ +25°C (Approx. 3 dB/Volt)

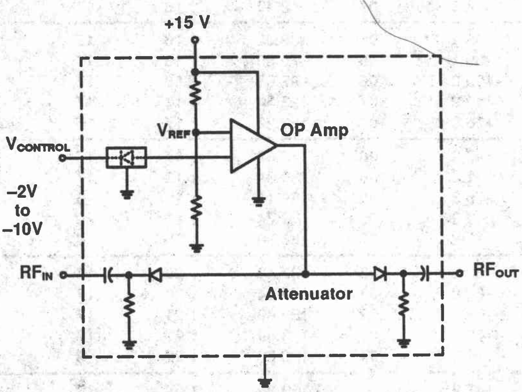
SWITCHING SPEED



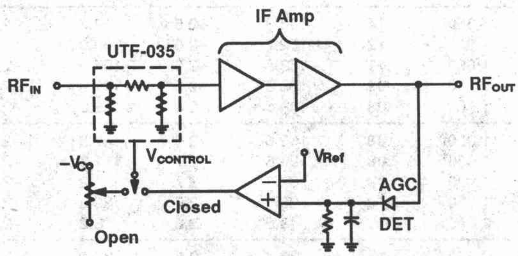
NOTE 1: 5 dB Step at Max Attenuation
Δt = 0.7 µsec

Step Through Full Attenuation
Δt =10 µsec

UTF-035 SIMPLIFIED SCHEMATIC



APPLICATIONS



CLOSED OR OPEN LOOP GAIN CONTROL

AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

Bias = 15 Volts Control Voltage = –10V
Bias Current = 45.9 mA Control Current = –36.3 mA

FREQ	S_{11}		S_{21}		S_{12}		S_{22}			GPDEL	PHASE
GHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	K	ns	DEG
.050	.11	–73.5	–1.7	–38.8	–1.7	–38.8	.11	–91.11	1.06	.33	4.58
.100	.08	–86.4	–1.7	–69.6	–1.7	–69.6	.08	–121.87	1.06	.33	1.81
.150	.07	–108.5	–1.7	–106.6	–1.7	–106.6	.07	–162.60	1.06	.23	.78
.200	.07	–134.9	–1.7	–143.1	–1.7	–143.1	.07	151.79	1.07	.20	.24
.250	.07	–163.4	–1.7	–179.4	–1.7	–179.4	.07	105.12	1.07	.19	–.09
.300	.06	168.0	–1.7	144.4	–1.7	144.4	.07	59.52	1.07	.18	–.28
.350	.06	141.1	–1.8	108.3	–1.8	108.3	.07	15.11	1.08	.18	–.45
.400	.07	115.6	–1.8	72.3	–1.8	72.2	.07	–29.78	1.08	.18	–.57
.450	.07	90.4	–1.8	36.2	–1.8	36.2	.06	–77.29	1.08	.18	–.65
.500	.08	64.1	–1.8	.2	–1.8	.2	.05	–129.47	1.08	.18	–.70
.550	.09	36.3	–1.9	–35.8	–1.9	–35.8	.05	174.28	1.09	.17	–.71
.600	.09	7.3	–1.9	–71.8	–1.9	–71.8	.05	121.67	1.09	.18	–.75
.650	.09	–22.1	–1.9	–107.7	–1.9	–107.8	.06	76.57	1.09	.17	–.75
.700	.08	–51.8	–2.0	–143.6	–2.0	–143.7	.07	36.24	1.09	.17	–.76
.750	.07	–81.3	–2.0	–179.6	–2.0	–179.7	.08	–2.62	1.10	.17	–.76
.800	.06	–111.4	–2.0	144.5	–2.0	144.4	.08	–42.16	1.10	.17	–.69
.850	.06	–142.3	–2.0	108.5	–2.1	108.5	.08	–84.88	1.10	.17	–.68
.900	.06	–175.5	–2.1	72.5	–2.1	72.5	.08	–132.96	1.11	.17	–.63
.950	.07	151.5	–2.1	36.5	–2.1	36.5	.08	174.43	1.11	.17	–.59
1.000	.09	119.1	–2.1	.5	–2.2	.4	.09	120.12	1.12	.17	–.56
1.050	.10	87.7	–2.2	–35.5	–2.2	–35.6	.11	69.38	1.12	.17	–.48
1.100	.12	58.3	–2.3	–71.3	–2.3	–71.5	.13	22.57	1.13	.17	–.44
1.150	.13	31.0	–2.3	–107.1	–2.4	–107.2	.14	–21.44	1.13	.17	–.42
1.200	.13	6.6	–2.4	–142.8	–2.4	–142.8	.14	–64.19	1.14	.17	–.33
1.250	.13	–14.4	–2.4	–178.5	–2.4	–178.4	.14	–107.50	1.14	.17	–.29
1.300	.13	–32.4	–2.4	145.8	–2.5	145.9	.12	–152.51	1.14	.17	–.14
1.350	.13	–49.5	–2.5	110.1	–2.5	110.1	.10	159.26	1.15	.17	–.13
1.400	.14	–67.6	–2.5	74.3	–2.5	74.2	.08	106.46	1.15	.17	–.13
1.450	.14	–87.5	–2.5	38.5	–2.5	38.3	.07	52.31	1.15	.17	–.10
1.500	.14	–108.7	–2.5	2.6	–2.5	2.6	.07	2.40	1.16	.17	.04
1.550	.14	–130.8	–2.5	–33.2	–2.5	–33.2	.06	–38.62	1.16	.17	.07
1.600	.12	–152.7	–2.6	–69.0	–2.6	–69.1	.06	–70.96	1.16	.17	.12
1.650	.11	–173.8	–2.6	–104.9	–2.6	–105.0	.06	–97.68	1.16	.17	.20
1.700	.09	165.3	–2.6	–140.9	–2.6	–140.9	.07	–123.54	1.17	.17	.23
1.750	.08	143.5	–2.6	–176.8	–2.6	–176.8	.07	–152.22	1.17	.17	.37
1.800	.08	118.6	–2.6	147.3	–2.6	147.2	.06	174.67	1.17	.17	.42
1.850	.08	89.6	–2.6	111.3	–2.7	111.2	.05	136.84	1.18	.17	.54
1.900	.09	57.6	–2.7	75.2	–2.7	75.2	.03	89.11	1.19	.16	.73
1.950	.10	26.0	–2.7	39.2	–2.7	39.2	.02	3.74	1.19	.16	.88
2.000	.12	–3.5	–2.8	3.2	–2.8	3.2	.03	–86.96	1.20	.16	1.07
2.050	.13	–30.4	–2.8	–32.8	–2.8	–32.8	.03	–137.43	1.20	.17	
2.100	.14	–54.0	–2.9	–68.7	–2.9	–68.8	.03	–174.94	1.20	.17	
2.150	.16	–74.6	–2.9	–104.5	–2.9	–104.6	.02	159.49	1.21	.17	
2.200	.17	–92.6	–3.0	–140.5	–3.0	–140.5	.01	–113.44	1.21	.17	
2.250	.18	–110.1	–3.0	–176.3	–3.0	–176.4	.04	–129.68	1.22	.18	
2.300	.20	–128.5	–3.1	147.9	–3.1	147.9	.07	–163.34	1.22	.17	
2.350	.22	–148.5	–3.1	112.2	–3.1	112.2	.09	158.89	1.23	.17	
2.400	.23	–169.9	–3.1	76.5	–3.1	76.4	.09	118.20	1.23	.17	
2.450	.22	168.5	–3.1	40.9	–3.2	40.7	.09	72.27	1.23	.17	
2.500	.21	147.2	–3.1	5.0	–3.2	4.9	.07	15.55	1.24	.17	

LINEARIZATION RANGE: .050 to 2.000 GHz

AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

Bias = 15V
Bias Current = 24.1 mA
Control Voltage = –2V
Control Current = –17.4 mA

FREQ GHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang	K	GPDEL ns	PHASE DEG
.050	.10	–103.6	–27.6	–27.4	–27.6	–27.4	.09	–137.22	280.55	.19	1.40
.100	.05	–133.2	–27.4	–64.1	–27.4	–64.1	.05	158.81	273.56	.19	–.04
.150	.04	–163.1	–27.3	–98.9	–27.4	–99.0	.04	97.27	269.88	.14	–.54
.200	.03	165.9	–27.3	–133.3	–27.3	–133.3	.04	42.95	266.59	.12	–.73
.250	.03	134.9	–27.2	–167.5	–27.2	–167.5	.04	–5.44	263.10	.11	–.74
.300	.03	105.7	–27.2	158.4	–27.2	158.3	.03	–53.39	259.97	.11	–.66
.350	.03	79.8	–27.1	124.3	–27.1	124.2	.03	–106.40	256.88	.11	–.61
.400	.03	56.8	–27.0	90.1	–27.1	90.1	.03	–165.29	253.08	.11	–.48
.450	.03	36.5	–27.0	55.9	–27.0	55.9	.03	138.49	249.99	.11	–.39
.500	.03	17.7	–26.9	21.8	–27.0	21.7	.04	92.42	246.55	.11	–.31
.550	.03	–.8	–26.9	–12.4	–26.9	–12.5	.04	53.27	243.14	.10	–.17
.600	.02	–19.7	–26.8	–46.7	–26.8	–46.7	.05	17.68	239.78	.11	–.04
.650	.02	–39.9	–26.7	–80.9	–26.8	–81.0	.05	–16.19	236.67	.10	.03
.700	.02	–64.4	–26.7	–115.2	–26.7	–115.2	.04	–51.06	233.18	.11	.13
.750	.01	–97.9	–26.6	–149.6	–26.7	–149.6	.03	–88.79	230.35	.11	.17
.800	.01	–146.7	–26.6	176.1	–26.6	176.1	.03	–133.27	227.47	.10	.32
.850	.01	161.8	–26.5	141.6	–26.5	141.6	.02	168.38	224.69	.10	.38
.900	.02	126.6	–26.5	107.2	–26.5	107.1	.02	109.59	222.29	.11	.44
.950	.03	101.6	–26.4	72.7	–26.5	72.6	.03	64.00	219.90	.11	.40
1.000	.04	80.7	–26.4	38.2	–26.4	38.1	.04	29.18	217.82	.11	.38
1.050	.05	61.6	–26.4	3.7	–26.4	3.6	.04	.74	215.89	.10	.53
1.100	.06	43.3	–26.3	–30.8	–26.4	–30.9	.04	–24.97	214.83	.11	.58
1.150	.07	25.6	–26.3	–65.3	–26.4	–65.3	.04	–48.99	214.07	.11	.52
1.200	.08	7.9	–26.3	–99.6	–26.4	–99.7	.04	–72.61	213.63	.11	.46
1.250	.09	–9.6	–26.3	–133.9	–26.4	–133.9	.04	–97.22	213.01	.11	.40
1.300	.10	–27.0	–26.3	–168.0	–26.3	–168.0	.03	–121.11	211.38	.10	.50
1.350	.11	–44.5	–26.2	157.9	–26.3	157.8	.02	–141.99	208.16	.12	.45
1.400	.11	–62.1	–26.2	123.6	–26.2	123.6	.01	–161.15	204.43	.12	.28
1.450	.12	–79.9	–26.1	89.2	–26.1	89.2	.01	174.82	200.80	.12	.15
1.500	.12	–98.0	–26.0	54.7	–26.0	54.7	0.00	66.48	196.98	.11	.14
1.550	.12	–116.8	–25.9	20.2	–26.0	20.1	.01	–2.51	193.65	.12	.11
1.600	.11	–136.5	–25.8	–14.4	–25.9	–14.4	.02	–29.03	190.37	.12	–.09
1.650	.11	–157.5	–25.8	–49.0	–25.8	–49.0	.03	–54.74	187.30	.12	–.17
1.700	.10	179.8	–25.7	–83.7	–25.7	–83.8	.04	–80.93	184.37	.12	–.24
1.750	.09	154.1	–25.6	–118.4	–25.7	–118.5	.05	–107.71	181.52	.11	–.31
1.800	.08	125.3	–25.6	–153.2	–25.6	–153.2	.06	–135.61	179.04	.12	–.45
1.850	.08	93.3	–25.5	172.1	–25.5	172.1	.06	–164.50	176.52	.11	–.45
1.900	.09	60.3	–25.5	137.2	–25.5	137.3	.06	165.01	173.95	.12	–.49
1.950	.09	28.7	–25.4	102.4	–25.4	102.4	.05	130.91	171.67	.11	–.52
2.000	.11	.2	–25.4	67.6	–25.4	67.6	.04	89.57	169.44	.11	–.35
2.050	.13	–25.5	–25.3	32.8	–25.3	32.7	.03	31.70	166.96	.11	
2.100	.14	–49.0	–25.3	–2.0	–25.3	–2.2	.04	–35.81	164.42	.12	
2.150	.16	–70.9	–25.2	–36.8	–25.2	–36.8	.05	–86.31	161.77	.12	
2.200	.18	–91.6	–25.2	–71.5	–25.2	–71.6	.07	–124.97	159.02	.13	
2.250	.19	–111.8	–25.1	–106.2	–25.1	–106.3	.08	–158.56	156.10	.13	
2.300	.20	–131.3	–25.1	–140.9	–25.1	–140.8	.09	169.47	153.27	.13	
2.350	.21	–150.5	–25.0	–175.5	–25.0	–175.5	.09	137.37	150.26	.13	
2.400	.21	–169.8	–24.9	149.9	–24.9	149.8	.08	103.88	147.25	.13	
2.450	.21	170.9	–24.8	115.3	–24.8	115.2	.07	66.17	144.15	.13	
2.500	.20	151.4	–24.7	80.5	–24.7	80.4	.05	19.22	141.04	.13	

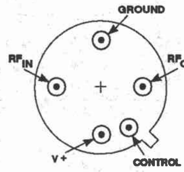
LINEARIZATION RANGE: .050 to 2.000 GHz

AVANTEK

UTF-040
Attenuator
10 to 1000 MHz

FEATURES
- 40 dB Attenuation Range
- Negative Control Voltage

APPLICATIONS
- Open and Closed Loop Gain Compensation
- AGC Circuits



TO-8F, p. 16–47

DESCRIPTION
The UTF-040 is a thin-film voltage controlled RF attenuator that offers a continuouly-variable attenuated up to 30 to 40 dB from 10 to 1000 MHz. Utilizing PIN diodes, attenuation over frequency is typically ±0.5 dB flat over the complete control voltage range. On the average, the attenuation will change roughly 5 dB for 2-volt increment. The UTF-040 comes hermetically sealed in a TO-8 case.

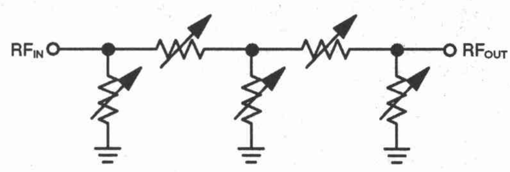
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
BW	Frequency Range	10-1000	10-1000	10-1000	MHz
—	Attenuation, Min. (V_C = 10 V)				
	30-250 MHz	—	40	—	dB
	10-500 MHz	—	35	—	dB
	10-1000 MHz	—	30	—	dB
—	Insertion Loss, Max (V_C = +0 V)				
	10-5000 MHz	—	2.2	—	dB
	500-1000 MHz	—	2.5	—	dB
—	VSWR (Worst Case in Attenuation Range)				
	10-500 MHz	—	2.0:1	—	—
	10-1000 MHz	—	2.5:1	—	—
—	Flatness Over Frequency (to 20 dB)	±.05	—	—	dB
—	Max Small Signal Input Level				
	10-500 MHz	—	0	—	dBm
	50-1000 MHz	—	+6.0	—	dBm
—	Switching Speed (10% to 90%) (ON to OFF or OFF to ON)	.4	—	—	ms
—	Bias Voltage	+15	+15	—	VDC
—	Bias Current	10	10	—	mA
—	Control Voltage	0 to –12	1 to –12	—	VDC
—	Control Current	0 to 75	0 to 75	—	mA

MAXIMUM RATINGS

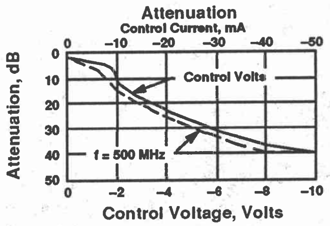
DC Voltage . . . . +17 Volts
Continuous RF Input Power . . . . +23.0 dBm
Operating Case Temperature . . . . –55°C to +125°C
Storage Temperature . . . . –62°C to +150°C
"R" Series Burn-In Temperature . . . . +125°C

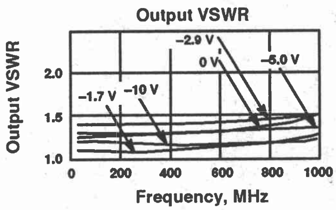
SCHEMATIC

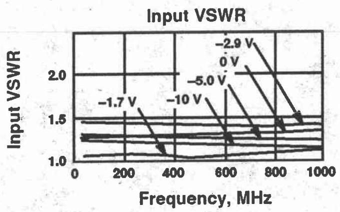


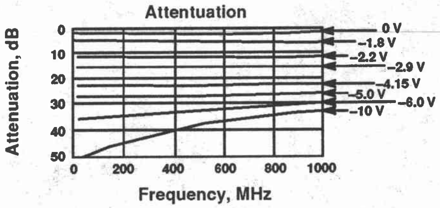
WEIGHT: (typical) 2.1 grams

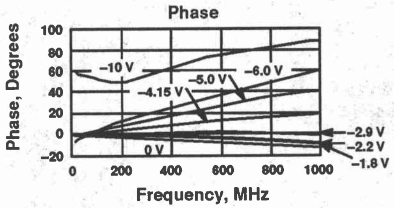
TYPICAL PERFORMANCE AT 25°C TEMPERATURE (at +15 VDC unless otherwise noted)

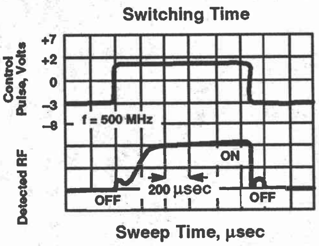


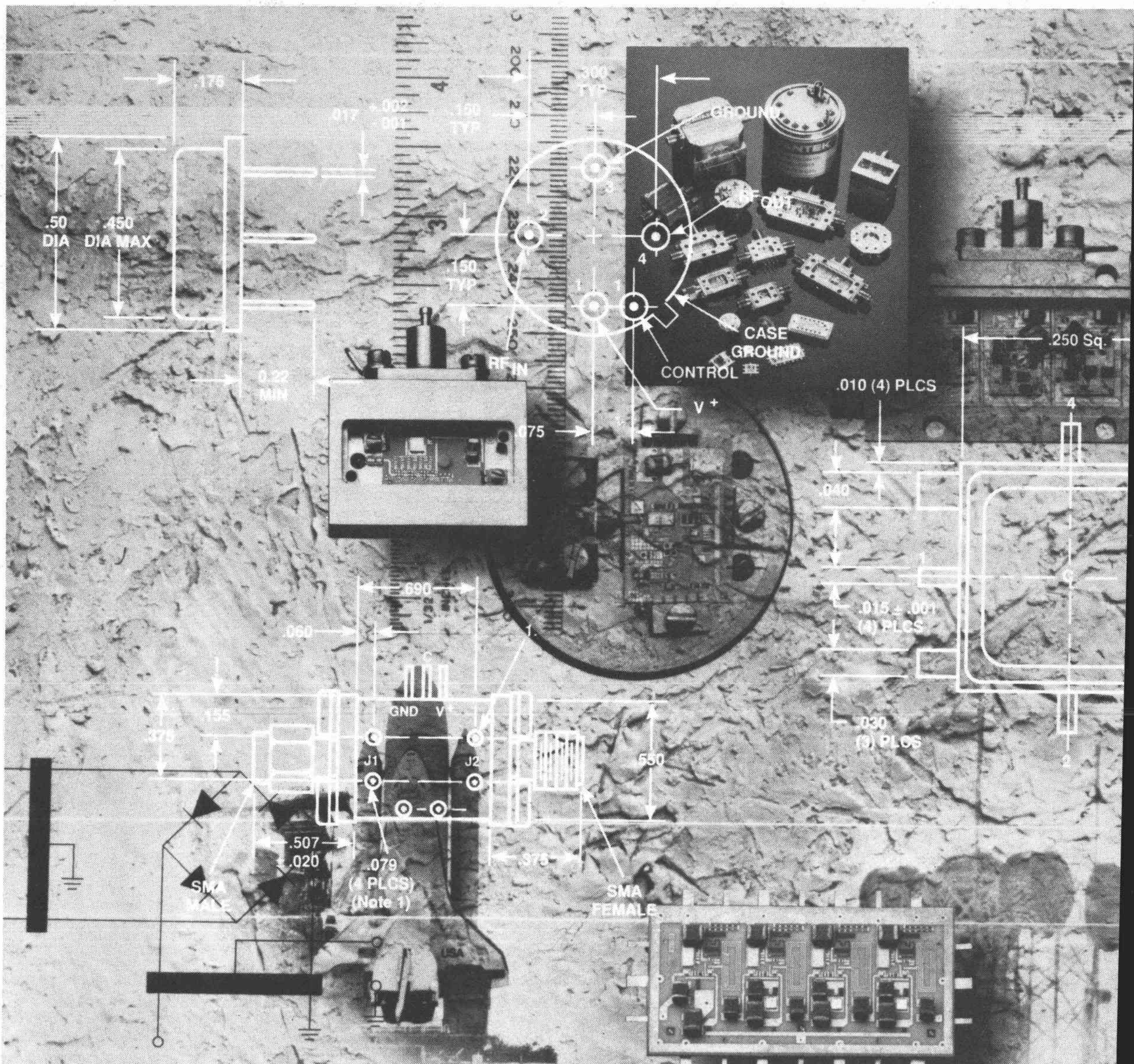


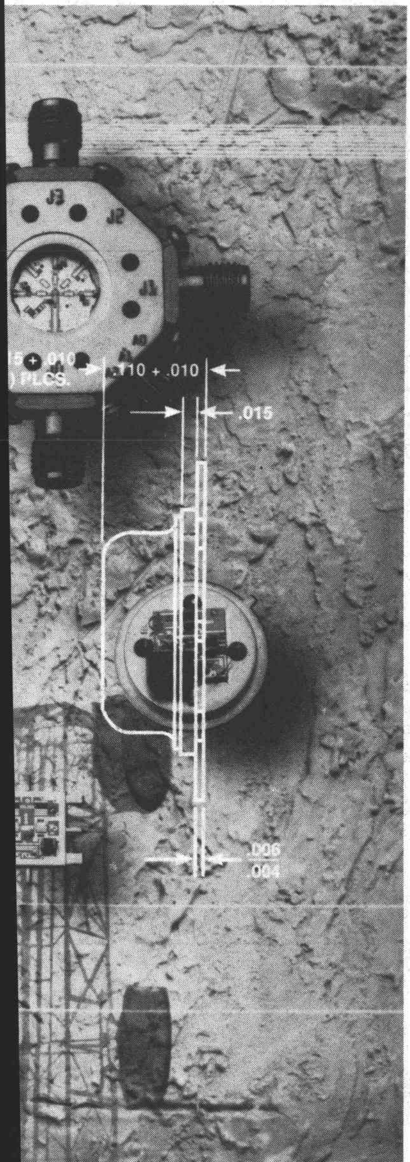









.175
.017 +.002 -.001
.150 TYP
.300 TYP
GROUND
RF OUT
.50 DIA
.450 DIA MAX
.150 TYP
CASE GROUND
CONTROL
RF IN
0.22 MIN
.075
V +
.250 Sq.
.010 (4) PLCS
.040
.015 ± .001 (4) PLCS
.030 (3) PLCS
.690
.060
GND
V +
J1
J2
.155
.375
.550
.507
.020
.079 (4 PLCS) (Note 1)
.375
SMA MALE
SMA FEMALE
USA


.110 + .010
.015
.006
.004

PRODUCT DESCRIPTION

Avantek offers two major categories of detectors: analog level detectors and adjustable threshold detectors. Analog level detectors provide a video output proportional to the input power. Typical applications are amplitude detection, detector log video amplifiers, automatic level control and signal monitoring. Avantek level detectors cover the frequency range of 10 to 2000 MHz and are offered in TO-8 and PlanarPak surface-mount package styles.

Adjustable threshold detectors provide a TTL output that is high or low depending on the RF input power and its relationship to the preset threshold level. Threshold level set can be accomplished with a single external resistor or, in some cases, an external voltage. Typical applications are built-in-test (BIT Detector), channel signal activity monitoring, excessive VSWR indication and gain switch control. Avantek threshold detectors cover the frequency range of 10 MHz to 18 GHz, and are offered in TO-8, surface-mount PlanarPak and Avanpak flat pack package styles.

Temperature compensation, impedance matching, internal amplifier circuitry and guaranteed specifications provide easy-to-use, drop-in solutions for the systems designer.

ANALOG LEVEL DETECTORS

Typical Specifications at 25°C Case Temperature

Model	Frequency Range (MHz)	VSWR (50Ω) Maximum	Sensitivity (V/mW) Typical	Input Flatness (dB) Maximum	Video B/W (kHz) Typical	Power (VDC) Nominal	Case Type	Page Number
PPD-2001	20-2000	1.8	1.0	±.3	150	±15	PP-25DA	5–6

Model	Frequency Range (MHz)	Detected Voltage at P_{IN} = –10 dB (mV), Typ.	Input Flatness (dB), Max.	Tangential Sensitivity w/BW = 1 MHz (dB)	Input Impedance (Ohms)	Input VSWR Maximum	Output Offset Voltage (mV), Typ.	Differential Voltage Tracking (mV), Typ.	Case Type	Page Number
UTD-1000	10-1000	–90	±1.0	–40	50	1.7	±15	±5	TO-8F	5–10
UTD-1001	10-1000	–90	±1.0	–40	300	—	±15	±5	TO-8F	5–10

TTL OUTPUT THRESHOLD DETECTORS

Typical Specifications at 25°C Case Temperature

Model	Frequency Range (MHz)	Input Flatness[1] (dB), Max.	Operating Range (dBm), Typ.	Input VSWR Max.	Control Level Typ.	Voltage Range Min./Max.	Current @15 VDC (mA), Typ.	Case Type	Page Number
UTD-2002[1]	10-2000	±0.7	–10 to +10	1.7	0-1 Volts 300-3K Ohms	+11 to +16	12	TO-8F	5–12
UTD-2004	10-2000	±1.0	–25 to –10	2.0[2]	20-2000 Ohms	+5 to +20	3	TO-8F	5–14
PPD-6002	100-6000	±1.0	–10 to +10	2.0	0-1 Volts 200-3K Ohms	+11 to +16	12	PP-25DD	5–7
ATD-18021	100-18000	±1.5	–25 to –10	3.0	20-2000 Ohms	+5 to +20	3	AT-1	5–3

NOTES: 1. P_{IN} = –10 to +10 dBm.
2. P_{IN} = <–20 dBm.

AVANTEK

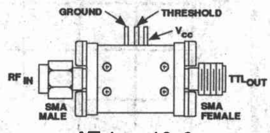
ATD-18021 Threshold Detector 0.1 to 18 GHz

FEATURES

- Frequency Range: 0.1 to 18 GHz
- Sensitive Input: –25 to –10 dBm
- Threshold Externally Programmable with One Resistor
- Temperature Compensated Threshold
- TTL Output
- 2.5 mA (Typ) Power Consumption @ +5 VDC
- Wide Supply Voltage: 5 to 15 V

APPLICATIONS

- System Built-In Test (BIT)
- Channel RF Activity Monitoring
- Excessive VSWR Indicator
- Gain Switch Control



AT-1, p. 16–9

DESCRIPTION

The ATD-18021 is a sensitive microwave threshold detector which provides efficient and accurate RF level measurement at critical systems points. It contains a planar tunnel diode detector, precision integrated circuit operational amp, comparator, voltage regulator, and a temperature-compensated voltage reference assembly. The unit is built with chip and wire construction on a thin-film substrate for small size and ruggedness.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +5 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
—	Frequency (Min.)	0.1-18	0.1-18	0.1-18	GHz
—	Input Operating Range	–25 to –10	–25 to –10	–25 to –10	dBm
—	Input Flatness (Max.)	±0.6	±1.5	±1.5	dB
—	Input VSWR (Max.)				
	$-25 < P_{IN} < -10$ dBm	2.2:1	3.0:1	3.0:1	—
—	Threshold Temperature Stability (Max.)	—	—	±1.5	dB
—	Threshold Hysteresis (Max.)	.7	1.2	1.2	dB
—	Response Time (see Note 1) (Max.)				
	T_{ON}, 90% RF to TTL "1"	20	300	300	µs
	T_{OFF}, 10% RF to TTL "0"	30	300	300	µs
—	Control Resistance at Threshold Level:				
	P_{IN} = –25 dBm	20	—	—	Ω
	P_{IN} = –20 dBm	200	—	—	Ω
	P_{IN} = –10 dBm	2000	—	—	Ω
—	Output Compatability STTL Loads) (Min.)	—	3	3	—
—	Output Voltage (see Note 2)	3.6	2.7	2.7	V
—	Supply Voltage	5-20	5	5	V
—	Supply Current @ +5 VDC (Max.)	2.5	5.0	5.0	mA

NOTES: 1. Response time for input change > 3 dB above CW threshold. R_{LOAD} = 1 MΩ, C_{LOAD} = 80 pF.
2. Output voltage for P_{IN} = > threshold. R_L = 100 KΩ.

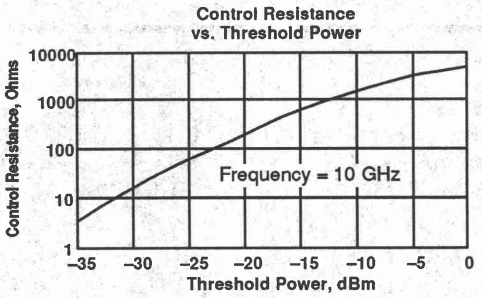
MAXIMUM RATINGS

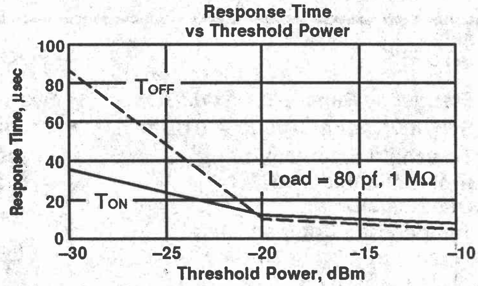
DC Voltage .... +20 Volts
Continuous RF Input Power .... +10 dBm
"R" Series Burn-In Temperature .... 100°C
Operating Case Temperature .... –55°C to +100°C
Storage Temperature .... –55°C to +100°C

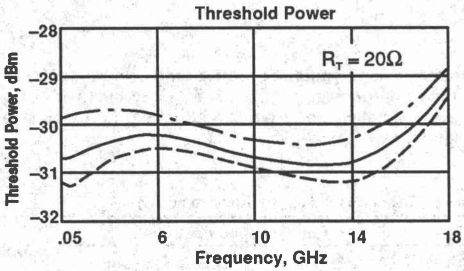
WEIGHT: (typical) 7.1 grams (without connectors)

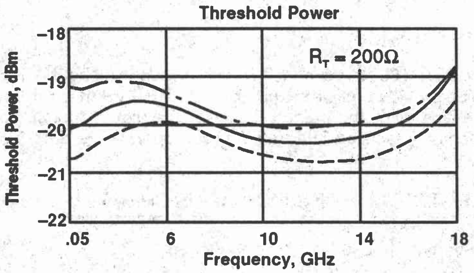
TYPICAL PERFORMANCE OVER TEMPERATURE (@ +5 VDC unless otherwise noted)

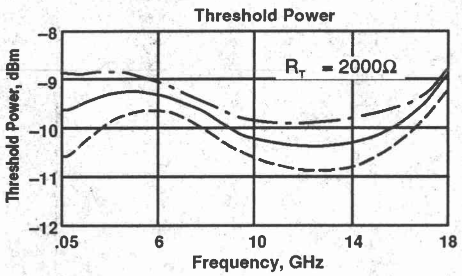
KEY: +25°C ———
+85°C – – – –
–55°C —- · -—

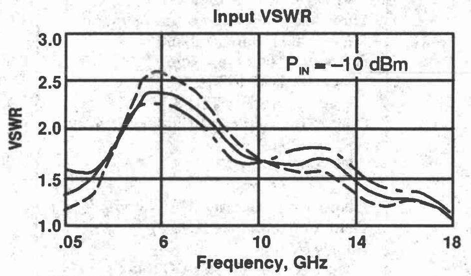




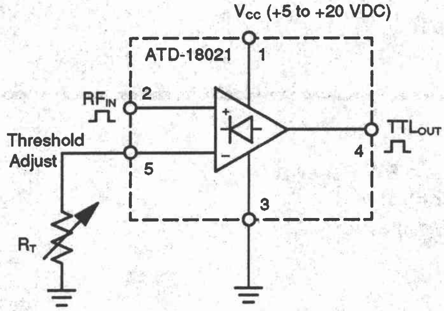








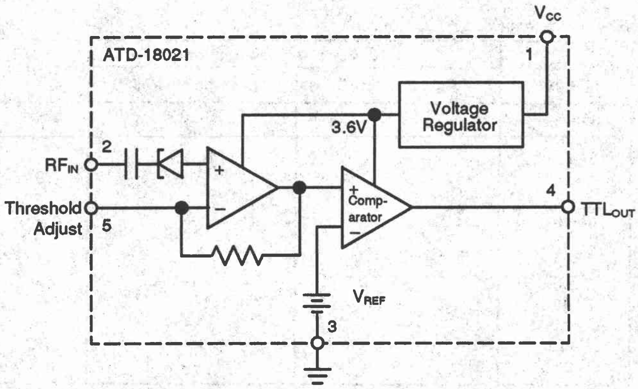
THRESHOLD ADJUST



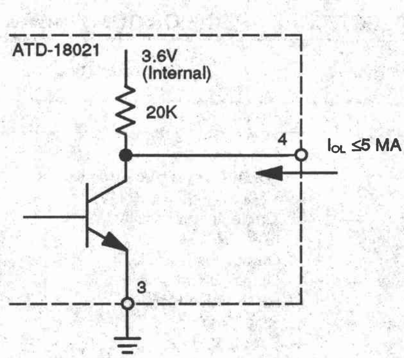
THRESHOLD ADJUST

R_T, Ω	SENSITIVITY dBm (typ)
20	–25
200	–20
2000	–10

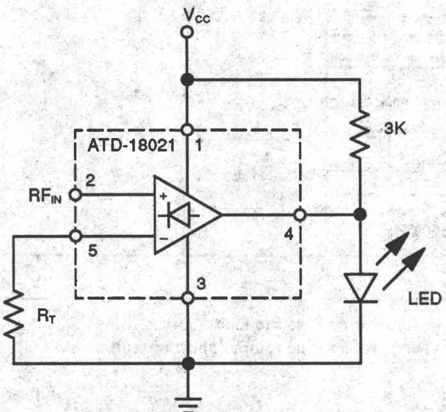
SIMPLIFIED SCHEMATIC



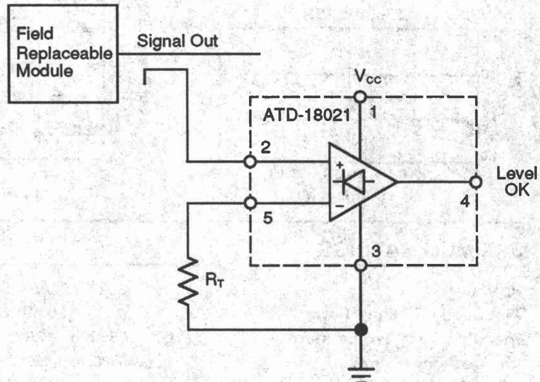
OUTPUT SCHEMATIC



INDICATOR DRIVE CIRCUIT



BUILT-IN TEST DETECTOR



AVANTEK

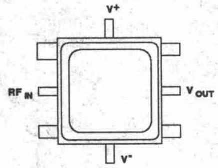
PPD-2001
surface Mount Analog Level Detector
20 to 2000 MHz

FEATURES

- Wideband
- Temperature Compensated
- Low VSWR
- Small Size, Easy to Use

APPLICATIONS

- Broadband EW Receiver
- Level Control
- Signal Monitoring



PP-25DA, p. 16–34

DESCRIPTION

The PPD-2001 is a wideband-sensitive threshold detector which provides efficient and accurate RF level measurement at critical system points. It contains a Schottky diode detector, comparator and a temperature compensated voltage reference assembly. The unit is built with chip and wire construction on a thin-film substrate for small size and ruggedness.

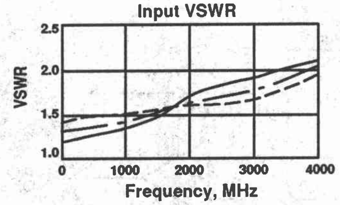
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ ±15 VDC nominal)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
—	Frequency	20-2000	20-2000	20-2000	MHz
—	VSWR (Small Signal) Max.	1.5:1	1.8:1	1.8:1	—
—	Sensitivity, P_{IN} = 0 dBm, Min.	1.0	.9	.9	V
—	Power Flatness, referred to input, Max., (V_{OUT} = 100 mV)	±0.1	±0.3	±0.3	dB
—	Tangential Sensitivity (BW_{VID} = 1 MHz)	–38	—	—	dBm
—	Output Resistance	15	—	—	Ω
—	Output Offset Drift	±5	—	—	mV
—	RF to Video Isolation	40	—	—	dB
—	Rise Time	2.0	—	—	µs
—	Supply Voltage	±15	—	—	VDC
—	Supply Current	2.0	—	—	mA

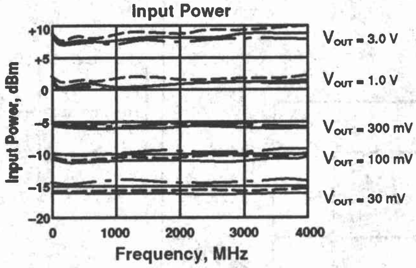
TYPICAL PERFORMANCE OVER TEMPERATURE (@ ±15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C — — — —
–55°C —·—·—

Input VSWR



Input Power



MAXIMUM RATINGS

DC Voltage .... ±22 Volts
Continuous RF Input Power .... +20 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... 125°C

Temperature Rise (no load) .... 9°C
Temperature Rise (output short circuit) .... 30°C

*For further information, see High Reliability section, p. 17–2.

WEIGHT: (typical) .21 grams

AVANTEK

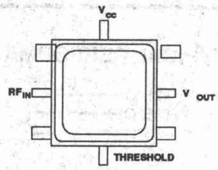
PPD-6002
Threshold Detector
.1 to 6 GHz

FEATURES

- Frequency Range: 0.1 to 6 GHz
- Threshold Externally Programmable with One Resistor or Voltage
- Temperature Compensated Threshold
- TTL Output
- 12 mA (typ) Power Consumption @ +15 VDC
- Surface Mount Package

APPLICATIONS

- System Built-In Test (BIT)
- Channel RF Activity Monitoring
- Excessive VSWR Indicator
- Gain Switch Control
- Surface Mount Assembly



PP-25DD, p. 16–34

DESCRIPTION

The PPD-6002 is a sensitive microwave threshold detector which provides efficient and accurate RF level measurement at critical system points. It contains a Schottky diode detector, a precision integrated circuit operational amp, comparator and a temperature compensated voltage reference assembly. The unit is built with chip and wire construction on a thin-film substrate for small size and ruggedness.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications $T_C = 0°$ to $50°C$	Guaranteed Specifications $T_C = -55°$ to $+85°C$	Unit
—	Frequency (Min.)	.1-6	.1-6	.1-6	GHz
—	Input Flatness (Max.)				
	$P_{IN} = -10$ to $+10$ dBm	±0.7	±1.0	±1.0	dB
—	Input Operating Range	–10 to +10	–10 to +10	–10 to +10	dBm
—	Input VSWR (Max.)				
	$P_{IN} = -10$ dBm	1.5:1	2.0:1	2.0:1	—
—	Input Power (Max.)	+15	+15	+15	dBm
—	Threshold Temp. Stability (Max.)				
	@ –10 dBm Input Power		±1.0	±1.5	dB
	@ 0 dBm Input Power		±1.7	±1.0	dB
	@ +10 dBm Input Power		±0.5	±0.7	dB
—	Threshold Control Level				
	@ –10 dBm Input Power	75/220	—	—	mV/Ω
	@ 0 dBm Input Power	250/800	—	—	mV/Ω
	@ +10 dBm Input Power	900/3100	—	—	mV/Ω
—	Threshold Hysteresis				
	Resistance Control	0.5	—	—	dB
	Voltage Control	0.1	—	—	dB
—	Control Terminal Current	0.3	—	—	mA
—	Output Compatibility	TTL	TTL	TTL	—
—	Output at P_{IN} Threshold (Min.)	2.7	2.7	2.7	V
—	Output Short Circuit Current (Min.)	3.0	3.0	3.0	mA
—	Output Sink Current (Min.)				
	$V_0 = 0.7$ V	2.0	2.0	2.0	mA
—	Output for Input Power Change				
	> 3 dB above CW Threshold				
	Rise Time	30	—	—	ns
	Fall Time	80	—	—	ns
	Propagation Delay	1000	—	—	ns
—	Supply Voltage				
	As Specified	+15	—	—	VDC
	Operational	+11 to +16	—	—	VDC
—	Supply Current				
	@ +15 Volts (Max.)	12	15	15	mA
—	Package	PP-25DD	—	—	—

MAXIMUM RATINGS

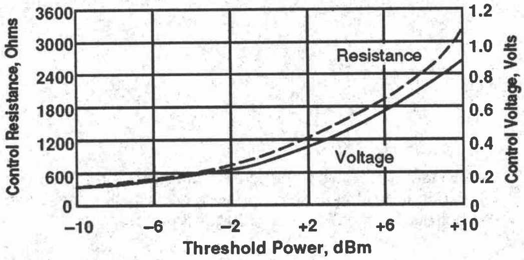
DC Voltage	+17 Volts	Operating Case Temperature	–55°C to +125°C
DC Voltage Reference	+2 Volts	Storage Temperature	–62°C to +150°C
Continuous RF Input Power	+15 dBm	"R" Series Burn-In Temperature	125°C

WEIGHT: (typical) 0.21 grams

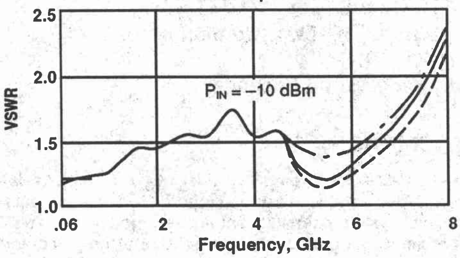
TYPICAL PERFORMANCE OVER TEMPERATURE (@ +15 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – –
–55°C —·—

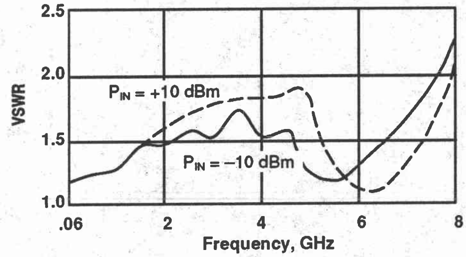
Control Resistance and Control Voltage vs. Threshold Power



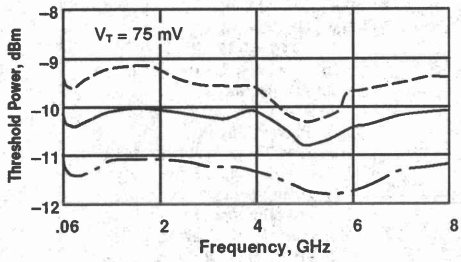
Input VSWR vs Frequency and Temperature



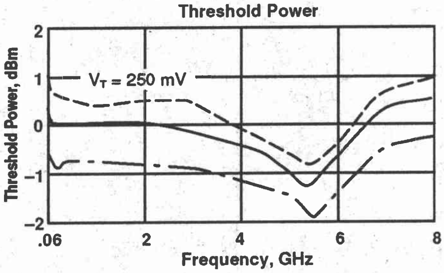
Input VSWR vs Frequency and Drive Level



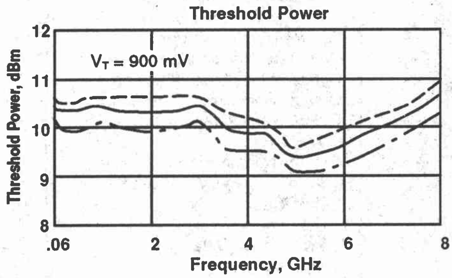
Threshold Power



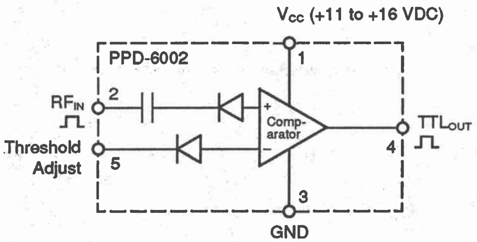
Threshold Power



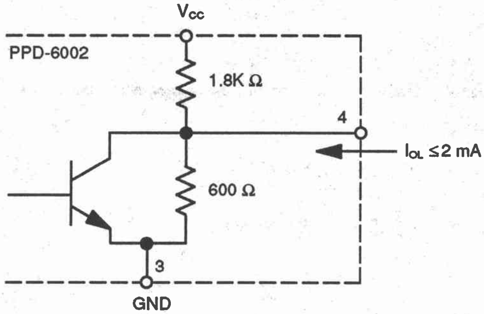
Threshold Power



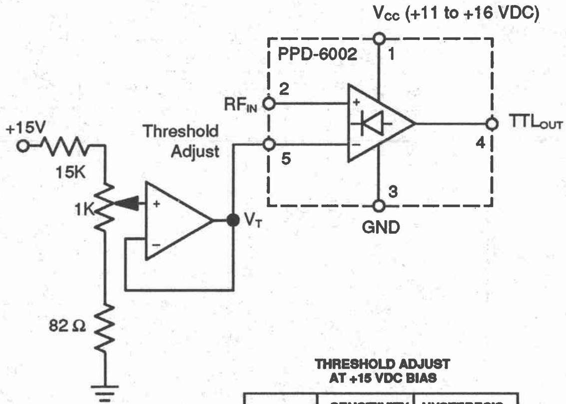
SIMPLIFIED SCHEMATIC



OUTPUT SCHEMATIC



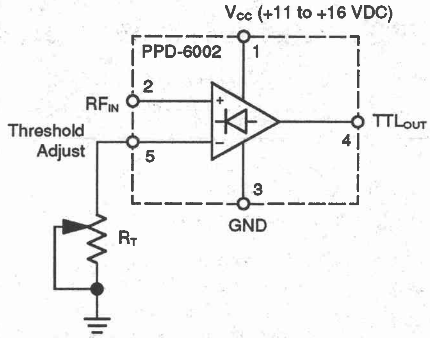
VOLTAGE CONTROL



THRESHOLD ADJUST AT +15 VDC BIAS

V_T	SENSITIVITY (Typ)	HYSTERESIS (Typ)
75 mV	−10 dBm	0.1 dB
250 mV	0 dBm	0.1 dB
900 mV	+10 dBm	0.1 dB

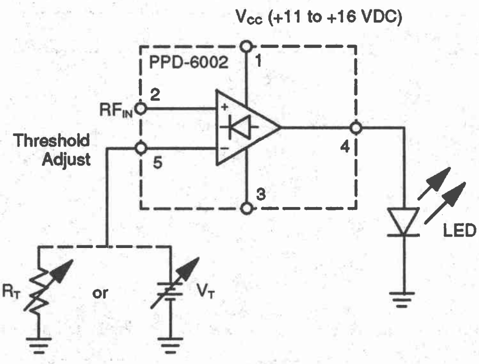
RESISTIVE CONTROL



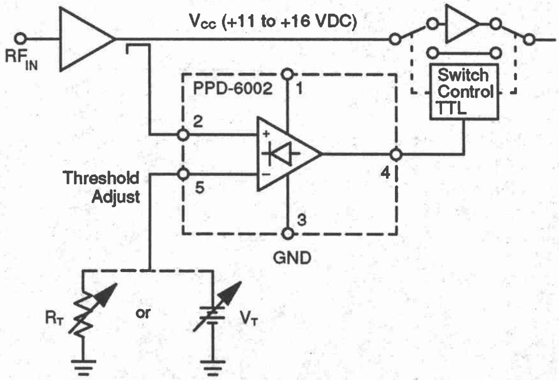
THRESHOLD ADJUST AT +15 VDC BIAS

R_T	SENSITIVITY (Typ)	HYSTERESIS (Typ)
220 Ω	−10 dBm	0.5 dB
800 Ω	0 dBm	0.5 dB
3100 Ω	+10 dBm	0.5 dB

INDICATOR DRIVE



RECEIVER GAIN ADJUST



AVANTEK

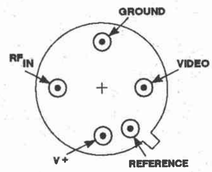
UTD-1000/1001
Analog Level Detectors
10 to 1000 MHz

FEATURES

- –120 mV Output for –10 dBm Pin
- ±1.0 dB Flatness
- 50- or 300-ohm Impedance

APPLICATIONS

- Specifically Designed for System Built–in Test
- RF/IF Level Monitor
- Level Control
- UTD-1001 Can Be Used Without a Coupler in Many Cases



TO-8F, p. 16–47

DESCRIPTION

The UTD-1000 has an input impedance of 50 ohms. The UTD-1001 has an input impedance of greater than 300 ohms. In all other respects the detectors are similar. The level detector consists of an active high-to-low impedance converter that drives a Schottky-barrier detector diode. Matched back-to-back silicon diodes which are closely thermally-coupled to the detector provide a DC tracking reference.

ELECTRICAL SPECIFICATIONS (Measured at +15 VDC nominal)

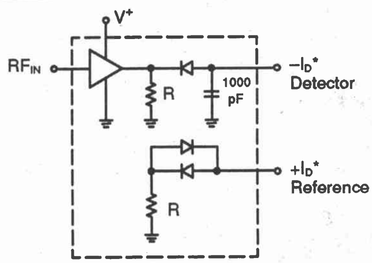
Symbol	Characteristic	Typical $T_c = 25°C$	Guaranteed Specifications		Unit
			$T_c = 0°$ to $50°C$	$T_c = -55°$ to $+85°C$	
—	Detected Voltage (Min.) f = 500 MHz, cond.[1,2]	–120	–90	—	mV
—	Flatness (referred to input) (Max.) f = 10-1000 MHz, cond.[1,2]	±0.7	±1.0	—	dB
—	Variation Over Temperature (referred to input) f = 500 MHz, cond.[1,2]	±1.0		—	dB
—	Tangential Sensitivity (TSS) (Min.) f = 500 MHz, BW_{VIDEO} = 1 MHz, cond.[1]	–45	–40	—	dB
—	Input VSWR, 50 Ω (UTD-1000 only) (Max.) f = 10-500 MHz	1.5:1	1.7:1	—	—
—	Input Impedance (UTD-1001 only)				
	Equivalent resistance	300Ω	—	—	—
	Equivalent capacitance	3.3 pf	—	—	—
—	Input 3rd Order Intercept Point f = 10-500 MHz	+20	—	—	dBm
—	Output Offset Voltage (Max.) $I_D = I_{REF} = 50$ µA, no RF drive	±10.0	±15.0	—	mV
—	Differential Voltage Tracking	±5.0	—	—	mV
—	Output Capacitance (Max.)	1000	1300	—	pf

CONDITIONS 1: I_D = 50 µA, R = 10K Ω
2. P_{IN} = –10 dBm (RF input)

MAXIMUM RATINGS

Bias Current (diode) .... 1 mA
Continuous RF Input Power .... +17.0 dBm
Operating Case Temperature .... –54°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... 125°C
Pulse Input Power (1.0 minute max.) .... 100 mW
Junction Temperature Above Case Temperature .... 3°C

SCHEMATIC



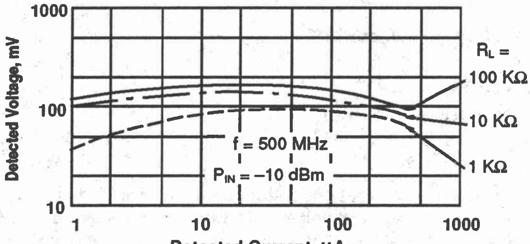
*Requires external bias resistors see "Application Note", page 14–28

WEIGHT: (typical) 2.1 grams

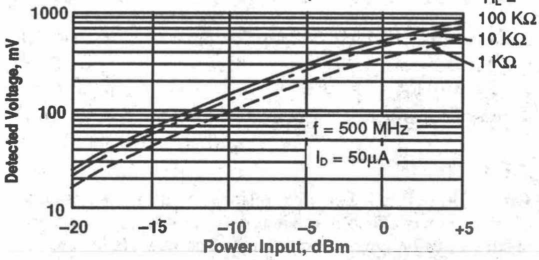
TYPICAL PERFORMANCE @ 25°C

KEY: +25°C ————
+85°C — — — —
–55°C —— - ——

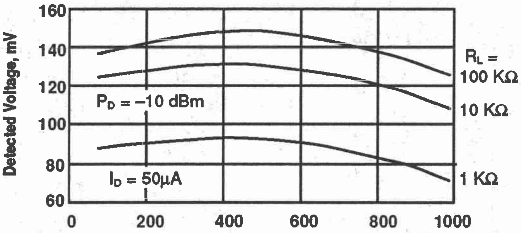
Detected Output
vs. Diode Bias Current



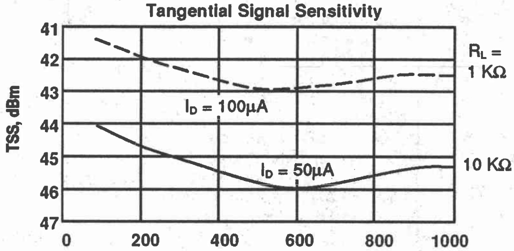
Detected Output
vs. Power Input



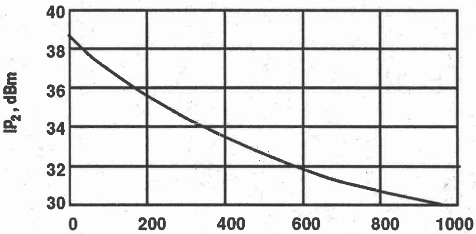
DC Output



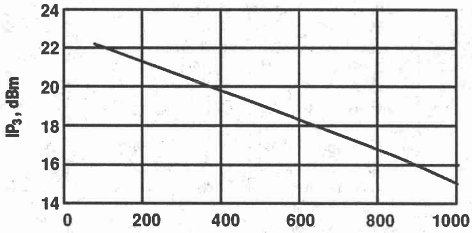
Tangential Signal Sensitivity



Second Order Two–Tone*
Intercept Point



Third Order Two–Tone*
Intercept Point



*Distortion Curves relative to the UTD-1001 operated in shunt with a 50 RF line.
(See "Application Note" on page 14–28.)

AVANTEK

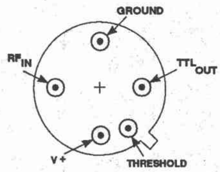
UTD-2002
Threshold Detector
10 to 2000 MHz

FEATURES

- Externally Set Threshold
- TTL Output
- Low VSWR
- 20dB Threshold Range

APPLICATIONS

- Specifically Designed for System Built–In Test
- Built for Retrofitting
- Channel RF Activity Monitoring



TO-8F, p. 16–47

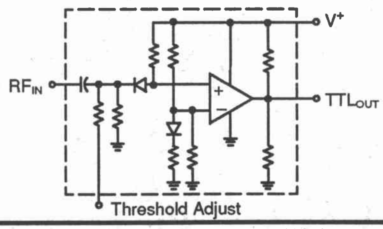
DESCRIPTION

The UTD-2002 is a sensitive microwave threshold detector which provides efficient and accurate RF level measurement at critical system points. It contains a Schottky diode detector, comparator, and a temperature compensated voltage reference assembly. The unit is built with chip and wire construction, on a thin-film substrate for small size and ruggedness.

ELECTRICAL SPECIFICATIONS (Measured in a 50 Ohm system @ +15 VDC nominal unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 50°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
—	Frequency Range (Min.)	10-2000	10-2000	10-2000	MHz
—	Input Flatness (Max.)				
	P_{IN} = –10 to +10 dBm	±0.5	±0.7	±1.0	dB
—	Input Operating Range	–10 to +10	–10 to +10	–10 to +10	dBm
—	Input VSWR (Max.)	1.3:1	1.7:1	2.0:1	—
—	Input Power (Max.)	+15	+15	+15	dBm
—	Threshold Temp. Stability (Max.)				
	@ –10 dBm Input Power		±1.0	±1.5	dB
	@ 0 dBm Input Power		±0.7	±1.0	dB
	@ +10 dBm Input Power		±0.5	±0.7	dB
—	Threshold Control Level				
	@ –10 dBm Input Power	90 mV/300	—	—	Ω
	@ 0 dBm Input Power	280 mV/900	—	—	Ω
	@ +10 dBm Input Power	900 mV/2900	—	—	Ω
—	Threshold Hysteresis (Max.)				
	Resistance Control	1.0	—	—	dB
	Voltage Control	0.1	—	—	dB
—	Control Terminal Current	0.3	—	—	mA
—	Output Compatibility	TTL	TTL	TTL	—
—	Output at P_{IN} Threshold (Min.)	2.7	2.7	2.7	V
—	Output Short Circuit Current (Min.)	3.0	3.0	3.0	mA
—	Output Sink Current (Min.)				
	V_o = 0.7 V	2.0	2.0	2.0	mA
—	Output for Input Power Change				
	> 3 dB above CW Threshold				
	C_L = 15 pF	—	—	—	—
	Rise Time	30	—	—	ns
	Fall Time	80	—	—	ns
	Propagation Delay	1000	—	—	ns
—	Supply Voltage				
	As Specified	+15	—	—	VDC
	Operational	+11 to +16	—	—	VDC
—	Supply Current				
	@ +15 Volts	12	15	15	mA

SCHEMATIC



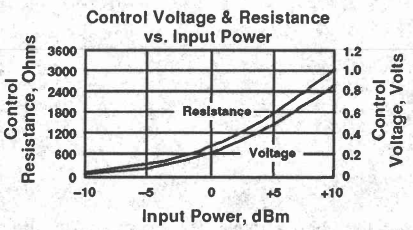
MAXIMUM RATINGS

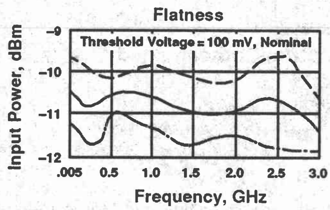
DC Voltage .... +17 Volts	Storage Temperature .... –62°C to +150°C
Continuous RF Input Power .... +15.0 dBm	"R" Series Burn-In Temperature .... 125°C
Operating Case Temperature .... –55°C to +125°C	DC Voltage Reference .... +12 Volts

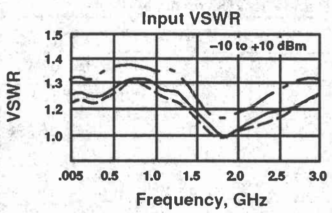
WEIGHT: (typical) 2.1 grams

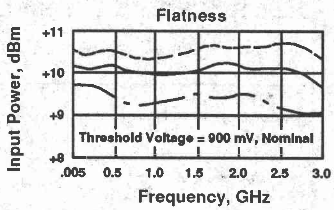
TYPICAL PERFORMANCE @ 25°C

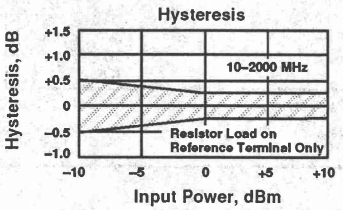
KEY: +25°C ———
+85°C — — —
–55°C — - —

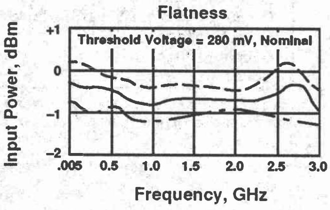












AVANTEK

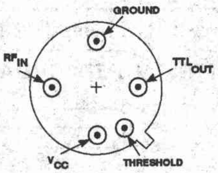
UTD-2004
Threshold Detector
10 to 2000 MHz

FEATURES

- Frequency Range: 10 to 2000 MHz
- Sensitive Threshold: –25 dBm
- Threshold Externally Programmable with One Resistor
- Wide Threshold Range: –25 to –10 dBm
- TTL Output
- Temperature Compensated Threshold
- 2.5 mA (Typ) Power Consumption @ +5 VDC

APPLICATIONS

- Specifically Designed for System Built-In Test
- Built for Retrofitting
- Channel RF Activity Monitoring



TO-8F, p. 16–47

DESCRIPTION

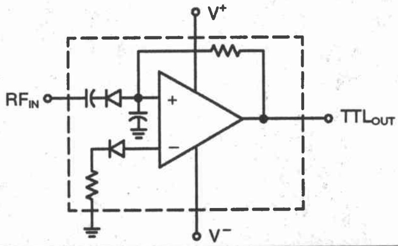
The UTD-2004 is a sensitive microwave threshold detector which provides efficient and accurate RF level measurement at critical systems points. It contains a planar tunnel diode detector, precision integrated circuit operational amp, comparator, voltage regulator, and a temperature compensated voltage reference assembly. The unit is built with chip and wire construction on a thin-film substrate for small size and ruggedness.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC and –15 VDC nominal)

Symbol	Characteristic	Typical T = 25°C	Guaranteed Specifications T = 0° to 50°C	T = –55° to +85°C	Unit
—	Frequency, (Min.)	10-2000	10-2000	100-2000	MHz
—	Input Operating Range	–25 to –10	–25 to –10	–25 to –10	dBm
—	Input Flatness, (Max.)	±.5	±1.0	±1.0	dB
—	Input VSWR, (Max.):				
	$-25 < P_{IN} < -20$ dBm	1.5:1	2.0:1	2.0:1	—
	$-20 < P_{IN} < -10$ dBm	1.8:1	2.2:1	2.2:1	—
—	Threshold Temperature Stability, (Max.)	—	—	±1.5	dB
—	Threshold Hysteresis, (Max.)	1.0	1.2	1.2	dB
—	Response Time (see Note 1), (Max.)				
	T_{ON}, 90% RF to TTL "1"	20	300	300	µs
	T_{OFF}, 10% RF to TTL "0"	30	300	300	µs
—	Control Resistance at Threshold Level:				
	$P_{IN} = -25$ dBm	20	—	—	Ω
	$P_{IN} = -20$ dBm	200	—	—	Ω
	$P_{IN} = -10$ dBm	2000	—	—	Ω
—	Output Compatability (S-TTL Loads), (Min.)	—	3	3	—
—	Output Voltage (see Note 2)	2.7	—	—	V
—	Supply Voltage	5-20	5	5	V
—	Supply Current @ +5 VDC (Max.)	2.5	5.0	5.0	mA

NOTES: 1. Response time for input change > 3 dB above CW threshold. $R_{LOAD} = 1$ M Ω, $C_{LOAD} = 80$ pF.
2. Output voltage for P_{IN} = > threshold. $R_{LOAD} = 1$ M Ω.

SCHEMATIC



MAXIMUM RATINGS

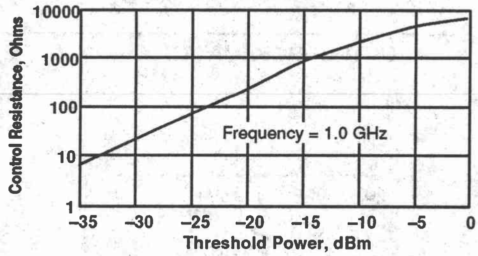
DC Voltage	+20 Volts	Operating Case Temperature	−55°C to +100°C
Continuous RF Input Power	+10 dBm	Storage Temperature	−55°C to +100°C
"R" Series Burn-In Temperature	100°C		

WEIGHT: (typical) 2.1 grams

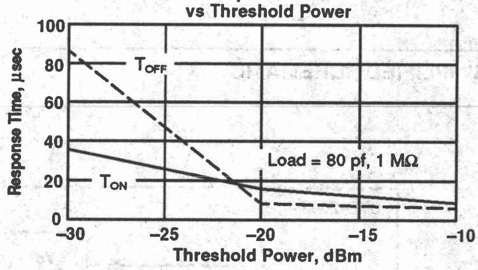
TYPICAL PERFORMANCE OVER TEMPERATURE (@ +5 VDC unless otherwise noted)

KEY: +25°C ———
+85°C – – – –
−55°C —— · ——

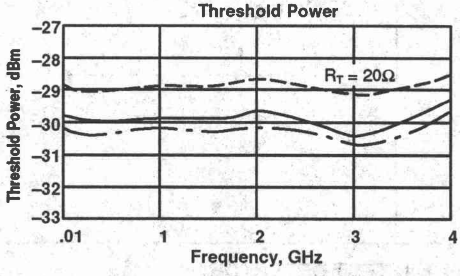
Control Resistance
vs. Threshold Power



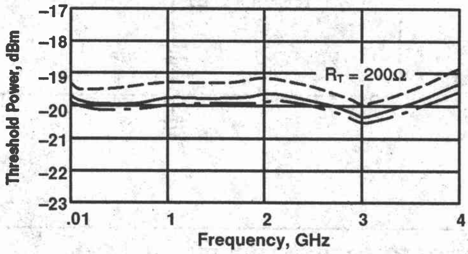
Response Time
vs Threshold Power



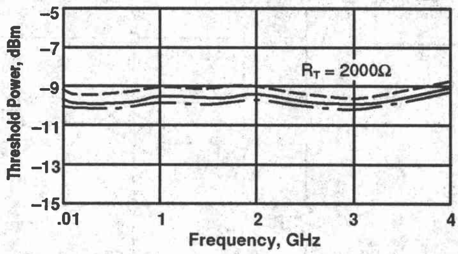
Threshold Power



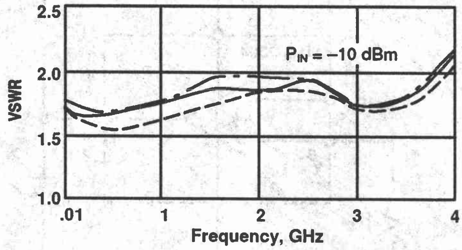
Threshold Flatness



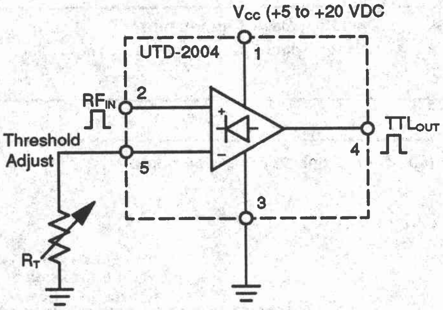
Threshold Power



Input VSWR



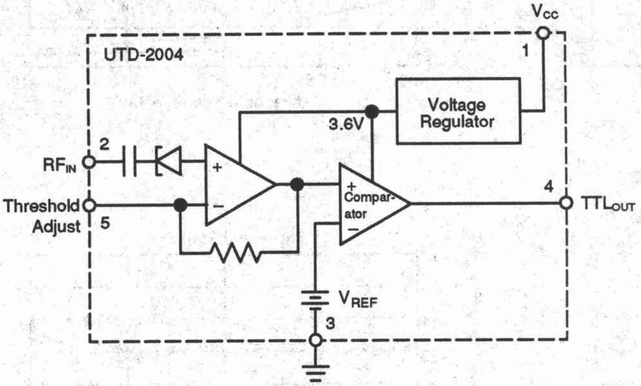
THRESHOLD ADJUST



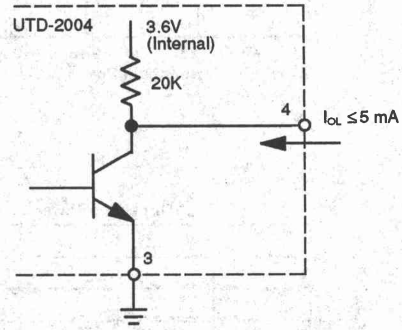
THRESHOLD ADJUST
AT +15 VDC BIAS

R_T, Ω	SENSITIVITY dBm (typ)
20	–25
200	–20
2000	–10

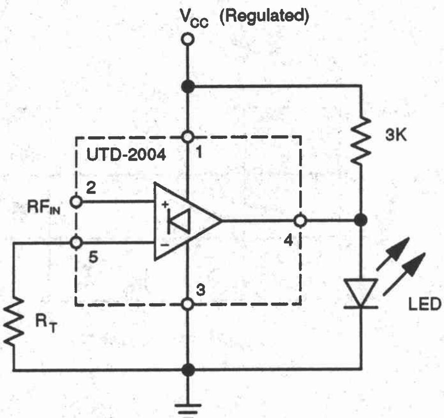
SIMPLIFIED SCHEMATIC



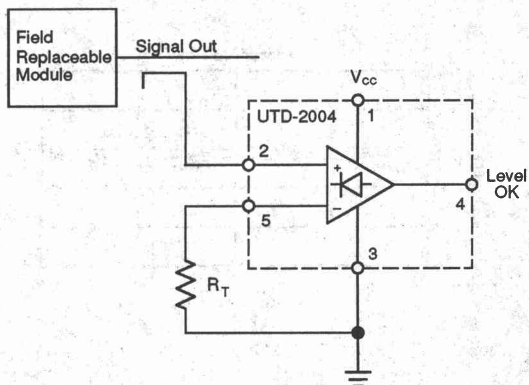
OUTPUT SCHEMATIC

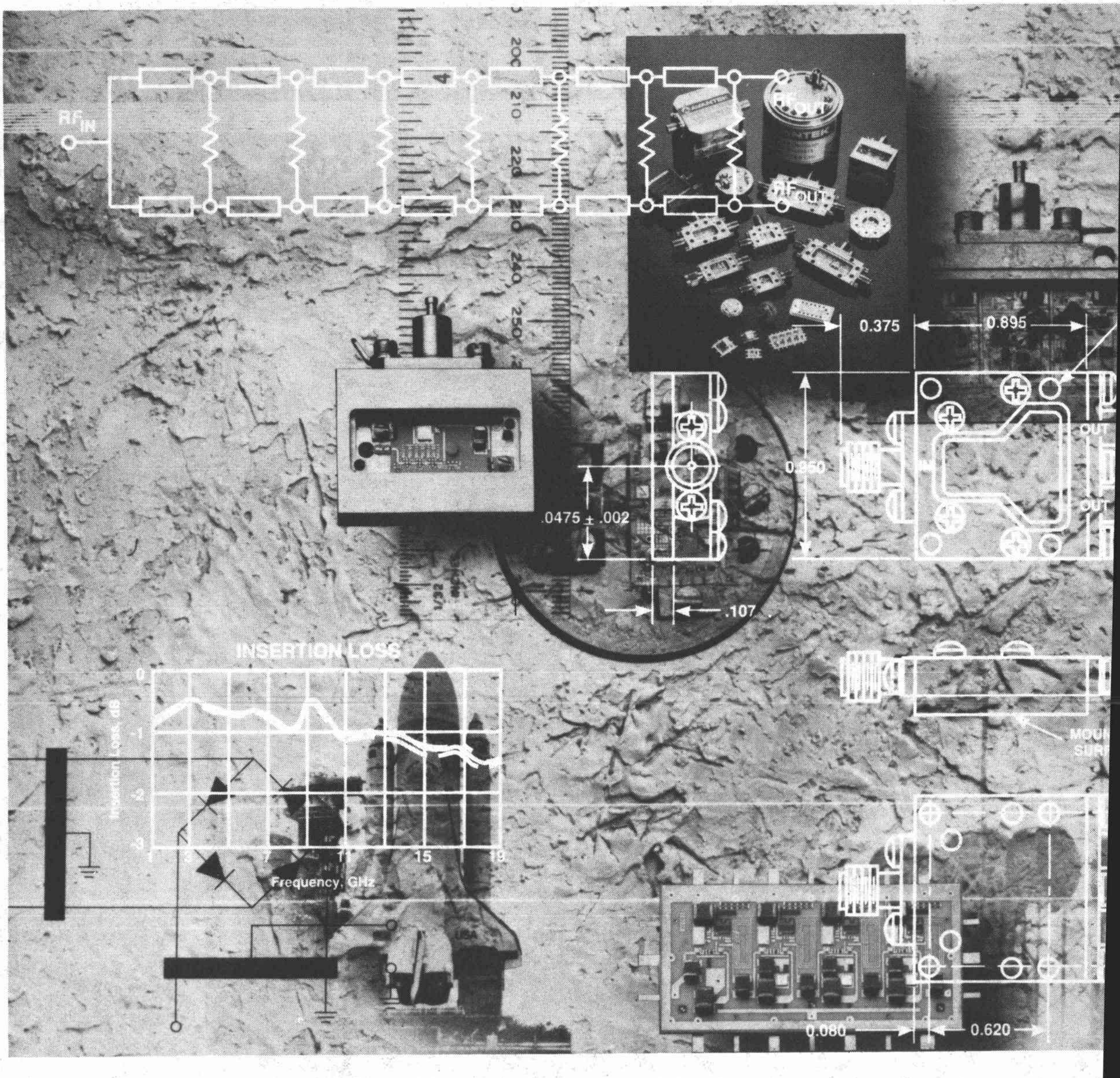


INDICATOR DRIVE CIRCUIT



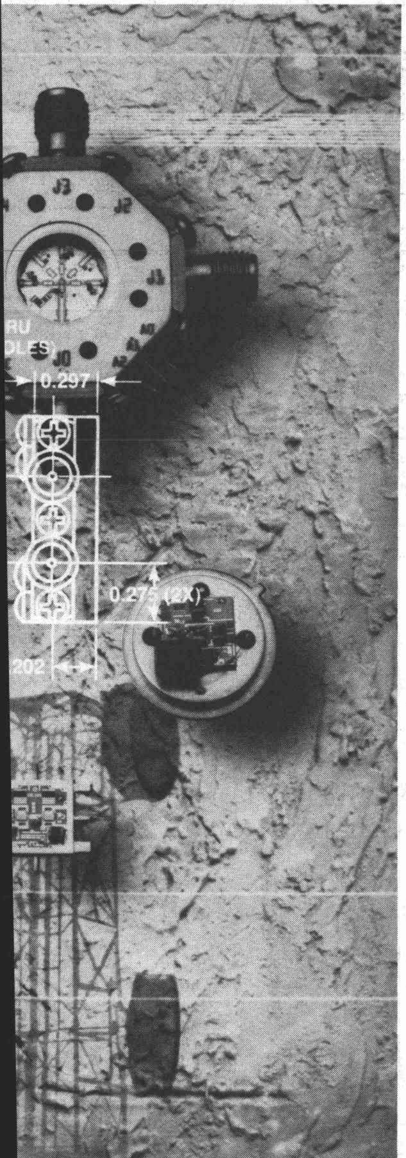
BUILT-IN TEST DETECTOR





RF_{IN}
RF_{OUT}
RF_{OUT}
0.375
0.895
0.250
.0475 ± .002
.107
INSERTION LOSS
Insertion Loss, dB
Frequency, GHz
0.080
0.620

THIN-FILM PASSIVES



PRODUCT DESCRIPTION

The SPT splitter uses distributed elements fabricated with Avantek's thin-film technology on an alumina substrate and packaged in a hermetic package. Featuring low-loss circuitry, the SPT splitter provides an even split in power between the two output ports over the extremely wide frequency range. All ports are well-matched to 50 ohms minimizing the amount of reflection on the input and output side. The Avantek splitter is excellent for driving two systems from a single signal source.

THIN-FILM SPLITTER

Guaranteed Specifications at 0° to 50°C Case Temperature

Model	Frequency Range (Minimum) (GHz)	Insertion Loss (Maximum) (dB)	Flatness (Maximum) (dB)	Isolation (Minimum) (dB)	VSWR Input/Output (Maximum)	Amplitude Balance (Maximum) (dB)	Phase Balance (Maximum) (Deg)	Case Type	Page Number
New SPT-1821	2-18	1.3	±0.7	17	2.0:1/1.7:1	±0.3	±4.0	SPT	6–3
SPT-1822	2-18	1.8	±0.7	15	2.0:1/1.7:1	±0.3	±8.0	SPT	6–3

LOW PASS FILTERS, SURFACE MOUNT PLANARPAK

Guaranteed Specifications at 0° to 55°C Case Temperature

Model	Passband Frequency Range (Minimum) (GHz)	Stopband Frequency Range (Maximum) (GHz)	Passband Insertion Loss (Maximum) (dB)	Stopband Insertion Loss (Minimum) (dB)	Passband VSWR Input (Maximum)	Case Type	Page Number
PLP-105	DC-1	2.3–5.5	1.2	35	1.5:1	PLP	6–6
New PLP-207	DC-2	3.5–7.5	1.5	35	1.5:1	PLP	6–8
PLP-407	DC-4	7.5–15	1.5	30	2.0:1	PLP	6–10

AVANTEK

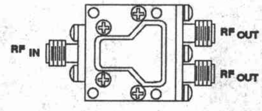
SPT-1821/1822
Thin-Film Power Splitters/Combiners
2 to 18 GHz

FEATURES

- Frequency Range: 2 to 18 GHz
- Excellent Phase and Amplitude Tracking
- Low Insertion Loss: < 1.4 dB (Typ)
- High Isolation: > 20 dB (Typ)
- Stainless Steel, Hermetic Case
- Field Replaceable Connectors
- Thin-Film Reliability

APPLICATIONS

- Local Oscillator Signal Splitting
- Systems Requiring Matched Output Signals From One Source
- EW Receiver Systems
- Applications Requiring High Isolation Between Channels
- Broadband Systems



SPT, p. 16–41

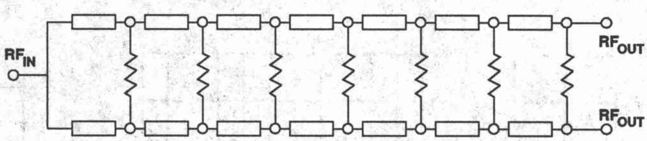
DESCRIPTION

The SPT-1821 and -1822 are 2 to 18 GHz, 3 dB power splitters/combiners designed for use in either connectorized or microstripline systems. These splitters use a thin-film distributed element design to achieve excellent performance over the entire 2 to 18 GHz band. Insertion loss is typically below 1.4 dB, isolation between output ports is greater than 20 dB (typ), and VSWR is better than 1.5:1 (typ). Avantek's thin-film approach allows for precise control of the circuit fabrication process, resulting in excellent phase and amplitude matching between output ports. Amplitude matching is typically within ±0.1 dB while phase matching is within 3 degrees. These components are packaged in hermetically-sealed stainless steel cases for use in demanding applications. Both models provide the unique feature of field replaceable, removable connectors for use in connecterized or stripline applications.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Symbol	Characteristic	Typical $T_c = 25°C$	Guaranteed Specifications $T_c = 0°$ to 50°C		Guaranteed Specifications $T_c = -55°$ to +85°C		Unit
			SPT-1821	SPT-1822	SPT-1821	SPT-1822	
BW	Frequency Range	2–18	2–18	2–18	2–18	2–18	GHz
—	Insertion Loss (Max.)	1.4	1.4	1.8	1.5	2.0	dB
—	Flatness (Max.)	±0.5	±0.7	±0.7	±0.7	±0.7	dB
—	Isolation (Min.)	20	17	15	17	15	dB
—	Input VSWR (Max.)	1.5:1	2.0:1	2.0:1	2.0:1	2.0:1	—
—	Output VSWR (Max.)	1.4:1	1.7:1	1.7:1	1.7:1	1.7:1	—
—	Amplitude Balance (Max.)	±0.1	±0.3	±0.3	±0.3	±0.3	dB
—	Phase Balance (Max.)	±3.0	±4.0	±8.0	±4.0	±8.0	Degrees
—	Case Dimensions:						
	Length (with connectors)	1.65/4.2					in./cm
	Width	0.95/2.4					in./cm
	Height (with spacer)	0.30/.76					in./cm

SCHEMATIC



MAXIMUM RATINGS

CW Input Power (any port) .... +20 dBm
CW Input Power with Input and Output Ports Matched to 50 ohms .... +33 dBm
Operating Case Temperature .... –62°C to +125°C
Storage Temperature .... –55°C to +150°C
"R" Series Burn-In Temperature .... +125°C

WEIGHT: 32 grams with Connectors and Spacer

AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

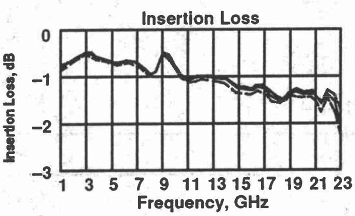
S-PARAMETERS

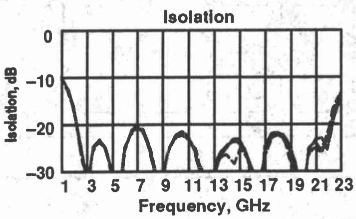
FREQ	S_{11}		S_{21}		S_{12}		S_{22}		GPDEL	PHASE
GHz	Mag	Ang	dB	Ang	dB	Ang	Mag	Ang	ns	DEG
1.000	.30	106.9	−3.82	−112.4	−3.8	−112.4	.05	1.43	.31	
1.500	.27	66.9	−3.74	−168.2	−3.7	−168.0	.04	88.73	.31	
2.000	.22	26.8	−3.64	135.5	−3.6	135.8	.09	24.89	.31	−7.21
2.500	.16	−17.6	−3.55	78.8	−3.5	79.0	.09	−34.28	.31	−5.80
3.000	.06	−67.7	−3.47	21.6	−3.5	21.7	.06	−87.05	.32	−4.86
3.500	.05	45.0	−3.52	−36.1	−3.5	−35.9	.02	−66.48	.32	−4.31
4.000	.12	−5.4	−3.62	−93.0	−3.6	−92.8	.07	−72.79	.32	−3.13
4.500	.11	−39.3	−3.64	−149.9	−3.6	−149.7	.12	−125.88	.32	−1.80
5.000	.13	−52.1	−3.68	152.9	−3.7	153.1	.14	173.65	.32	−.73
5.500	.17	−90.3	−3.72	96.0	−3.7	96.1	.14	110.77	.32	.53
6.000	.14	−137.7	−3.68	38.8	−3.7	39.0	.12	48.56	.32	1.55
6.500	.06	−177.1	−3.66	−19.1	−3.7	−18.8	.09	7.85	.32	1.90
7.000	.03	−71.7	−3.74	−77.0	−3.7	−76.7	.10	−6.61	.32	2.25
7.500	.13	−97.1	−3.85	−134.6	−3.8	−134.3	.16	−33.25	.32	2.61
8.000	.22	−147.7	−3.98	168.5	−3.9	169.1	.19	−75.69	.32	3.79
8.500	.25	149.5	−3.91	112.3	−3.8	112.2	.18	−115.49	.31	5.71
9.000	.17	75.9	−3.50	54.5	−3.5	53.7	.16	−135.37	.32	5.97
9.500	.08	−16.5	−3.53	−6.7	−3.6	−6.5	.16	−173.87	.34	3.01
10.000	.11	−147.6	−3.79	−65.5	−3.8	−65.1	.15	160.11	.32	2.66
10.500	.16	133.6	−3.99	−123.1	−4.0	−122.8	.16	121.85	.32	3.09
11.000	.19	70.1	−4.07	179.5	−4.1	179.8	.15	74.96	.32	3.56
11.500	.17	7.4	−4.04	121.7	−4.1	122.1	.13	25.36	.32	4.17
12.000	.12	−55.2	−4.01	63.3	−4.0	63.8	.12	−12.36	.32	4.18
12.500	.06	−119.2	−4.01	4.5	−4.0	4.8	.12	−38.86	.33	3.47
13.000	.05	136.6	−4.04	−54.2	−4.0	−54.1	.16	−65.54	.33	2.91
13.500	.11	39.1	−4.04	−113.1	−4.0	−113.1	.18	−106.88	.33	2.00
14.000	.18	−36.0	−4.08	−172.3	−4.1	−172.4	.17	−147.99	.33	.93
14.500	.19	−108.0	−4.19	128.4	−4.2	128.6	.15	171.10	.33	−.02
15.000	.15	177.6	−4.28	69.7	−4.3	70.1	.14	135.74	.32	−.33
15.500	.14	94.4	−4.29	10.8	−4.3	10.8	.13	100.99	.33	−1.04
16.000	.16	10.7	−4.31	−48.1	−4.3	−48.1	.13	58.11	.33	−1.66
16.500	.15	−71.5	−4.23	−107.7	−4.3	−107.4	.13	17.79	.33	−3.08
17.000	.10	−172.7	−4.27	−168.1	−4.3	−167.5	.14	−11.67	.34	−5.39
17.500	.11	67.0	−4.43	132.2	−4.4	133.0	.18	−39.62	.33	−6.94
18.000	.18	−2.2	−4.50	72.8	−4.4	73.6	.19	−74.64	.33	−7.99
18.500	.22	−53.9	−4.50	13.5	−4.4	13.7	.17	−110.20	.33	
19.000	.17	−101.8	−4.38	−46.4	−4.4	−46.4	.11	−141.49	.33	
19.500	.07	−108.4	−4.31	−107.5	−4.3	−107.1	.06	−139.86	.34	
20.000	.10	−92.0	−4.38	−168.5	−4.3	−168.3	.07	−136.18	.34	
20.500	.10	−114.7	−4.37	130.6	−4.3	130.2	.06	−174.65	.34	
21.000	.10	−110.9	−4.36	68.6	−4.5	68.5	.03	−17.88	.34	
21.500	.12	−150.8	−4.55	4.1	−4.6	4.9	.14	−72.16	.36	
22.000	.09	−135.6	−4.37	−53.5	−4.3	−52.9	.17	−123.11	.32	
22.500	.09	−90.8	−4.52	−118.7	−4.4	−118.1	.15	−132.60	.36	
23.000	.27	−109.8	−4.99	178.3	−4.8	178.9	.26	−152.06	.35	

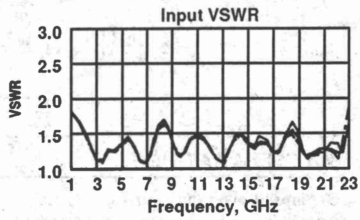
LINEARIZATION RANGE: 2.00 to 18.00 GHz

SPT-1822 TYPICAL PERFORMANCE OVER TEMPERATURE

KEY: +25°C ———
+85°C — — — —
−55°C —- · —







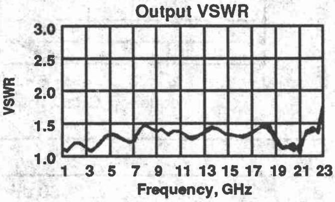
AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

S-PARAMETERS

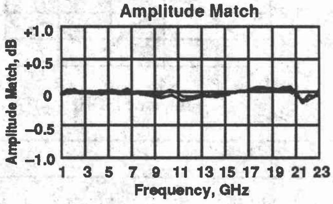
FREQ	S_{31}		S_{13}		S_{32}		S_{33}		GPDEL	PHASE
GHz	dB	Ang	dB	Ang	dB	Ang	Mag	Ang	ns	DEG
1.000	–3.86	–112.4	–3.8	–112.4	–9.10	–128.3	.04	5.07	.31	
1.500	–3.77	–168.4	–3.8	–168.3	–12.41	178.5	.05	82.91	.31	
2.000	–3.67	135.1	–3.7	135.4	–16.80	122.8	.09	20.79	.31	–7.21
2.500	–3.58	78.3	–3.6	78.5	–24.18	57.4	.10	–37.88	.31	–5.80
3.000	–3.50	20.8	–3.5	20.9	–32.62	–93.9	.06	–87.75	.32	–4.86
3.500	–3.55	–36.9	–3.5	–36.8	–24.98	165.7	.03	–67.24	.32	–4.31
4.000	–3.65	–94.1	–3.6	–93.9	–23.28	102.5	.08	–75.40	.32	–3.13
4.500	–3.69	–151.1	–3.7	–150.9	–24.95	41.4	.12	–129.28	.32	–1.80
5.000	–3.71	151.7	–3.7	151.8	–31.49	–30.0	.14	171.34	.32	–.73
5.500	–3.75	94.5	–3.7	94.6	–34.44	155.4	.14	108.74	.32	.53
6.000	–3.71	37.3	–3.7	37.4	–25.39	75.1	.12	46.38	.32	1.55
6.500	–3.68	–20.8	–3.7	–20.6	–21.85	13.6	.10	2.68	.32	1.90
7.000	–3.76	–78.9	–3.8	–78.7	–20.85	–46.3	.10	–13.56	.32	2.25
7.500	–3.89	–136.7	–3.9	–136.4	–21.91	–106.4	.16	–39.02	.32	2.61
8.000	–4.02	166.2	–4.0	166.7	–25.31	–163.0	.19	–78.13	.32	3.79
8.500	–3.97	109.8	–3.9	109.6	–32.55	108.8	.17	–116.97	.31	5.71
9.000	–3.57	51.9	–3.6	51.1	–31.67	–41.4	.16	–142.92	.32	5.97
9.500	–3.62	–9.3	–3.7	–9.0	–25.22	–120.2	.16	177.65	.34	3.01
10.000	–3.85	–68.1	–3.9	–67.7	–22.40	178.8	.14	153.56	.32	2.66
10.500	–4.04	–126.1	–4.1	–125.7	–21.67	120.4	.14	115.68	.32	3.09
11.000	–4.16	176.2	–4.2	176.5	–22.70	63.4	.14	65.55	.32	3.56
11.500	–4.18	118.5	–4.2	118.9	–25.77	6.3	.12	14.96	.32	4.17
12.000	–4.12	60.4	–4.1	60.8	–33.75	–51.2	.13	–29.11	.32	4.18
12.500	–4.10	1.5	–4.0	1.7	–40.57	71.2	.14	–55.30	.33	3.47
13.000	–4.11	–57.3	–4.1	–57.3	–30.50	23.3	.15	–77.30	.33	2.91
13.500	–4.11	–116.4	–4.1	–116.4	–27.32	–18.7	.16	–115.13	.33	2.00
14.000	–4.16	–175.7	–4.2	–175.8	–25.00	–59.9	.17	–159.20	.33	.93
14.500	–4.26	125.1	–4.3	125.3	–23.36	–108.5	.16	157.81	.33	–.02
15.000	–4.30	66.3	–4.3	66.7	–23.26	–164.6	.14	119.09	.32	–.33
15.500	–4.30	7.3	–4.3	7.4	–25.86	132.2	.13	85.24	.33	–1.04
16.000	–4.28	–51.9	–4.3	–51.7	–33.90	50.8	.12	47.36	.33	–1.66
16.500	–4.21	–111.7	–4.2	–111.4	–32.78	–127.4	.12	7.56	.33	–3.08
17.000	–4.24	–172.2	–4.3	–171.6	–25.65	158.2	.14	–22.96	.34	–5.39
17.500	–4.36	127.8	–4.3	128.7	–23.17	99.7	.17	–48.33	.33	–6.94
18.000	–4.42	68.1	–4.3	68.7	–22.57	44.5	.16	–81.19	.33	–7.99
18.500	–4.44	8.6	–4.4	8.7	–23.28	–9.7	.13	–115.22	.33	
19.000	–4.31	–51.5	–4.3	–51.5	–25.67	–68.6	.06	–147.27	.33	
19.500	–4.26	–112.7	–4.2	–112.4	–31.75	–148.7	.03	–72.26	.34	
20.000	–4.30	–174.1	–4.3	–173.7	–31.75	54.3	.06	–79.74	.34	
20.500	–4.32	124.4	–4.2	124.4	–25.14	–31.3	.06	–90.85	.34	
21.000	–4.39	62.3	–4.5	62.6	–23.88	–94.6	.11	–60.53	.34	
21.500	–4.71	–2.5	–4.7	–1.4	–25.98	–153.6	.21	–81.35	.36	
22.000	–4.43	–59.1	–4.4	–58.4	–22.63	–109.1	.23	–123.76	.32	
22.500	–4.57	–124.2	–4.5	–123.5	–16.51	–160.7	.21	–140.55	.36	
23.000	–5.01	173.8	–4.8	174.1	–13.62	144.4	.29	–160.25	.35	

LINEARIZATION RANGE: 2.00 to 18.00 GHz

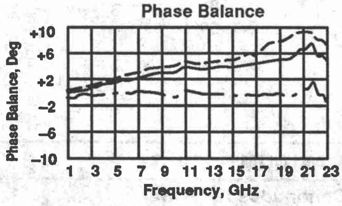
Output VSWR



Amplitude Match



Phase Balance



AVANTEK

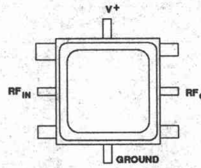
PLP-105
Thin-Film Low Pass Filter

FEATURES

- DC – 1 GHz
- Lumped Element Design
- Small Size
- Hermetic Surface Mount Package
- Light Weight

APPLICATIONS

- Communications Circuits
- Cellular Telephone Systems
- Fiber Optics
- Instrumentation
- Missile Systems



PP-38, p.16–35

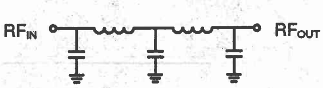
DESCRIPTION

The PLP-105 is a thin-film, lumped-element, 5-pole low-pass filter packaged in a small 3/8" x 3/8" PlanarPak surface mount package. Use of thin-film lumped elements provides a circuit much smaller and more repeatable than conventional distributed or discrete lumped element designs.

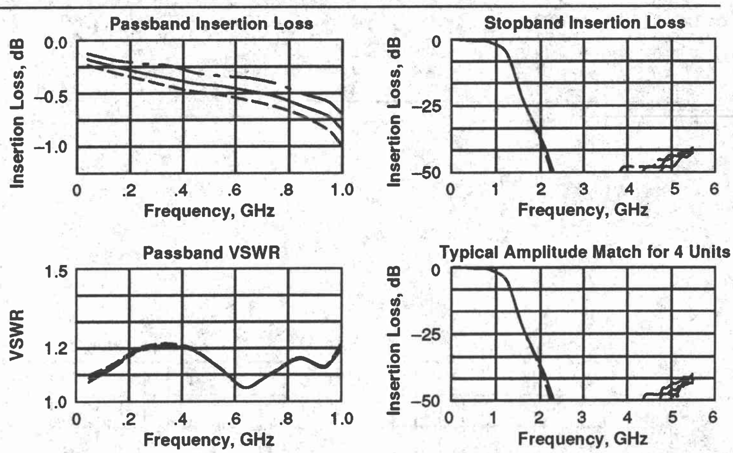
ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ T_A = –55 to +85°C unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications T_C = 0° to 55°C	Guaranteed Specifications T_C = –55° to +85°C	Unit
FP	Passband Frequency	DC-1	DC-1	DC-1	GHz
FS	Stopband Frequency	2.3–5.5	2.3–5.5	2.3–5.5	GHz
VSWR	Passband VSWR	1.2:1	1.5:1	1.5:1	—
IL Pass	Passband Insertion Loss (Maximum)	0.9	1.2	1.3	dB
IL Stop	Stopband Insertion Loss (Minimum)	45	35	35	dB
AM	Amplitude Matching (Unit-to-Unit), T_A = 25°C	±0.1	—	—	dB
PT	Phase Tracking (Unit-to-Unit), T_A = 25°C	±2	—	—	Degree
P	Maximum Continuous Power	+30	—	—	dBm

SCHEMATIC



TYPICAL PERFORMANCE OVER TEMPERATURE



KEY: +25°C ————
+85°C — — — —
–55°C —— - ——

MAXIMUM RATINGS

Continuous RF Power	+30 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

WEIGHT: (typical) .5 grams

Avantek, Inc. • 481 Cottonwood Drive, Milpitas, CA 95035 • Contact your local representative, distributor or field sales office for further information. Listings are in the back of this Data Book.

AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

S-PARAMETERS

FREQ GHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang	GPDEL (ps)
0.25	.07	–125.6	–0.34	–56.3	–0.37	–56.8	.07	–124.8	648
0.50	.06	170.4	–0.46	–114.7	–0.49	–115.1	.06	170.2	701
0.75	.03	–80.9	–0.57	–177.8	–0.60	–178.3	.03	–73.8	845
1.00	.08	–63.1	–0.91	106.0	–0.95	105.4	.08	–59.7	1.1+03
1.25	.67	–94.6	–4.91	4.7	–4.94	4.2	.66	–91.9	811
1.50	.91	–165.6	–16.03	–68.2	–16.06	–68.6	.90	–162.4	450
1.75	.93	152.9	–27.10	–108.7	–27.10	–109.4	.92	156.5	302
2.00	.94	123.0	–36.65	–136.0	–36.65	–136.9	.93	127.3	196
2.25	.95	98.3	–48.17	–153.7	–48.17	–156.2	.94	102.6	–245
2.50	.95	76.9	–60.00	–131.6	–60.00	–135.8	.94	82.4	–733
2.75	.96	55.4	–59.57	–65.6	–60.00	–67.3	.95	62.0	79
3.00	.96	35.3	–53.97	–72.8	–53.97	–65.9	.94	42.9	99
3.25	.95	15.1	–53.97	–81.8	–53.97	–80.8	.94	23.8	152
3.50	.95	–4.6	–53.97	–95.5	–53.97	–101.1	.94	4.8	254
3.75	.94	–24.6	–50.45	–118.4	–53.76	–120.4	.93	–14.2	204
4.00	.93	–44.9	–50.45	–136.7	–50.45	–138.5	.92	–33.9	226
4.25	.93	–65.4	–50.45	–157.1	–50.45	–161.1	.92	–53.8	235
4.50	.92	–85.8	–47.95	–178.3	–47.95	–178.2	.91	–74.0	232
4.75	.92	–106.8	–47.85	160.7	–47.95	159.2	.90	–94.8	243
5.00	.91	–128.1	–45.11	138.8	–45.11	138.0	.90	–116.5	254
5.25	.91	–149.9	–43.09	115.9	–43.09	114.7	.89	–138.8	265
5.50	.91	–171.8	–41.36	92.0	–41.36	90.1	.89	–161.1	265

LINEARIZATION RANGE: .25 to 5.5 GHz

AVANTEK

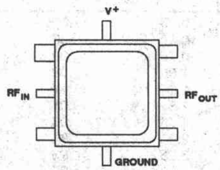
PLP-207
Thin-Film Low Pass Filter

FEATURES

- DC – 2 GHz
- Lumped Element Design
- Small Size
- Hermetic Surface Mount Package

APPLICATIONS

- Communications Circuits
- Cellular Telephone Systems
- Fiber Optics
- Instrumentation
- Missile Systems



PP-38, p.16–35

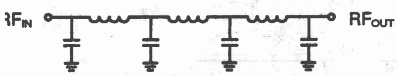
DESCRIPTION

The PLP-207 is a thin-film, lumped-element, 7-pole low-pass filter packaged in a small 3/8" x 3/8" PlanarPak surface mount package. Use of thin-film lumped elements provides a circuit much smaller and more repeatable than conventional distributed or discrete lumped element designs.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ T_A = –55 to +85°C unless otherwise noted)

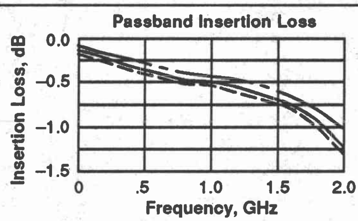
Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications		Unit
			T_C = 0° to 55°C	T_C = –55° to +85°C	
FP	Passband Frequency	DC-2	DC-2	DC-2	GHz
FS	Stopband Frequency	3.5–7.5	3.5–7.5	3.5–7.5	GHz
VSWR	Passband VSWR	1.2:1	1.5:1	1.5:1	—
IL Pass	Passband Insertion Loss (Maximum)	1.2	1.5	1.7	dB
IL Stop	Stopband Insertion Loss (Minimum)	45	35	35	dB
AM	Amplitude Matching (Unit-to-Unit), T_A = 25°C	±0.1	—	—	dB
PT	Phase Tracking (Unit-to-Unit), T_A = 25°C	±2	—	—	Degree
P	Maximum Continuous Power	+30	—	—	dBm

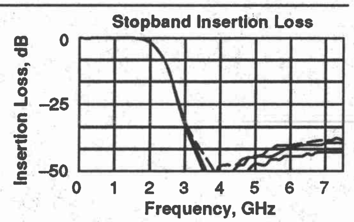
SCHEMATIC

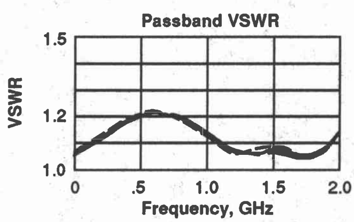


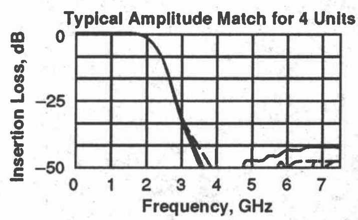
KEY: +25°C ————
+85°C – – – –
–55°C —- · —

TYPICAL PERFORMANCE OVER TEMPERATURE









MAXIMUM RATINGS

Continuous RF Power .... +30 dBm
Operating Case Temperature .... –55°C to +125°C
Storage Temperature .... –62°C to +150°C
"R" Series Burn-In Temperature .... +125°C

WEIGHT: (typical) .5 grams

AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

S-PARAMETERS

FREQ GHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang	GPDEL (ps)
0.25	.05	–89.4	–0.29	–31.4	–0.29	–31.2	.05	–89.9	358
0.50	.08	–139.4	–0.42	–63.7	–0.41	–63.6	.08	–138.0	356
0.75	.09	178.8	–0.50	–95.8	–0.50	–95.7	.09	–178.9	382
1.00	.06	134.2	–0.54	–130.3	–0.54	–130.1	.06	132.2	399
1.25	.01	54.7	–0.60	–166.2	–0.60	–166.0	.02	36.6	436
1.50	.02	–90.2	–0.71	154.4	–0.72	154.6	.03	–72.6	488
1.75	.01	–161.8	–0.89	110.4	–0.89	110.6	.01	–134.9	591
2.00	.03	81.1	–1.21	57.2	–1.21	57.3	.03	58.3	804
2.25	.30	60.1	–2.74	–15.1	–2.72	–15.0	.32	51.3	790
2.50	.75	–9.0	–9.49	–86.2	–9.52	–86.5	.76	–11.2	533
2.75	.89	–55.5	–20.61	–134.2	–20.70	–133.7	.90	–55.9	281
3.00	.92	–80.5	–30.50	–159.5	–30.50	–159.4	.93	–80.6	214
3.25	.94	–97.4	–39.33	–178.8	–39.29	–177.2	.94	–97.5	172
3.50	.95	–109.6	–47.03	165.5	–47.03	165.9	.95	–110.0	129
3.75	.95	–119.5	–50.60	153.9	–50.60	148.2	.95	–120.7	237
4.00	.95	–127.8	–53.97	132.5	–53.97	129.8	.95	–129.6	189
4.25	.94	–135.6	–53.97	115.5	–50.45	122.0	.95	–138.0	31
4.50	.94	–143.0	–50.45	112.6	–40.45	113.7	.94	–146.2	139
4.75	.93	–150.5	–50.31	100.1	–47.95	103.5	.93	–154.3	41
5.00	.92	–158.0	–47.95	96.4	–47.95	96.4	.93	–162.4	79
5.25	.91	–165.9	–47.95	89.2	–46.02	94.2	.92	–170.8	88
5.50	.91	–174.2	–46.02	81.2	–46.02	83.5	.92	–179.5	90
5.75	.91	–177.1	–45.93	73.0	–44.43	73.7	.92	171.6	98
6.00	.91	–168.1	–44.43	64.2	–44.43	62.8	.92	162.4	113
6.25	.91	–158.8	–44.43	54.0	–44.43	54.1	.92	153.3	75
6.50	.91	–149.2	–43.67	47.2	–44.43	45.5	.93	143.9	92
6.75	.92	–139.3	–43.09	38.9	–43.09	37.2	.93	134.4	113
7.00	.92	–131.0	–43.09	28.6	–43.09	28.8	.93	126.8	76
7.25	.92	–121.9	–43.09	21.8	–43.09	21.1	.93	118.6	116
7.50	.92	–111.3	–43.09	11.3	–43.09	12.8	.93	108.9	116

LINEARIZATION RANGE: .25 to 5.5 GHz

AVANTEK

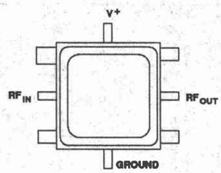
PLP-407
Thin-Film Low Pass Filter

FEATURES

- DC – 4 GHz
- Lumped Element Design
- Small Size
- Hermetic Surface Mount Package

APPLICATIONS

- Communications Circuits
- Cellular Telephone Systems
- Fiber Optics
- Instrumentation
- Missile Systems



PP-38, p.16–35

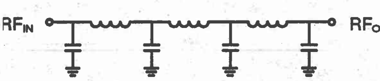
DESCRIPTION

The PLP–407 is a thin-film, lumped-element, 7-pole low-pass filter packaged in a small 3/8" x 3/8" PlanarPak surface mount package. Use of thin-film lumped elements provides a circuit much smaller and more repeatable than conventional distributed or discrete lumped element designs.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ T_A = –55 to +85°C unless otherwise noted)

Symbol	Characteristic	Typical T_C = 25°C	Guaranteed Specifications		Unit
			T_C = 0° to 55°C	T_C = –55° to +85°C	
FP	Passband Frequency	DC-4	DC-4	DC-4	GHz
FS	Stopband Frequency	7.5–15	7.5–15	7.5–15	GHz
VSWR	Passband VSWR	1.7:1	2.0:1	2.0:1	—
IL Pass	Passband Insertion Loss (Maximum)	1.0	1.5	1.7	dB
IL Stop	Stopband Insertion Loss (Minimum)	40	30	30	dB
AM	Amplitude Matching (Unit-to-Unit), T_A = 25°C	±0.1	—	—	dB
PT	Phase Tracking (Unit-to-Unit), T_A = 25°C	±2	—	—	Degree
P	Maximum Continuous Power	+30	—	—	dBm

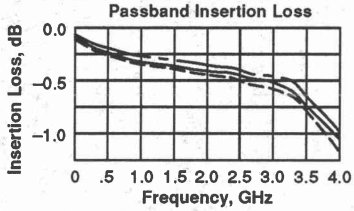
SCHEMATIC



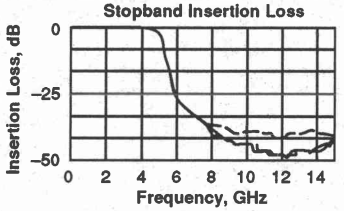
KEY: +25°C ————
+85°C – – – –
–55°C —- - —

TYPICAL PERFORMANCE OVER TEMPERATURE

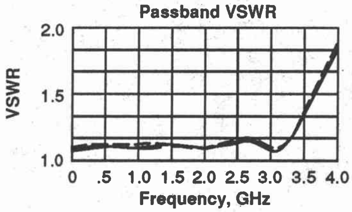
Passband Insertion Loss



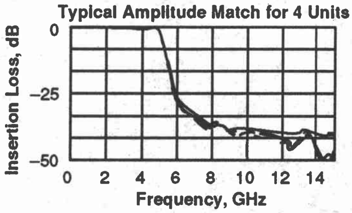
Stopband Insertion Loss



Passband VSWR



Typical Amplitude Match for 4 Units



MAXIMUM RATINGS

Continuous RF Power	+30 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

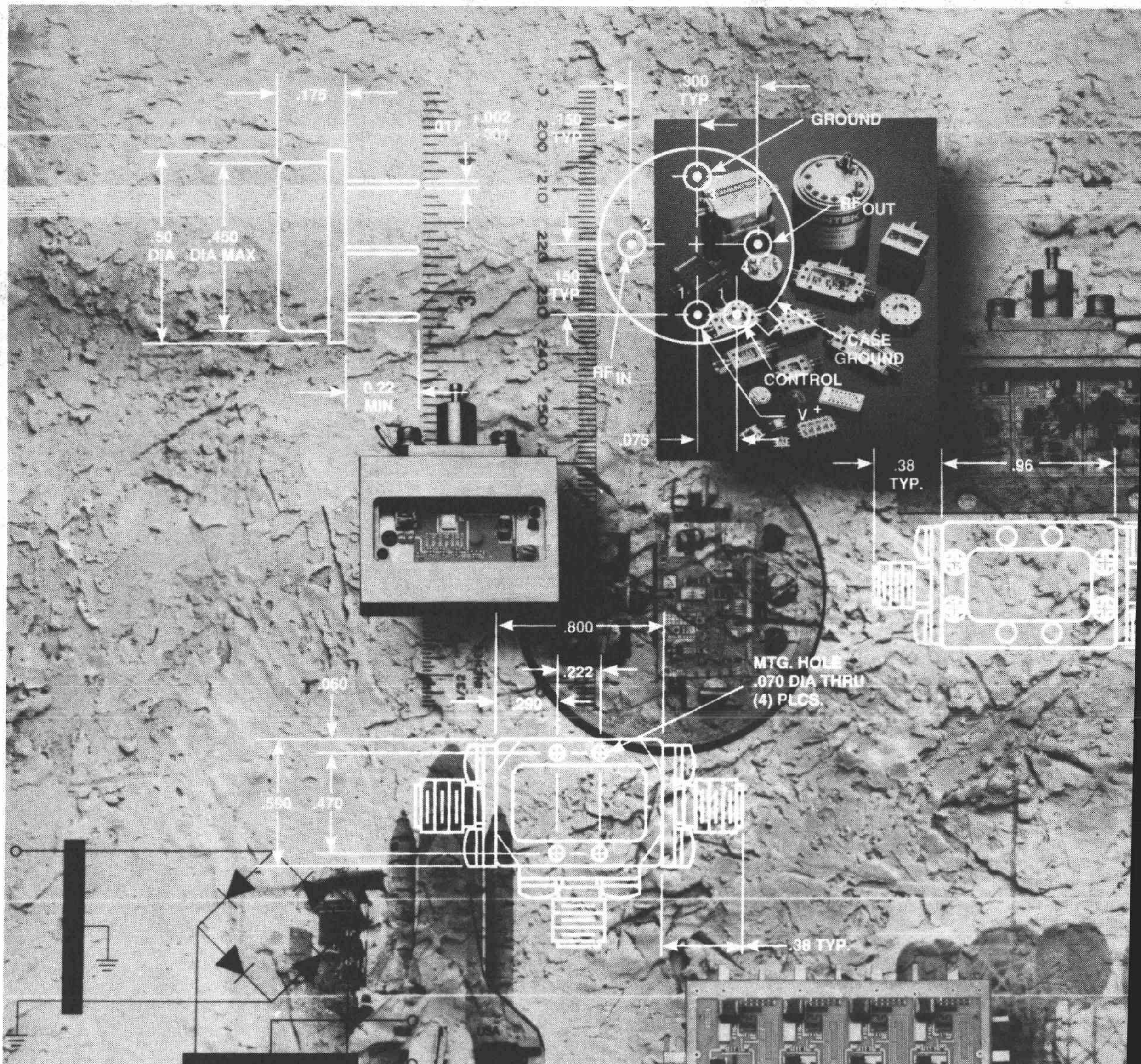
WEIGHT: (typical) .5 grams

AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit @ +25°C ambient)

S-PARAMETERS

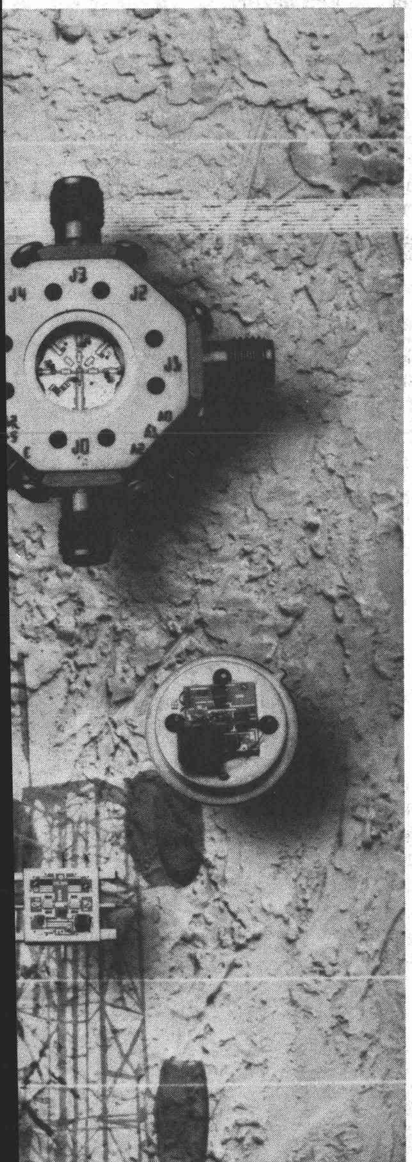
FREQ GHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang	GPDEL (ps)
0.50	.03	–57.7	–0.31	–34.0	–0.31	–33.9	.03	–59.7	190
1.00	.04	–128.2	–0.38	–68.2	–0.38	–68.0	.03	–140.8	188
1.50	.04	176.8	–0.44	–102.2	–0.44	–102.1	.04	147.4	195
2.00	.01	103.8	–0.48	–137.4	–0.49	–137.2	.02	54.0	184
2.50	.03	–88.1	–0.53	–170.7	–0.54	–170.6	.04	–67.5	213
3.00	.03	–72.4	–0.61	–150.8	–0.61	151.0	.01	–152.0	232
3.50	.12	–2.53	–0.74	–109.0	–0.75	109.2	.12	30.2	250
4.00	.27	–34.0	–1.08	64.0	–1.10	64.1	.26	–17.8	303
4.50	.10	–39.3	–1.05	9.4	–1.05	9.5	.08	–36.5	433
5.00	.68	9.5	–4.81	–68.5	–4.86	–68.5	.67	19.5	261
5.50	.91	–32.4	–13.57	–115.5	–13.59	–115.3	.91	–26.8	128
6.00	.93	–53.0	–20.88	–138.7	–20.83	–138.3	.93	–50.5	96
6.50	.92	–66.8	–26.62	–156.1	–26.61	–155.6	.93	–67.1	56
7.00	.92	–76.2	–31.73	–166.2	–31.73	–165.7	.92	–79.0	47
7.50	.92	–85.4	–35.44	–174.7	–35.44	–173.9	.92	–90.3	15
8.00	.91	–95.2	–37.72	–177.4	–37.72	–177.2	.92	–102.0	139
8.50	.92	–105.4	–37.42	–157.3	–37.42	156.4	.93	–114.0	143
9.00	.93	–118.3	–38.74	–131.6	–38.41	130.8	.93	–128.2	154
9.50	.93	–135.6	–38.41	–103.8	–38.41	104.0	.92	–145.5	162
10.00	.92	–158.0	–37.72	74.6	–37.72	74.7	.91	–165.5	169
10.50	.91	176.7	–37.72	44.2	–37.72	45.1	.90	173.6	157
11.00	.90	153.6	–38.09	15.9	–38.41	17.0	.90	156.1	112
11.50	.91	137.0	–39.17	–4.3	–39.17	–2.0	.91	143.7	168
12.00	.91	126.7	–40.49	–34.7	–40.49	–33.1	.91	136.9	–19
12.50	.92	121.4	–46.02	–31.2	–46.02	–27.9	.92	133.2	–86
13.00	.93	118.8	–43.67	–15.7	–42.9	–13.3	.93	131.3	97
13.50	.93	117.9	–40.91	–33.3	–40.40	34.7	.93	131.7	180
14.00	.93	116.7	–44.58	–65.8	–43.09	–67.3	.93	131.8	–126
14.50.	.94	114.2	–49.24	–43.1	–47.95	–44.1	.93	129.6	0
15.00	.93	110.8	–49.24	–43.1	–50.45	–42.3	.93	125.7	0

LINEARIZATION RANGE: .25 to 5.5 GHz



.175
.017 +.002
.150 TYP
.50 DIA
.450 DIA MAX
0.22 MIN
.300 TYP
GROUND
RF OUT
RF IN
CASE GROUND
CONTROL
V +
.075
.38 TYP.
.96
.800
.222
.290
.060
MTG. HOLE .070 DIA THRU (4) PLCS.
.550
.470
.38 TYP.

MIXERS



PRODUCT DESCRIPTION

Thin Film Mixers

Avantek's series of Thin-Film Ceramic Mixers features 14 different types of double- and triple-balanced mixers with RF/LO frequency ranges from 0.75 GHz to 26 GHz and IF from DC to 10 GHz.

Thin Film Mixers offer excellent gain and phase matching and tracking from unit-to-unit and lot-to-lot, with no compromise in performance specifications.

Superior stability over temperature is a result of the thin film alumina substrate construction. Conversion loss on these mixers typically varies <0.5 dB from –55° to 100°C.

The planar design and construction can survive high levels of thermal shock, mechanical shock and random vibration. Welding and thermo-compression bonding is used throughout instead of solder for improved performance and reliability.

Thin Film Mixers are supplied in Avanpak stainless steel hermetic cases. All TFX Series Mixers are available with a variety of connector options on all ports.

Included in the Thin Film models are block converters with high microwave IF frequencies and band overlap, wideband mixers with decade plus bandwidth and a .75 to 18 GHz dual channel mixer.

Applications include multi-channel system design due to the excellent amplitude and phase tracking between mixers with little or no matching or selecting required. Thin-Film Mixers are designed so that all units can be dropped into existing sockets with minimal change in system performance.

Avanpak DBX/DBY Mixers

Avantek's DBX/DBY Series covers the frequency range .05 to 18 GHz with various IF response frequencies ranging from DC to 10 GHz.

All DBX/DBY mixers feature high isolation, relatively low conversion loss and a good 50-ohm match (low VSWR) at all ports for ease of integration with other RF components.

The DBX/DBY Series uses precisely matched Schottky-barrier diodes and a "quasi-planar" physical construction for excellent overall symmetry. Construction techniques result in high LO-to-RF isolation, extremely low single-tone intermodulation distortion and very good amplitude and phase match characteristics.

Applications include use in threat warning self protection jammers and wideband heterodyned receivers. This series is also ideal for narrowband low IF frequency requirements.

These mixers are supplied in Avanpak DBX and DBY cases. The DBY is a smaller version of the DBX and is used in compact stripline/microstrip systems. The DBY offers all of the same performance and reliability advantages of the DBX package.

Planarpak™ Surface Mount Mixer

The PPM-2515M is a triple balanced surface mount mixer with a frequency range of .05 to 2.5 GHz and an IF range of .001 to 1.5 GHz.

This PlanarPak mixer uses precisely matched monolithic beam lead Schottky diodes and polyimide insulated baluns to yield excellent performance over more than five octaves of RF and LO bandwidths. With overlapping RF, LO and IF frequency ranges there is still greater than 25 dB of port-to-port isolation. IF bandwidths up to 1500 MHz are obtained with very flat conversion loss. Good 50-ohm match is realized at all ports.

UMX Double Balanced Mixers

Avantek's UMX Series of double balanced mixers covers the frequency range 1 to 5500 MHz with various IF response frequencies ranging from DC to 1300 MHz.

The UMX Series features high isolation and good harmonically-related intermodulation product suppression.

The UMX double balanced mixers have been designed for low cost/high performance applications. They are supplied in the hermetically sealed TO-8 package.

Avanpak Mixer-Preamplifiers

The MXA Series of Avanpak mixer-preamplifiers integrates Avantek's mixer and thin-film amplifier products into a miniature microwave flatpack.

MXA devices cover the frequency range from .05 to 18 GHz on the R and L ports with frequencies up to 2 GHz.

Virtually any combination of selected mixers and amplifiers may be cascaded to meet customer needs. All combinations are packaged in Avanpak MA-X cases which are small size and light weight and can be used for coax, stripline or microstrip applications.

Avantek Doubler

Avantek balanced doubler operates over the frequency range of 75 MHz to 2 GHz.

Mixer Model Number Selection Guide

TF X-18075-1

Construction
TF = Thin-Film
DB = Duroid Board

Case Type
X = .96" x .66" (Standard Case)
Y = .80" x .59" (Small Case)
K = Model 2621 (Unique Case)
W = Model 18075 Dual Channel Mixer
(Unique Case)

Model Number

Connector Configuration Designation

Dash Number	Connectors R Port	I Port	L Port
–1	F	F	F
–2	P	P	P
–3	M	M	M
–4	F	F	M
–5	F	M	M
–6	F	M	F
–7	M	M	F
–8	M	F	F
–9	M	F	M

See the following case drawings for connector options:

DBX/TFX, page 16–10
DBY, page 16–11
TFK page 16–44
TFW, page 16–45

Avantek's Mixer model number selection guide allows the end user to specify either thin-film or duroid board technology, case type, model number and connector configuration.

Contact your nearest Avantek direct sales engineer, manufacturer's representative, and/or distributor for assistance in ordering Avantek Mixer products.

MIXER SELECTION GUIDE

THIN FILM MIXERS*

Typical Specifications at 25°C Case Temperature

Model No.	Frequency Range RF/LO (GHz)	Frequency Range IF (GHz)	Conversion Loss (dB)	Isolation LO to RF (dB)	Isolation LO to IF (dB)	VSWR RF Port	VSWR LO Port	Case Type	Page Number
TFX-72L/M/H	2–7	DC–1.0	6.0	35	35	2.5	2.0	TFX	7–6
TFX824M/H	2–8	.005–4.0	7.5	22	35	2.0	2.0	TFX	7–18
TFX-158L/M	8–15	DC–1.0	6.0	30	30	2.0	2.0	TFX	7–8
TFX-167L/M	7–16	DC–4.0	6.5	30	20	2.5	2.0	TFX	7–10
TFX-184L	4–18	DC–4.0	7.0	25	20	2.5	2.5	TFX	7–12
TFX-185L	5–18	DC–5.0	6.5	25	20	2.0	2.5	TFX	7–14
TFX-186L	6–18	DC–5.5	6.5	30	25	2.5	2.5	TFX	7–16
TFX-18075L/M/H	.75–18	DC–0.5	8.0	25	20	2.7	2.5	TFX	7–24
TFW-18075D	.75–18	DC–0.3	7.0	25	20	2.7	2.5	TFW	7–26
TFX-2021M/H	2–20	DC–0.5	7.5	25	30	2.5	2.0	TFX	7–20
TFK-2621M	2–26	DC–0.5	8.0	35	25	2.5	2.5	TFK	7–22

*Mixers are available for use with low-power (+7 to +13 dBm), medium power (+10 to +17 dBm), and high-power (+17 to +24 dBm) LOs. The TFX-824 has two diode quads and operates with medium (+10 to +17 dBm) and high-power (+13 to +20 dBm) LOs.

DBX/DBY MIXERS

Typical Specifications at 25°C Case Temperature

Model No.	Frequency Range RF/LO (GHz)	Frequency Range IF (GHz)	Conversion Loss (dB)	Isolation LO to RF (dB)	Isolation LO to IF (dB)	VSWR RF Port	VSWR LO Port	Case Type	Page Number
DBX/DBY-3503M/H[3]	.05-3.0[1]	.001-3.0	8.0	30	35	2.0:1	2.0:1	DBX or DBY	7–50
DBX/DBY-72L/M/H	2-7	DC-1.5	6.0	35	25	2.5:1	1.7:1	DBX or DBY	7–28
DBX/DBY-824M/H[3]	2-8	.005-4.0	6.5	25	30	2.0:1	1.5:1	DBX or DBY	7–43
DBX/DBY-1221L/M/H	2-12	DC-1.3	6.0	35	25	2.5:1	2.0:1	DBX or DBY	7–45
DBX/DBY-158L/M/H	8-15	DC-1.0	6.0	30	20	2.0:1	1.5:1	DBX or DBY	7–30
DBX/DBY-167L/M/H	7-16	DC-4.0	6.5	30	20	2.0:1	1.5:1	DBX or DBY	7–32
DBX/DBY-184L/M/H[2]	4-18	DC-4.0	6.5	30	20	2.5:1	2.0:1	DBX or DBY	7–34
DBX/DBY-185L/M/H	5-18	DC-6.0	6.5	30	20	2.0:1	1.5:1	DBX or DBY	7–38
DBX/DBY-186L/M/H	6-18	DC-7.0	7.0	30	20	2.0:1	1.5:1	DBX or DBY	7–40
DBX/DBY-184LS/MS/HS	4-18	DC-1.5	6.5	30	30	2.0:1	2.0:1	DBX or DBY	7–36
DBX/DBY-1824M/H[3]	2-18	.005-4.0	7.0	25	30	2.5:1	2.0:1	DBX or DBY	7–47
DBX/DBY-18212M/H[3]	2-18	0.5-10	7.5	30	20	2.5:1	2.0:1	DBX or DBY	7–52

NOTES.
1. LO = .05-3.5 GHz
2. Also available with LS/MS/HS suffix (page 7–36) with 30 dB typ LO to IF isolation and IF response to 1.5 GHz for swept frequency applications
3. Triple balanced mixer (balanced on all three ports)

SURFACE MOUNT PACKAGE MIXER

Typical Specifications at 25°C Case Temperature

Model	Frequency Range RF & LO (GHz)	Frequency Range IF (GHz)	Conversion Loss (dB)	Isolation LO to RF (dB)	Isolation LO to IF (dB)	VSWR RF Port	VSWR LO Port	Case Type	Page Number
PPM-2515M	.05-2.5	.001-1.5	7.6	35	35	1.5:1	2.5:1	PP-38M	7–55

MIXER SELECTION GUIDE (continued)

UMX MIXERS

Typical Specifications at 25°C Case Temperature

Model	Frequency Range RF & LO (MHz)	Frequency Range IF (MHz)	Conversion Loss (dB)	Isolation LO to RF (dB)	Isolation LO to IF (dB)	VSWR RF Port	VSWR LO Port	Case Type	Page Number
UMX-520	1-500	DC-500	6.0	55	45	1.4	1.5	TO-8M	7–57
UMX-570[1]	1-500	DC-500	5.5	35	45	1.2	1.8	TO-8M	7–59
UMX-2020	10-2000	DC-1000	7.0	40	30	2.0	2.0	TO-8M	7–61
UMX-4220	3700-4200[2]	DC-1300	5.0	35	25	1.5	1.5	TO-8M	7–63

NOTES. 1. +27 dBm LO drive, +32 dBm intercept point
2. LO = 2400 to 5500 MHz

MIXER/PREAMPLIFIERS[1]

Typical Specifications at 25°C Case Temperature

Model	Consisting of the Following Products	Frequency Range f_{RF} (GHz)	Frequency Range f_{LO} (GHz)	Frequency Range f_{IF} (MHz)	RF-IF Gain (dB) Min.	Noise Figure (dB) Typ.	Power Output for 1 dB Gain Compression (dBm) Min.	DC Current (mA) Typ	Case Type	Page Number
MXA-2512	DBX-3503, UTO-440, UTO-210	.5-2.0	.5-2.0	10-200	10	11	6	30	MA-3	7–65
MXA-3012[2]	DBX-3503, UTO-1012, UTO-1013	.05-3.0	.05–3.5	10-1000	20	10.5	7	50	MA–2	7–65
MXA-7202	TFX-72M, UTO-514, UTO-516	2-7	2-7	30-160	22	8.5	9	45	MA-2	7–65
MXA-7203	TFX-72M, UTO-514, UTO-516, UTO-509	2-7	2-7	30-160	33	8.5	20	135	MA-3	7–65
MXA-10911	TFX-186M, UTO-222	9-10	9-10	70	20	9	18	50	MA-1	7–65
MXA-18422	TFX-184M, UTO-2012, UTO-2012	4-18	4-18	500-2000	9	11.5	12	100	MA-2	7–65
MXA-18423	TFX-184M, UTO-2012, UTO-2012, UTO-2013	4-18	4-18	500-2000	18	11.5	19	200	MA-3	7–65

NOTES. 1. Sample Listing of possible Mixer/Amplifier combinations
2. Power out at 1 dB compression is +3 dBm (Min.) from .05 to .6 GHz RF input frequency on MXA-3012

DOUBLERS

Typical Specifications At 25°C Case Temperature

Model	Input Port Frequency Range (MHz)	Output Port Frequency Range (MHz)	Conversion Loss (dB)	VSWR Input	VSWR Output	Case Type	Page Number
DRX-2075	75-2000	150-4000	11	2.0	2.0	DRX	7–67

AVANTEK

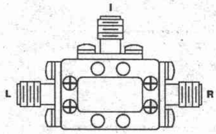
TFX-72L/M/H
Thin-Film Mixer
2 to 7 GHz Double Balanced

FEATURES

- Double Balanced
- All Thin-Film Ceramic Construction
- 2 to 7 GHz RF and LO Bandwidth
- DC to 1.2 GHz IF Bandwidth
- 6 dB Conversion Loss
- Low VSWRs All Ports
- Excellent Phase and Amplitude Matching and Tracking

APPLICATIONS

- Ideal for 2 to 6 GHz and 3.7 to 4.2 GHz Down Conversion
- Threat Warning Systems
- Self Protection Jammers
- Wideband Heterodyned Receivers



TFX, p. 16–10

DESCRIPTION

The TFX-72 double-balanced mixers are fabricated with double-sided ceramic thin-film circuitry using completely planar construction and a single beam lead Schottky diode quad. The ceramic substrates utilize double-sided metalization, allowing broadside coupled baluns with two lines to be fabricated, one on each side of the substrate. Circuit elements are attached and interconnections are made with thermocompression bonding and gap welding for high reliability, accurate placement of components, and reduction of parasitics. Thin-film design and construction techniques result in extremely low single tone intermodulation distortion, superior stability over temperature, and excellent amplitude and phase match characteristics. Conversion loss typically varies by ±0.5 dB from –55° to +100°C. Phase deviations from unit to unit are typically within ±5° and amplitude differences are within ±1.5 dB.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

L, M, H suffix models specified @ P_{LO} = +7, +10, +17 dBm respectively

	Frequency		Conversion Loss		Isolations						Typical 1 dB Compression Point	Input 3rd Order Intercept Point	VSWRS (Typ.)		
					L to R		L to I		R to I						
Suffix	RF/LO GHz	IF GHz	@F_{IF} GHz	dB Typ./Max.	@F_{LO} GHz	dB Typ./Min.	@F_{LO} GHz	dB Typ./Min.	@F_{RF} Ghz	dB Typ.	@RF, dBm	dBm, Typ.	R :1	L :1	I :1
L	2–7	DC–1.2	DC–.5 DC–1.2	5.5/7.5 6.5/8.5	2–7	35/25	2–7	35/20	2–7	35	+2 (P_{LO} = + 7)	+9 (P_{LO} = +10)	2.5	2.0	2.0
M	2–7	DC–1.2	DC–.5 DC–1.2	5.5/7.5 6.5/8.5	2–7	35/25	2–7	35/20	2–7	35	+6 (P_{LO} = +10)	+12 (P_{LO} = +17)	2.5	2.0	2.0
H	2–7	DC–1.2	DC–.5 DC–1.2	6.5/8.5 7.5/9.5	2–7	35/25	2–7	35/20	2–7	35	+12 (P_{LO} = +17)	+20 (P_{LO} = +20)	2.5	2.0	2.0

*MIN/MAX SPECS GUARANTEED –55° TO +100°C, TYP SPECS ARE FOR 25°C

MAXIMUM RATINGS

Peak Input Current @25°C	100 mA DC	Pin Temperature	260°C for 10 Sec	Operating Case Temp	–55° C to + 100°C
Continuous RF Input Power	200 mW @ 25°C 100 mW @ 100°C			Storage Temp	–65° C to + 125°C
Weight (typical): TFX—22 grams (with connectors)					

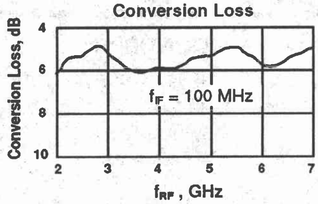
TYPICAL PERFORMANCE AT 25°C (LO Power Range Vs. Model Suffix—L: +7/+13; M: +10/+17; H: +17/+24 dBm)

Typical Single Tone Intermodulation Suppression @ 25°C (–dBc) (Measured with –10 dBm RF Input)

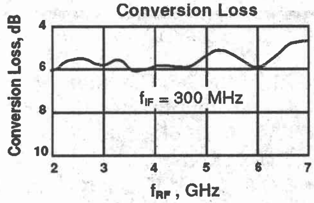
RF HARMONICS						
5	85	84	86	87	90	70
4	77	79	80	72	63	80
3	67	71	74	50	74	72
2	57	51	44	51	51	47
1	34	0	42	34	38	33
0	—	14	22	22	23	23
	0	1	2	3	4	5

LO HARMONICS

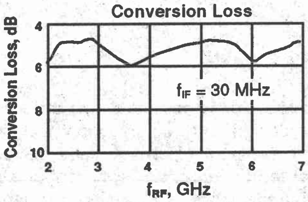
Conversion Loss



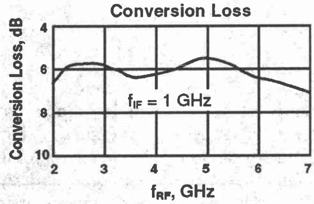
Conversion Loss



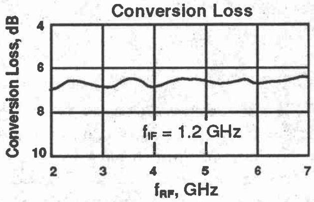
Conversion Loss



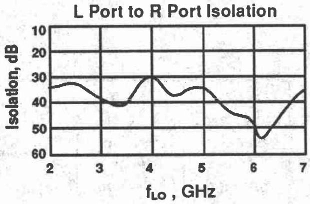
Conversion Loss



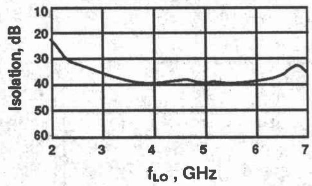
Conversion Loss



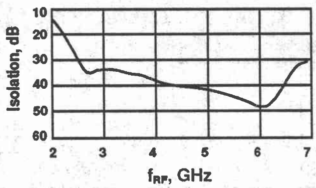
L Port to R Port Isolation



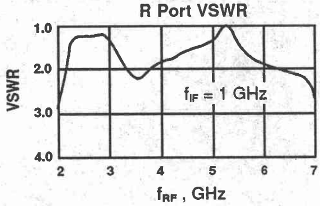
L Port to I Port Isolation



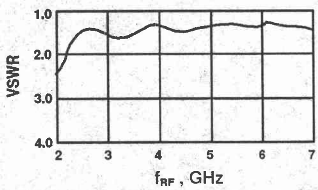
R Port to I Port Isolation



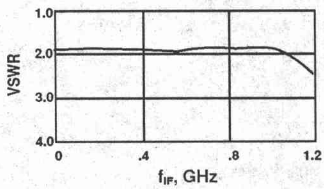
R Port VSWR



L Port VSWR



I Port VSWR



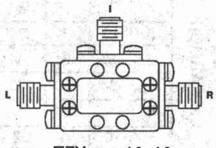
TFX-158L/M
Thin-Film Mixer
8 to 15 GHz Double Balanced

FEATURES

- All Thin-Film Ceramic Construction
- 8 to 15 GHz RF and LO Bandwidth
- DC to 1 GHz IF Bandwidth
- 6 dB Conversion Loss
- Low VSWRs All Ports
- Excellent Phase and Amplitude Matching and Tracking

APPLICATIONS

- 8 to 15 GHz Applications
- Low Cost 11.7 to 12.2 GHz Downconverter
- EW Systems



TFX, p. 16–10

DESCRIPTION

The TFX-158 double-balanced mixers are fabricated with double-sided ceramic thin-film circuitry using completely planar construction and a single beam lead Schottky diode quad. The ceramic substrates utilize double-sided metalization, allowing broadside coupled baluns with two lines to be fabricated, one on each side of the substrate. Circuit elements are attached and interconnections are made with thermocompression bonding and gap welding for high reliability, accurate placement of components, and reduction of parasitics. Thin-film design and construction techniques result in extremely low single tone intermodulation distortion, superior stability over temperature, and excellent amplitude and phase match characteristics. Conversion loss typically varies by ±0.5 dB from –55° to +100°C. Phase deviations from unit to unit are typically within ±5 degrees and amplitude differences are within ±1.5 dB.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

L, M suffix models specified @ P_{LO} = +7, +10 dBm respectively

Suffix	Frequency		Conversion Loss		Isolations L to R		Isolations L to I		Isolations R to I		Typical 1 dB Compression Point	Input 3rd Order Intercept Point	VSWRS (Typ.)		
	RF/LO GHz	IF GHz	@F_{IF} GHz	dB Typ./Max.	@F_{LO} GHz	dB Typ./Min.	@F_{LO} GHz	dB Typ./Min.	@F_{RF} Ghz	dB Typ.	@RF, dBm	dBm, Typ.	R :1	L :1	I :1
L	8–15	DC–1	DC–1	6.0/8.0	8–15	30/20	8–10 10–15	25/18 35/25	8–15	30	+2 (P_{LO} = + 7)	+9 (P_{LO} = +10)	2.0	2.0	1.5
M	8–15	DC–1	DC–1	6.0/8.0	8–15	30/20	8–10 10–15	25/18 35/25	8–15	30	+6 (P_{LO} = +10)	+12 (P_{LO} = +17)	2.0	2.0	1.5

*MIN/MAX SPECS GUARANTEED –55° TO +100°C, TYP SPECS ARE FOR 25°C

MAXIMUM RATINGS

Peak Input Current @25°C	100 mA DC	Pin Temperature	260°C for 10 Sec	Operating Case Temp	–55°C to + 100°C
Continuous RF Input Power	200 mW @25°C 100 mW @ 100°C			Storage Temp	–65°C to + 125°C
Weight (typical): TFX—22 grams (with connectors)					

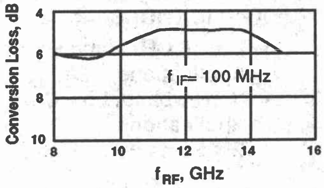
TYPICAL PERFORMANCE AT 25°C (LO Power Range Vs. Model Suffix — L: +7/+13; M: +10/+17 dBm)

Typical Single Tone Intermodulation Suppression @ 25°C (–dBc) (Measured with –10 dBm RF input)

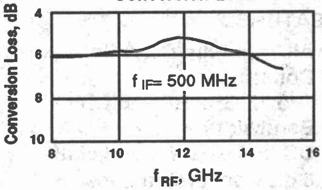
RF HARMONICS						
5	—	77	82	86	90	84
4	80	80	82	84	77	85
3	75	77	75	50	75	80
2	65	59	56	63	72	66
1	29	0	42	43	50	44
0	—	6	42	30	38	—
	0	1	2	3	4	5

LO HARMONICS

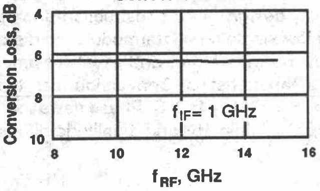
Conversion Loss



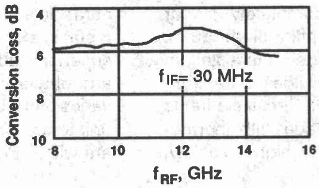
Conversion Loss



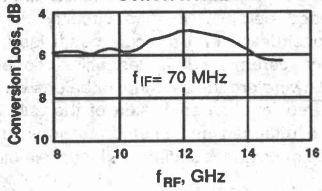
Conversion Loss



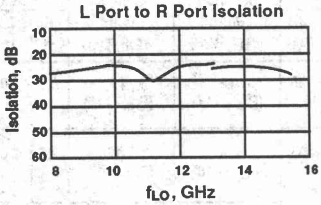
Conversion Loss



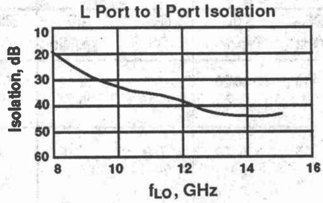
Conversion Loss



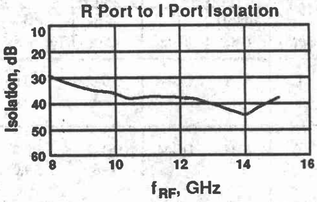
L Port to R Port Isolation



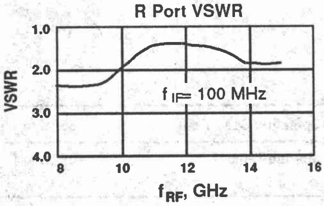
L Port to I Port Isolation



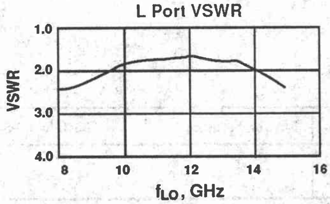
R Port to I Port Isolation



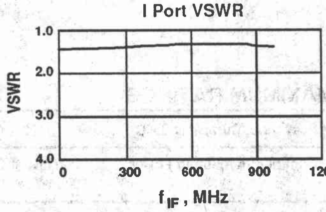
R Port VSWR



L Port VSWR



I Port VSWR

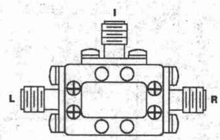


AVANTEK

TFX–167L/M
Thin-Film Mixer
7 to 16 GHz Double Balanced

FEATURES
- All Thin-Film Ceramic Construction
- 7 to 16 GHz RF and LO Bandwidth
- DC to 4 GHz IF Bandwidth
- 6 dB Conversion Loss
- Low VSWRs All Ports
- Excellent Phase and Amplitude Matching and Tracking

APPLICATIONS
- 7 to 16 GHz Band Folding Applications
- Narrowband, Low Cost Applications
- EW Systems



TFX, p. 16–10

DESCRIPTION
The TFX double-balanced mixers are fabricated with double-sided ceramic thin-film circuitry using completely planar construction and a single beam lead Schottky diode quad. The ceramic substrates utilize double-sided metalization, allowing broadside coupled baluns with two lines to be fabricated, one on each side of the substrate. Circuit elements are attached and interconnections are made with thermo-compression bonding and gap welding for high reliability, accurate placement of components, and reduction of parasitics. Thin-film design and construction techniques result in extremely low single tone intermodulation distortion, superior stability over temperature, and excellent amplitude and phase match characteristics. Conversion loss typically varies by ±0.5 dB from –55° to +100°C. Phase deviations from unit to unit are typically within ±5° and amplitude differences are within ±1.5 dB.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)
L, M suffix models specified @ P_{LO} = +7, +10 dBm respectively

	Frequency		Conversion Loss		Isolations						Typical 1 dB Compression Point	Input 3rd Order Intercept Point	VSWRS (Typ.)		
					L to R		L to I		R to I						
Suffix	RF/LO GHz	IF GHz	@F_{IF} GHz	dB Typ./Max.	@F_{LO} GHz	dB Typ./Min.	@F_{LO} GHz	dB Typ./Min.	@F_{RF} Ghz	dB Typ.	@RF, dBm	dBm, Typ.	R :1	L :1	I :1
L	7–16	DC–4	DC–2 2–4	6.5/8.0 7.5/9.0	7–16	30/20	7–9 9–16	15/12 25/20	7–16	35	+2 (P_{LO} = + 7)	+9 (P_{LO} = +10)	2.5	2.0	1.5
M	7–16	DC–4	DC–2 2–4	6.5/8.0 7.5/9.0	7–16	30/20	7–9 9–16	15/12 25/20	7–16	35	+6 (P_{LO} = +10)	+12 (P_{LO} = +17)	2.5	2.0	1.5

*MIN/MAX SPECS GUARANTEED –55° TO +100°C, TYP SPECS ARE FOR 25°C

MAXIMUM RATINGS

Peak Input Current @25°C	100 mA DC	**Pin Temperature**	260°C for 10 Sec	**Operating Case Temp**	–55° C to + 100°C
Continuous RF Input Power	200 mW @ 25°C 100 mW @ 100°C			**Storage Temp**	–65° C to + 125°C
Weight (typical): TFX—22 gram (with connectors)					

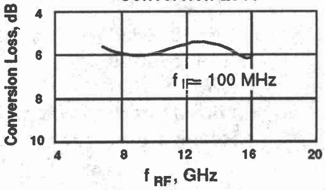
TYPICAL PERFORMANCE AT 25°C (LO Power Range Vs. Model Suffix — L: +7/+13; M: +10/+17 dBm)

Typical Single Tone Intermodulation Suppression @ 25°C (–dBc)
(Measured with –10 dBm RF input)

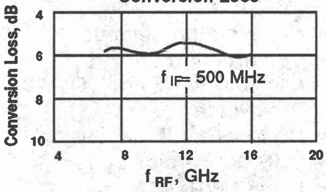
RF HARMONICS						
5	—	77	82	86	90	84
4	80	80	82	84	77	85
3	75	77	75	50	75	80
2	65	59	56	63	72	66
1	29	0	42	43	50	44
0	—	6	42	30	38	—
	0	1	2	3	4	5

LO HARMONICS

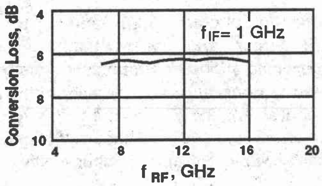
Conversion Loss



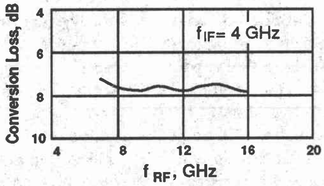
Conversion Loss



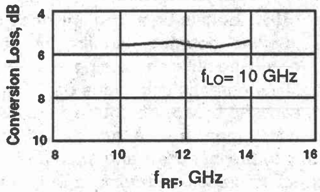
Conversion Loss



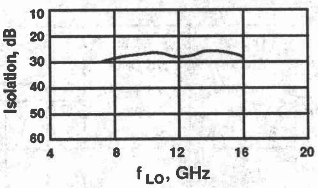
Conversion Loss



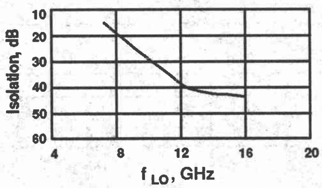
Conversion Loss



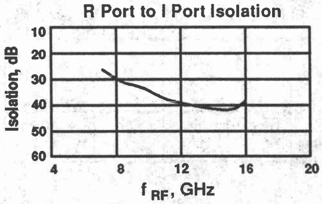
L Port to R Port Isolation



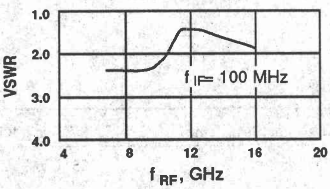
L Port to I Port Isolation



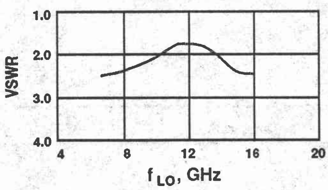
R Port to I Port Isolation



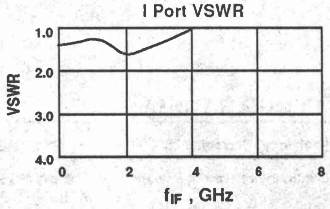
R Port VSWR



L Port VSWR



I Port VSWR

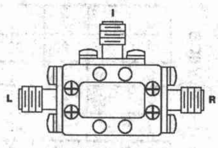


AVANTEK

TFX–184L
Thin-Film Mixer
4 to 18 GHz Double Balanced

FEATURES
- All Thin-Film Ceramic Construction
- 4 to 18 GHz RF and LO Bandwidth
- DC to 4 GHz IF Bandwidth
- 6 dB Conversion Loss
- Low VSWRs All Ports
- Excellent Phase and Amplitude Matching and Tracking

APPLICATIONS
- 4 to 18 GHz Band Folding Applications
- EW Systems
- Wideband Heterodyned Receivers



TFX, p. 16–10

DESCRIPTION
The TFX double-balanced mixers are fabricated with double-sided ceramic thin-film circuitry using completely planar construction and a single beam lead Schottky diode quad. The ceramic substrates utilize double-sided metalization, allowing broadside coupled baluns with two lines to be fabricated, one on each side of the substrate. Circuit elements are attached and interconnections are made with thermocompression bonding and gap welding for high reliability, accurate placement of components, and reduction of parasitics. Thin-film design and construction techniques result in extremely low single tone intermodulation distortion, superior stability over temperature, and excellent amplitude and phase match characteristics. Conversion loss typically varies by ±0.5 dB from –55° to +100°C. Phase deviations from unit to unit are typically within ±5° and amplitude differences are within ±1.5 dB.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)
L suffix model specified @ P_{LO} = +7 dBm

Suffix	Frequency RF/LO GHz	Frequency IF GHz	Conversion Loss @F_{IF} GHz	Conversion Loss dB Typ./Max.	Isolations L to R @F_{LO} GHz	Isolations L to R dB Typ./Min.	Isolations L to I @F_{LO} GHz	Isolations L to I dB Typ./Min.	Isolations R to I @F_{RF} Ghz	Isolations R to I dB Typ.	Typical 1 dB Compression Point @RF, dBm	Input 3rd Order Intercept Point dBm, Typ.	VSWRS (Typ.) R :1	VSWRS (Typ.) L :1	VSWRS (Typ.) I :1
L	4–18	DC–4	DC–3 3–4	7.0/9.0 8.5/10.0	4–16 4–18	25/20 25/18	4–6 6–9 9–18	10/7 15/12 35/20	6–18 4–18	35 25	+2 (P_{LO} = + 7)	+9 (P_{LO} = +10)	2.5	2.5	1.5

*MIN/MAX SPECS GUARANTEED –55° TO +100°C, TYP SPECS ARE FOR 25°C

MAXIMUM RATINGS

Peak Input Current @25°C	100 mA DC	**Pin Temperature**	260°C for 10 Sec	**Operating Case Temp**	–55° C to + 100°C
Continuous RF Input Power	200 mW @ 25°C 100 mW @ 100°C			**Storage Temp**	–65° C to + 125°C
Weight (typical): TFX—22 grams (with connectors)					

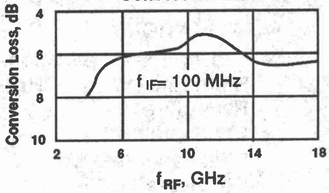
TYPICAL PERFORMANCE AT 25°C (LO Power: +7 dBm)

Typical Single Tone Intermodulation Suppression @ 25°C (–dBc) (Measured with –10 dBm RF input)

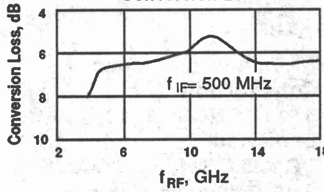
RF HARMONICS						
5	77	79	81	88	90	84
4	84	79	85	86	74	86
3	80	73	75	51	78	80
2	68	65	57	63	72	68
1	29	0	42	42	55	48
0	—	10	37	32	42	—
	0	1	2	3	4	5

LO HARMONICS

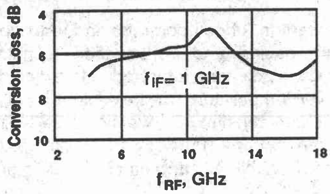
Conversion Loss



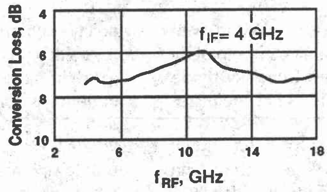
Conversion Loss



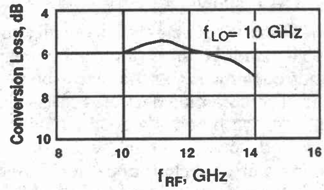
Conversion Loss



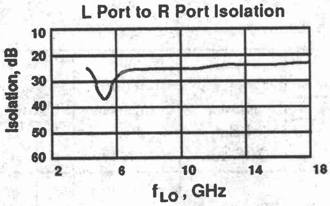
Conversion Loss



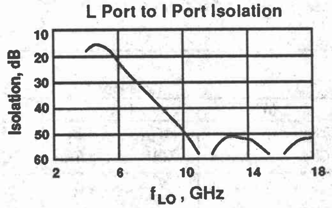
Conversion Loss



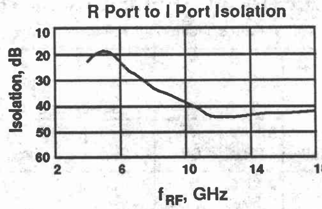
L Port to R Port Isolation



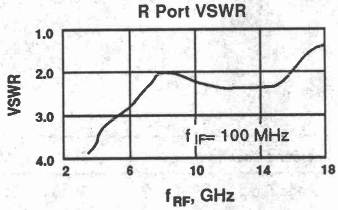
L Port to I Port Isolation



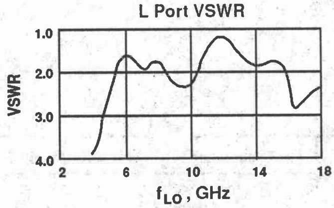
R Port to I Port Isolation



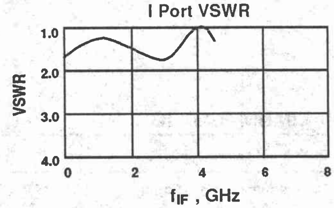
R Port VSWR



L Port VSWR



I Port VSWR



AVANTEK

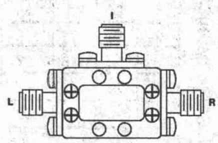
TFX–185L
Thin-Film Mixer
5 to 18 GHz Double Balanced

FEATURES

- All Thin-Film Ceramic Construction
- 5 to 18 GHz RF and LO Bandwidth
- DC to 5 GHz IF Bandwidth
- 6 dB Conversion Loss
- Low VSWRs All Ports
- Excellent Phase and Amplitude Matching and Tracking

APPLICATIONS

- 5 to 18 GHz Applications Requiring DC to 5 GHz IF Response
- EW Systems
- Wideband Heterodyned Receivers



TFX, p. 16–10

DESCRIPTION

The TFX-185 double-balanced mixers are fabricated with double-sided ceramic thin-film circuitry using completely planar construction and a single beam lead Schottky diode quad. The ceramic substrates utilize double-sided metalization, allowing broadside coupled baluns with two lines to be fabricated, one on each side of the substrate. Circuit elements are attached and interconnections are made with thermocompression bonding and gap welding for high reliability, accurate placement of components, and reduction of parasitics. Thin-film design and construction techniques result in extremely low single tone intermodulation distortion, superior stability over temperature, and excellent amplitude and phase match characteristics. Conversion loss typically varies by ±0.5 dB from –55° to +100°C. Phase deviations from unit to unit are typically within ±5° and amplitude differences are within ±1.5 dB.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

L suffix model specified @ P_{LO} = +7 dBm

	Frequency		Conversion Loss		Isolations						Typical 1 dB Compression Point	Input 3rd Order Intercept Point	VSWRS (Typ.)		
					L to R		L to I		R to I						
Suffix	RF/LO GHz	IF GHz	@F_{IF} GHz	dB Typ./Max.	@F_{LO} GHz	dB Typ./Min.	@F_{LO} GHz	dB Typ./Min.	@F_{RF} Ghz	dB Typ.	@RF, dBm	dBm, Typ.	R :1	L :1	I :1
L	5–18	DC–5	DC–.5 DC–5	6.0/8.5 7.5/10	5–18	25/20	5–6 6–9 9–18	10/7 15/12 30/20	5–18	30	+2 (P_{LO} = + 7)	+9 (P_{LO} = +10)	2.0	2.5	1.5

*MIN/MAX SPECS GUARANTEED –55° TO +100°C, TYP SPECS ARE FOR 25°C

MAXIMUM RATINGS

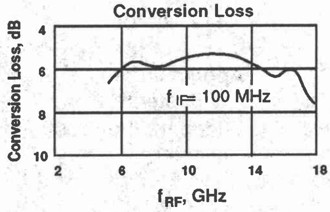
Peak Input Current @25°C	100 mA DC	**Pin Temperature**	260°C for 10 Sec	**Operating Case Temp**	–55° C to + 100°C
Continuous RF Input Power	200 mW @ 25°C 100 mW @ 100°C			**Storage Temp**	–65° C to + 125°C
Weight (typical): TFX—22 grams (with connectors)					

TYPICAL PERFORMANCE AT 25°C (LO Power Range Vs. Model Suffix — L: +7/+13 dBm)

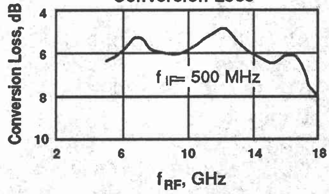
Typical Single Tone Intermodulation Suppression @ 25°C (–dBc) (Measured with –10 dBm RF input)

RF HARMONICS	LO HARMONICS 0	1	2	3	4	5
5	—	77	82	86	90	84
4	80	80	82	84	77	85
3	75	77	75	50	75	80
2	65	59	56	63	72	66
1	29	0	42	43	50	44
0	—	6	42	30	38	—

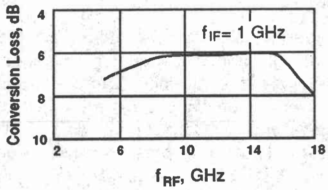
Conversion Loss



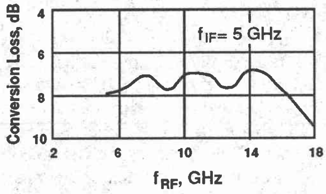
Conversion Loss



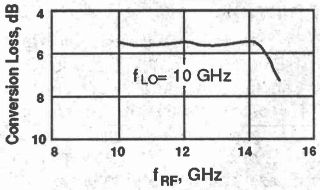
Conversion Loss



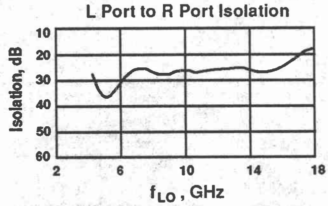
Conversion Loss



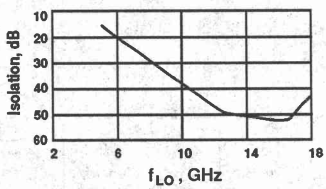
Conversion Loss



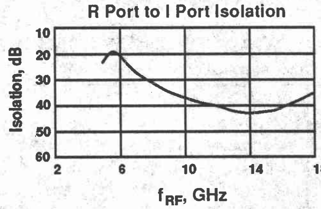
L Port to R Port Isolation



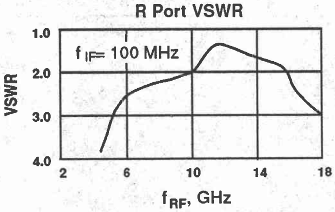
L Port to I Port Isolation



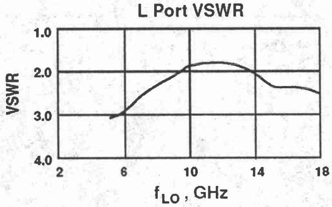
R Port to I Port Isolation



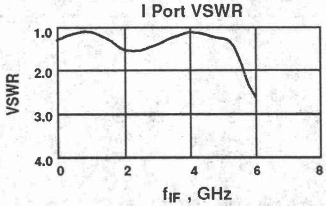
R Port VSWR



L Port VSWR



I Port VSWR



AVANTEK

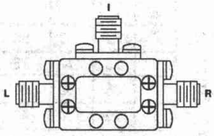
TFX–186L
Thin-Film Mixer
6 to 18 GHz Double Balanced

FEATURES

- All Thin-Film Ceramic Construction
- 6 to 18 GHz RF and LO Bandwidth
- DC to 5.5 GHz IF Bandwidth
- 6 dB Conversion Loss
- Low VSWRs All Ports
- Excellent Phase and Amplitude Matching and Tracking

APPLICATIONS

- 6 to 18 GHz Band Folding Applications
- EW Systems
- Wideband Heterodyned Receivers



TFX, p. 16–10

DESCRIPTION

The TFX-186 double-balanced mixers are fabricated with double-sided ceramic thin-film circuitry using completely planar construction and a single beam lead Schottky diode quad. The ceramic substrates utilize double-sided metalization, allowing broadside coupled baluns with two lines to be fabricated, one on each side of the substrate. Circuit elements are attached and interconnections are made with thermocompression bonding and gap welding for high reliability, accurate placement of components, and reduction of parasitics. Thin-film design and construction techniques result in extremely low single tone intermodulation distortion, superior stability over temperature, and excellent amplitude and phase match characteristics. Conversion loss typically varies by ±0.5 dB from –55° to +100°C. Phase deviations from unit to unit are typically within ±5° and amplitude differences are within ±1.5 dB.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

L suffix model specified @ P_{LO} = +7 dBm

	Frequency		Conversion Loss		Isolations						Typical 1 dB Compression Point	Input 3rd Order Intercept Point	VSWRS (Typ.)		
					L to R		L to I		R to I						
Suffix	RF/LO GHz	IF GHz	@F_{IF} GHz	dB Typ./Max.	@F_{LO} GHz	dB Typ./Min.	@F_{LO} GHz	dB Typ./Min.	@F_{RF} Ghz	dB Typ.	@RF, dBm	dBm, Typ.	R :1	L :1	I :1
L	6–18	DC–5.5	DC–1 DC–4 DC–5.5	6.0/7.5 6.5/8.0 7.5/9.0	6–18	30/20	6–9 9–18	15/6 35/20	6–8 8–18	25 35	+2 (P_{LO} = + 7)	+9 (P_{LO} = +10)	2.5	2.5	1.5

*MIN/MAX SPECS GUARANTEED –55° TO + 100°C, TYP SPECS ARE FOR 25°C

MAXIMUM RATINGS

Peak Input Current @25°C	100 mA DC	**Pin Temperature**	260°C for 10 Sec	**Operating Case Temp**	–55° C to + 100°C
Continuous RF Input Power	200 mW @ 25°C 100 mW @ 100°C			**Storage Temp**	–65° C to + 125°C
Weight (typical): TFX — 22 grams (with connectors)					

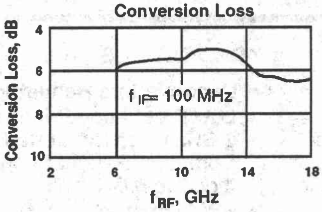
TYPICAL PERFORMANCE AT 25°C (LO Power: +7 dBm)

Typical Single Tone Intermodulation Suppression @ 25°C (–dBc) (Measured with –10 dBm RF input)

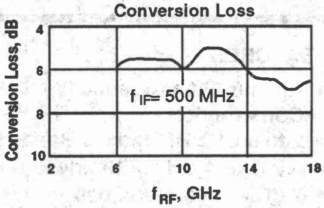
RF HARMONICS	LO 0	LO 1	LO 2	LO 3	LO 4	LO 5
5	—	76	82	85	91	83
4	—	80	83	86	80	85
3	75	80	72	50	78	80
2	65	54	48	62	63	51
1	32	0	37	40	40	—
0	—	6	35	20	—	—

LO HARMONICS

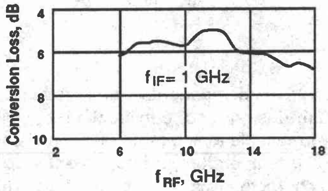
Conversion Loss



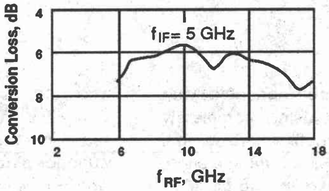
Conversion Loss



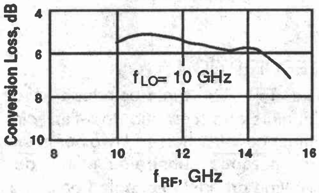
Conversion Loss



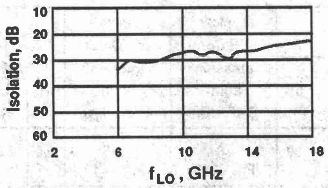
Conversion Loss



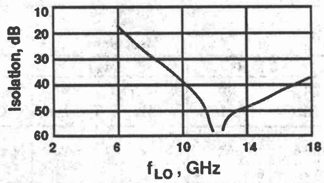
Conversion Loss



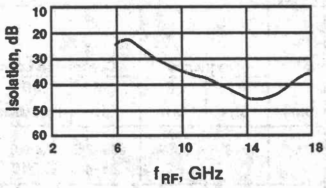
L Port to R Port Isolation



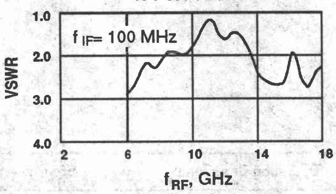
L Port to I Port Isolation



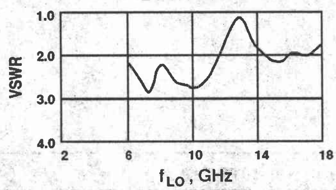
R Port to I Port Isolation



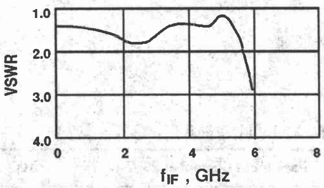
R Port VSWR



L Port VSWR



I Port VSWR

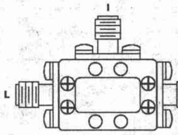


AVANTEK

TFX–824M/H
Thin-Film Mixer
2 to 8 GHz Triple Balanced

FEATURES
- All Thin-Film Ceramic Construction
- 2 to 8 GHz RF and LO Bandwidth
- 0.005 to 4 GHz IF Bandwidth
- 7 dB Conversion Loss
- Low VSWRs All Ports
- Excellent Phase and Amplitude Matching and Tracking

APPLICATIONS
- Upconverters Requiring Wide Low Frequency Bands of 0.1 to 2 GHz to Be Converted Into a Common IF Band Such As 2 to 4 or 2 to 6 GHz
- EW Systems
- Wideband Heterodyned Receivers



TFX, p. 16–10

DESCRIPTION
The TFX-824 triple-balanced mixers are fabricated with double-sided ceramic thin-film circuitry using completely planar construction and two beam lead Schottky diode quads. The ceramic substrates utilize double-sided metalization, allowing broadside coupled baluns with two lines to be fabricated, one on each side of the substrate. Circuit elements are attached and interconnections are made with thermo-compression bonding and gap welding for high reliability, accurate placement of components, and reduction of parasitics. Thin-film design and construction techniques result in extremely low single tone intermodulation distortion, superior stability over temperature, and excellent amplitude and phase match characteristics. Conversion loss typically varies by ±0.5 dB from –55° to +100°C. Phase deviations from unit to unit are typically within ±5° and amplitude differences are within ±1.5 dB.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)
M and H suffix models specified @ P_{LO} = +10 and +13 dBm respectively

	Frequency		Conversion Loss		Isolations						Typical 1 dB Compression Point*	Input 3rd Order Intercept Point	VSWRS (Typ.)		
					L to R		L to I		R to I						
Suffix	RF/LO GHz	IF GHz	@F_{IF} GHz	dB Typ./Max.	@F_{LO} GHz	dB Typ./Min.	@F_{LO} GHz	dB Typ./Min.	@F_{RF} Ghz	dB Typ.	@RF, dBm	dBm, Typ.	R :1	L :1	I :1
M	2–8	.005–4	.005–2.5 2.5–4	7.0/9.0 8.5/10	2–8	22/15	2–8	35/20	2–8	30	+6 (P_{LO} = +10)	+15 (P_{LO} = +10)	2.0	2.0	1.6
H	2–8	.005–4	.005–2.5 2.5–4	6.5/8.5 8.5/10	2–8	22/15	2–8	35/20	2–8	30	+9 (P_{LO} = +13)	+18 (P_{LO} = +13)	2.0	2.0	1.6

*MIN/MAX SPECS GUARANTEED –55° TO +100°C, TYP SPECS ARE FOR 25°C

MAXIMUM RATINGS

Peak Input Current @25°C	100 mA DC	Pin Temperature	260°C for 10 Sec	Operating Case Temp	–55° C to + 100°C
Continuous RF Input Power	200 mW @ 25°C 100 mW @ 100°C			Storage Temp	–65° C to + 125°C
Weight (typical): TFX—22 grams (with connectors)					

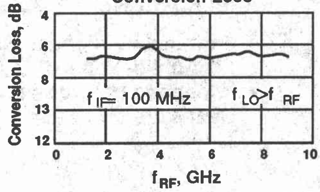
TYPICAL PERFORMANCE AT 25°C (LO Power Range Vs. Model Suffix—M: +10/+17; H: +13/+20 dBm)

Typical Single Tone Intermodulation Suppression @ 25°C (–dBc)
(Measured with –10 dBm RF input)

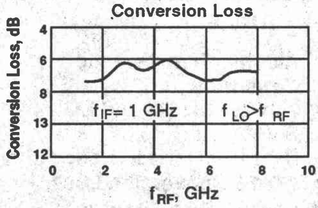
RF HARMONICS						
5	81	82	83	87	92	91
4	78	71	74	78	75	84
3	73	63	69	63	70	66
2	43	56	42	50	43	53
1	28	0	33	18	36	26
0	—	9	3	16	11	12
	0	1	2	3	4	5

LO HARMONICS

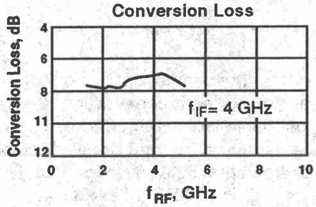
Conversion Loss



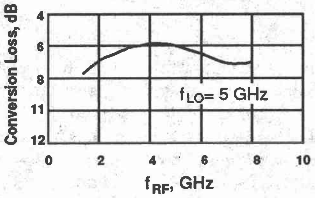
Conversion Loss



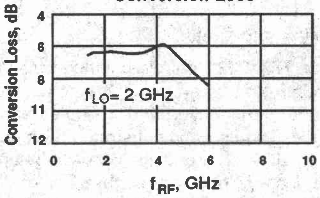
Conversion Loss



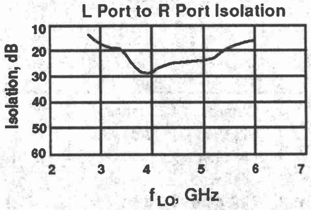
Conversion Loss



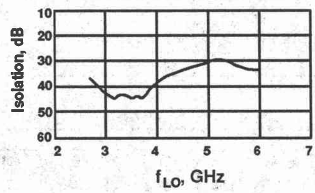
Conversion Loss



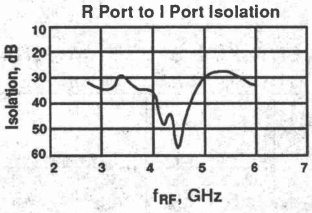
L Port to R Port Isolation



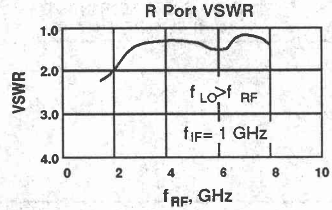
L Port to I Port Isolation



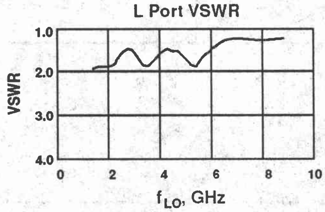
R Port to I Port Isolation



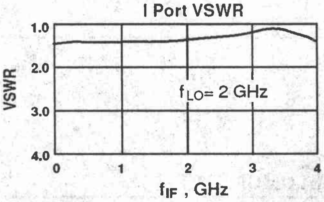
R Port VSWR



L Port VSWR



I Port VSWR



AVANTEK

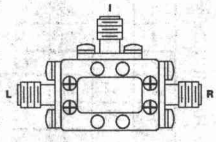
TFX–2021M/H Thin-Film Mixer 2 to 20 GHz Double Balanced

FEATURES

- All Thin-Film Ceramic Construction
- 2 to 20 GHz RF and LO Bandwidth
- DC to 500 MHz IF Bandwidth
- 7.0 dB Conversion Loss
- Low VSWRs All Ports
- Excellent Phase and Amplitude Matching and Tracking

APPLICATIONS

- Extremely Wideband RF and LO Applications
- Wideband Heterodyned Receivers



TFX, p. 16–10

DESCRIPTION

The TFX-2021 double-balanced mixers are fabricated with double-sided ceramic thin-film circuitry using completely planar construction and a single beam lead Schottky diode quad. The ceramic substrates utilize double-sided metalization, allowing broadside coupled baluns with two lines to be fabricated, one on each side of the substrate. Circuit elements are attached and interconnections are made with thermocompression bonding and gap welding for high reliability, accurate placement of components, and reduction of parasitics. Thin-film design and construction techniques result in extremely low single tone intermodulation distortion, superior stability over temperature, and excellent amplitude and phase match characteristics. Conversion loss typically varies by ±0.5 dB from –55° to +100°C. Phase deviations from unit to unit are typically within ±5° and amplitude differences are within ±1.5 dB.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

M and H suffix models specified @ P_{LO} = +10 and +13 dBm respectively

	Frequency		Conversion Loss		Isolations						Typical 1 dB Compression Point	Input 3rd Order Intercept Point	VSWRS (Typ.)		
					L to R		L to I		R to I						
Suffix	RF/LO GHz	IF GHz	@F_{IF} GHz	dB Typ./Max.	@F_{LO} GHz	dB Typ./Min.	@F_{LO} GHz	dB Typ./Min.	@F_{RF} Ghz	dB Typ.	@RF, dBm	dBm, Typ.	R :1	L :1	I :1
M	2–20	DC–0.5	DC–0.3 DC–0.5	7/9.5 8/10.5	2–20	25/16	2–3 3–20	15/12 30/18	2–20	30	+2 (P_{LO} = +10)	+7 (P_{LO} = +10)	2.5	2.0	2.0
H	2–20	DC–0.5	DC–0.3 DC–0.5	7/9.5 8/10.5	2–20	25/16	2–3 3–20	15/12 30/18	2–20	30	+5 (P_{LO} = +13)	+10 (P_{LO} = +13)	2.5	2.0	2.0
											*MIN/MAX SPECS GUARANTEED –55° TO +100°C, TYP SPECS ARE FOR 25°C				

MAXIMUM RATINGS

Peak Input Current @25°C	100 mA DC	**Pin Temperature**	260°C for 10 Sec	**Operating Case Temp**	–55°C to + 100°C
Continuous RF Input Power	200 mW @ 25°C 100 mW @ 100°C			**Storage Temp**	–65°C to + 125°C
Weight (typical): TFX—22 gram (with connectors)					

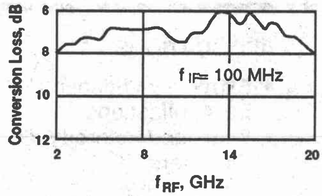
TYPICAL PERFORMANCE AT 25°C (LO Power Range Vs. Model Suffix—M: +10/+17; H: +13/+20 dBm)

Typical Single Tone Intermodulation Suppression @ 25°C (–dBc) (Measured with –10 dBm RF input)

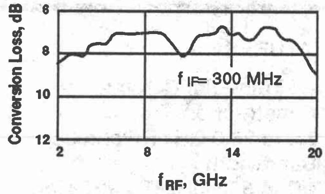
RF HARMONICS						
5	76	76	76	76	78	85
4	77	77	78	77	77	76
3	75	76	76	65	69	63
2	60	61	55	65	69	63
1	30	0	42	43	55	54
0	—	8	27	24	35	32
	0	1	2	3	4	5

LO HARMONICS

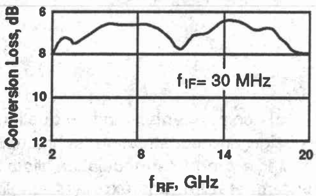
Conversion Loss



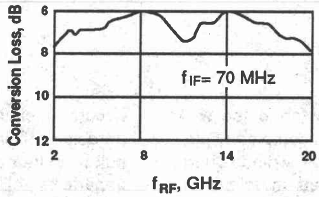
Conversion Loss



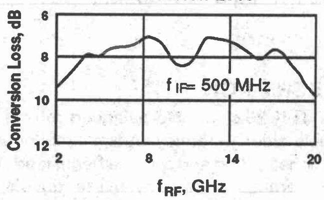
Conversion Loss



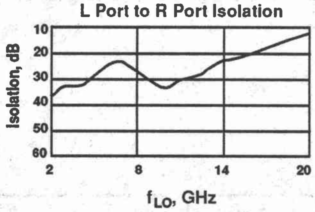
Conversion Loss



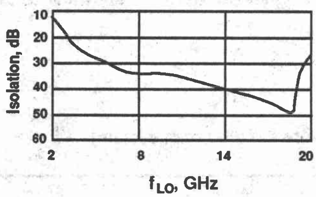
Conversion Loss



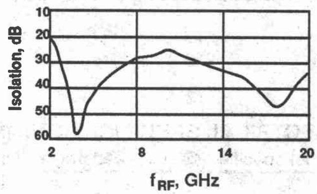
L Port to R Port Isolation



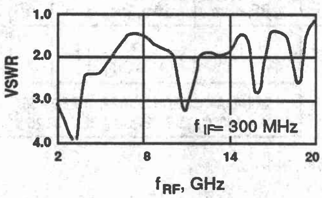
L Port to I Port Isolation



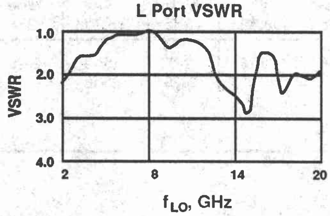
R Port to I Port Isolation



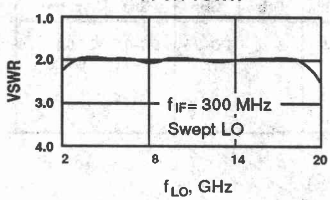
R Port VSWR



L Port VSWR



I Port VSWR



AVANTEK

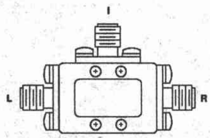
TFK–2621M
Thin-Film Mixer
2 to 26 GHz Double Balanced

FEATURES

- All Thin-Film Ceramic Construction
- 2.0 to 26.0 GHz RF and LO Bandwidth
- DC to 500 MHz IF Bandwidth
- 7 dB Conversion Loss
- Low VSWRs All Ports
- Excellent Phase and Amplitude Matching and Tracking

APPLICATIONS

- Extremely Wideband RF and LO Applications
- Wideband Heterodyned Receivers



TFK, p. 16–44

DESCRIPTION

The TFK-2621 double-balanced mixers are fabricated with double-sided ceramic thin-film circuitry using completely planar construction and a single beam lead Schottky diode quad. The ceramic substrates utilize double-sided metalization, allowing broadside coupled baluns with two lines to be fabricated, one on each side of the substrate. Circuit elements are attached and interconnections are made with thermocompression bonding and gap welding for high reliability, accurate placement of components, and reduction of parasitics. Thin-film design and construction techniques result in extremely low single tone intermodulation distortion, superior stability over temperature, and excellent amplitude and phase match characteristics. Conversion loss typically varies by ±0.5 dB from –55 to +100°C. Phase deviations from unit to unit are typically within ±5° and amplitude differences are within ±1.5 dB.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Model specified @ P_{LO} = +10 and +13 dBm

Suffix	Frequency		Conversion Loss		Isolations: L to R		Isolations: L to I		Isolations: R to I		Typical 1 dB Compression Point	Input 3rd Order Intercept Point	VSWRS (Typ.)		
	RF/LO GHz	IF GHz	@F_{IF} GHz	dB Typ./Max.	@F_{LO} GHz	dB Typ./Min.	@FL_O GHz	dB Typ./Min.	@F_{RF} Ghz	dB Typ.	@RF, dBm	dBm, Typ.	R :1	L :1	I :1
M	2–26	DC–0.5	DC–0.3 DC–0.5	8.0/11 9/11.5	2–26	35/16	2–3 3–26	15/12 25/16	2–26	25	+2 (P_{LO} = +10)	+7 (P_{LO} = +10)	2.5	2.5	2.5

*MIN/MAX SPECS GUARANTEED –55° TO +100°C, TYP SPECS ARE FOR 25°C

MAXIMUM RATINGS

Peak Input Current @25°C	100 mA DC	**Pin Temperature**	260°C for 10 Sec	**Operating Case Temp**	–55° C to + 100°C
Continuous RF Input Power	200 mW @ 25°C 100 mW @ 100°C			**Storage Temp**	–65° C to + 125°C
Weight (typical): 22 grams (with connectors)					

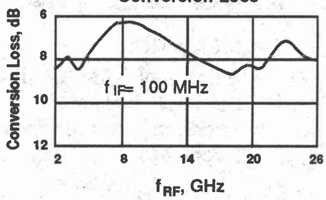
TYPICAL PERFORMANCE AT 25°C (LO Power Range Vs. Model Suffix — M: +10/+17 dBm)

Typical Single Tone Intermodulation Suppression @ 25°C (–dBc) (Measured with –10 dBm RF input)

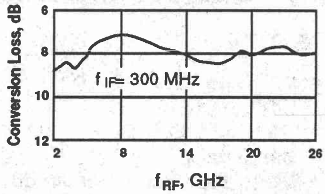
RF HARMONICS						
5	80	75	78	80	86	77
4	80	75	75	71	66	72
3	75	76	68	46	74	73
2	60	54	51	61	67	59
1	30	0	40	40	46	47
0	—	4	24	22	30	32
	0	1	2	3	4	5

LO HARMONICS

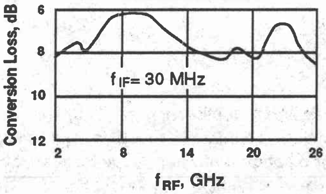
Conversion Loss



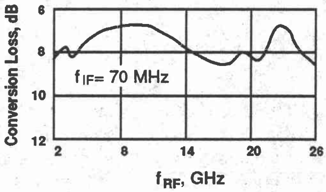
Conversion Loss



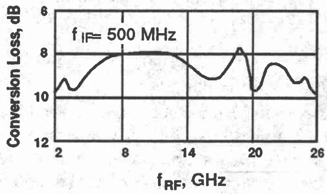
Conversion Loss



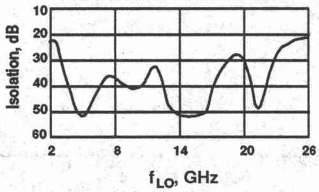
Conversion Loss



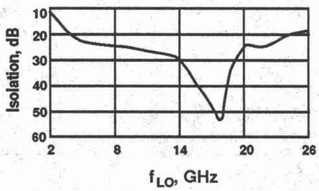
Conversion Loss



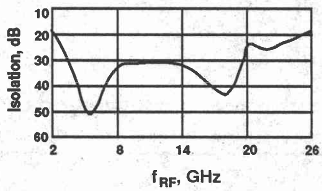
L Port to R Port Isolation



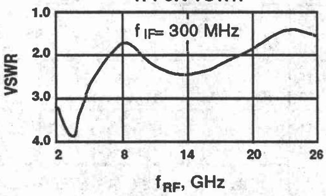
L Port to I Port Isolation



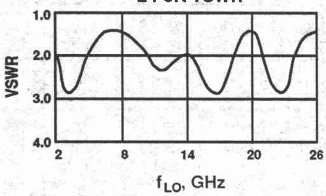
R Port to I Port Isolation



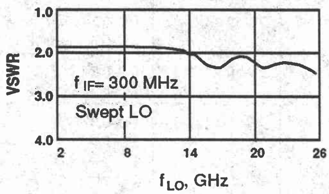
R Port VSWR



L Port VSWR



I Port VSWR



AVANTEK

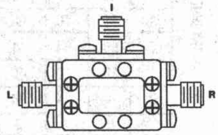
TFX–18075L/M/H Thin-Film Mixer .75 to 18 GHz Double Balanced

FEATURES

- All Thin-Film Ceramic Construction
- .75 to 18.0 GHz RF and LO Bandwidth
- DC to 500 MHz IF Bandwidth
- 7 dB Conversion Loss
- Low VSWRs All Ports
- Excellent Phase and Amplitude Matching and Tracking

APPLICATIONS

- Extremely Wide Band RF and LO Applications
- Wideband Heterodyned Receivers



TFX, p. 16–10

DESCRIPTION

The TFX-18075 double-balanced mixers are fabricated with double-sided ceramic thin-film circuitry using completely planar construction and a single beam lead Schottky diode quad. The ceramic substrates utilize double-sided metalization, allowing broadside coupled baluns with two lines to be fabricated, one on each side of the substrate. Circuit elements are attached and interconnections are made with thermocompression bonding and gap welding for accurate placement of components and reduction of parasitics. Thin-film design and construction techniques result in extremely low single tone intermodulation distortion, superior stability over temperature, and excellent amplitude and phase match characteristics. Conversion loss typically varies by ±0.5 dB from –55° to +100°C. Phase deviations from unit to unit are typically within ±5° and amplitude differences are within ±1.5 dB.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

L, M, H suffix models specified @ P_{LO} = +10, +13, +17 dBm respectively

Suffix	Frequency		Conversion Loss		Isolations L to R		Isolations L to I		Isolations R to I		Typical 1 dB Compression Point	Input 3rd Order Intercept Point	VSWRS (Typ.)		
	RF/LO GHz	IF GHz	@F_{IF} GHz	dB Typ./Max.	@FL_O GHz	dB Typ./Min.	@F_{LO} GHz	dB Typ./Min.	@F_{RF} Ghz	dB Typ.	@RF, dBm	dBm, Typ.	R :1	L :1	I :1
L	.75–18	DC–0.5	DC–0.3 DC–0.5	7/10 10/12	.75–1.5 1.5–18	20/17 25/19	.75–1.5 1.5–18	11/9 20/18	.75–1.5 1.5–18	11 22	+2 (P_{LO} = +10)	+9 (P_{LO} = +10)	2.7	2.5	2.0
M	.75–18	DC–0.5	DC–0.3 DC–0.5	7/10 10/12	.75–1.5 1.5/18	20/17 25/19	.75–1.5 1.5–18	11/9 20/18	.75–1.5 1.5–18	11 22	+5 (P_{LO} = +13)	+11 (P_{LO} = +17)	2.7	2.5	2.0
H	.75–18	DC–0.5	DC–0.3 DC–0.5	7/10 10/12	.75–1.5 1.5–18	20/17 25/19	.75/1.5 1.5–18	11/9 20/18	.75–1.5 1.5–18	11 22	+9 (P_{LO} = +17)	+20 (P_{LO} = +20)	2.7	2.5	2.0
											*MIN/MAX SPECS GUARANTEED –55° TO +100°C, TYP SPECS ARE FOR 25°C				

NOTE: Unlike other TFX series mixers, this product is not capable of meeting the requirements of MIL-STD-883 method 2001, Condition D: Y_1, 20 kgs (Shock and Vibration).

MAXIMUM RATINGS

Peak Input Current @ 25°C	100 mA DC	**Pin Temperature**	260°C for 10 Sec	**Operating Case Temp**	–55° C to + 100°C
Continuous RF Input Power	200 mW @ 25°C 100 mW @ 100°C			**Storage Temp**	–65° C to + 125°C
Weight (typical): TFX—22 grams (with connectors)					

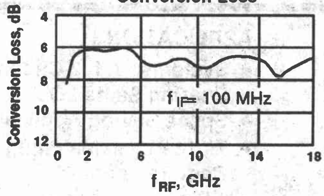
TYPICAL PERFORMANCE AT 25°C (LO Power Range Vs. Model Suffix—L: +7/+13; M: +10/+17; H: +13/+20 dBm)

Typical Single Tone Intermodulation Supression @ 25°C (–dBc) (Measured with –10 dBm RF input)

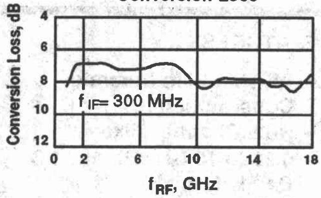
RF HARMONICS						
5	83	80	81	86	84	90
4	82	82	75	78	82	84
3	74	74	77	65	78	76
2	68	61	56	61	67	64
1	20	0	42	33	43	40
0	—	5	30	26	40	29
	0	1	2	3	4	5

LO HARMONICS

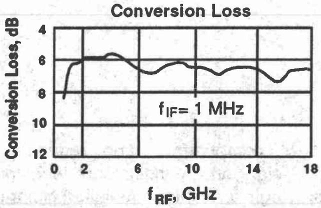
Conversion Loss



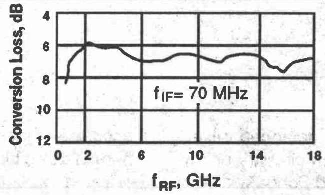
Conversion Loss



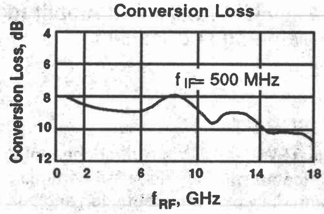
Conversion Loss



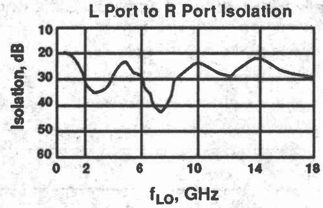
Conversion Loss



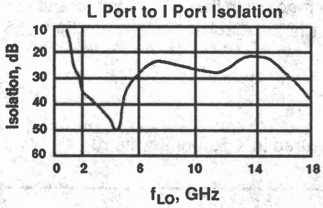
Conversion Loss



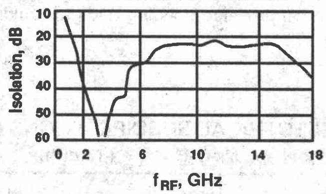
L Port to R Port Isolation



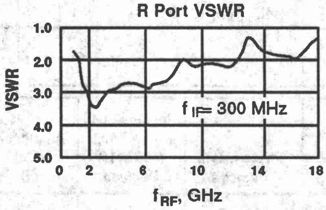
L Port to I Port Isolation



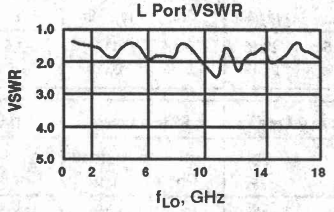
R Port to I Port Isolation



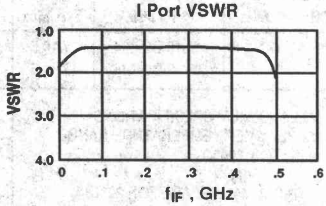
R Port VSWR



L Port VSWR



I Port VSWR



AVANTEK

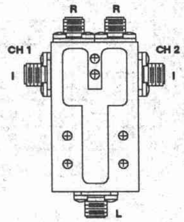
TFW–18075D Thin-Film Mixer .75 to 18 GHz Dual Channel

FEATURES

- All Thin-Film Ceramic Construction
- Dual Channel Mixer
- 0.75 to 18 GHz RF and LO Bandwidth
- DC-300 MHz IF Bandwidth
- 7 dB Conversion Loss
- Internal LO Power Splitter
- Excellent Phase and Amplitude Matching and Tracking

APPLICATIONS

- Systems With 2 Channels Sharing Same LO
- Space Saving Applications
- Tight Phase Matching Requirements



TFW, p. 16–45

DESCRIPTION

The TFW-18075D is a dual channel double-balanced mixer fabricated with double-sided ceramic thin-film circuitry using completely planar construction and beam lead Schottky diode quads. The ceramic substrates utilize double-sided metalization, allowing broadside coupled baluns with two lines to be fabricated, one on each side of the substrate. Circuit elements are attached and interconnections are made with thermocompression bonding and gap welding for high reliability, accurate placement of components, and reduction of parasitics. Thin-film design and construction techniques result in extremely low single tone intermodulation distortion, superior stability over temperature, and excellent amplitude and phase match characteristics. Conversion loss typically varies by ±0.5 dB from –55° to +100°C. Phase deviations from unit to unit are typically within ±5° and amplitude differences are within ±1.5 dB.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Model specified @ P_{LO} = +13 dBm

Frequency		Conversion Loss		Isolations L to R		Isolations L to I		Isolations R to I		1 dB Compression Point	Input 3rd Order Intercept Point	VSWRS (Typ.)		
RF/LO GHz	IF MHz	$@F_{RF}$, F_{LO} GHz $@ F_{IF}$ MHz	dB Typ./Max.	$@F_{LO}$ GHz	dB Typ./Min.	$@F_{LO}$ GHz	dB Typ./Min.	$@F_{RF}$ Ghz	dB Typ.	@RF, dBm	dBm, Typ.	R :1	L :1	I :1
.75–18	DC–300	1.5–16/DC–300	7/10.5	.75–1.5	20/15	.75–1.5	11/9	.75–1.5	11	+2/–1	+9	2.7	2.5	2.0
		.75–18/DC–300	7/11.5	1.5–18	25/19	1.5–18	20/18	1.5–18	22	(P_{LO} = +13)	(P_{LO} = +13)			

ALL MAXIMUM SPECIFICATIONS APPLY OVER TEMPERATURE RANGE –55° TO + 100°C. TYPICAL VALUES ARE FOR 25°C.	R1 to I2 Conv.		R2 to I1 Conv.		I1 to I2		Phase Match Degrees	Incremental Phase Track (400 MHz) Degrees	Amplitude Match dB
	@f GHz	dB Typ.	@f GHz	dB Typ.	@f MHz	dB Typ.			
	.75–18	60	.75–18	60	0–300	60	±15 Typ.	±5 Typ.	±1 Typ.

NOTE: Unlike other TFX series mixers, this product is not capable of meeting the requirements of MIL-STD-883 method 2001, Condition D: Y_1, 20 kgs (Shock and Vibration).

MAXIMUM RATINGS

Peak Input Current @25° C	100 mA DC	**Pin Temperature**	260° C for 10 Sec	**Operating Case Temp**	–55° C to + 100° C
Continuous RF Input Power	200 mW @ 25° C 100 mW @ 100° C			**Storage Temp**	–65° C to + 125° C
Weight (typical): 71 grams (with connectors)					

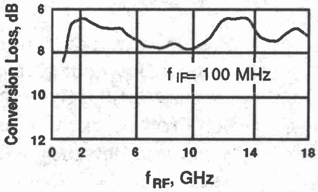
TYPICAL PERFORMANCE AT 25° C

Typical Single Tone Intermodulation Suppression @ 25°C (–dBc)
(Measured with –10 dBm RF input)

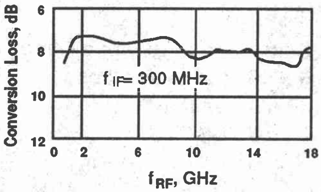
RF HARMONICS						
5	83	80	81	86	84	90
4	82	82	75	78	82	84
3	74	74	77	65	78	76
2	68	61	56	61	67	64
1	20	0	42	33	43	40
0	—	5	30	26	40	29
	0	1	2	3	4	5

LO HARMONICS

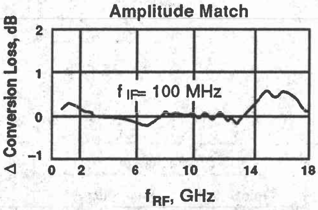
Conversion Loss



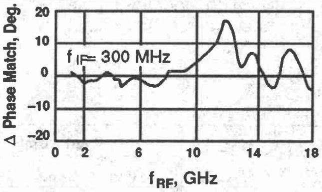
Conversion Loss



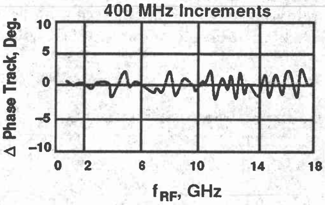
Amplitude Match



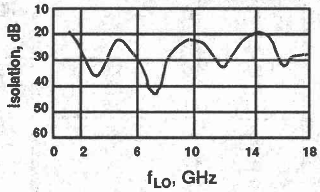
Phase Match



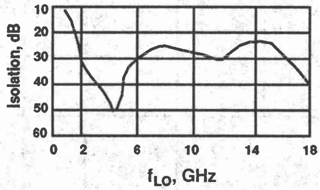
Incremental Phase Track
400 MHz Increments



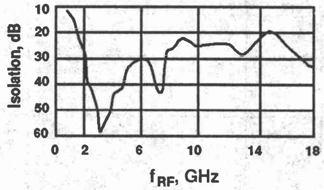
L Port to R Port Isolation



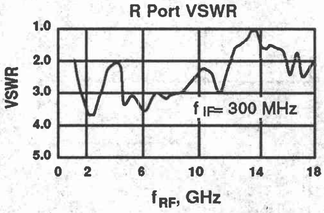
L Port to I Port Isolation



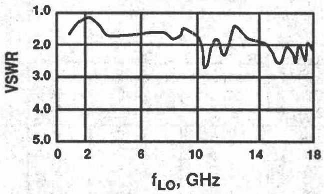
R Port to I Port Isolation



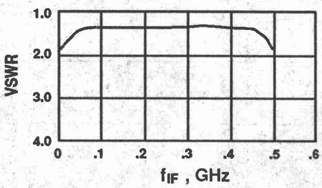
R Port VSWR



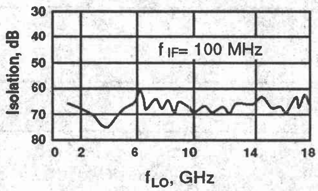
L Port VSWR



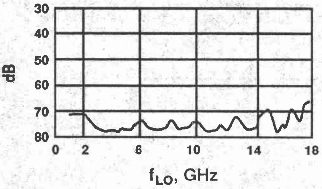
I Port VSWR



I1 to I2 Port Isolation



R1 to I2 Conversion
R2 to I1 Conversion



AVANTEK

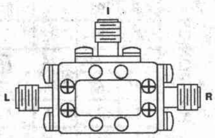
DBX–72L/M/H
DBY–72L/M/H
Duroid Mixer
2 to 7 GHz Double Balanced

FEATURES

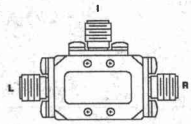
- Single Schottky Diode Quad
- 5.5 dB Conversion Loss
- 35 dB Isolation
- Low VSWR

APPLICATIONS

- Ideal for 2 to 6 GHz and 3.7 to 4.2 GHz Downconversion
- Threat Warning Systems
- Self Protection Jammers
- Wideband Heterodyned Receivers



DBX, p. 16–10



DBY, p. 16–11

DESCRIPTION

The DBX/DBY Series uses precisely matched Schottky-barrier diodes and a "quasi-planar" physical construction for excellent overall symmetry. Construction techniques result in high LO to RF isolation, extremely low single tone intermodulation distortion and very good amplitude and phase match characteristics.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Symbol	Characteristic		Operating Frequencies GHz f_{LO}	f_{RF}	f_{IF}	Power Level: LO Port dBm (typ)	Model Suffix	RF Port dBm	Specifications: Typical $T_C = 25°C$	Guaranteed $T_C = -55°$ to $+100°C$	Unit
BW	Operating Frequency Range		2.0–7.0	2.0–7.0	DC–1.5						GHz
CL	SSB Conversion Loss		2.0–7.0	2.0–7.0	DC–0.5				5.5	7.5	dB max
			2.0–7.0	2.0–7.0	DC–1.2				6.5	8.6	
			2.0–7.0	2.0–7.0	DC–1.5				7.5	9.5	
NF	SSB Noise Figure		2.0–7.0	2.0–7.0	0.03–0.5				5.5	7.5	dB max
			2.0–7.0	2.0–7.0	0.03–1.2				6.5	8.5	
			2.0–7.0	2.0–7.0	0.03–1.5				7.5	9.5	
ISOL	Isolation Port-to-Port	L–R	2.0–3.0	—	—				25	20	dB min
		L–R	3.0–7.0	—	—				35	25	
		R–L	—	2.0–7.0	—				35	—	
		R–I	—	2.0–7.0	—				20	—	
		L–I	2.0–7.0	—	—				25	20	
—	VSWR (50 ohm)	L	2.0–7.0	—	—				1.7:1		max
		R	4.0–7.0	—	—				1.5:1		
		R	2.0–3.0	—	—				3.0:1		
		R	3.0–4.0	—	—				2.0:1		
		I	—	—	≤1.5				1.5:1		
CC	Conversion Compression Point (1 dB)		2.0–7.0	2.0–7.0	≤1.5	≥+ 7	L		+ 2		dBm typ
			2.0–7.0	2.0–7.0	≤1.5	≥+10	M		+ 6		
			2.0–7.0	2.0–7.0	≤1.5	≥+17	H		+12		
IP_3	Third-Order Two-Tone Intercept Point		2.0–7.0	2.0–7.0	≤1.5	≥+ 7	L	—	+ 9	—	dBm typ
			2.0–7.0	2.0–7.0	≤1.5	≥+10	L	—	+10	—	
			2.0–7.0	2.0–7.0	≤1.5	≥+17	M	—	+12	—	
			2.0–7.0	2.0–7.0	≤1.5	≥+20	H	—	+22	—	
—	LO Port Drive Level (typical)		2.0–7.0	2.0–7.0	DC–1.5	+ 7–+13	L				dBm
			2.0–7.0	2.0–7.0	DC–1.5	+10–+17	M				
			2.0–7.0	2.0–7.0	DC–1.5	+17–+24	H				

NOTE: Specifications guaranteed at LO Power of +7 dBm for "L" model, +10 dBm for "M" model, and +17 dBm for "H" model.

MAXIMUM RATINGS

Peak Input Current @ 25°C	100 mA DC
Pin Temperature	260°C for 10 seconds
Operating Case Temperature	−55°C to +100°C
Storage Temperature	−65°C to +100°C
Continuous RF Input Power	200 mW @ +25°C 100 mW @ +100°C

WEIGHT: (typical) DBX — 22 grams; DBY — 16 grams (with connectors)

TYPICAL PERFORMANCE AT 25° C

Typical Single Tone Intermodulation Harmonic Suppression at 25°C (dB below desired output)

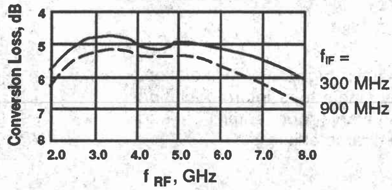
Harmonics of f_{RF}	1	2	3	4
4	>70	>70	>70	>70
3	65	>70	55	>70
2	50	55	50	58
1	0	25	18	40

Harmonics of f_{LO}

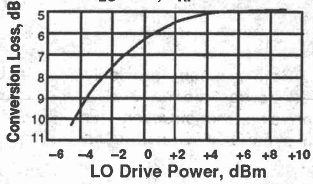
Typical Harmonic Intermodulation Suppression for mixer generated harmonics of the input signals. Suppression numbers are for a f_{RF} signal level at –10 dBm and f_{LO} signal level of:

L Suffix .... +7 dBm
M Suffix .... +10 dBm
H Suffix .... +17 dBm

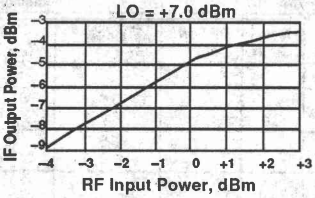
Conversion Loss



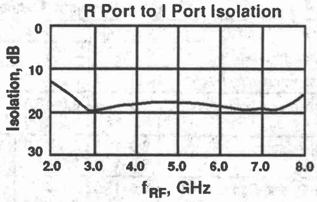
Conversion Loss
f_{LO}= 4.1, f_{RF}= 4.0 GHz



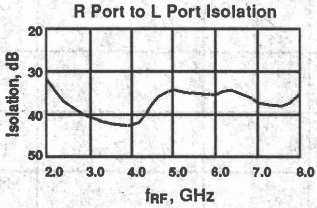
IF Output vs. RF Input Level
LO = +7.0 dBm



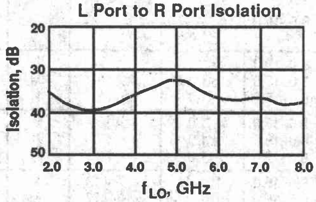
R Port to I Port Isolation



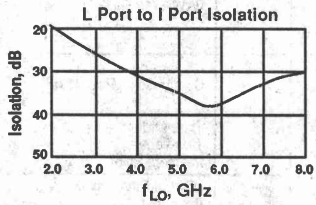
R Port to L Port Isolation



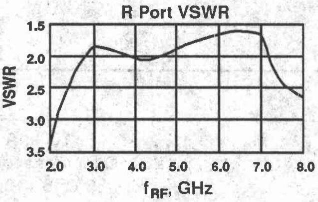
L Port to R Port Isolation



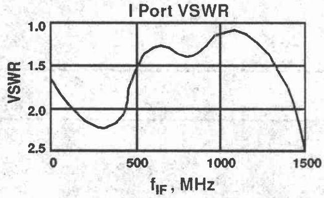
L Port to I Port Isolation



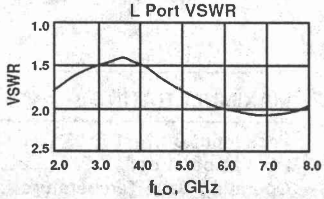
R Port VSWR



I Port VSWR



L Port VSWR



AVANTEK

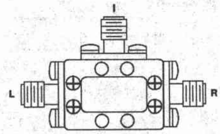
DBX–158L/M/H
DBY–158L/M/H
Duroid Mixer
8 to 15 GHz Double Balanced

FEATURES

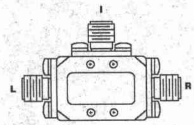
- Single Schottky Diode Quad
- 5.5 dB Conversion Loss
- 30 dB Isolation
- R Port VSWR ≤ 2.0:1

APPLICATIONS

- Low Cost 11.7 to 12.2 GHz Downconverter
- Threat Warning Systems
- Self Protection Jammers
- Wideband Heterodyned Receivers



DBX, p. 16–10



DBY, p. 16–11

DESCRIPTION

The DBX/DBY Series uses precisely matched Schottky-barrier diodes and a "quasi-planar" physical construction for excellent overall symmetry. Construction techniques result in high LO to RF isolation, extremely low single tone intermodulation distortion and very good amplitude and phase match characteristics.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Symbol	Characteristic	Operating Frequencies GHz f_{LO}	f_{RF}	f_{IF}	Power Level: LO Port dBm (typ)	Model Suffix	RF Port dBm	Specifications: Typical $T_C = 25°C$	Guaranteed $T_C = -55°$ to $+100°C$	Unit
BW	Operating Frequency Range	8.0–15.0	8.0–15.0	DC–1.0						GHz
CL	SSB Conversion Loss	8.0–15.0 8.0–15.0	8.0–15.0 8.0–15.0	DC–0.5 DC–1.0				5.5 6.0	7.0 7.5	dB max
NF	SSB Noise Figure	8.0–15.0 8.0–15.0	8.0–15.0 8.0–15.0	0.03–0.5 0.03–1.0				5.5 6.0	7.0 7.5	dB max
ISOL	Isolation Port-to-Port L–R R–L R–I L–I L–I	8.0–15.0 — — 8.0–12.0 12.0–15.0	— 8.0–15.0 8.0–15.0 — —	— — — — —				30 25 30 15 25	20 — — 12 20	dB min
—	VSWR (50 ohm) L R I	8.0–15.0 — —	— 8.0–15.0 —	— — ≤1.0				1.5:1 2.0:1 1.2:1		max
CC	Conversion Compression Point (1 dB)	8.0–15.0 8.0–15.0 8.0–15.0	8.0–15.0 8.0–15.0 8.0–15.0	≤1.0 ≤1.0 ≤1.0	≥+ 7 ≥+10 ≥+17	L M H		+ 2 + 6 +12		dBm typ
IP_3	Third-Order Two-Tone Intercept Point	8.0–15.0 8.0–15.0 8.0–15.0	8.0–15.0 8.0–15.0 8.0–15.0	≤1.0 ≤1.0 ≤1.0	≥+10 ≥+17 ≥+20	L M H	— — —	+ 9 +10 +20	— — —	dBm typ
—	LO Port Drive Level (typical)	8.0–15.0 8.0–15.0 8.0–15.0	8.0–15.0 8.0–15.0 8.0–15.0	DC–1 DC–1 DC–1	+ 7–+13 +10–+17 +17–+24	L M H				dBm

NOTE: Specifications guaranteed at LO Power of +7 dBm for "L" model, +10 dBm for "M" model, and +17 dBm for "H" model.

MAXIMUM RATINGS

Peak Input Current @ 25°C	100 mA DC
Pin Temperature	260° C for 10 seconds
Operating Case Temperature	−55°C to +100°C
Storage Temperature	−65°C to +100°C
Continuous RF Input Power	200 mW @ +25°C 100 mW @ +100°C

WEIGHT: (typical) DBX — 22 grams; DBY — 16 grams (with connectors)

TYPICAL PERFORMANCE AT 25°C

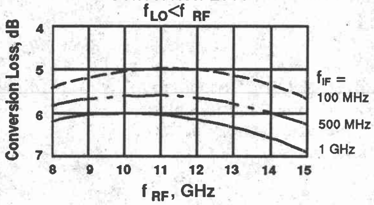
Typical Single Tone Intermodulation Harmonic Suppression at 25°C (dB below desired output)

Harmonics of f_{RF}	Harmonics of f_{LO}: 1	2	3	4
4	>70	>70	>70	>70
3	65	>70	55	>70
2	50	55	50	58
1	0	25	18	40

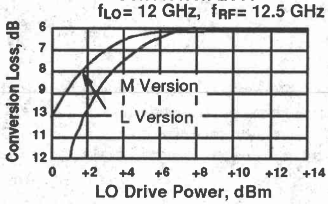
Typical Harmonic Intermodulation Suppression for mixer generated harmonics of the input signals. Suppression numbers are for a f_{RF} signal level at –10 dBm and f_{LO} signal level of:

L Suffix . . . . +7 dBm
M Suffix . . . . +10 dBm
H Suffix . . . . +17 dBm

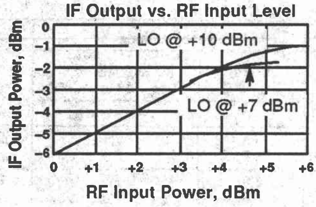
Conversion Loss
$f_{LO}<f_{RF}$



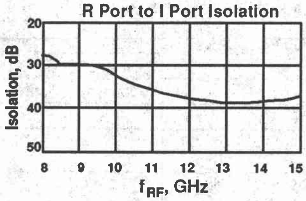
Conversion Loss
f_{LO}= 12 GHz, f_{RF}= 12.5 GHz



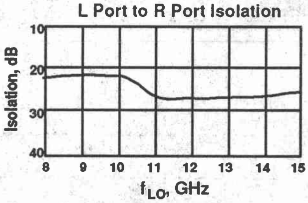
IF Output vs. RF Input Level



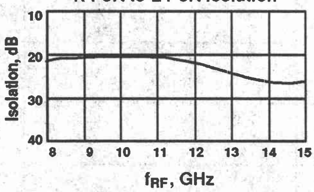
R Port to I Port Isolation



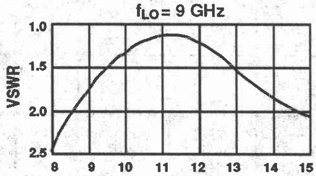
L Port to R Port Isolation



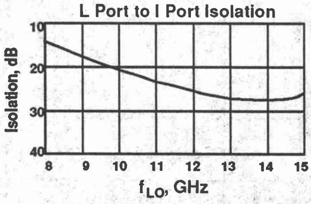
R Port to L Port Isolation



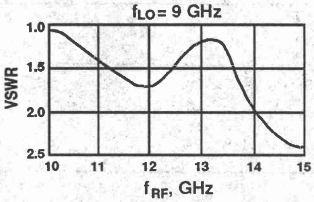
R Port VSWR
f_{LO}= 9 GHz



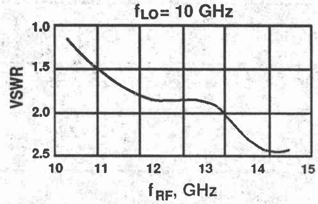
L Port to I Port Isolation



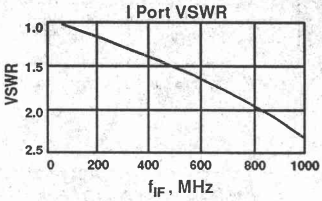
R Port VSWR
f_{LO}= 9 GHz



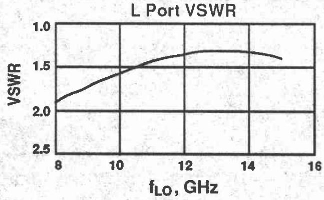
R Port VSWR
f_{LO}= 10 GHz



I Port VSWR



L Port VSWR



AVANTEK

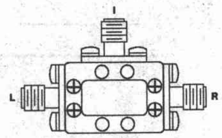
DBX–167L/M/H
DBY–167L/M/H
Duroid Mixer
7 to 16 GHz Double Balanced

FEATURES

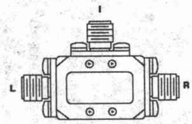
- Single Schottky Diode Quad
- DC to 4 GHz IF
- 30 dB Isolation
- R Port VSWR ≤2.0:1

APPLICATIONS

- 7 to 16 GHz Band Folding Applications
- Narrowband, Low-Cost Applications
- EW and ECM Systems
- Wideband Heterodyned Receivers



DBX, p. 16–10



DBY, p. 16–11

DESCRIPTION

The DBX/DBY Series uses precisely matched Schottky-barrier diodes and a "quasi-planar" physical construction for excellent overall symmetry. Construction techniques result in high LO to RF isolation, extremely low single tone intermodulation distortion and very good amplitude and phase match characteristics.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Symbol	Characteristic	Operating Frequencies GHz f_{LO}	f_{RF}	f_{IF}	Power Level LO Port dBm (typ)	Model Suffix	RF Port dBm	Specifications Typical $T_C = 25°C$	Guaranteed $T_C = -55°$ to $+100°C$	Unit
BW	Operating Frequency Range	7.0–16.0	7.0–16.0	DC–4.0						GHz
CL	SSB Conversion Loss	7.0–16.0 7.0–16.0	7.0–16.0 7.0–16.0	DC–1.0 DC–4.0				6.0 6.5	7.5 8.0	dB max
NF	SSB Noise Figure	7.0–16.0 7.0–16.0	7.0–16.0 7.0–16.0	0.03–1.0 0.03–4.0				6.0 6.5	7.5 8.0	dB max
ISOL	Isolation Port-to-Port L–R R–L R–I L–I L–I	7.0–16.0 — — 7.0– 8.0 8.0–16.0	— 7.0–16.0 7.0–16.0 — —	— — — — —				30 25 40 15 25	20 — — 12 20	dB min
—	VSWR (50 ohm) L R I	7.0–16.0 — —	— 7.0–16.0 —	— — ≤4.0				1.5:1 2.0:1 1.5:1		max
CC	Conversion Compression Point (1dB)	7.0–16.0 7.0–16.0 7.0–16.0	7.0–16.0 7.0–16.0 7.0–16.0	≤4.0 ≤4.0 ≤4.0	≥+ 7 ≥+10 ≥+17	L M H		+ 2 + 6 +12		dBm typ
IP_3	Third-Order Two-Tone Intercept Point	7.0–16.0 7.0–16.0 7.0–16.0	7.0–16.0 7.0–16.0 7.0–16.0	≤4.0 ≤4.0 ≤4.0	≥+ 7 ≥+10 ≥+20	L M H	— — —	+ 9 +10 +20	— — —	dBm typ
—	LO Port Drive Level (typical)	7.0–16.0 7.0–16.0 7.0–16.0	7.0–16.0 7.0–16.0 7.0–16.0	DC–4.0 DC–4.0 DC–4.0	+ 7–+13 +10–+17 +17–+24	L M H				dBm

NOTE: Specifications guaranteed at LO Power of +7 dBm for "L" model, +10 dBm for "M" model, and +17 dBm for "H" model.

MAXIMUM RATINGS

Peak Input Current @ 25°C .... 100 mA DC
Pin Temperature .... 260° C for 10 seconds
Operating Case Temperature .... −55°C to +100°C
Storage Temperature .... −65°C to +100°C
Continuous RF Input Power .... 200 mW @ +25°C
100 mW @ +100°C

WEIGHT: (typical) DBX — 22 grams; DBY — 16 grams (with connectors)

TYPICAL PERFORMANCE AT 25°C

Typical Single Tone Intermodulation Harmonic Suppression at 25°C (dB below desired output)

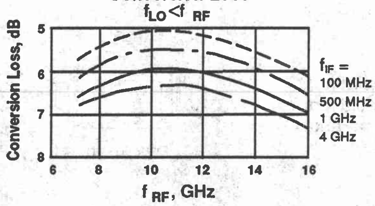
Harmonics of f_{RF}	1	2	3	4	5	6
6	>70	>70	>70	>70	>70	>70
5	>70	>70	>70	>70	>70	>70
4	>70	>70	>70	>70	>70	>70
3	65	>70	60	>70	65	>70
2	55	55	55	55	55	60
1	0	35	18	40	35	45

Harmonics of f_{LO}

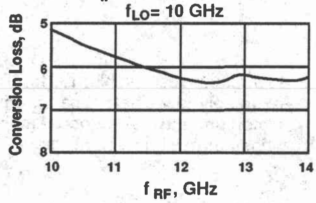
Typical Harmonic Intermodulation Suppression for mixer generated harmonics of the input signals. Suppression numbers are for a f_{RF} signal level at –10 dBm and f_{LO} signal level of:

L Suffix .... +7 dBm
M Suffix .... +10 dBm
H Suffix .... +17 dBm

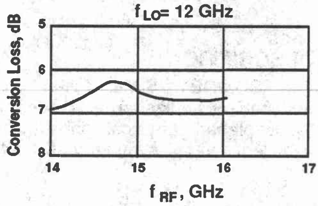
Conversion Loss
$f_{LO} < f_{RF}$



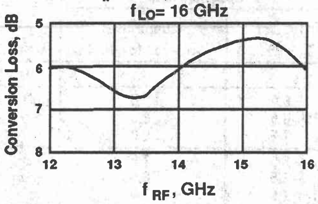
Conversion Loss
f_{IF} = 0.5 GHz–4 GHz
f_{LO} = 10 GHz



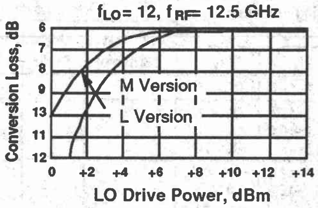
Conversion Loss
f_{IF} = 2–4 GHz
f_{LO} = 12 GHz



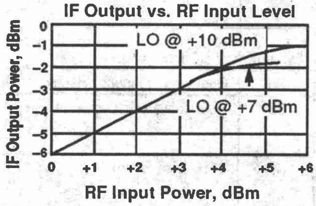
Conversion Loss
f_{IF} = 4.0 GHz–0.5 GHz
f_{LO} = 16 GHz



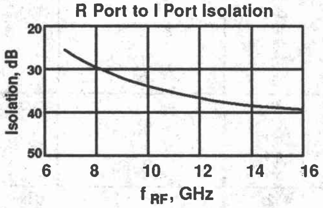
Conversion Loss
f_{LO} = 12, f_{RF} = 12.5 GHz



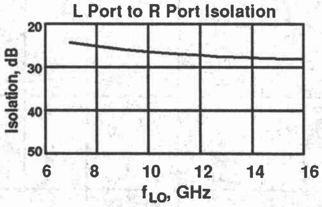
IF Output vs. RF Input Level



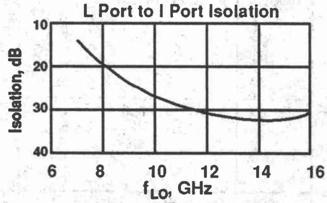
R Port to I Port Isolation



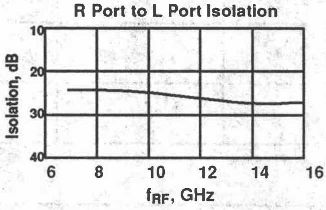
L Port to R Port Isolation



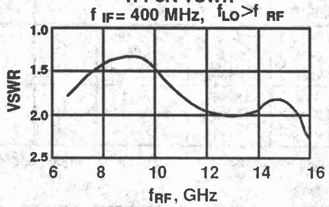
L Port to I Port Isolation



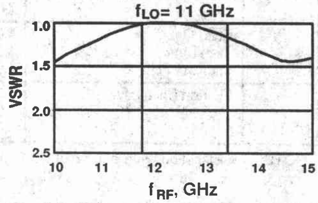
R Port to L Port Isolation



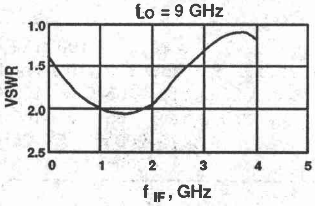
R Port VSWR
f_{IF} = 400 MHz, $f_{LO} > f_{RF}$



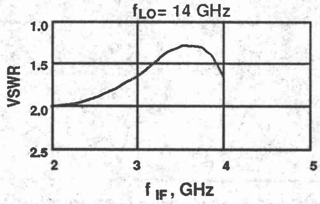
R Port VSWR
f_{LO} = 11 GHz



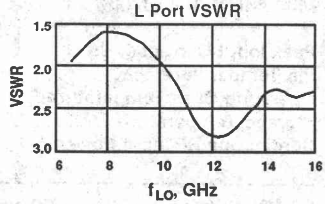
I Port VSWR
f_{LO} = 9 GHz



I Port VSWR
f_{LO} = 14 GHz



L Port VSWR



AVANTEK

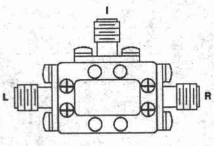
DBX–184L/M/H
DBY–184L/M/H
Duroid Mixer
4 to 18 GHz Double Balanced

FEATURES

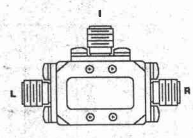
- Single Schottky Diode Quad
- DC to 4 GHz IF Bandwidth
- 6 dB Conversion Loss/NF
- 30 dB LO to RF Isolation
- Low VSWR

APPLICATIONS

- 4 to 18 GHz Band Folding Applications
- EW Systems
- Wideband Heterodyned Receivers



DBX, p. 16–10



DBY, p. 16–11

DESCRIPTION

The DBX/DBY Series uses precisely matched Schottky-barrier diodes and a "quasi-planar" physical construction for excellent overall symmetry. Construction techniques result in high LO to RF isolation, extremely low single tone intermodulation distortion and very good amplitude and phase match characteristics.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Symbol	Characteristic	Operating Frequencies GHz f_{LO}	f_{RF}	f_{IF}	Power Level LO Port dBm (typ)	Model Suffix	RF Port dBm	Specifications Typical $T_C = 25°C$	Guaranteed $T_C = -55°$ to $+100°C$	Unit
BW	Operating Frequency Range	4.0–18.0	4.0–18.0	DC–4.0						GHz
CL	SSB Conversion Loss	6.0–16.0 6.0–16.0 4.0–18.0	6.0–16.0 6.0–16.0 4.0–18.0	DC–0.5 DC–4.0 DC–4.0				6.0 6.5 7.5	7.5 8.5 9.0	dB max
NF	SSB Noise Figure	6.0–16.0 6.0–16.0 4.0–18.0	6.0–16.0 6.0–16.0 4.0–18.0	0.03–0.5 0.03–4.0 0.03–4.0				6.0 6.5 7.5	7.5 8.5 9.0	dB max
ISOL	Isolation Port-to-Port L–R R–L R–I L–I L–I L–I	4.0–18.0 — — 4.0–6.0 6.0–8.0 8.0–18.0	— 4.0–18.0 6.0–18.0 — — —	— — — — — —				30 25 30 10 15 25	20 — — 8 12 20	dB min
—	VSWR (50 ohm) L R R R I	5.0–17.0 — — — —	— 4.0–5.0 5.0–12.0 12.0–18.0 —	— — — — ≤4.0				2.0:1 3.0:1 2.0:1 1.5:1 1.5:1		max
CC	Conversion Compression Point (1 dB)	4.0–18.0 4.0–18.0 7.0–16.0	4.0–18.0 4.0–18.0 4.0–18.0	≤4.0 ≤4.0 ≤4.0	≥+ 7 min ≥+10 min ≥+17 min	L M H		+ 2 + 6 +12		dBm typ
IP_3	Third-Order Two-Tone Intercept Point	4.0–18.0 4.0–18.0 4.0–18.0	4.0–18.0 4.0–18.0 4.0–18.0	≤4.0 ≤4.0 ≤4.0	≥+10 min +17 ≥+20 min	L M H	— — —	+ 9 +12 +20	— — —	dBm typ
—	LO Port Drive Level (typical)	4.0–18.0 4.0–18.0 4.0–18.0	4.0–18.0 4.0–18.0 4.0–18.0	DC–4 DC–4 DC–4	+ 7–+13 +10–+17 +17–+24	L M H				dBm

NOTE: Specifications guaranteed at LO Power of +7 dBm for "L" model, +10 dBm for "M" model, and +17 dBm for "H" model.

MAXIMUM RATINGS

Peak Input Current @ 25°C . . . . 100 mA DC
Pin Temperature . . . . 260° C for 10 seconds
Operating Case Temperature . . . . –55°C to +100°C
Storage Temperature . . . . –65°C to +100°C
Continuous RF Input Power . . . . 200 mW @ +25°C
100 mW @ +100°C

WEIGHT: (typical) DBX — 22 grams; DBY — 16 grams (with connectors)

TYPICAL PERFORMANCE AT 25°C

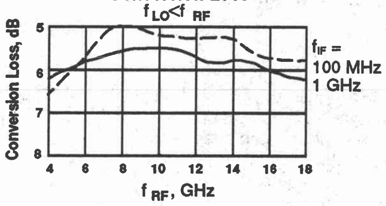
Typical Single Tone Intermodulation Harmonic Suppression at 25°C (dB below desired output)

Harmonics of f_{RF}	Harmonics of f_{LO}: 1	2	3	4
4	>70	>70	>70	>70
3	65	>70	55	>70
2	50	55	50	58
1	0	25	18	40

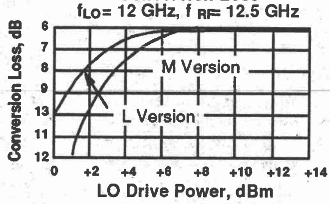
Typical Harmonic Intermodulation Suppression for mixer generated harmonics of the input signals. Suppression numbers are for a f_{RF} signal level at –10 dBm and f_{LO} signal level of:

- L Suffix .... +7 dBm
- M Suffix .... +10 dBm
- H Suffix .... +17 dBm

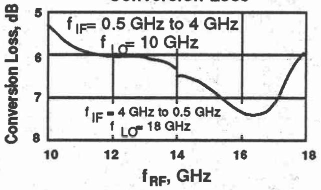
Conversion Loss $f_{LO} < f_{RF}$



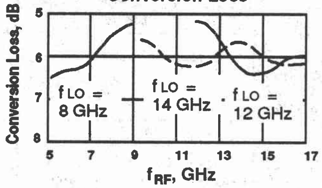
Conversion Loss f_{LO}= 12 GHz, f_{RF}= 12.5 GHz



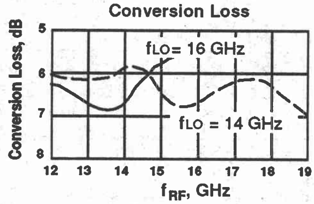
Conversion Loss



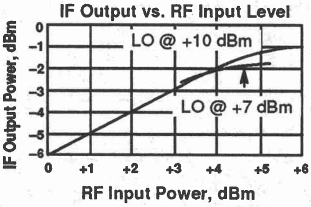
Conversion Loss



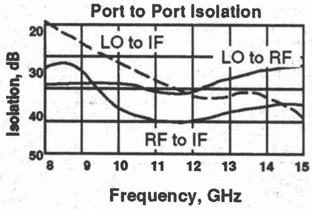
Conversion Loss



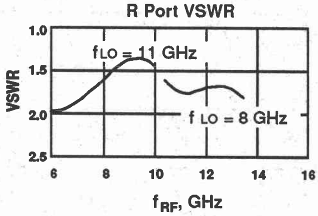
IF Output vs. RF Input Level



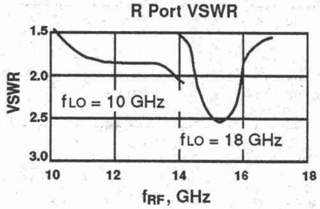
Port to Port Isolation



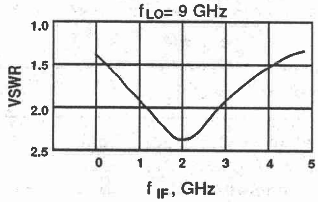
R Port VSWR



R Port VSWR



I Port VSWR
f_{LO}= 9 GHz



AVANTEK

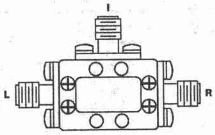
DBX–184LS/MS/HS
DBY–184LS/MS/HS
Duroid Mixer
4 to 18 GHz Double Balanced

FEATURES

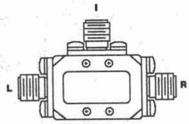
- Single Schottky Diode Quad
- 30 dB LO to IF Isolation
- 30 dB LO to RF Isolation
- 6.0 dB Conversion Loss/NF
- Low VSWR

APPLICATIONS

- 4 to 18 GHz Swept Frequency Applications
- Optimized for Increased L to I Isolation
- EW Systems
- Wideband Heterodyned Receivers



DBX, p. 16–10



DBY, p. 16–11

DESCRIPTION

The DBX/DBY Series uses precisely matched Schottky-barrier diodes and a "quasi-planar" physical construction for excellent overall symmetry. Construction techniques result in high LO to RF isolation, extremely low single tone intermodulation distortion and very good amplitude and phase match characteristics.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Symbol	Characteristic	Operating Frequencies GHz f_{LO}	f_{RF}	f_{IF}	Power Level: LO Port dBm (typ)	Model Suffix	RF Port dBm	Specifications: Typical $T_C = 25°C$	Guaranteed $T_C = -55°$ to $+100°C$	Unit
BW	Operating Frequency Range	4.0–18.0	4.0–18.0	DC–1.5						GHz
CL	SSB Conversion Loss	6.0–16.0 4.0–18.0 4.0–18.0	6.0–16.0 4.0–18.0 4.0–18.0	DC–0.5 DC–1.0 DC–1.5				6.0 6.5 7.5	7.5 8.5 9.0	dB max
NF	SSB Noise Figure	6.0–16.0 4.0–18.0 4.0–18.0	6.0–16.0 4.0–18.0 4.0–18.0	0.03–0.5 0.03–1.0 0.03–1.5				6.0 6.5 7.5	7.5 8.5 9.0	dB max
ISOL	Isolation Port-to-Port L–R R–L R–I R–I L–I	4.0–18.0 — — — 4.0–18.0	— 4.0–18.0 4.0– 9.0 9.0–18.0 —	— — — — —				30 25 30 45 30	20 — — — 20	dB min
—	VSWR (50 ohm) L R R R I	5.0–17.0 — — — —	— 4.0– 5.0 5.0–12.0 12.0–18.0 —	— — — — ≤1.5				2.0:1 3.0:1 2.0:1 1.5:1 1.5:1		max
CC	Conversion Compression Point (1 dB)	4.0–18.0 4.0–18.0 4.0–18.0	4.0–18.0 4.0–18.0 4.0–18.0	≤1.5 ≤1.5 ≤1.5	≥+ 7 ≥+10 ≥+17	L M H		+ 2 + 6 +12		dBm typ
IP_3	Third-Order Two-Tone Intercept Point	4.0–18.0 4.0–18.0 4.0–18.0	4.0–18.0 4.0–18.0 4.0–18.0	≤1.5 ≤1.5 ≤1.5	≥+10 +17 ≥+20	L M H	— — —	+ 9 +12 +20	— — —	dBm typ
—	LO Port Drive Level (typical)	4.0–18.0 4.0–18.0 4.0–18.0	4.0–18.0 4.0–18.0 4.0–18.0	DC–1.5 DC–1.5 DC–1.5	+ 7–+13 +10–+17 +17–+24	L M H				dBm

NOTE: Specifications guaranteed at LO Power of +7 dBm for "L" model, +10 dBm for "M" model, and +17 dBm for "H" model.

MAXIMUM RATINGS

Peak Input Current @ 25°C . . . . 100 mA DC
Pin Temperature . . . . 260° C for 10 seconds
Operating Case Temperature . . . . −55°C to +100°C
Storage Temperature . . . . −65°C to +100°C
Continuous RF Input Power . . . . 200 mW @ +25°C
100 mW @ +100°C

WEIGHT: (typical) DBX — 22 grams; DBY — 16 grams (with connectors)

TYPICAL PERFORMANCE AT 25°C

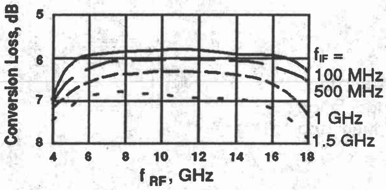
Typical Single Tone Intermodulation Harmonic Suppression at 25°C (dB below desired output)

Harmonics of f_{RF} \ Harmonics of f_{LO}	1	2	3	4
4	>70	>70	>70	>70
3	65	>70	55	>70
2	50	55	50	58
1	0	25	18	40

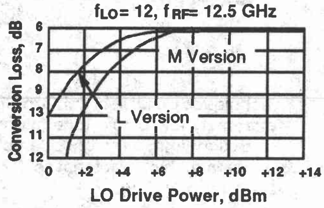
Typical Harmonic Intermodulation Suppression for mixer generated harmonics of the input signals. Suppression numbers are for a f_{RF} signal level at –10 dBm and f_{LO} signal level of:

L Suffix .... +7 dBm
M Suffix .... +10 dBm
H Suffix .... +17 dBm

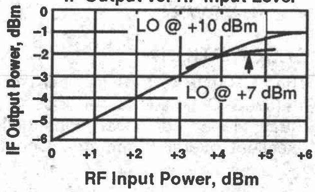
Conversion Loss



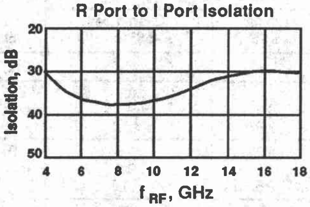
Conversion Loss
f_{LO}= 12, f_{RF}= 12.5 GHz



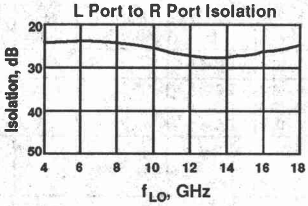
IF Output vs. RF Input Level



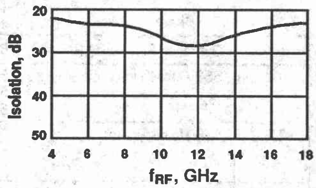
R Port to I Port Isolation



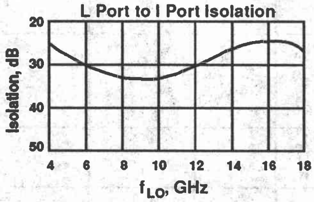
L Port to R Port Isolation



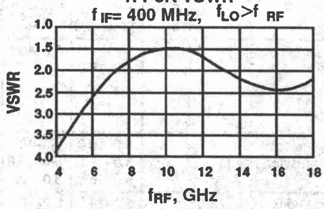
R Port to L Port Isolation



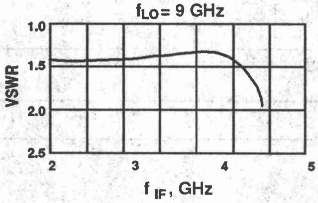
L Port to I Port Isolation



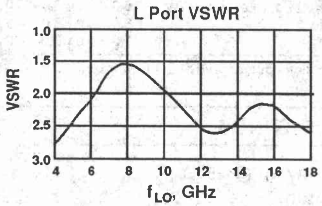
R Port VSWR
f_{IF}= 400 MHz, f_{LO}>f_{RF}



I Port VSWR
f_{LO}= 9 GHz



L Port VSWR



AVANTEK

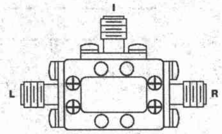
DBX–185L/M/H
DBY–185L/M/H
Duroid Mixer
5 to 18 GHz Double Balanced

FEATURES

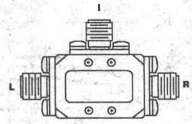
- Single Schottky Diode Quad
- DC to 6.0 GHz IF Bandwidth
- 6.0 dB Conversion Loss/NF
- 30 dB LO–RF Isolation
- Up to +30 dBm Input Intercept Point
- Low VSWR

APPLICATIONS

- 5 to 18 GHz Band Folding Applications with 2 to 6 GHz IF Response
- EW Systems
- Wideband Heterodyned Receivers



DBX, p. 16–10



DBY, p. 16–11

DESCRIPTION

The DBX/DBY Series uses precisely matched Schottky-barrier diodes and a "quasi-planar" physical construction for excellent overall symmetry. Construction techniques result in high LO to RF isolation, extremely low single tone intermodulation distortion and very good amplitude and phase match characteristics.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Symbol	Characteristic		Operating Frequencies GHz f_{LO}	f_{RF}	f_{IF}	Power Level: LO Port dBm (typ)	Model Suffix	RF Port dBm	Specifications: Typical $T_C = 25°C$	Guaranteed $T_C = -55°$ to $+100°C$	Unit
BW	Operating Frequency Range		5.0–18.0	5.0–18.0	DC–6.0						GHz
CL	SSB Conversion Loss		5.0–18.0	5.0–18.0	DC–0.5				6.0	8.5	dB max
			5.0–16.0	5.0–16.0	DC–6.0				6.5	9.0	
			5.0–18.0	5.0–18.0	DC–6.0				7.5	10.0	
NF	SSB Noise Figure		5.0–18.0	5.0–18.0	0.03–0.5				6.0	8.5	dB max
			5.0–16.0	5.0–16.0	0.03–6.0				6.5	9.0	
			5.0–18.0	5.0–18.0	0.03–6.0				7.5	10.0	
ISOL	Isolation Port-to-Port	L–R	5.0–18.0	—	—				30	20	dB min
		R–L	—	5.0–18.0	—				25	—	
		R–I	—	8.0–18.0	—				30	—	
		L–I	5.0–8.5	—	—				10	7	
		L–I	5.0–12.0	—	—				15	12	
		L–I	12.0–18.0	—	—				25	20	
—	VSWR (50 ohm)	R	—	5.0–18.0	—				2.0:1		max
		L	5.0–18.0	—	—				1.5:1		
		I	—	—	≤1.0				1.5:1		
		I	—	—	1.0–4.0				2.5:1		
		I	—	—	4.0–6.0				1.7:1		
CC	Conversion Compression Point (1 dB)		5.0–18.0	5.0–18.0	≤6.0	≥+ 7	L		+ 2		dBm typ
			5.0–18.0	5.0–18.0	≤6.0	≥+10	M		+ 6		
			5.0–18.0	5.0–18.0	≤6.0	≥+17	H		+12		
IP_3	Third-Order Two-Tone Intercept Point		5.0–18.0	5.0–18.0	≤6.0	≥+10	L	—	+ 9	—	dBm typ
			5.0–18.0	5.0–18.0	≤6.0	+17	M	—	+10	—	
			5.0–18.0	5.0–18.0	≤6.0	≥+20	H	—	+20	—	
—	LO Port Drive Level (typical)		5.0–18.0	5.0–18.0	DC–6.0	+ 7–+13	L				dBm
			5.0–18.0	5.0–18.0	DC–6.0	+10–+17	M				
			5.0–18.0	5.0–18.0	DC–6.0	+17–+24	H				

NOTE: Specifications guaranteed at LO Power of +7 dBm for "L" model, +10 dBm for "M" model, and +17 dBm for "H" model.

MAXIMUM RATINGS

Peak Input Current @ 25°C .... 100 mA DC
Pin Temperature .... 260° C for 10 seconds
Operating Case Temperature .... −55°C to +100°C
Storage Temperature .... −65°C to +100°C
Continuous RF Input Power .... 200 mW @ +25°C
100 mW @ +100°C

WEIGHT: (typical) DBX — 22 grams; DBY — 16 grams (with connectors)

TYPICAL PERFORMANCE AT 25°C

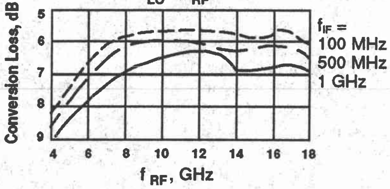
Typical Single Tone Intermodulation Harmonic Suppression at 25°C (dB below desired output)

Harmonics of f_{RF}				
4	>70	>70	>70	>70
3	65	>70	55	>70
2	50	55	50	58
1	0	25	18	40
Harmonics of f_{LO}	1	2	3	4

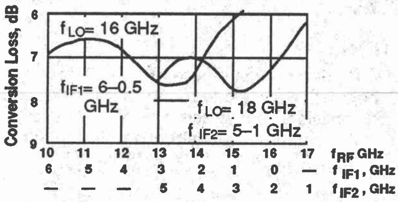
Typical Harmonic Intermodulation Suppression for mixer generated harmonics of the input signals. Suppression numbers are for a f_{RF} signal level at –10 dBm and f_{LO} signal level of:

L Suffix .... +7 dBm
M Suffix .... +10 dBm
H Suffix .... +17 dBm

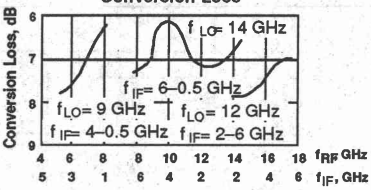
Conversion Loss f_{LO}<f_{RF}



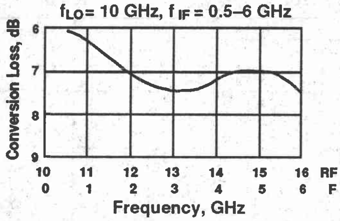
Conversion Loss



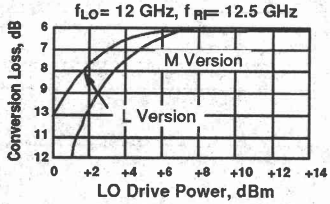
Conversion Loss



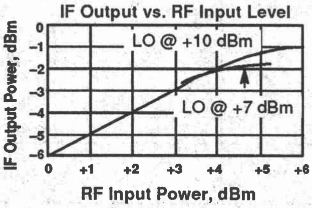
Conversion Loss
f_{LO}= 10 GHz, f_{IF} = 0.5–6 GHz



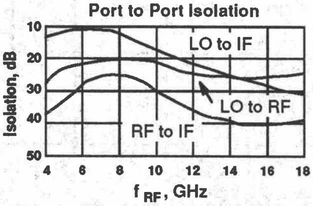
Conversion Loss
f_{LO}= 12 GHz, f_{RF}= 12.5 GHz



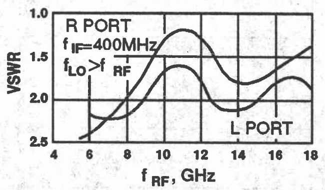
IF Output vs. RF Input Level



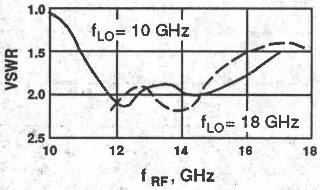
Port to Port Isolation



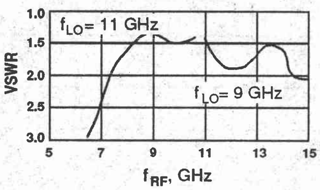
VSWR



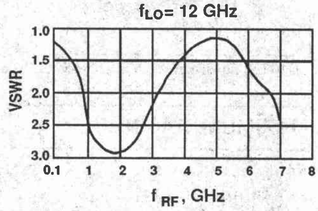
R Port VSWR



R Port VSWR



I Port VSWR
f_{LO}= 12 GHz



![AVANTEK]

AVANTEK

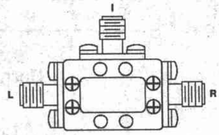
DBX–186L/M/H
DBY–186L/M/H
Double Balanced Mixer
6 to 18 GHz

FEATURES

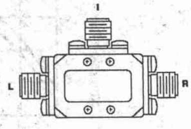
- Single Schottky Diode Quad
- DC to 7.0 GHz IF Bandwidth
- 6 dB Conversion Loss/NF
- 30 dB LO to RF Isolation
- Low VSWR

APPLICATIONS

- 6 to 18 GHz Band Folding Applications with 2 to 7 GHz IF Response
- EW Systems
- Wideband Heterodyned Receivers



DBX, p. 16–10



DBY, p. 16–11

DESCRIPTION

The DBX/DBY Series uses precisely matched Schottky-barrier diodes and a "quasi-planar" physical construction for excellent overall symmetry. Construction techniques result in high LO to RF isolation, extremely low single tone intermodulation distortion and very good amplitude and phase match characteristics.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Symbol	Characteristic	Operating Frequencies GHz			Power Level			Specifications		Unit
		f_{LO}	f_{RF}	f_{IF}	LO Port dBm (typ)	Model Suffix	RF Port dBm	Typical $T_C = 25°C$	Guaranteed $T_C = -55°$ to $+100°C$	
BW	Operating Frequency Range	6.0–18.0	6.0–18.0	DC–7.0						GHz
CL	SSB Conversion Loss	6.0–18.0 6.0–18.0 6.0–18.0	6.0–18.0 6.0–18.0 6.0–18.0	DC–0.5 DC–6.0 DC–7.0				6.5 8.0 9.0	8.5 10.0 11.0	dB max
NF	SSB Noise Figure	6.0–18.0 6.0–18.0 6.0–18.0	6.0–18.0 6.0–18.0 6.0–18.0	DC–0.5 DC–6.0 DC–7.5				6.5 8.0 9.0	8.5 10.0 11.0	dB max
ISOL	Isolation Port-to-Port L–R L–R R–L R–I L–I L–I L–I	6.0–16.0 6.0–18.0 — — 6.0–8.0 8.0–12.0 12.0–18.0	— — 6.0–18.0 8.0–18.0 — — —	— — — — — — —				30 22 25 30 10 15 25	20 18 — — 8 12 20	dB min
—	VSWR (50 ohm) R L I I I	— 6.0–18.0 — — —	6.0–18.0 — — — —	— — ≤1.0 1.0–4.0 4.0–7.0				2.0:1 1.5:1 1.5:1 2.5:1 1.7:1		max
CC	Conversion Compression Point (1dB)	6.0–18.0 6.0–18.0 6.0–18.0	6.0–18.0 6.0–18.0 6.0–18.0	≤7.0 ≤7.0 ≤7.0	≥+ 7 ≥+10 ≥+17	L M H		+ 2 + 6 +12		dBm typ
IP_3	Third-Order Two-Tone Intercept Point	6.0–18.0 6.0–18.0 6.0–18.0	6.0–18.0 6.0–18.0 6.0–18.0	≤7.0 ≤7.0 ≤7.0	≥+10 +17 ≥+20	L M H	— — —	+ 9 +12 +20	— — —	dBm typ
—	LO Port Drive Level (typical)	6.0–18.0 6.0–18.0 6.0–18.0	6.0–18.0 6.0–18.0 6.0–18.0	DC–7.0 DC–7.0 DC–7.0	+ 7–+13 +10–+17 +17–+24	L M H				dBm

NOTE: Specifications guaranteed at LO Power of +7 dBm for "L" model, +10 dBm for "M" model, and +17 dBm for "H" model.

MAXIMUM RATINGS

Peak Input Current @ 25°C .... 100 mA DC
Pin Temperature .... 260° C for 10 seconds
Operating Case Temperature .... −55°C to +100°C
Storage Temperature .... −65°C to +100°C
Continuous RF Input Power .... 200 mW @ +25°C
100 mW @ +100°C

WEIGHT: (typical) DBX — 22 grams; DBY — 16 grams (with connectors)

TYPICAL PERFORMANCE AT 25°C

Typical Single Tone Intermodulation Harmonic Suppression at 25°C (dB below desired output)

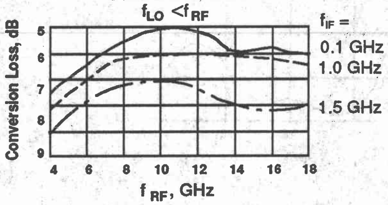
Harmonics of f_{RF}						
6	>70	>70	>70	>70	>70	>70
5	>70	>70	>70	>70	>70	>70
4	>70	>70	>70	>70	>70	>70
3	65	>70	60	>70	65	>70
2	55	55	55	55	55	60
1	0	35	18	40	35	45
	1	2	3	4	5	6

Harmonics of f_{LO}

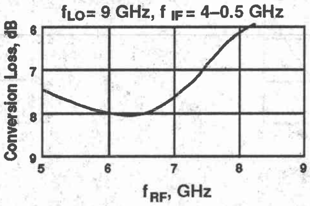
Typical Harmonic Intermodulation Suppression for mixer generated harmonics of the input signals. Suppression numbers are for a f_{RF} signal level at –10 dBm and f_{LO} signal level of:

L Suffix .... +7 dBm
M Suffix .... +10 dBm
H Suffix .... +17 dBm

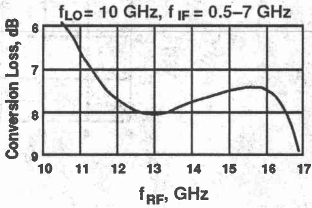
Conversion Loss
f_{LO} <f_{RF}



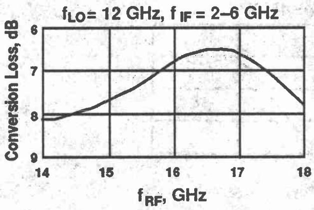
Conversion Loss
f_{LO}= 9 GHz, f_{IF} = 4–0.5 GHz



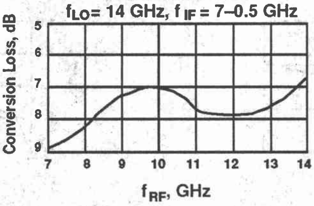
Conversion Loss
f_{LO}= 10 GHz, f_{IF} = 0.5–7 GHz



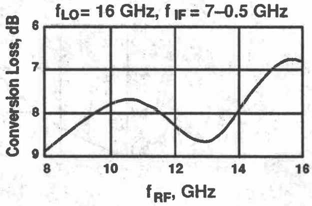
Conversion Loss
f_{LO}= 12 GHz, f_{IF} = 2–6 GHz



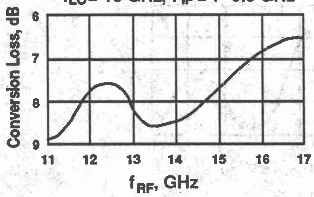
Conversion Loss
f_{LO}= 14 GHz, f_{IF} = 7–0.5 GHz



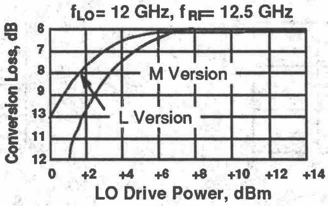
Conversion Loss
f_{LO}= 16 GHz, f_{IF} = 7–0.5 GHz



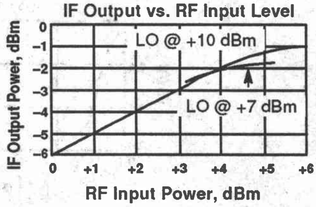
Conversion Loss
f_{LO}= 18 GHz, f_{IF} = 7–0.5 GHz



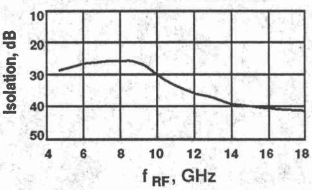
Conversion Loss
f_{LO}= 12 GHz, f_{RF}= 12.5 GHz



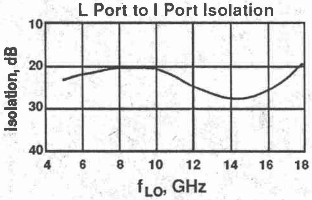
IF Output vs. RF Input Level



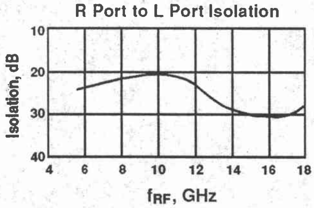
R Port to I Port Isolation



L Port to I Port Isolation

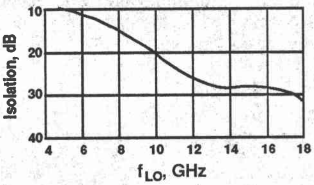


R Port to L Port Isolation

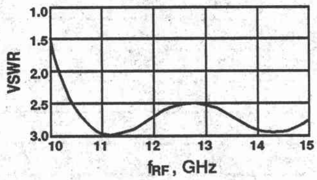


TYPICAL PERFORMANCE AT 25°C (continued)

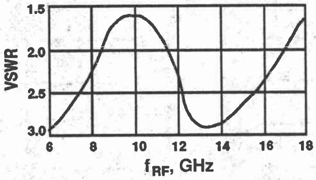
L Port to I Port Isolation



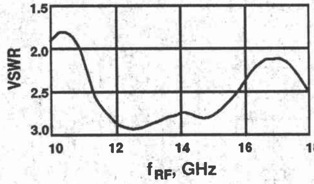
R Port VSWR
f_{LO}= 9 GHz



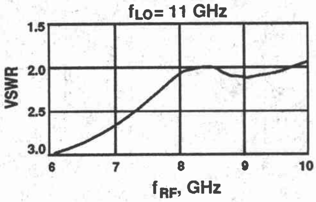
R Port VSWR
f_{IF}= 400 MHz, f_{LO}>f_{RF}



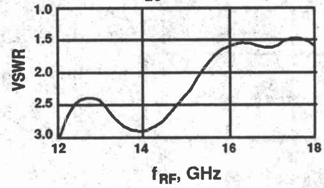
R Port VSWR
f_{LO}= 10 GHz



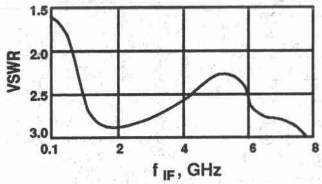
R Port VSWR
f_{LO}= 11 GHz



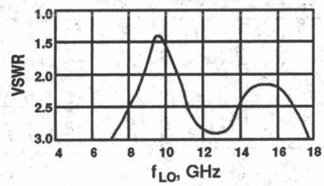
R Port VSWR
f_{LO}= 18 GHz



I Port VSWR
f_{LO} = 12 GHz



L Port VSWR



AVANTEK

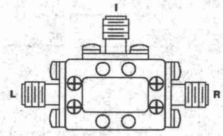
DBX–824M/H
DBY–824M/H
Duroid Mixer
2 to 8 GHz Triple Balanced

FEATURES

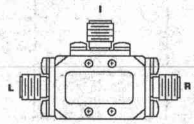
- Two Schottky Diode Quads
- .005 to 4.0 GHz IF Bandwidth
- Up to +32 dBm Input Intercept Point

APPLICATIONS

- Up Conversion Applications that Require Wide Low Frequency Bands (0.1 to 2 GHz) to be Converted into Common IF Band (2 to 4 GHz or 2 to 6 GHz)
- EW Systems
- Wideband Heterodyned Receivers



DBX, p. 16–10



DBY, p. 16–11

DESCRIPTION

The DBX/DBY Series uses precisely matched Schottky-barrier diodes and a "quasi-planar" physical construction for excellent overall symmetry. Construction techniques result in high LO to RF isolation, extremely low single tone intermodulation distortion and very good amplitude and phase match characteristics.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Symbol	Characteristic	Operating Frequencies GHz f_{LO}	f_{RF}	f_{IF}	Power Level: LO Port dBm (typ)	Model Suffix	RF Port dBm	Specifications: Typical $T_C = 25°C$	Guaranteed $T_C = -55°$ to $+100°C$	Unit
BW	Operating Frequency Range	2.0–8.0	2.0–8.0	.005–4.0						GHz
CL	SSB Conversion Loss	2.0–8.0	2.0–8.0	0.005–1.5				6.0	8.0	dB
		2.0–8.0	2.0–8.0	0.005–4.0				6.5	8.5	max
NF	SSB Noise Figure	2.0–8.0	2.0–8.0	0.005–1.5				6.0	8.0	dB
		2.0–8.0	2.0–8.0	0.03–4.0				6.5	8.5	max
ISOL	Isolation Port-to-Port L–R	2.0–4.0	—	—				20	15	dB
	L–R	4.0–8.0	—	—				25	20	min
	R–L	—	2.0–8.0	—				25	—	
	R–I	—	2.0–8.0	—				25	—	
	L–I	2.0–8.0	—	—				30	20	
	I–R	—	—	0.005–4.0				30	—	
	I–L	—	—	0.005–4.0				30	—	
—	VSWR (50 ohm) (large signal) L	2.0–8.0	—	—				1.5:1		max
	(small signal) R	—	2.4–4.0	—				2.5:1		
	(small signal) R	—	4.0–8.0	—				2.0:1		
	(large signal) R	—	2.0–8.0	—				2.0:1		
	(large signal) I	—	—	0.005–4.0				1.5:1		
	(small signal) I	—	—	0.005–4.0				1.5:1		
CC	Conversion	2.0–8.0	2.0–8.0	0.005–4.0	+10	M		+ 6		dBm
	Compression Point (1dB)	2.0–8.0	2.0–8.0	0.005–4.0	+13	H		+ 8	—	typ
IP_3	Third-Order	2.0–8.0	2.0–8.0	0.005–4.0	≥+13	M	—	+15	—	dBm
	Two-Tone	2.0–8.0	2.0–8.0	0.005–4.0	≥+17	H	—	+18	—	typ
	Intercept Point									
—	LO Port Drive Level	2.0–8.0	2.0–8.0	0.005–4.0	+10–+17	M				dBm
	(typical)	2.0–8.0	2.0–8.0	0.005–4.0	+13–+20	H				

NOTE: Specifications guaranteed at LO Power of +7 dBm for "L" model, +10 dBm for "M" model, and +17 dBm for "H" model.

MAXIMUM RATINGS

Peak Input Current @ 25°C .... 100 mA DC
Pin Temperature .... 260° C for 10 seconds
Operating Case Temperature .... −55°C to +100°C
Storage Temperature .... −65°C to +100°C
Continuous RF Input Power .... 400 mW @ +25°C
200 mW @ +100°C

WEIGHT: (typical) DBX — 22 grams; DBY — 16 grams (with connectors)

TYPICAL PERFORMANCE AT 25°C

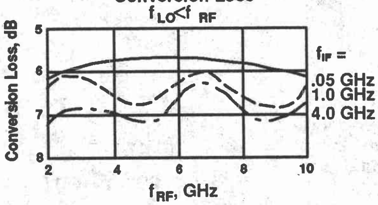
Harmonics of f_{RF}	1	2	3	4	5	6
6	>70	>70	>70	>70	>70	>70
5	>70	>70	>70	>70	>70	>70
4	>70	>70	>70	>70	>70	>70
3	65	>70	60	>70	65	>70
2	55	55	55	55	55	60
1	0	35	18	40	35	45

Harmonics of f_{LO}

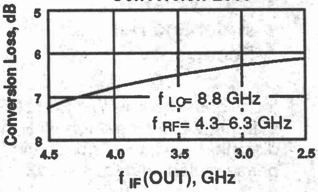
Typical Harmonic Intermodulation Suppression for mixer generated harmonics of the input signals. Suppression numbers are for a f_{RF} signal level at –10 dBm and f_{LO} signal level of:

M Suffix . . . . +10 dBm
H Suffix . . . . +13 dBm

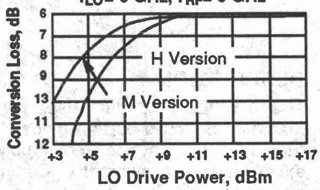
Conversion Loss
f_{LO}<f_{RF}



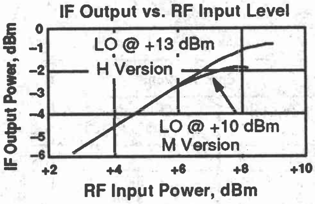
Conversion Loss



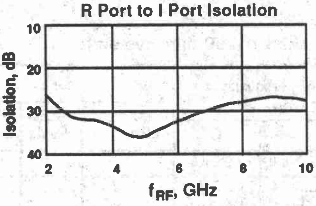
Conversion Loss
f_{LO}= 6 GHz, f_{RF}= 8 GHz



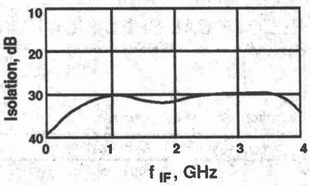
IF Output vs. RF Input Level



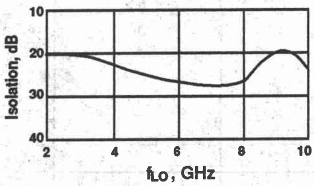
R Port to I Port Isolation



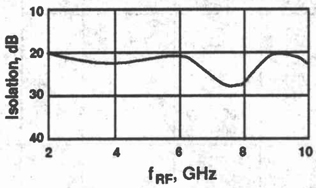
I Port to R Port Isolation



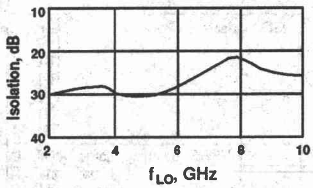
L Port to R Port Isolation



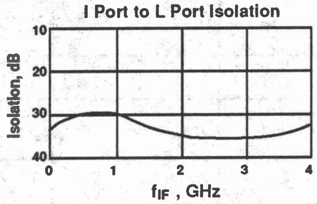
R Port to L Port Isolation



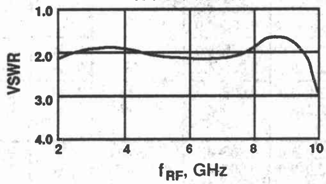
L Port to I Port Isolation



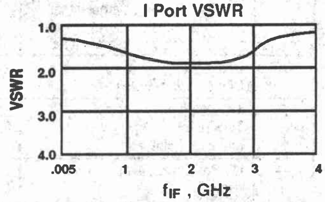
I Port to L Port Isolation



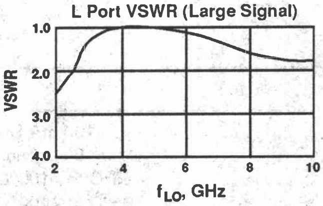
R Port VSWR



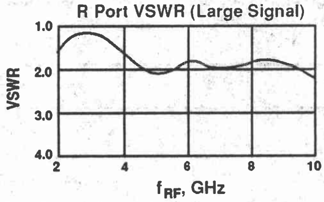
I Port VSWR



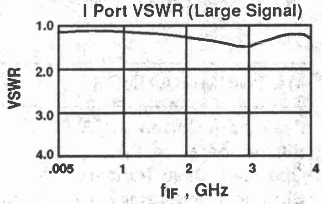
L Port VSWR (Large Signal)



R Port VSWR (Large Signal)



I Port VSWR (Large Signal)



AVANTEK

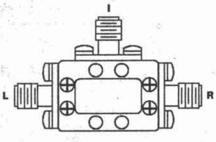
DBX–1221L/M/H
DBY–1221L/M/H
Duroid Mixer
2 to 12 GHz Double Balanced

FEATURES

- Single Schottky Diode Quad
- 5.5 dB Conversion Loss
- 40 dB Isolation
- Up to +30 dBm Input Intercept Point
- Low VSWR

APPLICATIONS

- 2 to 12 GHz Down Conversion
- 5.9 to 6.4 GHz Conversion Applications
- EW Systems
- Wideband Heterodyned Receivers



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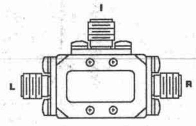


DBY, p. 16–11

DESCRIPTION

The DBX/DBY Series uses precisely matched Schottky-barrier diodes and a "quasi-planar" physical construction for excellent overall symmetry. Construction techniques result in high LO to RF isolation, extremely low single tone intermodulation distortion and very good amplitude and phase match characteristics.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Symbol	Characteristic		Operating Frequencies GHz f_{LO}	f_{RF}	f_{IF}	Power Level LO Port dBm (typ)	Model Suffix	RF Port dBm	Specifications Typical $T_C = 25°C$	Guaranteed $T_C = -55°$ to $+100°C$	Unit
BW	Operating Frequency Range		2.0–12.0	2.0–12.0	DC–1.3						GHz
CL	SSB Conversion Loss		3.0–10.0 2.0–12.0	3.0–10.0 2.0–12.0	DC–0.5 DC–1.3				5.5 6.5	7.5 8.5	dB max
NF	SSB Noise Figure		3.0–10.0 2.0–12.0	3.0–10.0 2.0–12.0	0.03–0.5 0.03–1.3				5.5 6.5	7.5 8.5	dB max
ISOL	Isolation Port-to-Port	L–R R–L R–I L–I L–I	2.0–12.0 — — 3.0–12.0 2.0–3.0	— 2.0–12.0 2.0–12.0 — —	— — — — —				35 35 20 25 20	25 — — 20 18	dB min
—	VSWR (50 ohm)	L L R R I	3.0–12.0 2.0–12.0 — — —	— — 4.0–10.0 2.0–12.0 —	— — — — ≤1.3				1.5:1 2.0:1 1.5:1 2.5:1 1.5:1		max
CC	Conversion Compression Point (1dB)		2.0–12.0 2.0–12.0 2.0–12.0	2.0–12.0 2.0–12.0 2.0–12.0	≤1.3 ≤1.3 ≤1.3	≥+ 7 ≥+10 ≥+17	L M H		+ 2 + 6 +12		dBm typ
IP_3	Third-Order Two-Tone Intercept Point		2.0–12.0 2.0–12.0 2.0–12.0	2.0–12.0 2.0–12.0 2.0–12.0	≤1.3 ≤1.3 ≤1.3	≥+10 +17 ≥+20	L M H	— — —	+ 9 +12 +20	— — —	dBm typ
—	LO Port Drive Level (typical)		2.0–12.0 2.0–12.0 2.0–12.0	2.0–12.0 2.0–12.0 2.0–12.0	DC–1.3 DC–1.3 DC–1.3	+ 7–+13 +10–+17 +17–+24	L M H				dBm

NOTE: Specifications guaranteed at LO Power of +7 dBm for "L" model, +10 dBm for "M" model, and +17 dBm for "H" model.

MAXIMUM RATINGS

Peak Input Current @ 25°C .... 100 mA DC
Pin Temperature .... 260° C for 10 seconds
Operating Case Temperature .... –55°C to +100°C
Storage Temperature .... –65°C to +100°C
Continuous RF Input Power .... 200 mW @ +25°C
100 mW @ +100°C

WEIGHT: (typical) DBX — 22 grams; DBY — 16 grams (with connectors)

TYPICAL PERFORMANCE AT 25°C

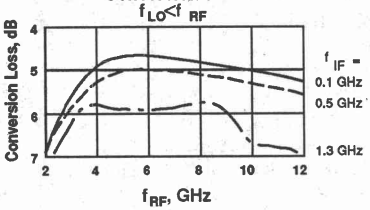
Typical Single Tone Intermodulation Harmonic Suppression at 25°C (dB below desired output)

Harmonics of f_{RF}	Harmonics of f_{LO}: 1	2	3	4
4	>70	>70	>70	>70
3	65	>70	55	>70
2	50	55	50	58
1	0	25	18	40

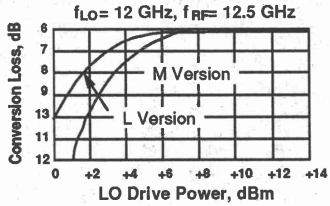
Typical Harmonic Intermodulation Suppression for mixer generated harmonics of the input signals. Suppression numbers are for a f_{RF} signal level at –10 dBm and f_{LO} signal level of:

L Suffix . . . . +7 dBm
M Suffix . . . . +10 dBm
H Suffix . . . . +17 dBm

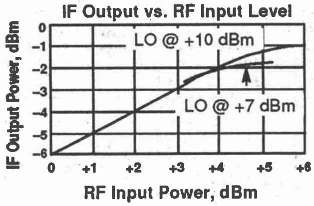
Conversion Loss
$f_{LO} < f_{RF}$



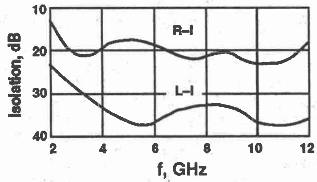
Conversion Loss
f_{LO}= 12 GHz, f_{RF}= 12.5 GHz



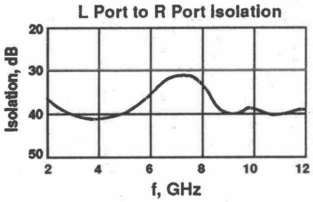
IF Output vs. RF Input Level



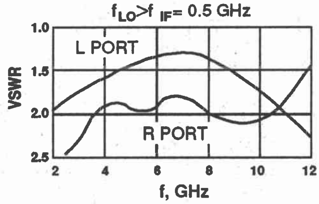
Port to Port Isolation



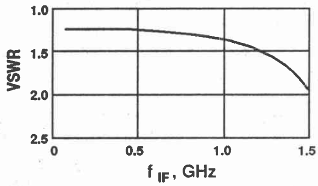
L Port to R Port Isolation



VSWR
$f_{LO} > f_{IF}$= 0.5 GHz



I Port VSWR
f_{LO}= 9 GHz

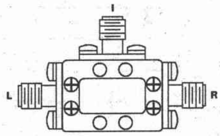


AVANTEK

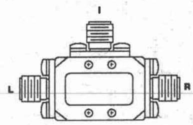
DBX–1824M/H
DBY–1824M/H
Duroid Mixer
2 to 18 GHz Triple Balanced

FEATURES
- Two Schottky Diode Quads
- .005 to 4 GHz IF Bandwidth
- 2.0 to 18.0 GHz RF and LO Bandwidth

APPLICATIONS
- 2 to 18 GHz Swept Frequency Applications with IF < 4 GHz
- EW Systems
- Wideband Heterodyned Receivers



DBX, p. 16–10



DBY, p. 16–11

DESCRIPTION
The DBX/DBY Series uses precisely matched Schottky-barrier diodes and a "quasi-planar" physical construction for excellent overall symmetry. Construction techniques result in high LO to RF isolation, extremely low single tone intermodulation distortion and very good amplitude and phase match characteristics.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Symbol	Characteristic	Operating Frequencies GHz			Power Level			Specifications		Unit
		f_{LO}	F_{RF}	f_{IF}	LO Port dBm (typ)	Model Suffix	RF Port dBm	Typical T_C = 25°C	Guaranteed T_C = –55° to +100°C	
BW	Operating Frequency Range	2.0–18.0	2.0–18.0	.005–4.0						GHz
CL, NF	SSB Conversion Loss and Noise Figure	2.0– 8.0 2.0–18.0 2.0–18.0 2.9–18.0	2.0– 8.0 2.0–18.0 2.0–18.0 2.0–18.0	0.005–1.5 0.005–1.5 0.005–2.5 0.005–4.0				6.0 6.5 7.0 7.5	8.0 8.5 9.0 9.5	dB max
ISOL	Isolation Port-to-Port L–R L–R R–L R–I L–I I–R I–L	2.0– 4.0 4.0–18.0 — — 2.0–18.0 — —	— — 2.0–18.0 2.0–18.0 — — —	— — — — — 0.005–8.0 0.005–8.0				20 25 25 25 30 25 25	15 20 — — 20 — —	dB min
—	VSWR (50 ohm) (large signal) L (small signal) R (small signal) R (large signal) R (large signal) I (small signal) I	2.0–18.0 — — — — —	— 2.0– 4.0 4.0–18.0 2.0–18.0 — —	— — — — 0.005–8.0 0.005–8.0				2.0:1 2.5:1 2.0:1 2.0:1 1.5:1 1.5:1		max
CC	Conversion Compression Point (1dB)	2.0–18.0 2.0–18.0	2.0–18.0 2.0–18.0	0.005–4.0 0.005–4.0	+10 +13	M H		+ 6 + 8		dBm typ
IP_3	Third-Order Two-Tone Intercept Point	2.0–18.0 2.0–18.0	2.0–18.0 2.0–18.0	0.005–4.0 0.005–4.0	≥+13 ≥+17	M H	— —	+15 +18	— —	dBm typ
—	LO Port Drive Level (typical)	2.0–18.0 2.0–18.0	2.0–18.0 2.0–18.0	0.005–4.0 0.005–4.0	+10–+17 +13–+20	M H				dBm

NOTE: Specifications guaranteed at LO Power of +7 dBm for "L" model, +10 dBm for "M" model, and +17 dBm for "H" model.

MAXIMUM RATINGS

Peak Input Current @ 25°C .... 100 mA DC
Pin Temperature .... 260° C for 10 seconds
Operating Case Temperature .... –55°C to +100°C
Storage Temperature .... –65°C to +100°C
Continuous RF Input Power .... 400 mW @ +25°C
200 mW @ +100°C

WEIGHT: (typical) DBX — 22 grams; DBY — 16 grams (with connectors)

TYPICAL PERFORMANCE AT 25°C

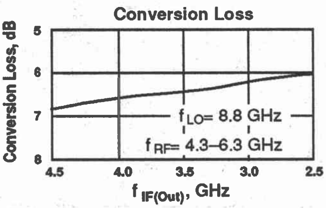
Typical Single Tone Intermodulation Harmonic Suppression at 25°C (dB below desired output)

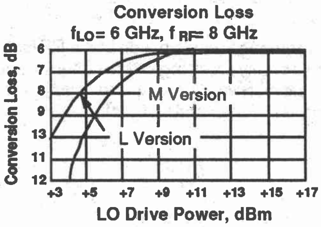
Harmonics of f_{RF}	1	2	3	4	5	6
6	>70	>70	>70	>70	>70	>70
5	>70	>70	>70	>70	>70	>70
4	>70	>70	>70	>70	>70	>70
3	65	>70	60	>70	65	>70
2	55	55	55	55	55	60
1	0	35	18	40	35	45

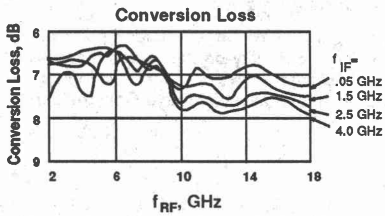
Harmonics of f_{LO}

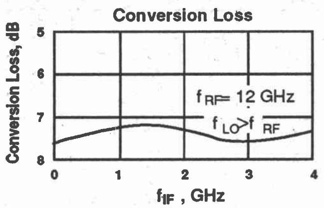
Typical Harmonic Intermodulation Suppression for mixer generated harmonics of the input signals. Suppression numbers are for a f_{RF} signal level at –10 dBm and f_{LO} signal level of:

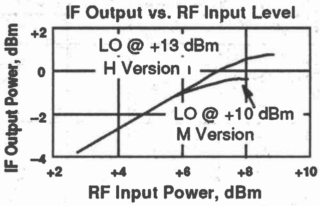
M Suffix .... +10 dBm
H Suffix .... +13 dBm

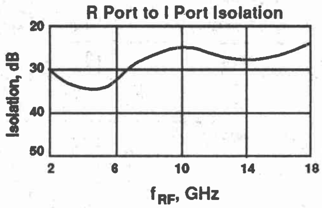


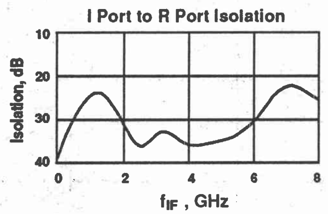


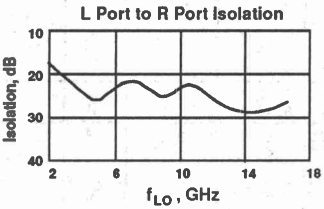


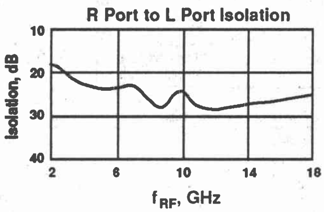


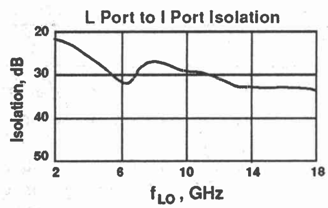


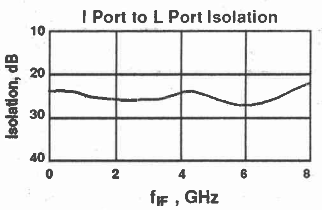


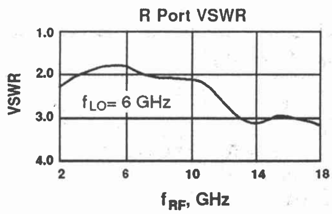






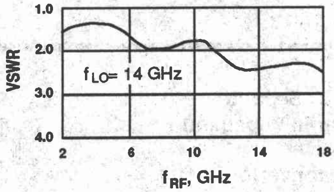




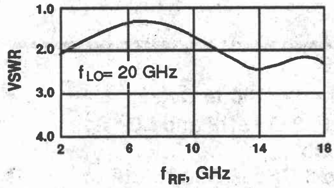


TYPICAL PERFORMANCE AT 25°C (continued)

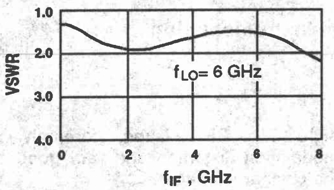
R Port VSWR



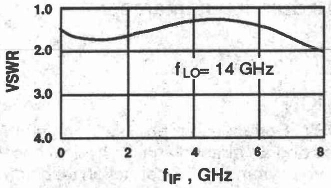
R Port VSWR



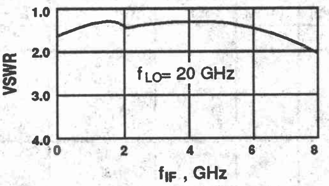
I Port VSWR



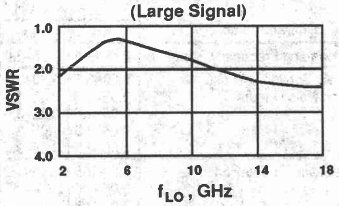
I Port VSWR



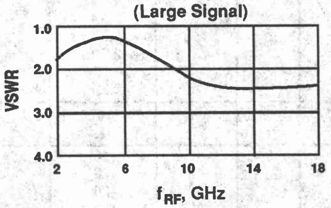
I Port VSWR



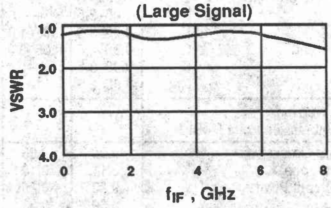
L Port VSWR
(Large Signal)



R Port VSWR
(Large Signal)



I Port VSWR
(Large Signal)



AVANTEK

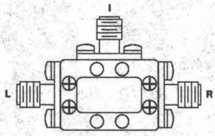
DBX–3503M/H
DBY–3503M/H
Duroid Mixer
.05 to 3 GHz Triple Balanced

FEATURES

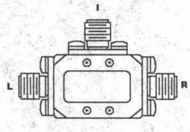
- Two Schottky Diode Quads
- 50 MHz to 3 GHz RF and LO Bandwidth
- 1 MHz to 3 GHz IF Bandwidth
- 7 dB Conversion Loss/NF
- 30 dB Isolation
- Low VSWR, All Ports
- Up to +18 dBm Input Intercept Point

APPLICATIONS

- Ideal for First or Second Downconverter in Wideband Supernet Receiver
- Frequency Upconverters
- DSB Suppressed Carrier Modulators
- VHF, UHF, L and S Band Block Conversions
- Wideband Test Instrumentation



DBX, p. 16–10



DBY, p. 16–11

DESCRIPTION

The DBX/DBY Series uses precisely matched Schottky-barrier diodes and a "quasi-planar" physical construction for excellent overall symmetry. Construction techniques result in high LO to RF isolation, extremely low single tone inter-modulation distortion and very good amplitude and phase match characteristics.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Symbol	Characteristic	Operating Frequencies GHz f_{LO}	f_{RF}	f_{IF}	Power Level LO Port dBm (typ)	Model Suffix	RF Port dBm	Specifications Typical $T_C = 25°C$	Guaranteed $T_C = -55°$ to $+100°C$	Unit
BW	Operating Frequency Range	0.05–3.5	0.05–3.0	.001–3.0						GHz
CL, NF	SSB Conversion Loss and Noise Figure	0.20–1.5	0.20–1.0	0.001–0.5				6.8	7.5	dB max
		0.05–1.5	0.05–1.0	0.001–0.5				7.0	8.0	
		0.05–3.5	0.05–3.0	0.001–0.5				7.4	8.4	
		0.05–3.5	0.05–3.0	0.001–1.5				8.0	—	
		0.05–3.5	0.05–3.0	0.001–3.0				8.5	—	
ISOL	Isolation Port-to-Port L–R	0.25–1.5	—	—				34	28	dB min
	L–R	0.05–1.5	—	—				30	26	
	L–R	0.05–3.5	—	—				24	20	
	L–I	0.05–3.5	—	—				35	30	
	R–I	0.05–3.5	1.00–3.0	—				30		
	R–I	0.05–3.5	0.05–3.0	—				26		
—	VSWR (50 ohm) L	0.05–1.5	—	—				1.8:1		max
	L	0.05–3.5	—	—				2.5:1		
	R	0.05–3.5	0.05–1.0	—				1.7:1		
	R	0.05–3.5	0.05–3.0	—				2.3:1		
	I	0.05–3.5	—	0.001–1.0				1.8:1		
	I	0.05–3.5	—	0.001–3.0				2.2:1		
CC	Conversion Compression Point (1dB)	—	—	—	≥+10	M		+6		dBm typ
					≥+15	H		+8		
IP_3	Third-Order Two-Tone Intercept Point	0.06	0.05	0.01	+10		−10	+18	—	dBm typ
		0.11	0.10	0.01	+10		−10	+20	—	
		0.30	0.25	0.05	+10		−10	+20	—	
		0.60	0.50	0.10	+10		−10	+19		
		1.10	1.00	0.10	+10		−10	+20		
		2.50	2.00	0.50	+10		−10	+16		
		3.50	3.00	0.50				+17		
—	LO Port Drive Level (typical)	.05–3.5	.05–3.0	.001–3.0	+10–+17	M				dBm
		.05–3.5	.05–3.0	.001–3.0	+13–+20	H				

NOTE: Specifications guaranteed at LO Power of +10 dBm for "M" model, and +13 dBm for "H" model.

MAXIMUM RATINGS

Peak Input Current @ 25°C .... 100 mA DC
Pin Temperature .... 260° C for 10 seconds
Operating Case Temperature .... −55°C to +100°C
Storage Temperature .... −62°C to +100°C
Continuous RF Input Power .... 200 mW @ +25°C
100 mW @ +100°C

WEIGHT: (typical) DBX — 22 grams, DBY — 16 grams (with connectors)

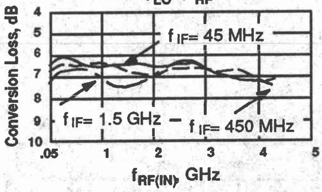
TYPICAL PERFORMANCE AT 25°C

Typical Single Tone Intermodulation Harmonic Suppression at 25°C (dB below desired output)

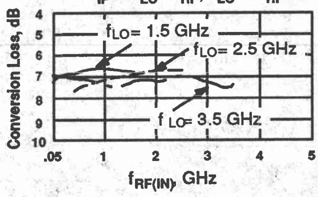
Harmonics of f_{RF}					
5	>70	>70	>70	>70	>70
4	>70	>70	>70	>70	>70
3	65	>70	60	>70	65
2	55	45	55	58	55
1	0	35	18	45	30
	1	2	3	4	5
	Harmonics of f_{LO}				

Typical Harmonic Intermodulation Suppression for mixer generated harmonics of the input signals. Suppression numbers are for a f_{RF} signal level at –10 dBm and f_{LO} signal level of +10 dBm for "M" suffix mixers, and +13 dBm for "H" suffix mixers.

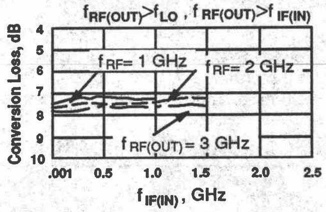
Conversion Loss
$f_{LO} > f_{RF}$



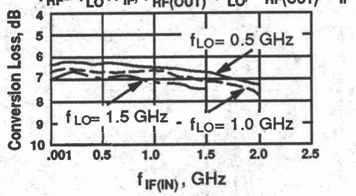
Conversion Loss
$f_{IF} = f_{LO} - f_{RF}$, $f_{LO} > f_{RF}$



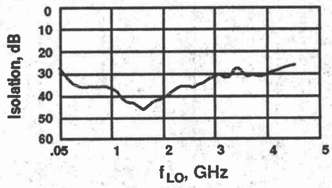
Conversion Loss
$f_{RF(OUT)} > f_{LO}$, $f_{RF(OUT)} > f_{IF(IN)}$



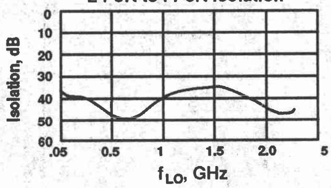
Conversion Loss
$f_{RF} = f_{LO} + f_{IF}$, $f_{RF(OUT)} > f_{LO}$, $f_{RF(OUT)} > f_{IF}$



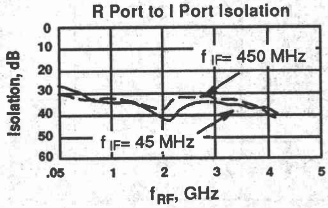
L Port to R Port Isolation



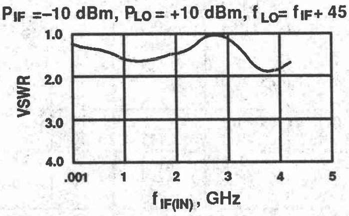
L Port to I Port Isolation



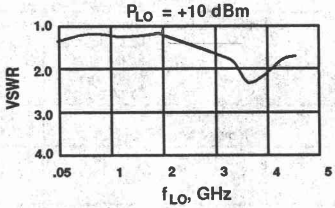
R Port to I Port Isolation



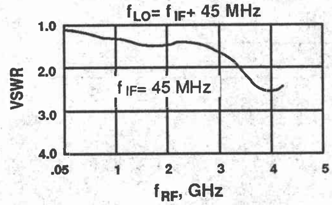
I Port VSWR
P_{IF} = –10 dBm, P_{LO} = +10 dBm, $f_{LO} = f_{IF}$ + 45 MHz



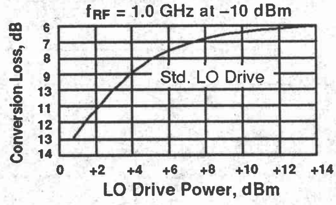
L Port VSWR
P_{LO} = +10 dBm



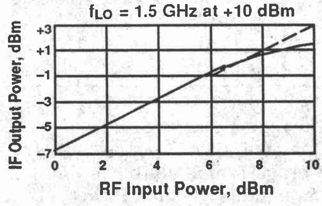
R Port VSWR
P_{RF} = –10 dBm, P_{LO} = +10 dBm
$f_{LO} = f_{IF}$ + 45 MHz



Conversion Loss
f_{LO} = 1.5 GHz, f_{IF} = 500 MHz
f_{RF} = 1.0 GHz at –10 dBm



IF Output vs. RF Input Level
f_{RF} = 1 GHz, f_{IF} = 500 MHz
f_{LO} = 1.5 GHz at +10 dBm

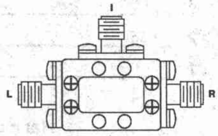


AVANTEK

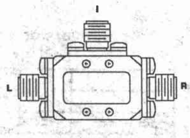
DBX–18212M/H
DBY–18212M/H
Duroid Mixer
2 to 18 GHz Triple Balanced

FEATURES
- Two Schottky Diode Quads
- 2 to 18 GHz RF and LO Bandwidth
- 1 to 10 GHz IF Bandwidth
- 7 dB Conversion Loss/NF

APPLICATIONS
- 2 to 18 GHz Band Folding Applications
- 1 to 10 GHz Upconverting Applications Requiring High IF
- EW Systems



DBX, p. 16–10



DBY, p. 16–11

DESCRIPTION
The DBX/DBY Series uses precisely matched Schottky-barrier diodes and a "quasi-planar" physical construction for excellent overall symmetry. Construction techniques result in high LO to RF isolation, extremely low single tone intermodulation distortion and very good amplitude and phase match characteristics.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Symbol	Characteristic	Operating Frequencies GHz f_{LO}	f_{RF}	f_{IF}	Power Level: LO Port dBm (typ)	Model Suffix	RF Port dBm	Specifications: Typical T_C = 25°C	Guaranteed T_C = −55° to +100°C	Unit
BW	Operating Frequency Range	2.0–18.0	2.0–18.0	1.0–10.0						GHz
CL, NF	SSB Conversion Loss and Noise Figure	2.0–18.0	2.0–18.0	1.5– 6.0				6.5	8.5	dB max
		2.0–18.0	2.0–18.0	1.5–10.0				7.0	9.5	
		2.0–18.0	2.0–18.0	1.0–10.0				7.5	10.0	
		2.0–18.0	2.0–18.0	1.0–10.0				8.5	12.0	
		2.0–18.0	2.0–18.0	0.5–10.0				9.0	12.0	
ISOL	Isolation Port-to-Port L–R	4.0–18.0	—	—				30	20	dB min
	L–R	2.0– 4.0	—	—				25	18	
	L–I	4.0– 8.0	—	—				25	20	
	L–I	12.0–18.0	—	—				25	20	
	L–I	2.0– 4.0	—	—				20	15	
	L–I	8.0–12.0	—	—				20	15	
	R–L	—	4.0–18.0	—				30	—	
	R–L	—	2.0– 4.0	—				25	—	
	R–I	—	2.0–18.0	—				25	—	
	I–L	—	—	1.0–10.0				25	—	
	I–R	—	—	1.0–10.0				25	—	
—	VSWR (50 ohm) (small signal) R	2.0–18.0	2.0–18.0	—	≥+13	—	≤ 0	2.0:1	—	
	(large signal) L	2.0–18.0	—	—	≥+10	—	—	2.0:1	—	
	(small signal) I	2.0–18.0	—	0.6–10.0	≥+13	—	≤ 0	2.0:1	—	
	(large signal) I	—	—	2.0–10.0	—	—	≥+10	2.0:1	—	
	(large signal) R	—	2.0–18.0	—	—	—	≥+10	2.0:1	—	
CC	Conversion Compression Point (1dB)	2.0–18.0	2.0–18.0	0.5–10.0	≥+10	M		+ 6		dBm typ
		2.0–18.0	2.0–18.0	0.5–10.0	≥+13	H		+ 8		
IP_3	Third-Order Two-Tone Intercept Point	2.0–18.0	2.0–18.0	0.5–10.0	≥+13	M	—	+15	—	dBm typ
		2.0–18.0	2.0–18.0	0.5–10.0	≥+17	H	—	+18	—	
—	LO Port Drive Level (typical)	2.0–18.0	2.0–18.0	1.0–10.0	+10–+17	M				dBm
		2.0–18.0	2.0–18.0	DC–1.5	+13–+20	H				

NOTES: 1. Specifications guaranteed at LO Power of +10 dBm for "M" model, and +13 dBm for "H" model
2. The DBX-18212 mixer can be used as either a down or up converter with similar performance. Use of the I Port as a LO Port (pump Port) is recommended in some applications where the LO frequency is below 10.0 GHz. In most cases, the LO and RF Ports of the DBX-18212 mixer can be interchanged below 18.0 GHz.

MAXIMUM RATINGS

Peak Input Current @ 25°C	200 mA DC
Pin Temperature	260° C for 10 seconds
Operating Case Temperature	−55°C to +100°C
Storage Temperature	−65°C to +100°C
Continuous RF Input Power	400 mW @ +25°C 200 mW @ +100°C

WEIGHT: (typical) DBX — 22 grams; DBY — 16 grams (with connectors)

TYPICAL PERFORMANCE AT 25°C

Typical Single Tone Intermodulation Harmonic Suppression at 25°C (dB below desired output)

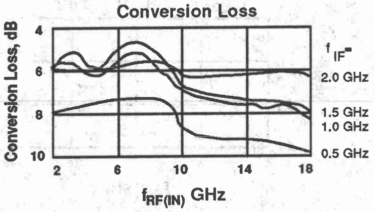
Harmonics of f_{RF}	1	2	3	4	5	6
6	>70	>70	>70	>70	>70	>70
5	>70	>70	>70	>70	>70	>70
4	>70	>70	>70	>70	>70	>70
3	65	>70	60	>70	65	>70
2	55	55	55	55	55	60
1	0	35	18	40	35	45

Harmonics of f_{LO}

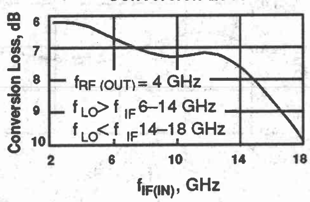
Typical Harmonic Intermodulation Suppression for mixer generated harmonics of the input signals. Suppression numbers are for a f_{RF} signal level at –10 dBm and f_{LO} signal level of:

M Suffix .... +10 dBm
H Suffix .... +13 dBm

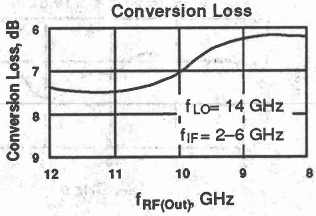
Conversion Loss



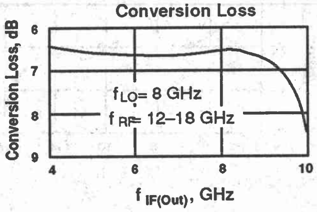
Conversion Loss



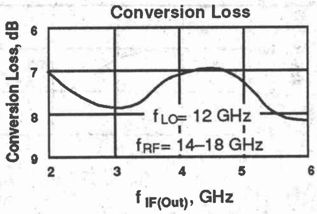
Conversion Loss



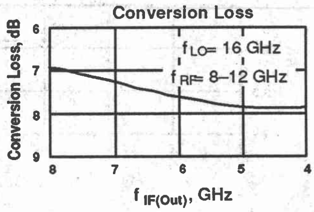
Conversion Loss



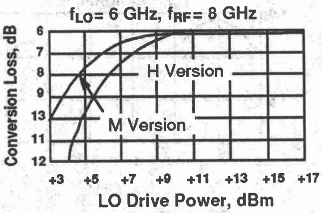
Conversion Loss



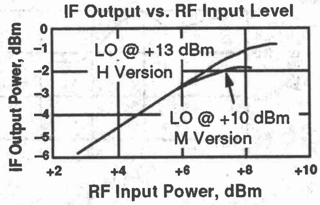
Conversion Loss



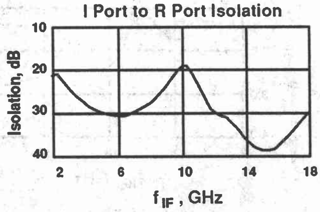
Conversion Loss
f_{LO}= 6 GHz, f_{RF}= 8 GHz



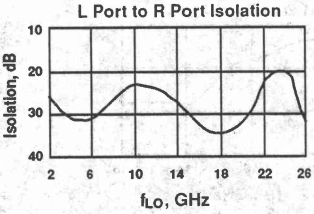
IF Output vs. RF Input Level



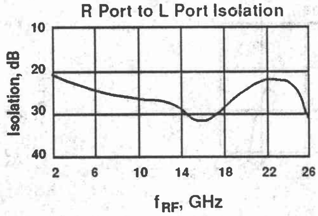
I Port to R Port Isolation



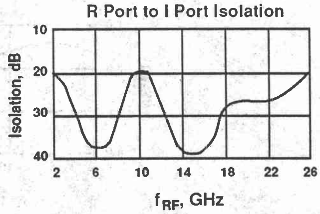
L Port to R Port Isolation



R Port to L Port Isolation

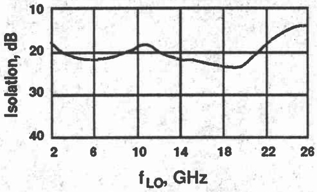


R Port to I Port Isolation

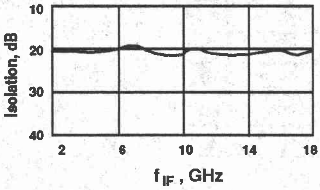


TYPICAL PERFORMANCE AT 25°C (continued)

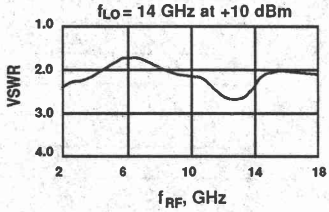
L Port to I Port Isolation



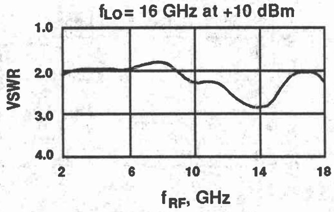
I Port to L Port Isolation



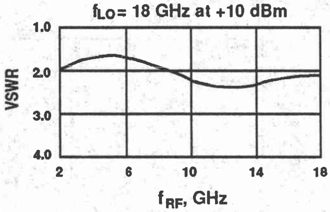
R Port VSWR
f_{LO}= 14 GHz at +10 dBm



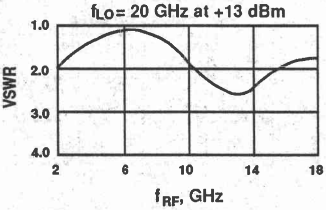
R Port VSWR
f_{LO}= 16 GHz at +10 dBm



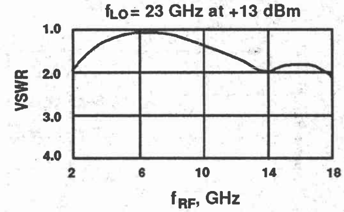
R Port VSWR
f_{LO}= 18 GHz at +10 dBm



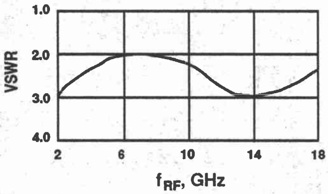
R Port VSWR
f_{LO}= 20 GHz at +13 dBm



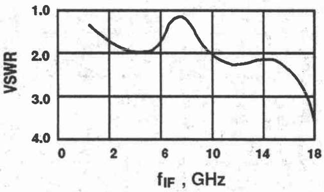
R Port VSWR
f_{LO}= 23 GHz at +13 dBm



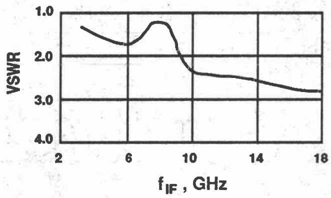
R Port VSWR
f_{LO}= 26 GHz at +13 dBm



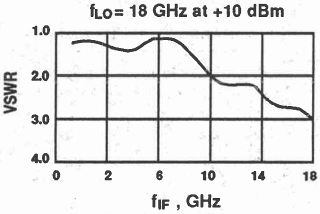
I Port VSWR
f_{LO}= 14 GHz at +10 dBm



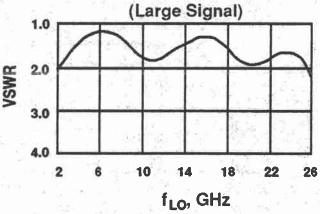
I Port VSWR
f_{LO}= 16 GHz at +10 dBm



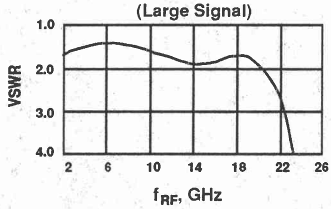
I Port VSWR
f_{LO}= 18 GHz at +10 dBm



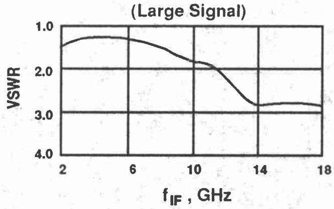
L Port VSWR
(Large Signal)



R Port VSWR
(Large Signal)



I Port VSWR
(Large Signal)

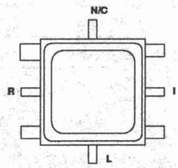


AVANTEK

PPM–2515M
Surface Mount Mixer
.05 to 2.5 GHz

FEATURES
- PlanarPak Surface Mount Package
- 7 dB Conversion Loss/Noise Figure
- 30 dB Port-to-Port Isolation
- Low VSWR at All Ports

APPLICATIONS
- High Density Microstrip Applications
- Overlapping RF, LO, and IF Requirements
- EW Systems



PP-38M, p. 16–35

DESCRIPTION
The PPM-2515M is a triple-balanced surface mount mixer with a frequency range of 0.05 to 2.5 GHz and an IF range of 0.001 to 1.5 GHz. This PlanarPak mixer uses precisely matched monolithic beam lead Schottky diodes and polyimide insulated baluns to yield excellent performance over more than 5 octaves of RF and LO bandwidths. With overlapping RF, LO and IF frequency ranges there is still greater than 25 dB of port to port isolation. IF bandwidths up to 1500 MHz are obtained with very flat conversion loss. A good 50-ohm match is realized at all ports.

The PPM-2515M is supplied in Avantek's 0.375 x 0.375 in. surface mount package which allows the use of simpler microstrip installation at higher densities and improved performance. Refer to the Application Note on page 14–38.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Symbol	Characteristic	Operating Frequencies GHz			Power Level			Specifications		Unit
		f_{LO}	f_{RF}	f_{IF}	LO Port dBm (typ)	Model Suffix	RF Port dBm	Typical $T_C = 25°C$	Guaranteed $T_C = -55°$ to $+100°C$	
BW	Operating Frequency Range	0.05–3.0	0.05–2.5	0.001–1.5	+10 to +15	M				GHz
CL, NF	SSB Conversion Loss and Noise Figure	0.05–2.0 0.05–3.0 0.05–3.0 0.05–3.0	0.05–1.5 0.05–1.5 1.5–2.5 1.5–2.5	0.001–1.5 0.500–1.5 0.001–0.5 0.500–1.5				7.0 7.2 7.4 7.6	9.0 9.0 10.0 10.0	dB max
ISOL	Isolation Port-to-Port L–R L–I R–I	0.05–3.0 0.05–3.0 0.05–3.0	— — 0.05–2.5	— — 0.001–1.5				35 35 30	25 25	dB min
—	VSWR (50 ohm) L L R R I	0.05–2.0 2.00–3.0 0.05–2.0 0.05–3.0 0.05–3.0	— — 0.05–0.5 0.5–2.5 0.05–2.5	— — 0.001–1.5 0.001–1.5 0.001–1.5				1.5:1 2.5:1 1.2:1 2.0:1 1.5:1	2.5:1 3.0:1 2.5:1 3.0:1 2.5:1	max
CC	Conversion Compression Point (1dB)	0.05–2.0	0.05–2.5	0.001–1.5	≥+10	M		+5		dBm typ
IP_3	Third-Order Two-Tone Intercept Point	0.06 0.11 0.30 0.60 1.10 2.50 3.00	0.05 0.10 0.25 0.50 1.00 2.00 2.50	0.01 0.01 0.05 0.10 0.10 0.50 0.50				15 16 18 22 15 13 13		dBm typ

NOTES:
1. Specifications apply in a 50-ohm system with LO input power of +10 dBm and RF input power of –10 dBm.
2. Low frequency performance can be extended and/or enhanced through use of additional turns on LO, RF or IF transformers or by use of transformer material with higher relative permeability. Such modifications result in degradation of high frequency performance.
3. Guaranteed specifications apply with LO input power of +10 dBm.

WEIGHT: (typical) 0.5 grams

TYPICAL PERFORMANCE AT 25°C

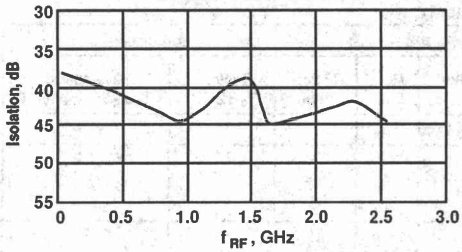
Typical Single Tone Intermodulation Harmonic Suppression at 25°C (dB below desired output)

Harmonics of f_{RF}					
5	>70	>70	>70	>70	>70
4	>70	>70	>70	>70	>70
3	65	>70	60	>70	65
2	55	45	55	58	55
1	0	35	18	45	30
	1	2	3	4	5
	Harmonics of f_{LO}				

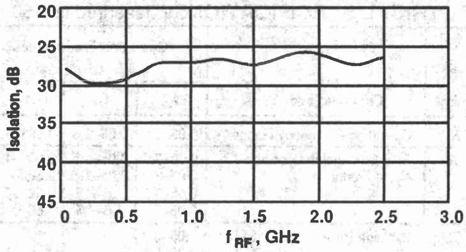
Typical Harmonic Intermodulation Suppression for mixer generated harmonics of the input signals. Suppression numbers are for a f_{RF} signal level at –10 dBm and f_{LO} signal level of +10 dBm and RF input power of –10 dBm.

NOTES: f_{IF} = 50 MHz
$f_{LO} > f_{RF}$
LO = +10 dBm
RF = –10 dBm

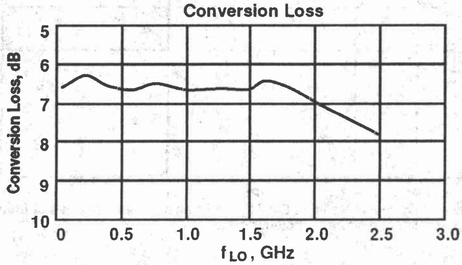
L Port to I Port Isolation



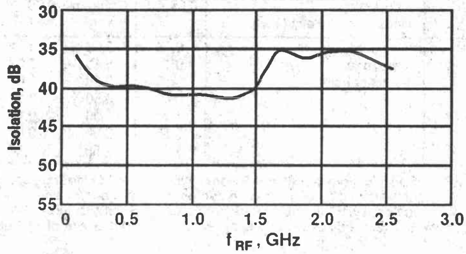
R Port to I Port Isolation



Conversion Loss



L Port to R Port Isolation



AVANTEK

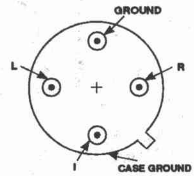
UMX–520
Double Balanced Mixer
1.0 to 500 MHz

FEATURES

- 50 dB LO to RF Isolation
- 6 dB Conversion Loss/Noise Figure
- Low VSWR (1.5:1) at All Ports

APPLICATIONS

- Low Cost, High Performance
- High Density Requirements
- Communications Systems
- Instrumentation and Test Equipment



TO-8M, p. 16–47

DESCRIPTION

The UMX Series double-balanced mixers feature exceptionally high isolation and good harmonically-related intermodulation product suppression. They are packaged in compact easy-to-use hermetically sealed TO-8 cans. The UMX-520 is a low level Class I mixer with four closely matched Schottky-barrier diodes in a ring configuration.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Symbol	Characteristic		Operating Frequencies MHz			Power Level			Specifications		Unit
			f_{LO}	f_{RF}	f_{IF}	LO Port dBm (typ)	Model Suffix	RF Port dBm	Typical $T_C = 25°C$	Guaranteed $T_C = -55°$ to $+100°C$	
BW	Operating Frequency Range		1–500	1–500	DC–500						MHz
CL	SSB Conversion Loss		1–500	1–500	DC–500	+7			6.0	7.0	dB max
NF	SSB Noise Figure		1–500	1–500	0.1–500	+7			6.0	7.0	dB max
ISOL	Isolation Port-to-Port	L–R	1–100	—	—				65	40	dB min
		L–R	100–500	—	—				50	40	
		L–I	1–100	—	—				50	35	
		L–I	100–500	—	—				45	30	
		R–I	—	1–100	—				40		
		R–I	—	100–500	—				25		
—	VSWR (50 ohm)	L	1–500	—	—				1.5:1		typ
		R	—	1–500	—				1.4:1		
		I	—	—	1–500				1.5:1		
CC	Conversion Compression Point (1dB)		1–500	1–500	DC–500	+7			1.0	—	dBm typ
IP_3	Third-Order Two-Tone Intercept Point		1–100	1–100	DC–500	+7		—	+12	—	dBm typ
			100–500	100–500	DC–500	+7		—	+10	—	

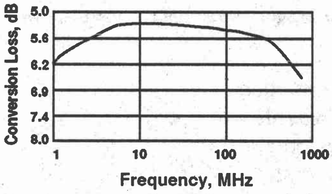
MAXIMUM RATINGS

Peak Input Current @ 25°C .... 100 mA DC
Pin Temperature .... 260° C for 10 seconds
Operating Case Temperature .... –55°C to +100°C
Storage Temperature .... –65°C to +100°C
Continuous RF Input Power .... 200 mW @ +25°C
100 mW @ +100°C

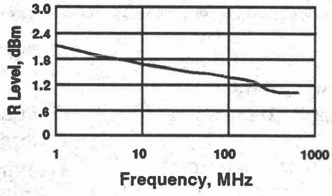
WEIGHT: (typical) 0.06 oz.

TYPICAL PERFORMANCE AT 25°C (Measured in a 50-ohm system with LO = +7 dBm)

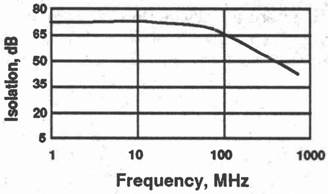
Conversion Loss



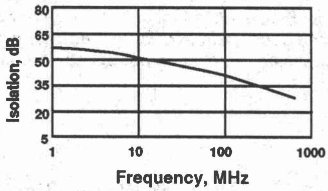
1 dB Conversion Compression



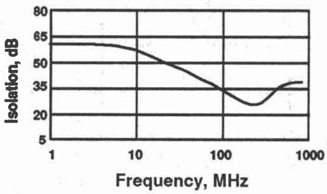
L Port to R Port Isolation



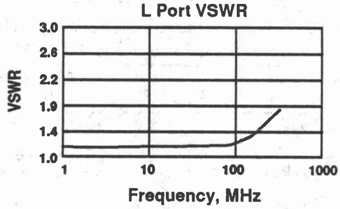
L Port to I Port Isolation



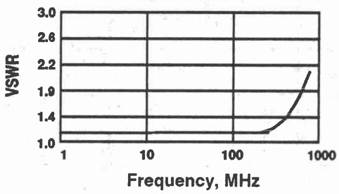
R Port to I Port Isolation



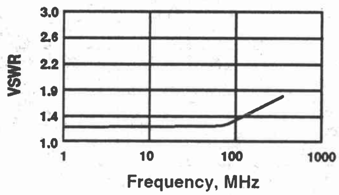
L Port VSWR



R Port VSWR



I Port VSWR



AVANTEK

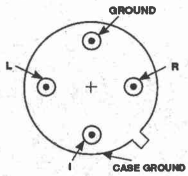
UMX–570
Double Balanced Mixer
1.0 to 500 MHz

FEATURES

- 40 dB LO to RF Isolation
- 5.5 dB Conversion Loss/Noise Figure
- +34 dBm Input Intercept Point

APPLICATIONS

- Low Cost, High Performance
- High IP3 Requirements
- Instrumentation and Test Equipment
- EW Systems



TO-8M, p. 16–47

DESCRIPTION

The UMX Series double-balanced mixers feature exceptionally high isolation and good harmonically-related intermodulation product suppression. They are packaged in compact easy-to-use hermetically sealed TO-8 cans. The UMX-570 is a high level Class II type 1 mixer with eight closely matched Schottky-barrier diodes in a ring configuration. Since the diodes are highly dissipative, the UMX-570 can accept +27 dBm local oscillator power (rather than the typical +13 to +17 dBm) without the added complexity of series resistors (type 2) or resistor-capacitor combinations (Class III). The third-order input intercept point is greater than +34 dBm below 100 MHz and +32 dBm from 100 to 500 MHz. Along with very small size for a high level mixer, the UMX-570 is unique in that its conversion loss is only 5.0 to 6.0 dB. This conversion loss is 1.0 to 2.0 dB less than comparable high level mixers.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

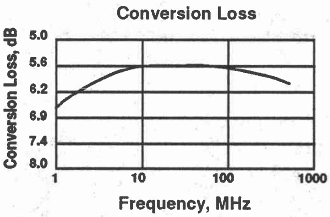
Symbol	Characteristic	Operating Frequencies MHz f_{LO}	f_{RF}	f_{IF}	Power Level: LO Port dBm (typ)	Model Suffix	RF Port dBm	Specifications: Typical $T_C = 25°C$	Guaranteed $T_C = -55°$ to $+100°C$	Unit
BW	Operating Frequency Range	1–500	1–500	DC–500						MHz
CL	SSB Conversion Loss	1–100 100–500	1–100 100–500	DC–500 DC–500	+27 +27			5.5	7.0	dB max
NF	SSB Noise Figure	1–100 100–500	1–100 100–500	0.1–500 0.1–500	+27 +27			5.5	7.0	dB max
ISOL	Isolation Port-to-Port L–R L–R L–I L–I R–I R–I	1–100 100–500 1–100 100–500 — —	— — — — 1–100 100–500	— — — — — —				55 40 45 35 40 25	45 35 40 30	dB min
—	VSWR (50 ohm) L R I	1–500 — —	— 1–500 —	— — 1–500				1.8:1 1.2:1 1:6:1		typ
CC	Conversion Compression Point (1 dB)	1–500	1–500	DC–500	+27			+20	—	dBm typ
IP_3	Third-Order Two-Tone Intercept Point	1–500	100–500	DC–500	+27		—	+30	—	dBm typ

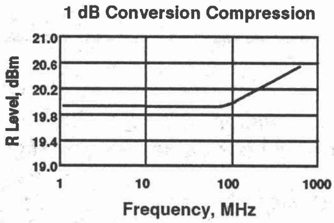
MAXIMUM RATINGS

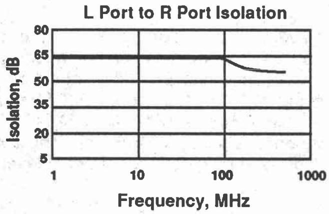
Peak Input Current @ 25°C	200 mA DC
Pin Temperature	260° C for 10 seconds
Operating Case Temperature	−55°C to +100°C
Storage Temperature	−65°C to +100°C
Continuous RF Input Power	1W @ +25°C 500 mW @ +100°C

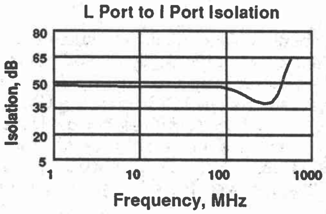
WEIGHT: (typical) 0.06 oz.

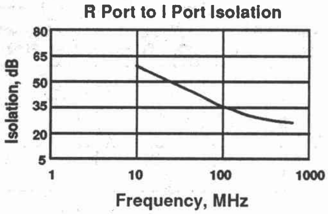
TYPICAL PERFORMANCE AT 25°C (Measured in a 50-ohm system with LO = +27 dBm)

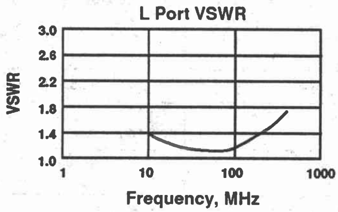


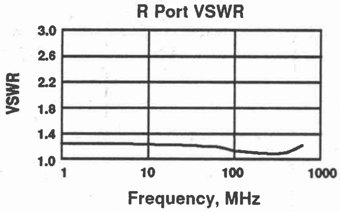


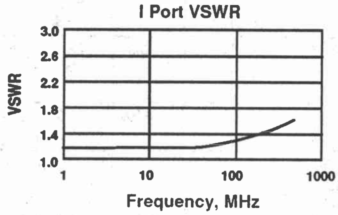












AVANTEK

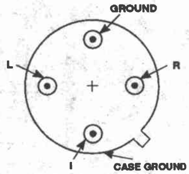
UMX–2020
Double Balanced Mixer
10 to 2000 MHz

FEATURES

- 40 dB LO to RF Isolation
- 10 to 2000 MHz RF and LO Bandwidth
- DC to 1000 MHz IF Bandwidth

APPLICATIONS

- Low Cost, High Performance
- High LO to RF Isolation Requirements
- Communications Systems
- Instrumentation and Test Equipment
- EW Systems



TO-8M, p. 16–47

DESCRIPTION

The UMX Series double-balanced mixers feature exceptionally high isolation and good harmonically-related intermodulation product suppression. They are packaged in compact easy-to-use hermetically sealed TO-8 cans. The UMX-2020 is a low level Class I mixer with four closely matched Schottky-barrier diodes in a ring configuration. The LO to RF isolation of the UMX-2020 is typically greater than 60 dB from 10 to 150 MHz, greater than 50 dB from 150 to 500 MHz and greater than 40 dB from 500 to 2000 MHz.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

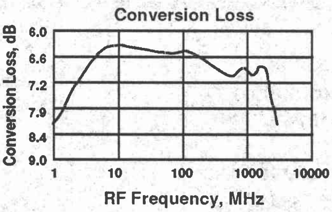
Symbol	Characteristic	Operating Frequencies MHz f_{LO}	f_{RF}	f_{IF}	Power Level: LO Port dBm (typ)	Model Suffix	RF Port dBm	Specifications: Typical $T_C = 25°C$	Guaranteed $T_C = -55°$ to $+100°C$	Unit
BW	Operating Frequency Range	10–2000	10–2000	DC–1000						MHz
CL	SSB Conversion Loss	10–2000	10–2000	DC–500	+7			7.0	8.0	dB
		10–2000	10–2000	DC–1000				8.0	9.0	max
NF	SSB Noise Figure	10–2000	10–2000	0.1–500	+7			7.0	8.0	dB
		10–2000	10–2000	0.1–1000				8.0	9.0	max
ISOL	Isolation Port-to-Port L–R	10–1000	—	—				45	40	dB
	L–R	10–1500	—	—				40	35	min
	L–R	10–2000	—	—				40	30	
	L–I	10–1000	—	—				35	25	
	L–I	10–1500	—	—				30	20	
	L–I	10–2000	—	—				25	15	
	R–I	—	10–1000	—				20	—	
	R–I	—	10–2000	—				16	—	
—	VSWR (50 ohm) L	10–1500	—	—				2.0:1	—	max
	L	10–2000	—	—				2.7:1	—	
	R	—	10–500	—				1.6:1	—	
	R	—	10–1500	—				2.7:1	—	
	I	—	—	10–1000				1.6:1	—	
CC	Conversion Compression Point (1dB)	10–2000	10–1500	DC–1500	+7			1.0	—	dBm typ
IP_3	Third-Order Two-Tone Intercept Point	10–1000	10–1000	DC–1500	+7		—	+12	—	dBm
		1000–2000	100–1500	DC–1500	+7		—	+10		typ

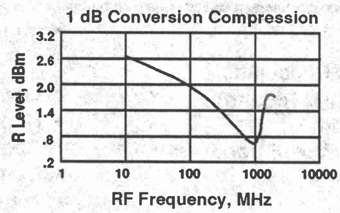
MAXIMUM RATINGS

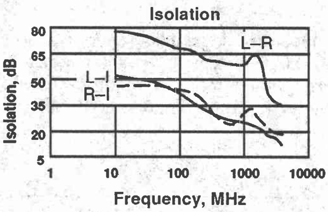
Peak Input Current @ 25°C . . . . 100 mA DC
Pin Temperature . . . . 260° C for 10 seconds
Operating Case Temperature . . . . −55°C to +100°C
Storage Temperature . . . . −65°C to +100°C
Continuous RF Input Power . . . . 200mW @ +25°C
100 mW @ +100°C

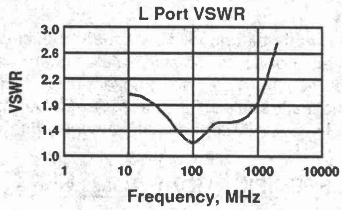
WEIGHT: (typical) 0.06 oz.

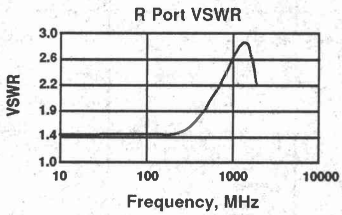
TYPICAL PERFORMANCE AT 25°C (Measured in a 50-ohm system with LO = +7 dBm and IF = 100 MHz)

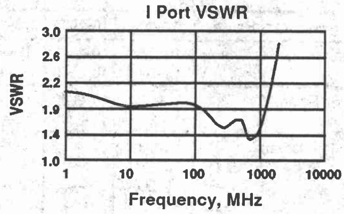












AVANTEK

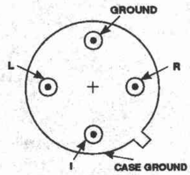
UMX–4220
Double Balanced Mixer
3700 to 4200 MHz

FEATURES

- 1.5:1 VSWR
- 4.5 dB Conversion Loss/Noise Figure
- Low Cost

APPLICATIONS

- Low Cost, High Performance
- 3.7 to 4.2 GHz Downconverter in TVRO Applications
- Instrumentation and Test Equipment



TO-8M, p. 16–47

DESCRIPTION

The UMX Series double-balanced mixers feature exceptionally high isolation and good harmonically-related intermodulation product suppression. They are packaged in compact easy-to-use hermetically sealed TO-8 cans. The UMX-4220 is a microwave mixer designed to meet the need for a low cost, high performance 3.7 to 4.2 GHz downconverter in TVRO applications. Typical conversion loss is 4.5 dB with a low-side LO and 5.0 with a high-side LO for either an 880 or 1125 MHz IF frequency. LO to RF isolation exceeds 30 dB.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system)

Symbol	Characteristic	Operating Frequencies GHz f_{LO}	f_{RF}	f_{IF}	Power Level LO Port dBm (typ)	Model Suffix	RF Port dBm	Specifications Typical $T_C = 25°C$	Guaranteed $T_C = -55°$ to $+100°C$	Unit
BW	Operating Frequency Range	2.4–5.5	3.7–4.2	DC–1.3						GHz
CL	SSB Conversion Loss	$>f_{RF}$ $<f_{RF}$	3.7–4.2 3.7–4.2	DC–1.3 DC–1.3	+7–+10 +7–+10			5.0 4.5	6.0 6.0	dB max
—	Conversion Loss Flatness over any 40 MHz segment of f_{RF} 3.7 to 4.2 GHz peak-to-peak	2.3–5/5	3.7–4.2	DC–1.3	+7–+10			0.1	—	dB typ
NF	SSB Noise Figure	$>f_{RF}$ $<f_{RF}$	3.7–4.2 3.7–4.2	0.03–1.3 0.03–1.3	+6–+8 +6–+8			5.0 4.5	6.0 6.0	dB max
ISOL	Isolation Port-to-Port L–R R–L R–I L–I	2.4–5.5 — — 2.4–5.5	— 3.7–4.2 3.7–4.2 —	— — — —				35 35 20 25	25 — — 20	dB min
—	VSWR (50 ohm) L R I	2.4–5.5 — —	— 3.7–4.2 —	— — 0.01–1.3				1.5:1 1.5:1 1.5:1	— — —	max
CC	Conversion Compression Point (1dB)	2.3–5.5	3.7–4.2	≤1.3	≥+7			+1	—	dBm typ
IP_3	Third-Order Two-Tone Intercept Point	2.4–5.5	3.7–4.2	≤1.3	≥+7		—	+12	—	dBm typ

NOTE: Guaranteed specifications apply with LO input power of +7 dBm.

MAXIMUM RATINGS

Peak Input Current @ 25°C .... 100 mA DC
Pin Temperature .... 260° C for 10 seconds
Operating Case Temperature .... −55°C to +100°C
Storage Temperature .... −65°C to +100°C
Continuous RF Input Power .... 200 mW @ +25°C
100 mW @ +100°C

WEIGHT: (typical) 0.06 oz.

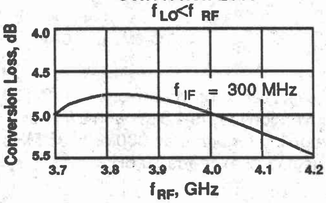
TYPICAL PERFORMANCE AT 25°C

Typical Single Tone Intermodulation Harmonic Suppression at 25°C (dB below desired output)

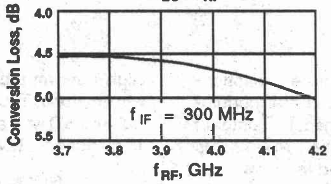
Harmonics of f_{RF}				
4	>70	>70	>70	>70
3	65	>70	55	>70
2	50	55	50	58
1	0	25	18	40
	1	2	3	4
	Harmonics of f_{LO}			

Typical Harmonic Intermodulation Suppression for mixer generated harmonics of the input signals. Suppression numbers are for a f_{RF} signal level at –10 dBm and f_{LO} signal level of +7 dBm.

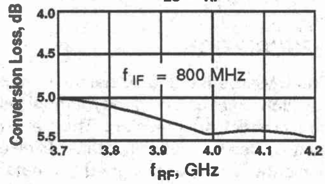
Conversion Loss
$f_{LO}<f_{RF}$



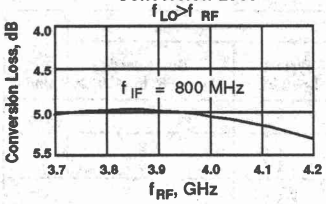
Conversion Loss
$f_{LO}>f_{RF}$



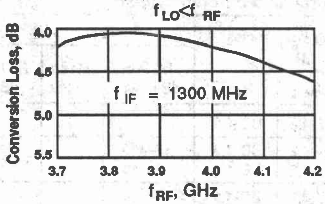
Conversion Loss
$f_{LO}<f_{RF}$



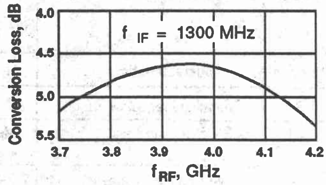
Conversion Loss
$f_{LO}>f_{RF}$



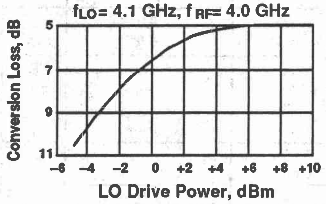
Conversion Loss
$f_{LO}<f_{RF}$



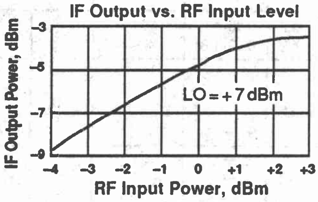
Conversion Loss
$f_{LO}>f_{RF}$



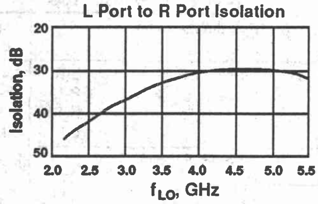
Conversion Loss
f_{LO}= 4.1 GHz, f_{RF}= 4.0 GHz



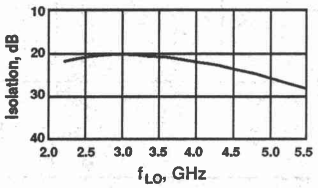
IF Output vs. RF Input Level



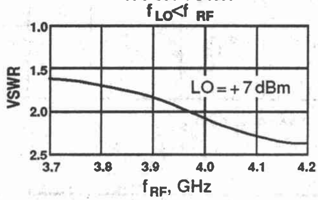
L Port to R Port Isolation



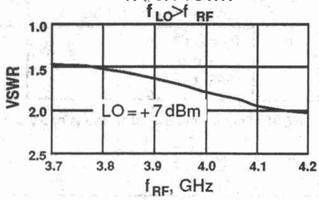
L Port to I Port Isolation



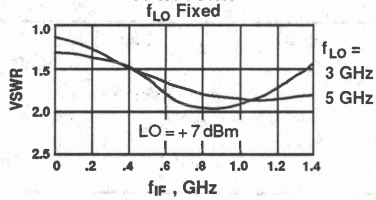
R Port VSWR
$f_{LO}<f_{RF}$



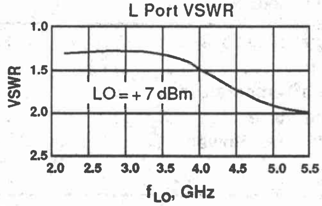
R Port VSWR
$f_{LO}>f_{RF}$



I Port VSWR
f_{LO} Fixed



L Port VSWR

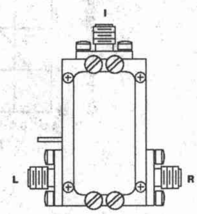


AVANTEK

MXA Series
Avanpak Mixer-Preamplifiers
.05 to 18 GHz

FEATURES
- 0.05 to 18 GHz Coverage
- Premium Performance
- Miniature Size
- Configured As Down Converter

APPLICATIONS
- High Density Microstrip Applications
- Overlapping RF, LO, and IF Requirements
- EW Systems



MA-1, -2, -3, p. 16–27

DESCRIPTION
The Avantek MXA Series of mixer-preamplifiers integrates Avantek's proven thin-film mixer and amplifier lines. These devices cover the frequency range from 0.05 to 18 GHz on the R and L ports with IF coverage up to 2 GHz. Virtually any combination of one standard TFX mixer with one, two, or three UTO thin-film amplifiers may be cascaded to meet customer needs. All combinations are packaged in Avanpak style cases to give the customer the advantages of small size, light weight and either coax, stripline or microstrip application.

AVANPAK MIXER-PREAMPLIFIERS[1] (Guaranteed Specifications at 25°C Case Temperature)

Model	Consisting of the Following Products	Frequency Range f_{RF} (GHz)	f_{LO} (GHz)	f_{IF} (MHz)	RF-IF Gain (dB) Min.	Noise Figure (dB) Typ.	Power Output for 1 dB Gain Compression (dB) Min.	DC Current (dBm) Typ	Case Drawing
MXA-2512	DBX-3503, UTO-440, UTO-210	.5–2.0	.5–2.0	10–200	10	11	6	30	MA–3
MXA-3012[2]	DBX-3503, UTO-1012, UTO-1013	.05–3.0	.05–3.5	10–1000	20	10.5	7	50	MA–2
MXA-7202	TFX-72M, UTO-514, UTO-516	2–7	2–7	30–160	22	8.5	9	45	MA–2
MXA-7203	TFX-72M, UTO-514, UTO-519, UTO-509	2–7	2–7	30–160	33	8.5	20	135	MA–3
MXA-10911	TFX-186M, UTO-222	9–10	9–10	70	20	9	18	50	MA–1
MXA-18422	TFX-184M, UTO-2012, UTO-2012	4–18	4–18	500–2000	9	11.5	12	100	MA–2
MXA-18423	TFX-184M, UTO-2012, UTO-2012, UTO-2013	4–18	4–18	500–2000	18	11.5	19	200	MA–3

NOTES: 1. Sample Listing of poddible Mixer/Amplifier combinations
2. Power out at 1 dB compression is +3 dBm (Min.) from .05 to .6 GHz RF input frequency on MXA-3012.

WEIGHT: (typical) MA-1 = 40 grams; MA-2 = 50 grams; MA-3 = 60 grams

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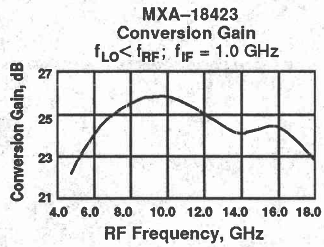
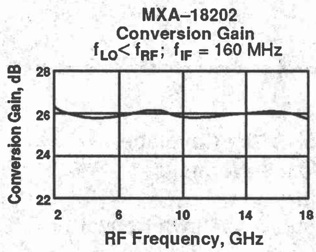
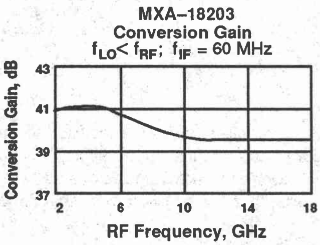
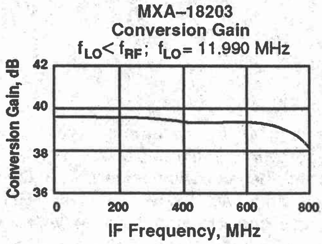
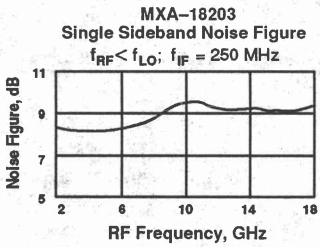
TYPICAL PERFORMANCE











AVANTEK

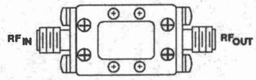
DRX–2075
Avanpak Doubler
.075 to 2 GHz

FEATURES

- Wide Input Frequency Range: 75 MHz to 2 GHz
- Hermetically Sealed, Small Package: .96 in. x .66 in. x .22 in.
- Low Conversion Loss: <12.5 dB (Typ)
- Balanced Design
- +13 dBm Nominal Input Level

APPLICATIONS

- Extend Frequency Range of Test Equipment
- System Upgrades
- Extend Instrumentation Frequency Range



DRX, p. 16–15

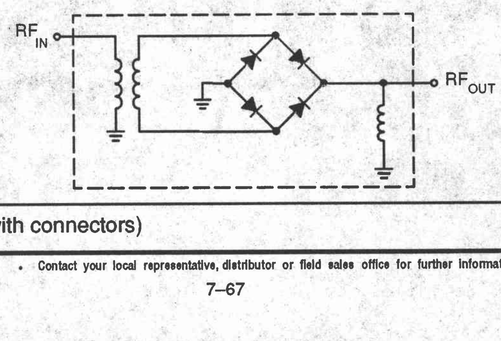
DESCRIPTION

The DRX-2075 is a balanced doubler offering excellent performance over a wide frequency range. It uses a precisely balanced, monolithic Schottky-barrier diode bridge to produce an output signal at a frequency twice that of the input signal. The precise balancing inherent in a monolithic bridge serves to greatly reduce the fundamental frequency feedthrough, thus producing a clean, low distortion 2f output signal. By combining the broadband frequency response characteristics of the monolithic bridge with both lumped and distributed elements, this doubler is able to achieve excellent performance over the entire 0.075 to 2 GHz input frequency range. It is packaged in a unique Avanpak miniature hermetic case for applications in microstripline or coaxial connector interfaced systems. Avantek's DRX-2075 is also designed to assure a good 50-ohm match at all ports to simplify the design of the systems in which they are used.

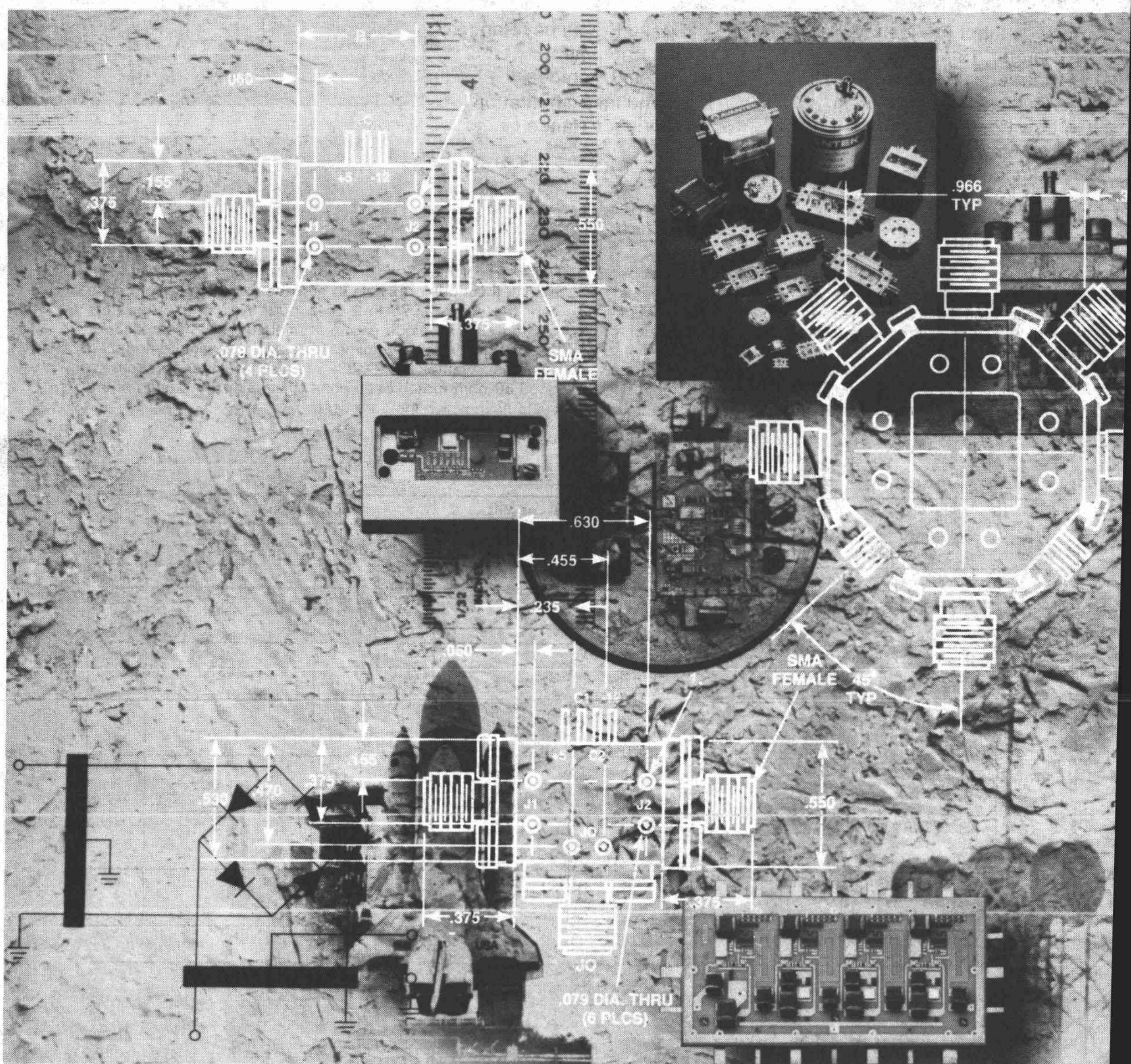
ELECTRICAL SPECIFICATIONS (Measured in a 50–ohm system)

Symbol	Characteristic	Operating Frequencies, MHz		Specifications		Unit
		Input Port	Output Port	Typical $T_C = 25°C$	Guaranteed $T_C = -55° - +100°C$	
BW	Operating Frequency Range	75-2000	150-4000			MHz
CL	Conversion Loss (2F vs. 1F)	75-800 800-1500 1500-2000		10.0 11.0 12.5	11.5 12.5 14.0	dB max
—	1F @ Output Relative to 2F	75-800 800-1500 1500-2000		34 28 16	25 23 14	dBc min
—	3F @ Output Relative to 2F		225-3000 3000-4500 4500-6000	28 28 35	25 25 30	dBc min
—	4F @ Output Relative to 2F		300-4000 4000-6000 6000-8000	14 15 12	13 14 11	dBc min
—	Input VSWR (50 Ohm)	75-1000 1000-1500 1500-2000		1.7 2.0 1.7	— —	max
—	Output VSWR (50 Ohm)		150-1500 1500-3000 3000-4000	1.4 2.0 2.7	— — —	max

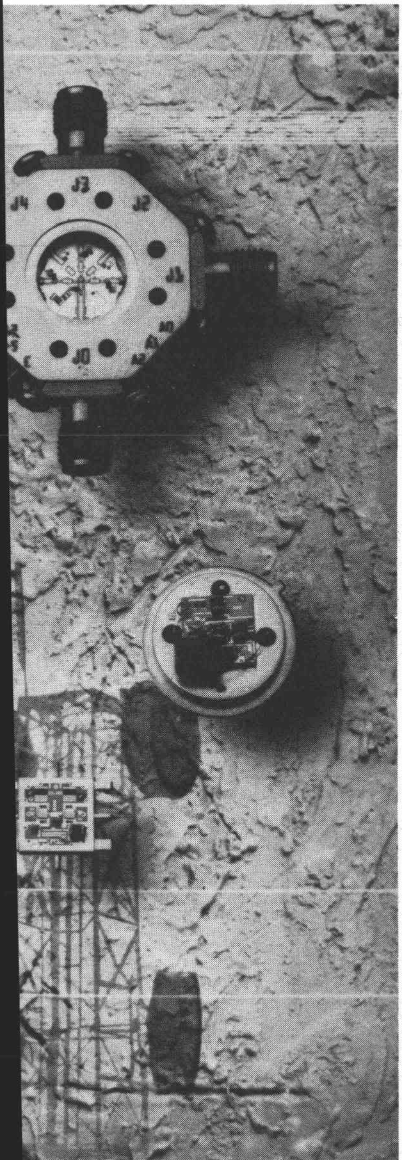
SCHEMATIC



Weight: (typical) — 20 grams (with connectors)


.060
+5
-12
.155
.375
J1
J2
.550
.375
.079 DIA. THRU
(4 PLCS)
SMA
FEMALE
.966
TYP
.630
.455
.235
.060
C1
-12
+5
C2
.155
.530
.470
.375
J1
J2
JO
.550
.375
.375
JO
.079 DIA. THRU
(6 PLCS)
SMA
FEMALE
45°
TYP

SWITCHES



PRODUCT DESCRIPTION

PIN diode RF Switches

The "AH" Series of PIN diode switches covers the 2 to 18 GHz frequency range. These switches have been designed into extremely small cases which are setting a new standard for convenience and miniaturization in the industry.

The AH Series uses Avantek's all thin-film design technology for superb reliability and repeatability. All hybrid components are epoxy-mounted or eutectically die attached, and thermosonic bonded.

Avantek offers three different types of AH switches—SPST, SPDT and SPMT. Each type provides a complete range of options which includes:

- Frequency coverage from 2 to 18 GHz
- Reflective or non-reflective
- Female SMA, male SMA or connectorless RF interface
- Integral TTL compatible high speed drivers
- High reliability "R" Series screening
- Low insertion loss/High isolation options

The AH Series case is packaged in a stainless steel case and laser welded for hermeticity. Numerous case mounting holes are provided for ease of installation into stripline assemblies.

SPST Switches

Avantek offers two series of 2 to 18 GHz single pole single throw switches. The low loss series is designed to provide up to 40 dB of isolation while the high isolation series offers up to 60 dB. Both are available with TTL compatible hybrid switch drivers and have typical switching speeds of under 10 nanoseconds from 10 to 90% of the detected RF. These units are extremely small (less than .07 cubic inches) and weigh less than 6.5 grams without connectors.

SPDT Switches

The Avanpak AHD Series reflective and non-reflective single pole double throw switches are designed to operate over the full 2 to 18 GHz band and offer very low insertion loss and VSWR while providing 50 dB of isolation. They are available with TTL compatible hybrid switch drivers and have typical switching speeds of under 15 nanoseconds from 10 to 90% of the detected RF. These units are extremely small (less than .07 cubic inches) and weigh less than 7 grams without connectors.

SPMT Switches

The Avanpak AHT, AHQ and AHF Series reflective and non-reflective single pole multi throw switches are designed to operate over the entire 2 to 18 GHz band and offer very low insertion loss and VSWR while providing 50 dB of isolation. They are available with TTL compatible hybrid switch drivers and have typical switching speeds of under 15 nanoseconds from 10 to 90% of the detected RF. These units are extremely small (less than .2 cubic inches) and weigh less than 18 grams without connectors.

Planarpak™ Surface Mount Switch

The PPS-010 is a single pole double throw surface mount switch which covers the 10 to 2000 MHz frequency range.

This PlanarPak switch is a non-reflective device that offers low insertion loss.

The PPS–010 is supplied in the newly designed surface mount package which allows the use of simpler microstrip installation at higher densities and improved performance.

Capabilities

In addition to the standard switch lines, Avantek also offers extensive custom capabilities to meet specific customer needs. Past specials include extended frequency range switches (0.5 to 18 GHz, 2 to 20 GHz), very high isolation switches (70+ dB), and GaAs MMIC switches covering DC-6 GHz. Contact the factory to discuss your individual requirements.

SELECTION GUIDE

AH SERIES, SINGLE POLE, SINGLE THROW (SPST) PIN DIODE SWITCHES

Guaranteed Specifications[2] at 25°C Case Temperature[3]

Model	Frequency (GHz)	Switching Speed[1] (Nanoseconds) Maximum	Isolation (dB) Minimum	VSWR Maximum	Insertion Loss Max. (dB) @ Freq. (GHz) 2.0-4.0	4.0-8.0	8.0-12.0	12.0-18.0	Case Type
LOW LOSS									
AHS0402-0XX	2.0-4.0	25	40	1.8	0.9	—	—	—	SPST
AHS0802-0XX	2.0-8.0	25	40	1.8	0.9	1.2	—	—	SPST
AHS1202-0XX	2.0-12.0	25	40	1.8	0.9	1.2	1.7	—	SPST
AHS1802-0XX	2.0-18.0	25	40	1.8	0.9	1.2	1.7	2.1	SPST
HIGH ISOLATION									
AHS0402-1XX	2.0-4.0	25	60	1.8	1.1	—	—	—	SPST
AHS0802-1XX	2.0-8.0	25	60	1.8	1.1	1.4	—	—	SPST
AHS1202-1XX	2.0-12.0	25	60	1.8	1.1	1.4	1.9	—	SPST
AHS1802-1XX	2.0-18.0	25	60	1.8	1.1	1.4	1.9	2.4	SPST

NOTES: 1. Speed is defined as 50% input trigger to 90% detected R.F. change including driver delay. Rise and fall times are less than 10 nS typical.
2. Isolation is measured at +10 dBm input power. All other specifications are measured at 0 dBm input power.
3. Operating temperature: –55° to +100°C.

SELECTION GUIDE (continued)

AH SERIES, SINGLE POLE, DOUBLE THROW (SPDT) PIN DIODE SWITCHES
Guaranteed Specifications[2] at 25°C Case Temperature[3]

Model	Frequency (GHz)	Switching Speed[1] (Nanoseconds) Maximum	Isolation (dB) Minimum	VSWR Maximum	Insertion Loss Max. (dB) @ Freq. (GHz) 2.0-4.0	4.0-8.0	8.0-12.0	12.0-18.0	Case Type
REFLECTIVE									
AHD0402-0XX	2.0-4.0	75	50	1.8	1.3	—	—	—	SPDT
AHD0802-0XX	2.0-8.0	75	50	1.8	1.3	1.8	—	—	SPDT
AHD1202-0XX	2.0-12.0	75	50	1.8	1.3	1.8	2.3	—	SPDT
AHD1802-0XX	2.0-18.0	75	50	1.8	1.3	1.8	2.3	2.9	SPDT
NON-REFLECTIVE									
AHD0402-1XX	2.0-4.0	75	50	1.8	1.6	—	—	—	SPDT
AHD0802-1XX	2.0-8.0	75	50	1.8	1.6	1.8	—	—	SPDT
AHD1202-1XX	2.0-12.0	75	50	1.8	1.6	1.8	2.3	—	SPDT
AHD1802-1XX	2.0-18.0	75	50	1.8	1.6	1.8	2.3	2.9	SPDT

AH SERIES, SINGLE POLE, MULTI-THROW PIN DIODE SWITCHES
Guaranteed Specifications[2] at 25°C Case Temperature[3]

Model	Frequency (GHz)	Switching Speed[1] (Nanoseconds) Maximum	Isolation (dB) Minimum	VSWR Maximum	Insertion Loss Max. (dB) @ Freq. (GHz) 2.0-4.0	4.0-8.0	8.0-12.0	12.0-18.0	Case Type
TRIPLE THROW REFLECTIVE									
AHT0402-0XX	2.0-4.0	75	50	2.0	1.4	—	—	—	SPMT
AHT0802-0XX	2.0-8.0	75	50	2.0	1.4	2.0	—	—	SPMT
AHT1202-0XX	2.0-12.0	75	50	2.0	1.4	2.0	2.5	—	SPMT
AHT1802-0XX	2.0-18.0	75	50	2.0	1.4	2.0	2.5	3.1	SPMT
FOUR THROW REFLECTIVE									
AHQ0402-0XX	2.0-4.0	75	50	2.0	1.6	—	—	—	SPMT
AHQ0802-0XX	2.0-8.0	75	50	2.0	1.6	2.2	—	—	SPMT
AHQ1202-0XX	2.0-12.0	75	50	2.0	1.6	2.2	2.7	—	SPMT
AHQ1802-0XX	2.0-18.0	75	50	2.0	1.6	2.2	2.7	3.4	SPMT
FIVE THROW REFLECTIVE									
AHF0402-0XX	2.0-4.0	75	50	2.0	1.7	—	—	—	SPMT
AHF0802-0XX	2.0-8.0	75	50	2.0	1.7	2.2	—	—	SPMT
AHF1202-0XX	2.0-12.0	75	50	2.0	1.7	2.2	2.7	—	SPMT
AHF1802-0XX	2.0-18.0	75	50	2.0	1.7	2.2	2.7	3.5	SPMT
TRIPLE THROW NON-REFLECTIVE									
AHT0402-1XX	2.0-4.0	75	50	2.0	1.8	—	—	—	SPMT
AHT0802-1XX	2.0-8.0	75	50	2.0	1.8	2.3	—	—	SPMT
AHT1202-1XX	2.0-12.0	75	50	2.0	1.8	2.3	2.7	—	SPMT
AHT1802-1XX	2.0-18.0	75	50	2.0	1.8	2.3	2.7	3.1	SPMT
FOUR THROW NON-REFLECTIVE									
AHQ0402-1XX	2.0-4.0	75	50	2.0	2.0	—	—	—	SPMT
AHQ0802-1XX	2.0-8.0	75	50	2.0	2.0	2.5	—	—	SPMT
AHQ1202-1XX	2.0-12.0	75	50	2.0	2.0	2.5	2.9	—	SPMT
AHQ1802-1XX	2.0-18.0	75	50	2.0	2.0	2.5	2.9	3.4	SPMT
FIVE THROW NON-REFLECTIVE									
AHF0402-1XX	2.0-4.0	75	50	2.0	2.1	—	—	—	SPMT
AHF0802-1XX	2.0-8.0	75	50	2.0	2.1	2.5	—	—	SPMT
AHF1202-1XX	2.0-12.0	75	50	2.0	2.1	2.5	2.9	—	SPMT
AHF1802-1XX	2.0-18.0	75	50	2.0	2.1	2.5	2.9	3.5	SPMT

NOTES:
1. Speed is defined as 50% input trigger to 90% detected R.F. change including driver delay. Rise and fall times are less than 10 nS typical.
2. All specifications are at +10 dBm input power. Maximum input is +30 dBm.
3. Operating temperature: –55° to +100°C.
4. Switching speed measurements are made using detected video with RF input power of +10 dBm at a frequency of 10 GHz.

SELECTION GUIDE (continued)

PPS-010, PLANARPAK™ SURFACE MOUNTED, NON-REFLECTIVE, SPDT SWITCH
Guaranteed Specifications at 25°C Case Temperature

Model	Frequency Range (MHz)	Insertion Loss (dB) Maximum	Isolation (dB) Minimum	VSWR (50Ω) Maximum	Switching Speed (μsec) Maximum	Control Voltage (VDC)	Case Type
PPS-010	10-200	1.5	40	1.7	5.0	±15	PP-25S
	200-500	1.5	30				
	500-2000	2.5	20				

AVANTEK

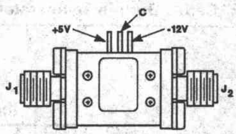
AHS Series
Thin-Film Switches
Single Pole Single Throw
2 to 18 GHz

FEATURES

- Full Band 2 to 18 GHz Performance
- Low Loss/High Isolation Options
- Reliable Thin-Film Construction
- Removable SMA Connectors
- Low Insertion Loss
- Low VSWR
- High Isolation
- High Speed

APPLICATIONS

- Receiver Selection
- Antenna Selection
- Signal Sampling
- Active Protection Circuits
- Local Oscillator Selection
- Channelized Receivers



SPST, p. 16–40

DESCRIPTION

The AHS-0 Series (low loss) and the AHS-1 Series (high isolation) are designed to operate over the full 2 to 18 GHz band while providing excellent insertion loss, VSWR and isolation performance. They are available with high speed hybrid TTL driver assemblies and have maximum switching times under 25 nsec. The RF circuitry is fabricated using thin-film hybrid construction on ceramic substrates for high reliability. The AHS-0 Series uses two PIN diodes in a shunt configuration for very low insertion loss; the AHS-1 Series uses four shunt diodes to achieve excellent isolation over the entire 2 to 18 GHz band.

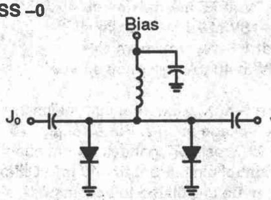
AVANPAK™ THIN-FILM PIN-DIODE SWITCHES (Guaranteed Specifications at +25°C Case Temperature)

Frequency	2.0 to 4.0 GHz			4.0 to 8.0 GHz			8.0 to 12.0 GHz			12.0 to 18.0 GHz		
Type and Model	Insertion Loss (dB) Max.	VSWR Max.	Isolation (dB) Min.	Insertion Loss (dB) Max.	VSWR Max.	Isolation (dB) Min.	Insertion Loss (dB) Max.	VSWR Max.	Isolation (dB) Min.	Insertion Loss (dB) Max.	VSWR Max.	Isolation (dB) Min.
Single Pole Single Throw (SPST), Low Loss — Speed < 25 nsec.												
AHS0402-00X	0.9	1.8	40	—	—	—	—	—	—	—	—	—
AHS0802-00X	0.9	1.8	40	1.2	1.8	40	—	—	—	—	—	—
AHS1202-00X	0.9	1.8	40	1.2	1.8	40	1.7	1.8	40	—	—	—
AHS1802-00X	0.9	1.8	40	1.2	1.8	40	1.7	1.8	40	2.1	1.8	40
Single Pole Single Throw (SPST), High Isolation — Speed < 25 nsec.												
AHS0402-1XX	1.1	1.8	60	—	—	—	—	—	—	—	—	—
AHS0802-1XX	1.1	1.8	60	1.4	1.8	60	—	—	—	—	—	—
AHS1202-1XX	1.1	1.8	60	1.4	1.8	60	1.9	1.8	60	—	—	—
AHS1802-1XX	1.1	1.8	60	1.4	1.8	60	1.9	1.8	60	2.4	1.8	60

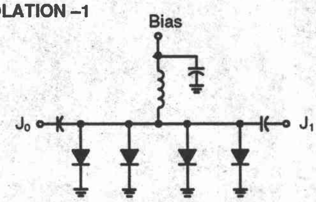
NOTES:
1. See next page for Model Number descriptions.
2. Speed is defined as 50% input trigger to 90% RF change including driver delay. Rise and fall times < 10 nanoseconds typical.
3. Switching speed measurements are made using detected video with RF input power of +10 dBm at a frequency of 10 GHz.
4. Isolation is measured at +10 dBm input power. All other specifications are measured at 0 dBm input power.
5. Operating temperature: –55° to +100°C.

SCHEMATICS

LOW LOSS –0



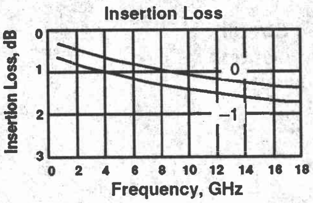
HIGH ISOLATION –1

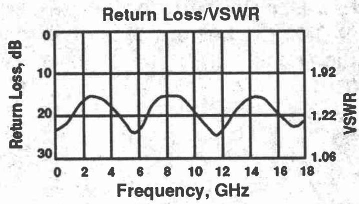


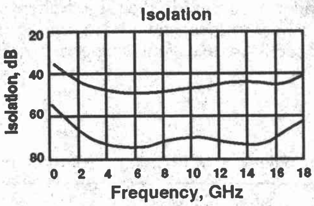
WEIGHT: (typical) AHS-0: With Connectors and Spacer = 11.5 grams; Without Connectors and Spacer = 5.5 grams
AHS–1: With Connectors and Spacer = 12.5 grams; Without Connectors and Spacer = 6.5 grams

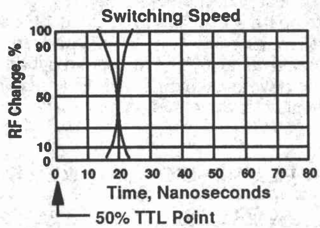
MAXIMUM RATINGS

DC Voltage	+5.5 V/–16.5V
Rf Input Power (CW/Pulse)	
Into "ON" PATH	1 W CW/10 W 1 µsec Pulse Width
Into "OFF" PATH	1 W CW/10 W 1 µsec Pulse Width
Operating Case Temperature	125°C
Storage Temperature	150°C
"R" Series Burn-In Temperature	125°C









MODEL NUMBERING DESCRIPTION

TYPICAL PART NUMBER

AHS1202-124

- Type (Single Throw)
- Upper Frequency, GHz
- Lower Frequency, GHz
- Connector Option
- Driver Option
- Isolation Option:
  - 0 = Low Loss
  - 1 = High Isolation

CONNECTOR OPTION TABLE		
Dash No.	J1	J2
XX1	FEM	FEM
XX2	NONE	NONE
XX3	MALE	MALE
XX4	MALE	FEM
XX5	FEM	MALE

DRIVER OPTION TABLE		
	Control Input C	
Dash No.	ON	OFF
X0X	–10V	+40 mA
X1X	TTL LO	TTL HI
X2X	TTL HI	TTL LO

Driver Bias: +5 ±0.5V at 75 mA maximum
–5 to –15V at 75 mA maximum
TTL LO = 0 to .8V at 1.6 mA maximum sink
TTL HI = 2.0 to 0.5V at 40 µA maximum source

Driverless Operation (–X0X): External current limiting required for positive voltage supply. For example, +5V supply requires a 100Ω resistor connected from supply to control pin to limit control pin current to +40 mA. Different resistance values can be calculated to accommodate other voltage supplies.

AVANTEK

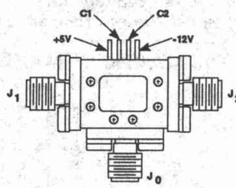
AHD Series
Thin-Film Switches
Single Pole Double Throw
2 to 18 GHz

FEATURES

- Full Band 2 to 18 GHz Performance
- Reflective and Non-reflective Versions
- Reliable Thin-Film Construction
- Removable SMA Connectors
- Low Insertion Loss
- Low VSWR
- High Isolation
- High Speed

APPLICATIONS

- Receiver Selection
- Antenna Selection
- Signal Sampling
- Active Protection Circuits
- Local Oscillator Selection
- Channelized Receivers



SPDT, p. 16–38

DESCRIPTION

The AHD-0 Series (reflective) and the AHD-1 Series (non-reflective) switches are designed to operate over the full 2 to 18 GHz band while providing excellent insertion loss, VSWR and isolation performance. They are available with high speed hybrid TTL driver assemblies and have maximum switching times under 75 nsec. The RF circuitry is fabricated using thin-film hybrid construction on ceramic substrates for high reliability. The AHD-0 Series (reflective) has three shunt diodes and one series diode per arm. Each arm of the AHD-1 Series (non-reflective) has three series diodes and a shunt diode-resistor combination, providing a 50-ohm impedance to the system in both insertion loss and isolation states.

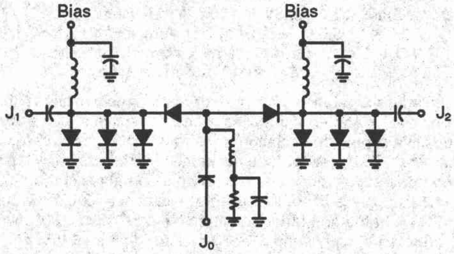
AVANPAK™ THIN-FILM PIN-DIODE SWITCHES (Guaranteed Specifications at +25°C Case Temperature)

Frequency	2.0 to 4.0 GHz			4.0 to 8.0 GHz			8.0 to 12.0 GHz			12.0 to 18.0 GHz		
Type and Model	Insertion Loss (dB) Max.	VSWR Max.	Isolation (dB) Min.	Insertion Loss (dB) Max.	VSWR Max.	Isolation (dB) Min.	Insertion Loss (dB) Max.	VSWR Max.	Isolation (dB) Min.	Insertion Loss (dB) Max.	VSWR Max.	Isolation (dB) Min.
Single Pole Double Throw (SPDT), Reflective — Speed < 75 nsec.												
AHD0402-0XX	1.3	1.8	50	—	—	—	—	—	—	—	—	—
AHD0802-0XX	1.3	1.8	50	1.8	1.8	50	—	—	—	—	—	—
AHD1202-0XX	1.3	1.8	50	1.8	1.8	50	2.3	1.8	50	—	—	—
AHD1802-0XX	1.3	1.8	50	1.8	1.8	50	2.3	1.8	50	2.9	1.8	50
Single Pole Double Throw (SPDT), Non-Reflective — Speed < 75 nsec.												
AHD0402-1XX	1.6	1.8	50	—	—	—	—	—	—	—	—	—
AHD0802-1XX	1.6	1.8	50	1.8	1.8	50	—	—	—	—	—	—
AHD1202-1XX	1.6	1.8	50	1.8	1.8	50	2.3	1.8	50	—	—	—
AHD1802-1XX	1.6	1.8	50	1.8	1.8	50	2.3	1.8	50	2.9	1.8	50

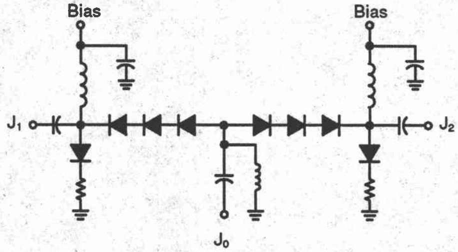
NOTES:
1. See next page for Model Number descriptions.
2. Speed is defined as 50% input trigger to 90% RF change including driver delay. Rise and fall times < 10 nanoseconds typical.
3. Switching speed measurements are made using detected video with RF input power of +10 dBm at a frequency of 10 GHz.
4. Isolation is measured at +10 dBm input power. All other specifications are measured at 0 dBm input power.
5. Operating temperature: –55 ° to +100°C.

SCHEMATICS

REFLECTIVE –0



NON-REFLECTIVE-1



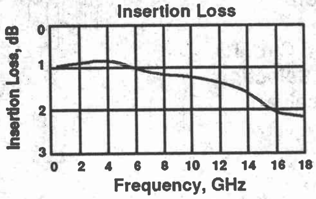
WEIGHT: (typical) With Connectors and Spacer = 14.5 grams; Without Connectors and Spacer = 6.5 grams

MAXIMUM RATINGS

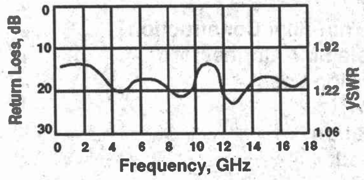
DC Voltage .... +5.5 V/–16.5V
Rf Input Power (CW/Pulse)
  Into "ON" PATH .... 1 W CW/10 W 1 μsec Pulse Width
  Into "OFF" PATH .... 1 W CW/10 W 1 μsec Pulse Width
Operating Case Temperature .... 125°C
Storage Temperature .... 150°C
"R" Series Burn-In Temperature .... 125°C

TYPICAL PERFORMANCE AT 25°C

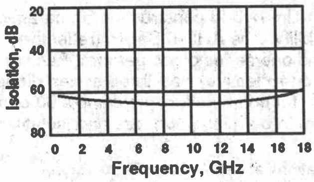
Insertion Loss



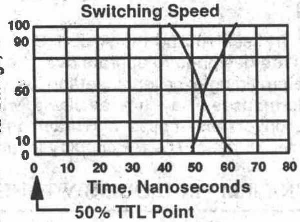
Return Loss/VSWR



Isolation

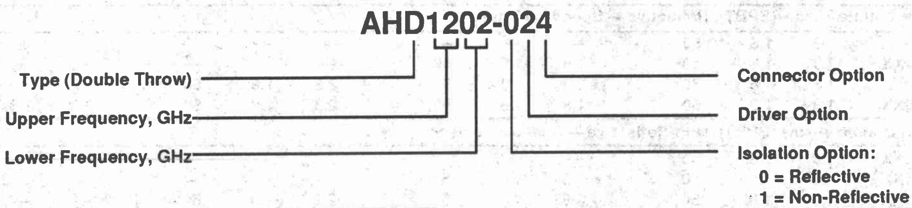


Switching Speed



MODEL NUMBERING DESCRIPTION

TYPICAL PART NUMBER



CONNECTOR OPTION TABLE			
Dash No.	J0	J1	J2
XX1	FEM	FEM	FEM
XX2	NONE	NONE	NONE
XX3	MALE	MALE	MALE
XX4	MALE	FEM	FEM
XX5	FEM	MALE	MALE

	DRIVER OPTION TABLE			
	C1		C2	
Dash No.	ON	OFF	ON	OFF
X0X	–40 mA	+40 mA	–40 mA	+40 mA
X1X	TTL LO	TTL HI	TTL LO	TTL HI
X2X	TTL HI	TTL LO	TTL HI	TTL LO
X3X	TTL LO	TTL HI	TTL HI	TTL LO
X4X	TTL HI	TTL LO	TTL LO	TTL HI

Driver Bias: +5.0 ±.0.5V at 100 mA maximum
–5.0 to –15.0V at 75 mA mximum
TTL LO = 0 to 0.8V at 1.6 mA maximum sink
TTL HI = 2.0 to 5.0 V at 40 μA maximum source

Driverless Operation (-X0X): External current limiting required. Using +5 V and –5 V supplies, with a reflective switch (-00X), the positive supply (for isolation) requires a 100Ω resistor. Due to an internal 175Ω resistor (see schematic for reflective switch), the negative supply does not require an external resistor at –5 V. If a –12 V supply is used, the external resistance required would be 100Ω. For the non-reflective version (–10X), use a 50Ω resistor on the +5 V supply and a 100Ω resistor on the –5 V supply. Other resistance values can be calculated to accommodate different voltage supplies.

AVANTEK

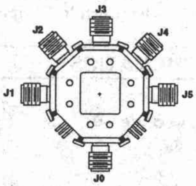
AHT/AHQ/AHF Series Thin-Film Switches Single Pole Multi Throw 2 to 18 GHz

FEATURES

- Full Band 2 to 18 GHz Performance
- Reflective and Non-reflective Versions
- Reliable Thin-Film Construction
- Removable SMA Connectors
- Low Insertion Loss
- Low VSWR
- High Isolation
- High Speed

APPLICATIONS

- Receiver Selection
- Antenna Selection
- Signal Sampling
- Active Protection Circuits
- Local Oscillator Selection
- Channelized Receivers



SPMT, p. 16–39

DESCRIPTION

The AHT-0, AHQ-0 and AHF-0 Series (reflective) and AHT-1, AHQ-1 and AHF-1 Series (non-reflective) are designed to operate over the full 2 to 18 GHz band while providing excellent insertion loss, VSWR and isolation performance. They are available with high speed hybrid TTL driver assemblies and have maximum switching times under 75 nsec. The RF circuitry is fabricated using thin-film hybrid construction on ceramic substrates for high reliability. The reflective versions have two shunt diodes and one series diode per arm. Each arm of the non-reflective versions has three series diodes and a shunt diode-resistor combination, providing a 50-ohm impedance to the system in both insertion loss and isolation states.

AVANPAK™ THIN-FILM PIN-DIODE SWITCHES (Guaranteed Specifications at +25°C Case Temperature)

Frequency	2.0 to 4.0 GHz			4.0 to 8.0 GHz			8.0 to 12.0 GHz			12.0 to 18.0 GHz		
Type and Model	Insertion Loss (dB) Max.	VSWR Max.	Isolation (dB) Min.	Insertion Loss (dB) Max.	VSWR Max.	Isolation (dB) Min.	Insertion Loss (dB) Max.	VSWR Max.	Isolation (dB) Min.	Insertion Loss (dB) Max.	VSWR Max.	Isolation (dB) Min.
Single Pole Triple Throw (SPMT), Reflective — Speed < 75 nsec.												
AHT0402-0XX	1.4	2.0	50	—	—	—	—	—	—	—	—	—
AHT0802-0XX	1.4	2.0	50	2.0	2.0	50	—	—	—	—	—	—
AHT1202-0XX	1.4	2.0	50	2.0	2.0	50	2.5	2.0	50	—	—	—
AHT1802-0XX	1.4	2.0	50	2.0	2.0	50	2.5	2.0	50	3.1	2.0	50
Single Pole Triple Throw (SPMT), Non-Reflective — Speed < 75 nsec.												
AHT0402-1XX	1.8	2.0	50	—	—	—	—	—	—	—	—	—
AHT0802-1XX	1.8	2.0	50	2.3	2.0	50	—	—	—	—	—	—
AHT1202-1XX	1.8	2.0	50	2.3	2.0	50	2.7	2.0	50	—	—	—
AHT1802-1XX	1.8	2.0	50	2.3	2.0	50	2.7	2.0	50	3.1	2.0	50
Single Pole Four Throw (SPMT), Reflective — Speed < 75 nsec.												
AHQ0402-0XX	1.6	2.0	50	—	—	—	—	—	—	—	—	—
AHQ0802-0XX	1.6	2.0	50	2.2	2.0	50	—	—	—	—	—	—
AHQ1202-0XX	1.6	2.0	50	2.2	2.0	50	2.7	2.0	50	—	—	—
AHQ1802-0XX	1.6	2.0	50	2.2	2.0	50	2.7	2.0	50	3.4	2.0	50
Single Pole Four Throw (SPMT), Non-Reflective — Speed < 75 nsec.												
AHQ0402-1XX	2.0	2.0	50	—	—	—	—	—	—	—	—	—
AHQ0802-1XX	2.0	2.0	50	2.5	2.0	50	—	—	—	—	—	—
AHQ1202-1XX	2.0	2.0	50	2.5	2.0	50	2.9	2.0	50	—	—	—
AHQ1802-1XX	2.0	2.0	50	2.5	2.0	50	2.9	2.0	50	3.4	2.0	50
Single Pole Five Throw (SPMT), Reflective — Speed < 75 nsec.												
AHF0402-0XX	1.7	2.0	50	—	—	—	—	—	—	—	—	—
AHF0802-0XX	1.7	2.0	50	2.2	2.0	50	—	—	—	—	—	—
AHF1202-0XX	1.7	2.0	50	2.2	2.0	50	2.7	2.0	50	—	—	—
AHF1802-0XX	1.7	2.0	50	2.2	2.0	50	2.7	2.0	50	3.5	2.0	50
Single Pole Five Throw (SPMT), Non-Reflective — Speed < 75 nsec.												
AHF0402-1XX	2.1	2.0	50	—	—	—	—	—	—	—	—	—
AHF0802-1XX	2.1	2.0	50	2.5	2.0	50	—	—	—	—	—	—
AHF1202-1XX	2.1	2.0	50	2.5	2.0	50	2.9	2.0	50	—	—	—
AHF1802-1XX	2.1	2.0	50	2.5	2.0	50	2.9	2.0	50	3.5	2.0	50

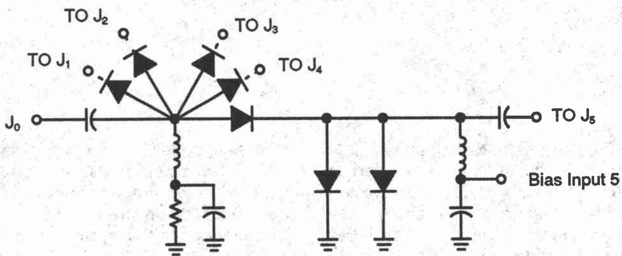
NOTES:
1. See next page for Model Number descriptions.
2. Speed is defined as 50% input trigger to 90% RF change including driver delay. Rise and fall fimes < 15 nanoseconds typical.
3. Switching speed measurements are made using detected video with RF input power of +10 dBm at a frequency of 10 GHz.
4. Isolation is measured at +10 dBm input power. All other specifications are measured at 0 dBm input power.
5. Operating temperature: –55° to +100 °C.

MAXIMUM RATINGS

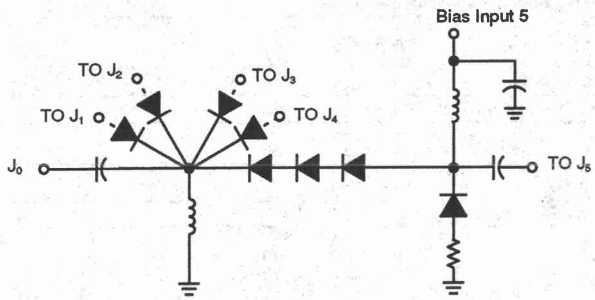
DC Voltage .... +5.5 V/–16.5V
RF Input Power (CW/Pulse)
Into "ON" PATH .... 1 W CW/10 W 1 µsec Pulse Width
Iinto "OFF" PATH .... 1 W CW/10 W 1 µsec Pulse Width
Operating Case Temperature .... 125°C
Storage Temperature .... 150°C
"R" Series Burn-In Temperature .... 125°C

SCHEMATICS

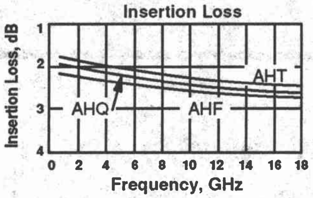
Reflective –0

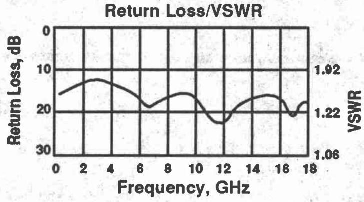


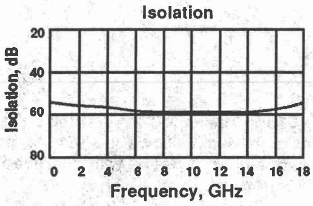
Non–Reflective –1

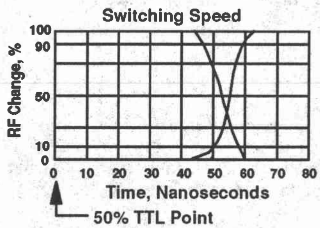


TYPICAL PERFORMANCE AT 25°C









MODEL NUMBERING DESCRIPTION

TYPICAL PART NUMBER

AHQ1202-024

- Type (Four Throw)
- Upper Frequency, GHz
- Lower Frequency, GHz
- Connector Option
- Driver Option
- Reflective/Non-Reflective
  - 0 = Reflective
  - 1 = Non-Reflective

CONNECTOR OPTION TABLE		
Dash No.	J0	J1-J5
XX1	FEM	FEM
XX2	NONE	NONE
XX3	MALE	MALE
XX4	MALE	FEM
XX5	FEM	MALE

DRIVER OPTION			
Dash No.	Type	ON	OFF
X0X	No Driver	+40 mA	–40 mA
X1X	No Driver	–40 mA	+40 mA
X2X	Decoded Driver	See truth table	
X3X	Standard Driver	TTL LO	TTL HI
X4X	Inverted Driver	TTL HI	TTL LO

NOTE: X3X and X4X dash numbers not available on SP5T models.

Driver Bias: +5.0 ±.0.5V at 75 mA maximum
–5.0 to –15.0V at 150 mA maximum
TTL LO = 0 to 0.8V at 1.6 mA maximum sink
TTL HI = 2.0 to 5.0 V at 40 µA maximum source

Driverless Operation (–X0X and –X1X): External current limiting resistance required. Using the –01X (reflective) with +5 V and –5 V supplies, the positive supply (for isolation) requires a 100Ω resistor. Due to an internal 175Ω resistor (see schematic for reflective version), the negative supply does not require an external resistor at –5 V. If a –12V supply is used, the external resistance required would be 100Ω. For the non-reflective version (–11X), use a 50Ω resistor on the +5 V supply and a 100Ω resistor on the –5V supply. For the –X0X models (positive voltage for insertion loss, negative voltage for isolation), switch resistors. Different resistor values can be calculated to accommodate other supply voltages.

Truth Table of X2X Decoded Driver				
Low Loss ON Port	TTL Input Level			
	A0	A1	A2	E
J1	1	0	0	1
J2	0	1	0	1
J3	1	1	0	1
J4	0	0	1	1
J5	1	0	1	1
ALL OFF	X	X	X	0

AVANTEK

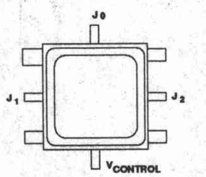
PPS-010
Surface Mount Switch
Single Pole Double Throw
10 to 2000 MHz

FEATURES

- 10 to 2000 MHz Broadband Frequency Coverage
- Non-Reflective
- Less than 1.6 dB Typical Insertion Loss
- PlanarPak™ Surface Mount Package

APPLICATIONS

- High Density, High Performance Applications
- Receiver Selection
- Antenna Selection
- Filter Selection



PP-25S, p. 16–34

DESCRIPTION

The PPS-010 is a single-pole-double-throw non-reflective surface mount switch which covers the 10 to 2000 MHz frequency range. The RF circuitry is fabricated using thin-film hybrid construction on ceramic substrates for high reliability.

The PPS-010 is packaged in Avantek's PlanarPak surface mount package which allows the use of simpler microstrip installation at higher densities with improved performance.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system unless otherwise noted)

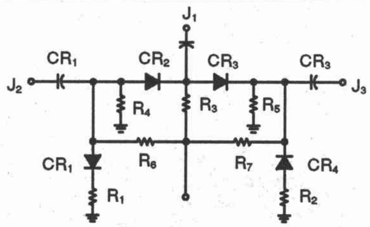
Symbol	Characteristic	Typical $T_c = 25°C$	Guaranteed Specifications		Unit
			$T_c = 0°$ to $50°C$	$T_c = -55°$ to $+85°C$	
BW	Frequency Range	10-2000	10-2000	10-2000	MHz
—	Insertion Loss				
	10 to 500 MHz	1.1	1.5 Max.	1.5 Max.	dB
	500 to 2000 MHz	1.6	2.5 Max.	2.5 Max.	dB
—	VSWR (ON or OFF)	1.1:1	1.7:1 Max.	1.7:1 Max.	
—	Isolation				
	10-200 MHz	45	40 Min.	40 Min.	dB
	200-500 MHz	36	30 Min.	30 Min.	dB
	500-2000 MHz	27	20 Min.	20 Min.	dB
—	Amplitude Match Between Channels				
	10-500 MHz	±0.05			dB
	500-2000 MHz	±0.1			dB
—	Phase Match Between Channels	±1			Degree
—	Third Order Intercept Point				
	10-100 MHz	+30			dBm
	100-2000 MHz	+41			dBm
—	Second Harmonic Intercept Point				
	10-100 Mhz	+52			dBm
	100-2000 MHz	+65			dBm
—	Switching Speed (10-90%)	5			µsec
—	Control Voltage	±15			Volts
—	Current @ ±15 Volts	7			mA

WEIGHT: (typical) 0.2 grams

MAXIMUM RATINGS

DC Voltage	±17.0 Volts
Continuous RF Input Power	
Into "ON" Channel	+26 dBm
Into "OFF" Channel	+21 dBm
Operating Case Temperature	–55°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

SCHEMATIC

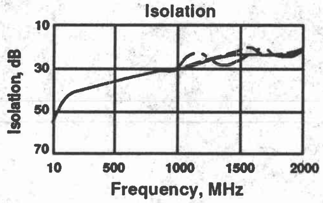


+15 VDC $J_1 \rightarrow J_3$
–15 VDC $J_1 \rightarrow J_2$

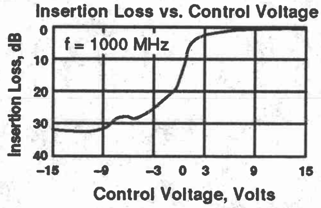
TYPICAL PERFORMANCE AT 25°C

KEY: +25 °C ———
+85 °C – – – –
–55 °C —·—

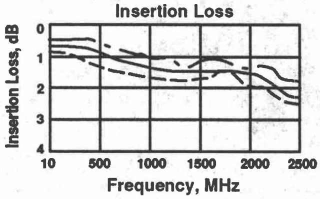
Isolation



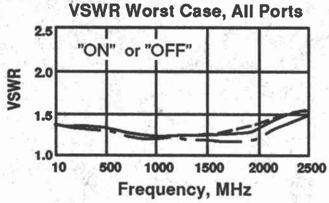
Insertion Loss vs. Control Voltage



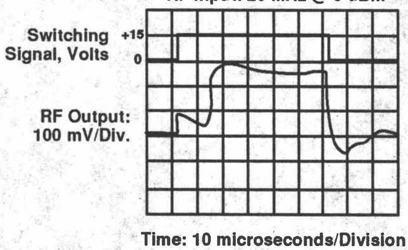
Insertion Loss

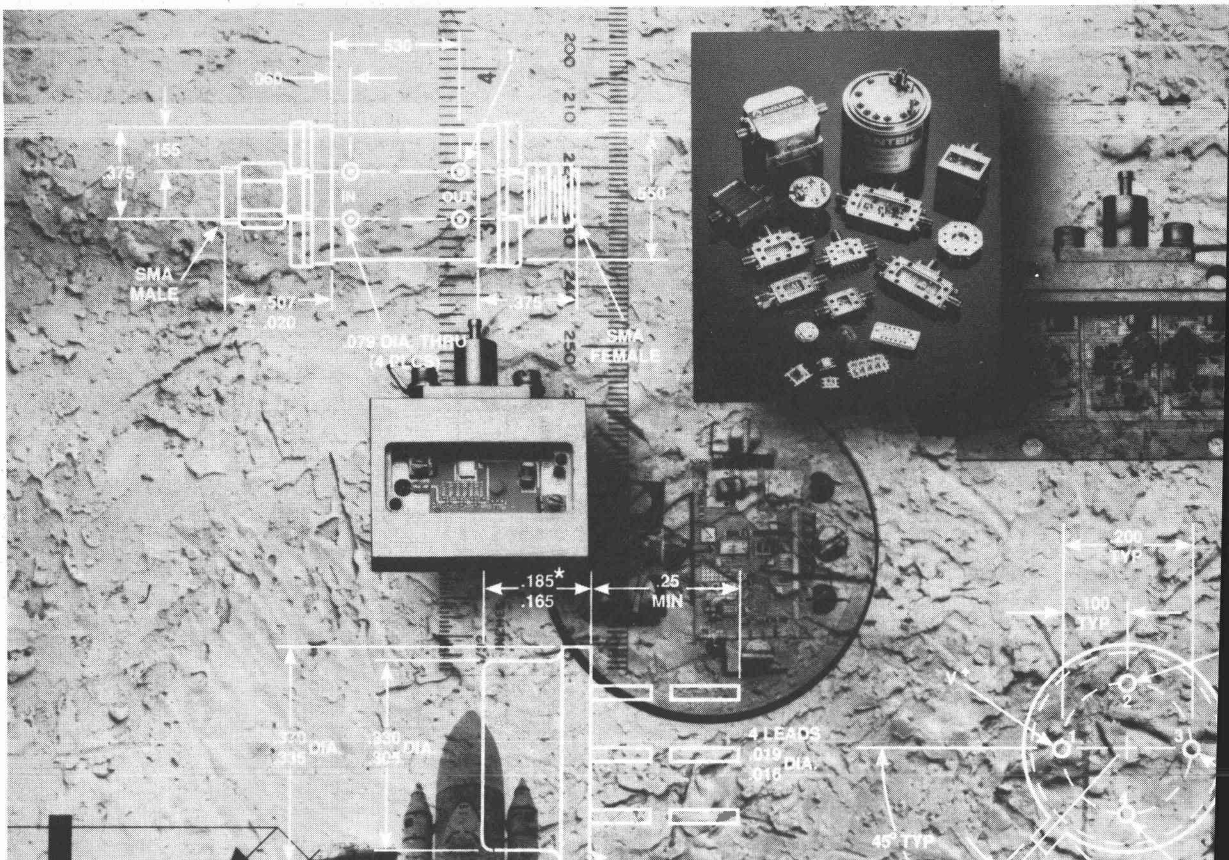


VSWR Worst Case, All Ports



Switching Speed
RF Input: 20 MHz @ 0 dBm




.530
.060
.155
.375
IN
OUT
.550
SMA
MALE
.507
.375
.079 DIA. THRU
(4 PLCS)
SMA
FEMALE
.185*
.165
.25
MIN
.200
TYP
.100
TYP
V+
4 LEADS
.019
.016 DIA.
45° TYP
.034
.028
.045
.029
.028
.020
SEATING
PLANE

LIMITERS

PRODUCT DESCRIPTION

The AH Series of thin-film limiters covers the full 2 to 18 GHz frequency range. They are offered in the subminiature limiter package with field replaceable SMA connectors.

These Avanpak passive limiters are used to protect sensitive components from high peak or CW power levels while maintaining low insertion loss and VSWR under low power conditions. The units incorporate all required ground returns and DC blocks, providing a complete component within a very small hermetic package.

Avantek offers two series of passive microwave limiters. The low loss (–0) series are designed to handle up to 200 watts peak and 2 watts CW. The high power (–1) series will handle 1000 watts peak and 4 watts CW. Peak power ratings are for one microsecond pulses at a .1 percent duty cycle.

A high power 40 watt CW device will be available in the future. Contact your local Avantek representative for availability information.

Avantek limiters are available with high reliability "R" series screening. Avantek uses all thin-film design technology for superb reliability and repeatability. All hybrid components are eutectically die attached and thermocompression bonded.

The stainless steel Avanpak case is laser welded for hermeticity. Numerous case mounting holes are provided for ease of installation into stripline assemblies.

Voltage Controlled Signal Limiters

The UTL/GPL Series consists of voltage-controlled signal limiters which cover the 5 to 1000 MHz frequency range.

These thin-film limiters feature voltage programmable output levels with input levels as high as +26 dBm. They have VSWR of less than 2:1, low insertion loss, excellent second- and third-harmonic suppression, and very low AM-to-PM conversion. Recovery from fully saturated input levels is less than 50 nanoseconds.

The UTL model is provided in the TO-8 package and the GPL model is available in the smaller TO-12 case.

AHL SERIES SELECTION GUIDE

AVANTEK THIN-FILM LIMITERS
Guaranteed Specifications @ 25°C Case Temperature

Model	Frequency Range (GHz)	VSWR Maximum	Maximum Insertion Loss (dB) at Frequency (GHz) 2-4	4-8	8-12	12-18
AHL0402-0	2-4	1.8	1.0	—	—	—
AHL0802-0	2-8	1.8	1.0	1.3	—	—
AHL1201-0	2-12	1.8	1.0	1.3	1.8	—
AHL1802-0	2-18	1.8	1.0	1.3	1.8	2.2
AHL0402-1	2-4	1.8	1.4	—	—	—
AHL0802-1	2-8	1.8	1.4	1.8	—	—
AHL1201-1	2-12	1.8	1.4	1.8	2.4	—
AHL1802-1	2-18	1.8	1.4	1.8	2.4	2.8

NOTES:
1. All specifications at –10 dBm power.
2. Case dimensions and weight are exclusive of connectors.

Additional Specifications which apply to all units
1. Limiting threshold +6 dBm, minimum, +10 dBm, typical.
2. Flat leakage: 100 mW maximum with 200 watts (-0 series) or 1000 watts (-1 series) peak; 1.0 microsecond pulse width; 0.1% duty cycle.
3. Spike leakage: 0.1 erg maximum with 20 nanosecond risetime pulses for -0 models; 0.2 erg maximum. with 20 nanosecond risetime pulses for -1 models.
4. Maximum continuous input 2 watts (-0 series), 4 watts (-1 series).
5. Recovery time: 100 nanoseconds maximum (-0 series), 200 nanoseconds maximum (-1 series).
6. Case Weight: 5.0 grams (excluding connectors).
7. Available in Limiter Avanpak case.
8. Operating Temperature Range : –55° to +85°C

UTL/GPL SERIES, VOLTAGE CONTROLLED SIGNAL LIMITERS
Guaranteed Specifications @ 25°C Case Temperature

Model	Frequency Range (MHz)	Input Power Limiting Range (dBm) Minimum	Saturated Output Power (dBm) Maximum	Output Flatness (dB) Maximum	Insertion Loss (dB) Maximum	Operating Bias (VAC) Nominal	Case Type	Page Number
UTL-1001	50-1000	0 to +20	–10 to 0*	±1.0	3.0	+5 to +20	TO-8U	9–7
UTL-1002	5-1000	0 to +20	–10 to 0*	±1.0	3.0	+5 to +20	TO-8U	9–7
GPL-1001	5-1000	0 to +20	–4. 0	±1.0	5.0	+15	TO-12	9–6

*Determined by bias voltage.

AVANTEK

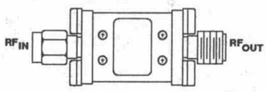
AHL Series Thin-Film Limiters 2 to 18 GHz

FEATURES

- Full Band 2 to 18 GHz Performance
- All Thin-Film Construction
- 200 W/1000 W Peak Power Handling Option
- VSWR less than 1.8:1
- Insertion Loss Less Than 2.8 dB

APPLICATIONS

- Protection for Detectors, Mixers, and Amplifiers
- EW Receiver Circuit Protection
- Wideband System Protection



AHL Case, p. 16–7

DESCRIPTION

These AHL Series passive limiters are used to protect sensitive components from high peak or CW power levels while maintaining low insertion loss and VSWR under low power conditions. Avantek uses all thin-film design technology for superb reliability and repeatability. All hybrid components are eutectically die attached and thermocompression bonded. The units incorporate all required ground returns and DC blocks, providing a complete component in a miniature hermetic package.

Avantek offers two series of passive microwave limiters. The low loss (–0) series is designed to handle up to 200 watts peak and 2 watts CW. The high power (–1) series will handle 1000 watts peak and 4 watts (CW). Peak power ratings are for one microsecond pulses at a 0.1 percent duty cycle.

AVANPAK™ THIN-FILM RF LIMITERS (Guaranteed Specifications at +25°C Case Temperature)

Frequency	2.0 to 4.0 GHz		4.0 to 8.0 GHz		8.0 to 12.0 GHz		12.0 to 18.0 GHz	
Model Number	Insertion Loss (dB) Max	VSWR Max	Insertion Loss (dB) Max	VSWR Max	Insertion Loss (dB) Max	VSWR Max	Insertion Loss (dB) Max	VSWR Max
AHL0402-00X	1.0	1.8	—	—	—	—	—	—
AHL0802-00X	1.0	1.8	1.3	1.8	—	—	—	—
AHL1202-00X	1.0	1.8	1.3	1.8	1.8	1.8		
AHL1802-00X	1.0	1.8	1.3	1.8	1.8	1.8	2.2	1.8
AHL0402-10X	1.4	1.8	—	—	—	—	—	—
AHL0802-10X	1.4	1.8	1.8	1.8	—	—	—	—
AHL1202-10X	1.4	1.8	1.8	1.8	2.2	1.8	—	—
AHL1802-10X	1.4	1.8	1.8	1.8	2.2	1.8	2.8	1.8

NOTES:
1. See page 9–5 for Model Number descriptions.
2. All specifications at –10 dBm input power.
3. Limiting threshold +10 dBm, typical, +6 dBm minimum.
4. Flat leakage: 100 mW maximum with 200 watts (-0 series) or 1000 watts (-1 series) peak; 1.0 microsecond pulse width; 0.1% duty cycle.
5. Spike leakage: 0.1 erg maximum with 20 nanosecond risetime pulses for –0 models; 0.2 erg maximum with 20 nanosecond risetime pulses for –1 models.
6. Contact Factory for Selected Broader Bandwidths.

MAXIMUM RATINGS

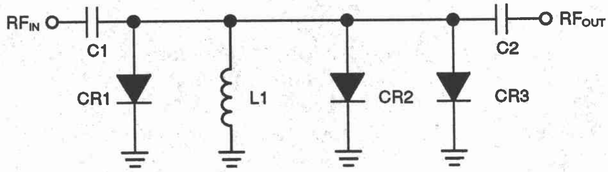
RF Input Power (CW/Pulse)
- –0XX .... 2 W CW/200 W 1 μsec Pulse Width
- –1XX .... 4 W CW/1000 W 1 μsec Pulse Width

Operating Case Temperature .... –55°C to +85°C
Storage Temperature .... 150°C
"R" Series Burn-In Temperature .... 125°C

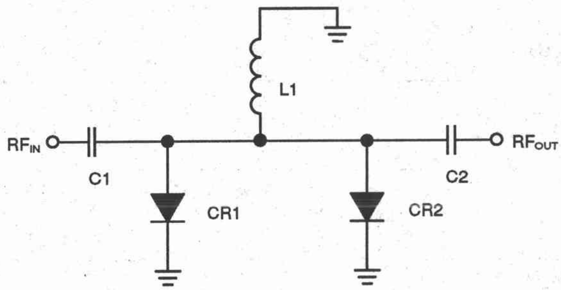
WEIGHT: (typical) with Connectors and Spacer = 10.5 grams; without Connectors and Spacer = 5.0 grams

SCHEMATICS

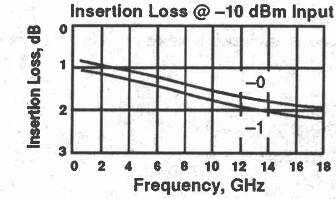
AHL1802-1

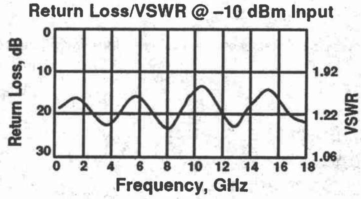


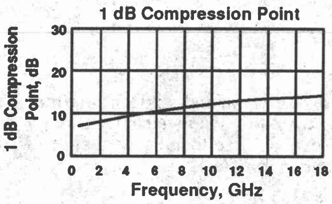
AHL1802-0

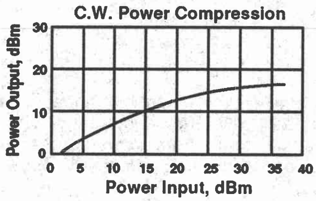


TYPICAL PERFORMANCE AT 25°C



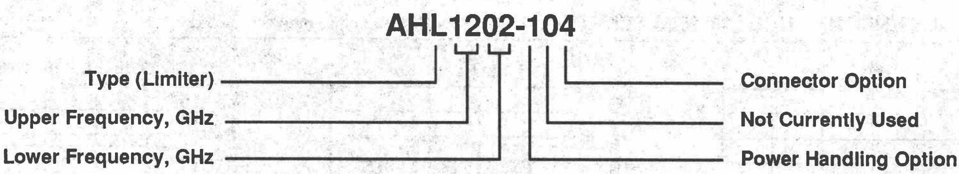






MODEL NUMBERING DESCRIPTION

TYPICAL PART NUMBER



CONNECTOR OPTION TABLE		
Dash No.	Input	Output
XX1	FEM	FEM
XX2	NONE	NONE
XX3	MALE	MALE
XX4	MALE	FEM
XX5	FEM	MALE

POWER HANDLING OPTION		
Dash No.	C.W. (Watts) Maximum	Peak (Watts) Maximum
OXX	2	200
1XX	4	1000

AVANTEK

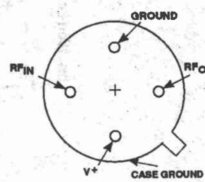
GPL-1001
Voltage Controlled Signal Limiter
5 to 1000 MHz

FEATURES

- 5 to 1000 MHz Frequency Coverage
- Voltage Controllable
- VSWR ≤ 2.0:1

APPLICATIONS

- Protection for Detectors, Mixers, and Amplifiers
- Cascadable Gain Control
- EW Receiver Circuits
- Wideband System Protection



TO-12, p. 16–50

DESCRIPTION

The GPL-1001 is a voltage controlled signal limiter which covers the 5 to 1000 MHz frequency range. This thin-film limiter features a voltage programmable output level with an input level as high as +26 dBm. It has low VSWR, low insertion loss, excellent second- and third-harmonic suppression, and very low AM-to-PM conversion. Recovery from fully saturated input levels is less than 50 nanoseconds. The GPL-1001 is provided in the TO-12 package.

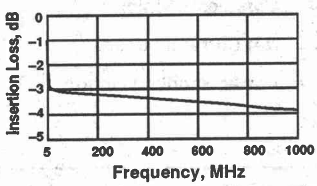
ELECTRICAL SPECIFICATIONS* (Measured in a 50-ohm system @ +15 VDC nominal unless 0therwise noted)

Model	Frequency Response (MHz) Minimum	Limited Output Power (@ +10 dBm P_{IN}) dBm Maximum	Insertion Loss Small Signal (dB) Typical	Output Power Flatness (±dB) Typical	VSWR Typical Input	VSWR Typical Output	Third-Harmonic (dBc) Typical	Second-Harmonic (dBc) Typical	Operating Bias VDC Nominal	Operating Bias Current (mA) Typical	Maximum Recommend Input Power (dBm)	Maximum Recommend Bias (VDC)
GPL-1001	5-1000	–4.0 (–8 typ)	5.0	1.0	2.0	2.0	12	30	+15	5	+26	+20

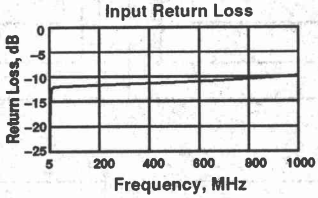
*Limiter incorporates DC coupled diodes shunted to ground at input pin.

TYPICAL PERFORMANCE AT 25°C TEMPERATURE (at +15 VDC unless otherwise noted)

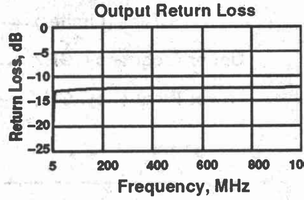
Insertion Loss



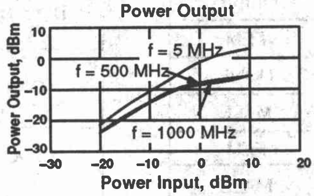
Input Return Loss



Output Return Loss



Power Output



WEIGHT: (typical) 1.5 grams

AVANTEK

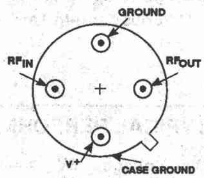
UTL-1001/1002
Voltage Controlled Signal Limiter
5 to 1000 MHz

FEATURES

- AM to PM Conversion Less Than 0.2 degrees/dB
- 0 to –13 dBm Programmable Output
- VSWR less than 2.0:1

APPLICATIONS

- Protection for Detectors, Mixers, and Amplifiers
- Cascadable Gain Control
- EW Receiver Circuits
- Wideband System Protection



TO-8U, p. 16–48

DESCRIPTION

The UTL Series consists of two voltage controlled signal limiters which cover the 5 to 1000 MHz frequency range. These thin-film limiters feature voltage programmable output levels with input levels as high as +26 dBm. They have low VSWR, low insertion loss, excellent second- and third-harmonic suppression, and very low AM-to-PM conversion. Recovery from fully saturated input levels is less than 50 nanoseconds. The UTL models are provided in the TO-8 package.

ELECTRICAL SPECIFICATIONS (Measured in a 50-ohm system @ +15 VDC nominal unless otherwise noted)

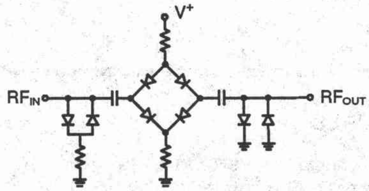
Symbol	Characteristic	Typical $T_C = 25°C$	Guaranteed Specifications		Unit
			T_C = 0° to 50°C	T_C = –55° to +85°C	
BW	Frequency Range				
	UTL-1001	50-1000	50-1000	50-1000	MHz
	UTL-1002	5-1000	5-1000	5-1000	MHz
—	Output Level at Limiting Threshold (1 dB Compression)				
	+20 volts bias	0	+2	—	dBm
	+15 volts bias	–2	0	—	dBm
	+10 volts bias	–6	–4	—	dBm
	+5 volts bias	–13	—	—	dBm
—	Maximum Output Limiting Level (+20 dBm Input)				
	+20 volts bias	0	+2	—	dBm
	+15 volts bias	–1	+1	—	dBm
	+10 volts bias	–4	–2	—	dBm
	+5 volts bias	–9	—	—	dBm
—	Maximum Insertion Loss at 500 MHz @ –20 dBm input				
	+20 volts bias	1.6	2.0	—	dB
	+15 volts bias	1.9	2.4	—	dB
	+10 volts bias	2.5	3.0	—	dB
	+5 volts bias	4.3	—	—	dB
—	Maximum Insertion Loss at 1000 MHz				
	+20 volts bias	2.0	2.5	—	dB
	+15 volts bias	2.5	3.0	—	dB
	+10 volts bias	3.1	3.7	—	dB
	+5 volts bias	5.2	—	—	dB
—	Input VSWR				
	P_{IN} < +20 dBm	—	—	2.0:1	
—	Output VSWR				
	P_{IN} < –10 dBm	—	—	2.0:1	
—	Output Level Variation vs. Temperature	—	—	±1.0	dB
—	Bias Current				
	At +20 VDC	10	—	—	mA
	At +25 VDC	7	—	—	mA

WEIGHT: (typical) 2.1 grams

MAXIMUM RATINGS

DC Voltage	+25.0 Volts
Continuous RF Input Power	+26.0 dBm
Peak Input Power (3 μsec Max.)	+30 dBm
Operating Case Temperature	–54°C to +125°C
Storage Temperature	–62°C to +150°C
"R" Series Burn-In Temperature	+125°C

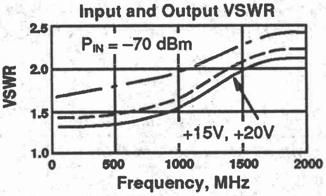
SCHEMATIC



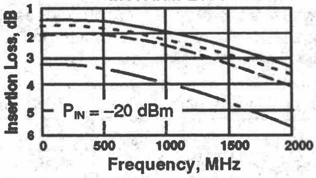
TYPICAL PERFORMANCE AT 25°C TEMPERATURE (at +15 VDC unless otherwise noted)

Bias Voltage: 5V —— - ——
10V — — — — —
15V - - - - - - - -
20V ————————

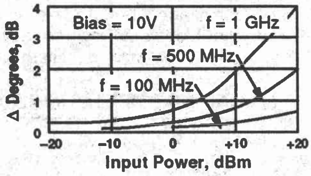
Input and Output VSWR



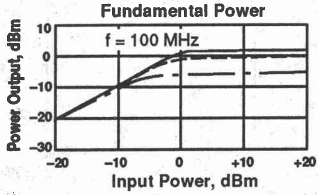
Insertion Loss



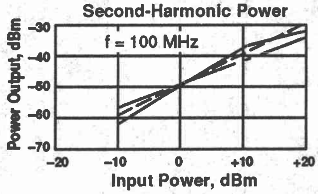
AM-to-PM Conversion



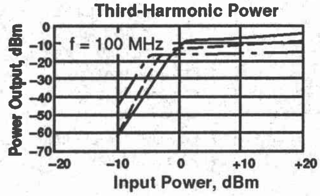
Fundamental Power



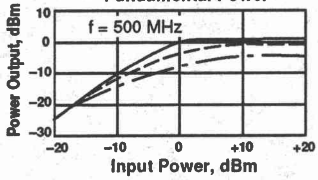
Second-Harmonic Power



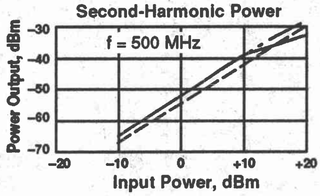
Third-Harmonic Power



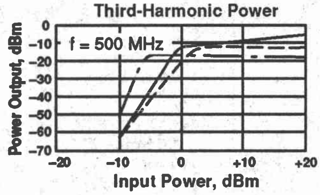
Fundamental Power



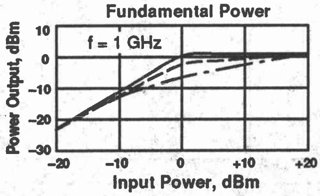
Second-Harmonic Power



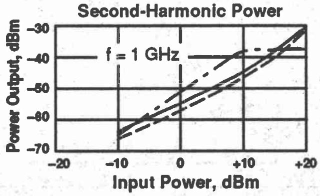
Third-Harmonic Power



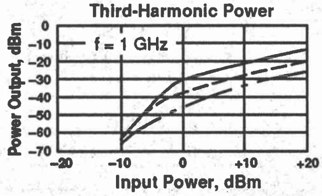
Fundamental Power

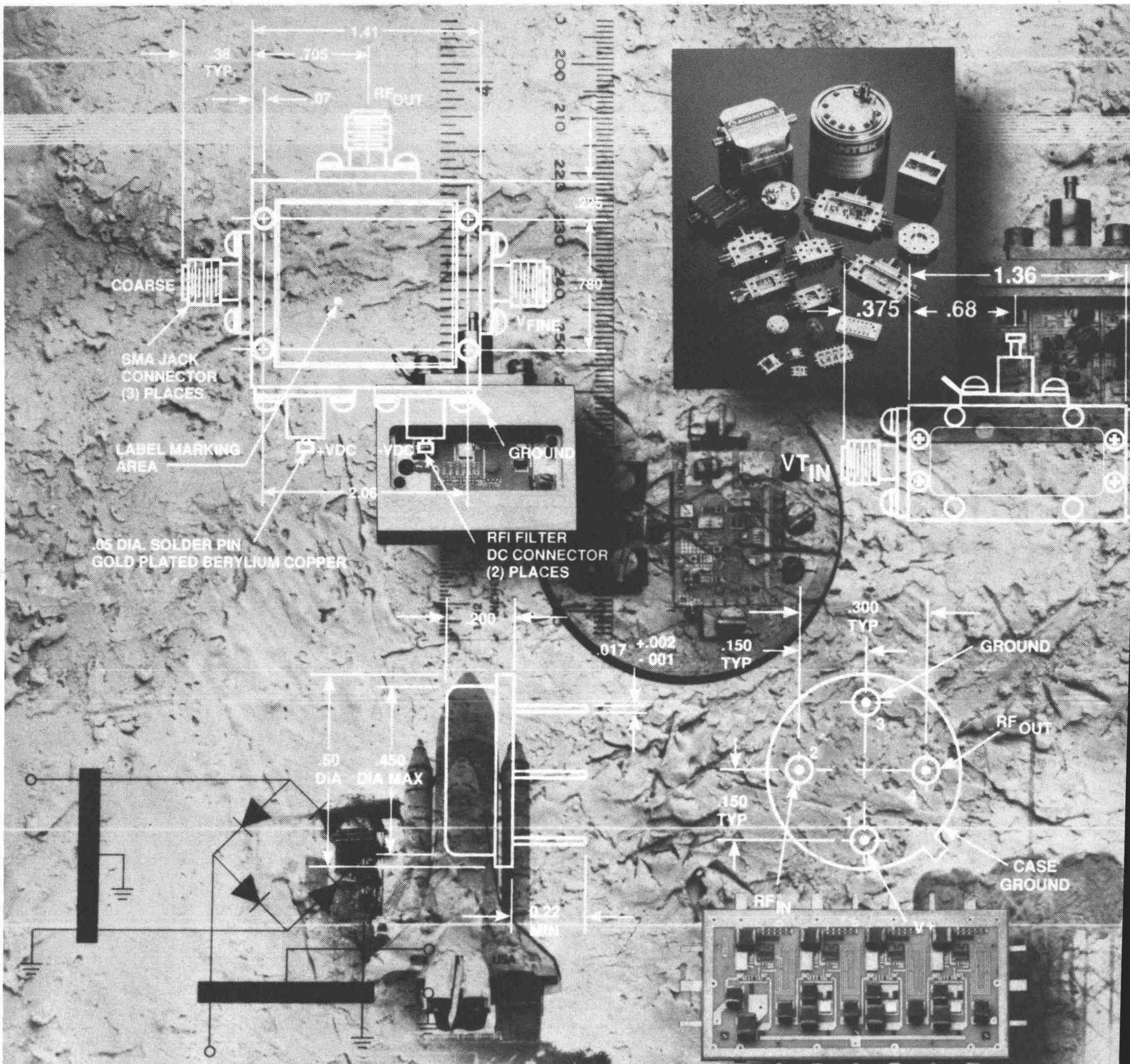


Second-Harmonic Power

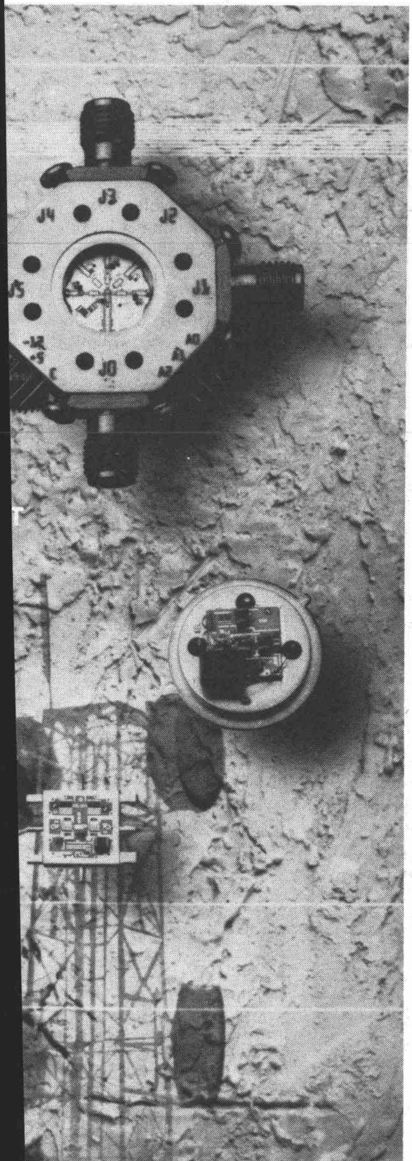


Third-Harmonic Power




1.41
.38
TYP.
.705
.07
RF_{OUT}
.225
.780
COARSE
V_{FINE}
SMA JACK
CONNECTOR
(3) PLACES
LABEL MARKING
AREA
+VDC
-VDC
GROUND
2.06
.05 DIA. SOLDER PIN
GOLD PLATED BERYLLIUM COPPER
RFI FILTER
DC CONNECTOR
(2) PLACES
VT_{IN}
1.36
.375
.68
.200
.017 +.002
-.001
.150
TYP
.300
TYP
GROUND
RF_{OUT}
.50
DIA
.450
DIA MAX
.150
TYP
CASE
GROUND
RF_{IN}
V+
0.22
MIN

VOLTAGE CONTROLLED OSCILLATORS



GENERAL DESCRIPTION

In a varactor-tuned oscillator, a varactor diode serves as a voltage-variable capacitor in a tuned circuit to control the frequency of a negative resistance oscillator. The active device can be a Gunn or Impatt diode or a transistor with appropriate biasing and feedback circuitry. More specifically, the Avantek series oscillators use the varactor as part of a thin-film microstrip resonator and a transistor chip as the negative resistance device.

The major feature of a varactor-tuned oscillator is its extremely fast tuning speed. With a low impedance driver, the Avantek VTO-8580 can sweep through 800 MHz in less than 30 nanoseconds and other VTO and VTD Series oscillators have comparable speeds. The limiting factor is the ability of the external voltage driver circuit to change the voltage across the varactor diode, which is primarily controlled by the driver impedance and the bypass capacitor in the tuning circuit.

Tuning curves for varactor-tuned oscillators are relatively nonlinear due both to the capacitance-voltage characteristic of the varactor itself and the varying RF impedance of the negative-resistance circuit. The curve, however, is quite smooth and monotonic.

THE HYPERABRUPT VARACTOR

A hyperabrupt varactor diode differs from the conventional (or abrupt) varactor used in microwave oscillators in that the concentration of the N-type material in the depletion region is made non-uniform through advanced computer-controlled profiling techniques. As a result, the hyperabrupt varactor produces a greater capacitance change in tuning voltage and a far more linear voltage-vs-frequency tuning curve.

In the Avantek HTO and VTO-9000 Series oscillator, the hyperabrupt varactor means improved tuning linearity (note the modulation sensitivity curves) and low tuning voltage.

CONSTRUCTION

Avantek fundamental varactor-tuned oscillators are constructed using ceramic substrates and thin-film construction techniques. Discrete transistors and capacitors are bonded directly to the ceramic substrate. All resistors are thin-film tantalum-nitride and are heat treated for stability. Exact resistor values are achieved using laser trimmers.

Hermeticity and reliability are assured by filling each completed oscillator package with an inert atmosphere, welding the lids in place and leak testing. Avantek MTO and HTO Series oscillators can be qualified to high reliability and MIL specifications appropriate to hybrid thin-film components.

APPLICATIONS

VTOs are frequently used as signal sources in frequency-agile transmitters and receivers for EW and ECM applications. A varactor-tuned source allows an EW transmitter to generate jamming signals at selected frequencies extremely rapidly, often enabling a number of threat receivers to be jammed "simultaneously." In ECM receivers using computer control and digital tuning, the frequencies of unfriendly transmission can be quickly pinpointed.

For commercial applications such as receiver oscillators and frequency synthesizers, the varactor-tuned oscillator is commonly used in a phase-locked loop. A VTO in a phase-locked loop has a frequency stability comparable to that of the reference oscillator (generally crystal controlled). Phase locked loops can be designed simply to stabilize a single output frequency or, with programmable frequency dividers, to allow the oscillator frequency to be varied in discrete steps as small as required.

PHASE LOCKING THE VTO

Where an oscillator of high stability is required, such as in communications equipment, Avantek VTOs can be readily phase-locked. A simplified block diagram of a practical circuit for use with the VTO-8060 (below 1000 MHz) is shown in Figure 1. At its RF output, this circuit duplicates the stability of the crystal input (frequently being multiplied by 16 times.)

Typical units built using this configuration display noise performance of better than –110 dBc/Hz at 20 kHz (sideband power to carrier power).

To fill requirements for highly stable oscillators above 1000 MHz, a possible circuit is offered in Figure 2.

Since phase locking is a rather complex subject requiring considerable tailoring to individual system requirements, several excellent sources of reference material have been prepared by manufacturers of op-amps and dividers. One of these books entitled, *Phase-Locked Loop Data Book*, is available from Motorola Semiconductor, Phoenix, Arizona. Another excellent reference on the subject is *Phase-Lock Techniques* by Floyd M. Gardner (John Wiley & Sons, publisher).

TYPICAL PLL CIRCUITS

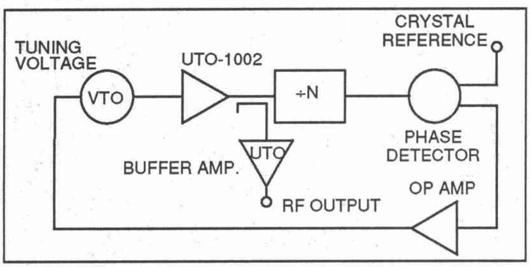


Figure 1. Programmable Divider

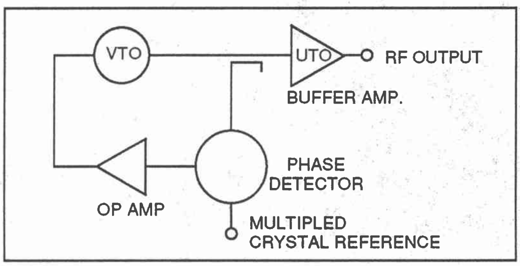


Figure 2. Multiplier

VOLTAGE CONTROLLED OSCILLATORS SELECTION GUIDE

VTO-8000 SERIES

Guaranteed Specifications at 25°C Case Temperature (0 to 65°C Operating Temperature)

Model	Frequency Range (GHz)	Power Output Into 50 ohms Minimum (dBm)	Power Output Variation Maximum (dB)	Tuning Voltage Limits (at each end of specified freq. range) +VDC @ Low Freq.	+VDC @ High Freq.	Input Power (1% Reg.) Voltage (VDC)	Current (mA) Maximum	All Harmonics Typical (dBc)	Page Number
VTO-8030	0.3–0.45	+10	±1.5	5±4	50±10	+15	50	–15	10–6
VTO-8040	0.4–0.6	+13	±1.5	3±1	40±8	+15	50	–15	10–6
VTO-8060	0.6–1.0	+13	±1.5	3±1	40±8	+15	50	–15	10–6
VTO-8080	0.8–1.4	+13	±1.5	2±1.5	35±10	+15	50	–15	10–6
VTO-8090	0.9–1.6	+13	±1.5	2±1	48+8/–10	+15	50	–15	10–6
VTO-8100	1.0–1.4	+10	±1.5	3±1	20±4	+15	50	–15	10–6
VTO-8150	1.5–2.5	+10	±1.5	2.5±1	47±8	+15	50	–15	10–6
VTO-8200	2.0–3.0	+10	±1.5	2+2/–1	20±4	+15	50	–18	10–6
VTO-8240	2.4–3.7	+10	±1.5	2+2/–1	30±8	+15	50	–18	10–6
VTO-8300	3.0–3.5	+10	±1.5	3.5 min.	11 max.	+15	50	–18	10–6
VTO-8350	3.5–4.5	+10	±1.5	5 min.	35 max.	+15	50	–20	10–7
VTO-8360	3.6–4.3	+10	±1.5	8±2	24±4	+15	50	–25	10–7
VTO-8400	4.0–4.5	+10	±1.5	2 min.	14 max.	+15	50	–25	10–7
VTO-8420	4.2–5.0	+10	±1.5	7.5±2.5	25+2.5/–4	+15	50	–25	10–7
VTO-8430	4.3–5.8	+10	±1.5	1.0 min.	20 max.	+15	50	–25	10–7
VTO-8490	4.9–5.9	+10	±1.5	5.5±2	24+3/–4	+15	50	–25	10–7
VTO-8520	5.2–6.1	+10	±1.5	5.5±2	24±3	+15	50	–25	10–7
VTO-8540	5.4–5.9	+10	±1.5	8 min.	28 max.	+15	50	–15	10–7
VTO-8580	5.8–6.6	+7	±1.5	5±2.5	24+3/–5	+15	50	–25	10–7
VTO-8650	6.5–8.6	+10	±1.5	2±1	20±5	+15	100	–20	10–7
VTO-8790	7.9–10.1	+10	±1.5	3±2	26±4	+15	100	–10	10–8
VTO-8810	8.1–9.1	+10	±1.5	2 min.	16 max.	+15	100	–15	10–8
VTO-8850	8.5–9.6	+10	±1.5	5±2	13±5	+15	100	–25	10–8
VTO-8950	9.5–10.5	+10	±1.5	4±1	10 max.	+15	100	–20	10–8
VTO-81000	10.0–10.25	+10	±1.5	0 min.	15 max.	+15	100	–15	10–8

VTO-9000 SERIES

Guaranteed Specifications at 25°C Case Temperature (0 to 65°C Operating Temperature)

7.78–
1294

Model	Frequency Range (GHz)	Power Output Into 50 ohms Minimum (dBm)	Power Output Variation Maximum (dB)	Tuning Voltage Limits (at each end of specified freq. range) +VDC @ Low Freq.	+VDC @ High Freq.	Input Power (1% Reg.) Voltage (VDC)	Current (mA) Maximum	All Harmonics Typical (dBc)	Page Number
VTO-9032	0.32–0.64	+10	±2	0 min.	20 max.	+15	50	–14	10–12
VTO-9050	0.5–1.0	+10	±2	0 min.	20 max.	+15	50	–10	10–12
VTO-9068	0.68–1.36	+10	±2	0 min.	20 max.	+15	50	–14	10–12
VTO-9090	0.9–1.6	+10	±2	+2 min.	18 max.	+15	50	–14	10–12
VTO-9120	1.2–2.0	+10	±2	3±1	12±2	+15	50	–14	10–13
VTO-9130	1.3–2.3	+10	±1.5	+2 min.	20 max.	+15	50	–15	10–13
VTO-9140	1.4–2.1	+10	±1.5	4±2	10±2	+15	50	–15	10–13

MTO-8000 SERIES

Guaranteed Specifications at –54°C to 85°C Case Temperature

Model	Frequency Range (GHz)	Power Output Into 50 ohms Minimum (dBm)	Power Output Variation Maximum (dB)	Tuning Voltage Limits (at each end of specified freq. range) +VDC @ Low Freq.	+VDC @ High Freq.	Input Power (1% Reg.) Voltage (VDC)	Current (mA) Maximum	All Harmonics Typical (dBc)	Page Number
MTO-8040	0.4–0.6	+10	±2.5	3.5±1.5	38±8	+15	50	–10	10–18
MTO-8060	0.6–0.9	+10	±2.5	3±1	26+10/–8	+15	50	–12	10–18
MTO-8090	0.9–1.5	+10	±2.5	2±1	30+10/–8	+15	50	–11	10–18
MTO-8240	2.4–3.7	+10	±2.0	2+2/–1	30±8	+15	50	–10	10–18
MTO-8360	3.6–4.3	+10	±2.0	8±2	24±4	+15	50	–22	10–18
MTO-8650	6.5–8.6	+10	±2.0	2±1	20±4	+15	100	–18	10–18
MTO-8950	9.5–10.5	+10	±2.5	4±1.5	10 max.	+15	100	–20	10–18

VOLTAGE CONTROLLED OSCILLATORS SELECTION GUIDE

HTO SERIES

Guaranteed Specifications at –54°C to +85°C Case Temperature

Model	Frequency Range (GHz)	Power Output Into 50 ohms Minimum (dBm)	Power Output Variation Maximum (dB)	Tuning Voltage Limits (at each end of specified freq. range) +VDC @ Low Freq.	+VDC @ High Freq.	Input Power (1% Reg.) Voltage (VDC)	Current (mA) Maximum	All Harmonics Typical (dBc)	Page Number
HTO-0900	0.9–1.6	+10	±2.5	3+2; –1	16±2	+15	50	–8	10–21
HTO-1000	1.0–2.0	+10	±2.5	2±1	15+5/–2	+15	50	–7	10–21
HTO-2000	2.0–4.0	+10	±2.5	1+2; –0.7	14±4	+15	100	–12	10–21
HTO-2600	2.6–5.2	+10	±2.5	1+2; –0.7	14±4	+15	100	–12	10–21
HTO-4000	4.0–8.0	+10	±2.5	1+2; –0.5	14±4	+15	100	–12	10–22
HTO-7500	7.5–11.0	+10	±2.5	1+2; –0.5	14±4	+15	100	–15	10–22
HTO-8000	8.0–12.4	+10	±2.5	2.5±1.5	17±3	+10 to +15	150	–20	10–22
HTO-12000	12.4–18.0	+10	±2.5	2.5±1.5	17±3	+10 to +15	150	–20	10–22

VTD SERIES

Guaranteed Specifications at 80°C ±5°C Case Temperature

Model	Frequency Range (GHz)	Power Output (dBm) Minimum	Power Output Variation (dB) Maximum	Tuning Voltage Limits +VDC @ Low Freq.	+VDC @ High Freq.	Pushing Figure (MHz/V) Typical	Pulling Figure (3:1 VSWR all phases) (MHz) Typical	All Harmonics (dBc) Minimum	Input Power (+1% regulation) Voltage (VDC)	Current (mA) (Max)	Page Number
VTD-600	0.6–1.0	+13	±1.5	3.0±1.0	40±8	6	2	–20	+12	125	10–25
VTD-2000	2.0–2.8	+13	±2.0	4.5±1.5	25±3	6	2	–20	+12	125	10–25
VTD-2800	2.8–3.8	+13	±2.0	4.5±1.5	25±3	6	2	–20	+12	125	10–25
VTD-3800	3.8–4.9	+13	±2.0	4.5±1.5	25±3	10	3	–20	+12	125	10–25
VTD-4900	4.9–6.1	+13	±2.0	4.5±1.5	25±3	10	5	–20	+12	125	10–25

LNO-550, LOW NOISE VCO

Guaranteed Specifications at –54°C to +85°C Case Temperature

Model	Frequency Range (GHz) Minimum	Power Output (dBm) Minimum	Power Output Variation (dB) Maximum	Drift (MHz) Maximum	Second-Harmonic (dBc) Minimum	Tuning Voltage (VDC)	Phase Noise 50 kHz from Carrier (dBc/Hz), Max.	Input Current @ +12 VDC (mA), Max.	Page Number
LNO-550	.55–.775	+10	±2.5	20	–10	+2.5±1 to +17±3	–110	50	10–28

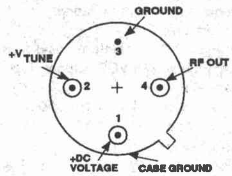
LNO-7800, LOW NOISE VCO

Guaranteed Specifications at –54°C to +85°C Case Temperature

Model	Frequency Range (GHz)	Power Output (dBm) Minimum	Power Output Variation (dB) Maximum	Drift (MHz) Maximum	Second-Harmonic (dBc) Minimum	Tuning Voltage (VDC)	Phase Noise 100 kHz from Carrier (dBc/Hz), Max.	Input Current @ +15/–15 VDC (mA), Max.	Page Number
LNO-7800	7.8–8.5	+10	±2.5	150	–15	–2 to –20	–98	100/50	10–30

FEATURES

- 300 MHz to 10.5 GHz Coverage
- Fast Tuning
- Fast Settling Time
- +7 to +13 dBm Output Power
- ±1.5 dB Output Flatness
- Hermetic Thin-Film Construction



TO-8V, p. 16–49

DESCRIPTION

Avantek® VTO-8000 Series oscillators use a silicon transistor chip as a negative resistance oscillator. The oscillation frequency is determined by a silicon abrupt varactor diode acting as a voltage-variable capacitor in a thin-film microstripline resonator. This provides extremely fast tuning speed, limited primarily by the internal impedance of the user-supplied voltage driver. With a low-impedance driver, the Avantek VTO-8580 can be swept through 800 MHz in less than 30 ns (see curve) and the other VTO-8000 Series oscillators have comparable tuning speeds. Fast settling is another feature of Avantek's VTO-8000 Series oscillators. Typical settling times for the VTO-8090 are <200 kHz within one microsecond while the VTO-8490 and VTO-8950 settle to <2 MHz within two microseconds referenced to ten milliseconds. The VTO-8850, which provides typical 7.5 to 10.5 GHz tuning range, combines a bipolar transistor oscillator with a GaAs FET buffer stage. This GaAs FET buffer isolates the oscillator from variations in load impedance for low frequency pulling, allows the oscillator to run lightly-loaded for low phase noise content and provides +10 dBm of minimum output power over the full tuning range. The VTO-8000 Series varactor-tuned oscillators are packaged in TO-8 transistor cans for simple installation in a conventional 50-ohm microstripline PC board. They are ideal for the most compact, lightweight commercial and military equipment designs. Test fixturing is also available for lab bench test applications. See page 15–10 for test fixture outlines.

APPLICATIONS

Frequency agile systems, such as digitally controlled receivers and active jamming transmitters often use externally linearized varactor-tuned oscillators. Avantek oscillators are relatively monotonic making external linearization easy using analog (opamp) or digital (EPROM) linearizing techniques. The Avantek VTO Series has been designed with a tuning input bypass capacitance which is sufficient to provide the necessary RF filtering action yet as low as possible to maximize dV/dT characteristics for excellent tuning speeds. Used in a phase locked loop circuit, a VTO provides a receiver LO with stability equivalent to the reference oscillator (usually crystal controlled), yet variable in discrete steps or continuously depending on the PLL configuration.

Another important aspect of VTOs used in LO application is their power vs. frequency flatness (±1.5 dB). This assures that once a receiver mixer is biased for best dynamic range the local oscillator drive will remain constant throughout the tuning range without complex leveling circuitry.

ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications @ 25°C Case Temperature (0° to +65°C Operating Temperature)

Model No.	VTO-8030	VTO-8040	VTO-8060	VTO-8080	VTO-8090
Frequency Range, Min.	300–450 MHz	400–600 MHz	600-1000 MHz	800–1400 MHz	900–1600 MHz
Power Output into 50-ohm Load, Min.	10 mW/+10 dBm	20 mW/+13 dBm	20 mW/+13 dBm	20 mW/+13 dBm	20 mW/+13 dBm
Power Output Variation @ 25°C, Max.	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB
Operating Case Temperature Range	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C
Frequency Drift Over Operating Temperature, Typ.	8 MHz	8 MHz	8 MHz	10 MHz	10 MHz
Pulling Figure (12 dB Return Loss), Typ.	20 MHz	20 MHz	25 MHz	25 MHz	25 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.6 MHz/V	0.6 MHz/V	5 MHz/V	6 MHz/V	6 MHz/V
Harmonics, Below Carrier, Typ.	–15 dB	–15 dB	–15 dB	–15 dB	–15 dB
Spurious Output Below Carrier, Min.	–60 dB	–60 dB	–60 dB	–60 dB	–60 dB
Tuning Voltage, Typ.					
Low Frequency	5±4 VDC	3±1 VDC	3±1 VDC	2±1.5 VDC	2±1 VDC
High Frequency	50±10 VDC	40±8 VDC	40±8 VDC	35±10 VDC	48+8/–10 VDC
Maximum Tuning Voltage	+60 VDC	+60 VDC	+60 VDC	+60 VDC	+60 VDC
Tuning Port Capacitance, Nom.	180 pF	180 pF	180 pF	180 pF	180 pF
Phase Noise, Single Sideband, 1 Hz Bandwidth, Typ.					
50 kHz From Carrier	–114 dBc	–114 dBc	–110 dBc	–100 dBc	–100 dBc
100 kHz From Carrier	–120 dBc	–120 dBc	–117 dBc	–107 dBc	–107 dBc
Input Power ±1% Regulation					
Voltage, Nom.	+15 VDC	+15 VDC	+15 VDC	+15 VDC	+15 VDC
Current, Max.	50 mA	50 mA	50 mA	50 mA	50 mA
Case Style	TO–8V	TO–8V	TO–8V	TO–8V	TO–8V

Model No.	VTO-8100	VTO-8150	VTO-8200	VTO-8240	VTO–8300
Frequency Range, Min.	1000–1400 MHz	1500–2500 MHz	2000–3000 MHz	2400–3700 MHz	3000–3500 MHz
Power Output into 50-ohm Load, Min.	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm
Power Output Variation @ 25°C., Max.	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB
Operating Case Temperature Range	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C
Frequency Drift Over Operating Temperature, Typ.	10 MHz	18 MHz	30 MHz	30 MHz	30 MHz
Pulling Figure (12 dB Return Loss), Typ.	25 MHz	35 MHz	35 MHz	35 MHz	35 MHz
Pushing Figure, +15 VDC Supply, Typ.	6 MHz/V	6 MHz/V	6 MHz/V	6 MHz/V	6 MHz/V
Harmonics, Below Carrier, Typ.	–15 dB	–15 dB	–18 dB	–18 dB	–18 dB
Spurious Output Below Carrier, Min.	–60 dB	–60 dB	–60 dB	–60 dB	–60 dB
Tuning Voltage, Typ.					
Low Frequency	3±1 VDC	2.5±1 VDC	2+2/–1 VDC	2+2/–1 VDC	3.5 VDC Min.
High Frequency	20±4 VDC	47±8 VDC	20±4 VDC	30±8 VDC	11 VDC Max.
Maximum Tuning Voltage	+60 VDC	+60 VDC	+45 VDC	+45 VDC	+30 VDC
Tuning Port Capacitance, Nom.	180 pF	90 pF	45 pF	45 pF	45 pF
Phase Noise, Single Sideband, 1 Hz Bandwidth, Typ.					
50 kHz From Carrier	–100 dBc	–95 dBc	–95 dBc	–95 dBc	–95 dBc
100 kHz From Carrier	–107 dBc	–102 dBc	–102 dBc	–102 dBc	–102 dBc
Input Power +1% Regulation					
Voltage, Nom.	+15 VDC	+15 VDC	+15 VDC	+15 VDC	+15 VDC
Current, Max.	50 mA	50 mA	50 mA	50 mA	50 mA
Case Style	T0-8V	TO-8V	TO–8V	TO–8V	TO–8V

ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications @ 25°C Case Temperature (0° to +65°C Operating Temperature)

Model No.	VTO–8350	VTO-8360	VTO-8400	VTO-8420	VTO-8430
Frequency Range, Min.	3500–4500 MHz	3600–4300 MHz	4000–4500 MHz	4200–5000 MHz	4300–5800 MHz
Power Output into 50-ohm Load, Min.	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm
Power Output Variation @ 25°C., Max.	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB
Operating Case Temperature Range	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C
Frequency Drift Over Operating Temperature, Typ.	36 MHz	35 MHz	45 MHz	45 MHz	60 MHz
Pulling Figure (12 dB Return Loss), Typ.	40 MHz	40 MHz	45 MHz	45 MHz	50 MHz
Pushing Figure, +15 VDC Supply, Typ.	6 MHz/V	6 MHz/V	6 MHz/V	6 MHz/V	6 MHz/V
Harmonics, Below Carrier, Typ.	–20 dB	–25 dB	–25 dB	–25 dB	–25 dB
Spurious Output Below Carrier, Min.	–60 dB	–60 dB	–60 dB	–60 dB	–60 dB
Tuning Voltage, Typ.					
Low Frequency	5.0 VDC Min.	8±2 VDC	2 VDC Min.	7.5±2.5 VDC	1.0 VDC Min.
High Frequency	35 VDC Max.	24±4 VDC	14 VDC Max.	25+2.5/–4 VDC	20.0 VDC Max.
Maximum Tuning Voltage	+35 VDC	+30 VDC	+30 VDC	+30 VDC	+30 VDC
Tuning Port Capacitance, Nom.	45 pF	45 pF	45 pF	45 pF	45 pF
Phase Noise, Single Sideband, 1 Hz Bandwidth, Typ.					
50 kHz From Carrier	–100 dBc	–100 dBc	–90 dBc	–90 dBc	–90 dBc
100 kHz From Carrier	–108 dBc	–108 dBc	–97 dBc	–97 dBc	–97 dBc
Input Power +1% Regulation					
Voltage, Nom.	+15 VDC	+15 VDC	+15 VDC	+15 VDC	+15 VDC
Current, Max.	50 mA	50 mA	50 mA	50 mA	50 mA
Case Style	TO–8V	TO–8V	TO–8V	TO–8V	TO–8V

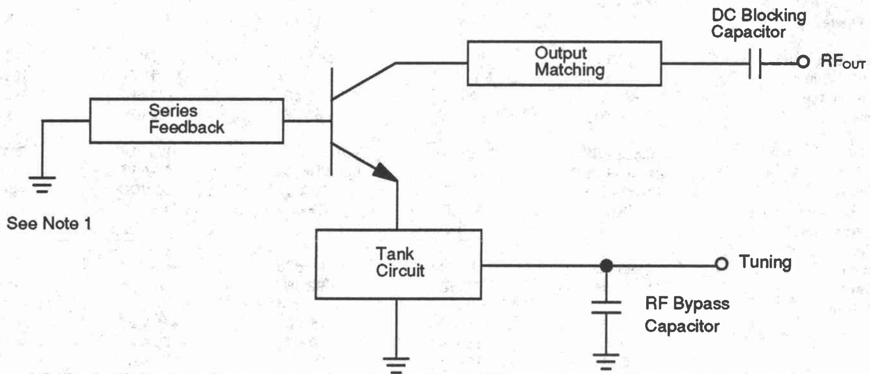
Model No.	VTO-8490	VTO–8520	VTO–8540	VTO-8580	VTO-8650
Frequency Range, Min.	4900–5900 MHz	5200–6100 MHz	5400–5900 MHz	5800–6600 MHz	6500–8600 MHz
Power Output into 50-ohm Load, Min.	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm	5 mW/+7 dBm	10 mW/+10 dBm
Power Output Variation @ 25°C., Max.	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB
Operating Case Temperature Range	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C
Frequency Drift Over Operating Temperature, Typ.	60 MHz	70 MHz	60 MHz	70 MHz	100 MHz
Pulling Figure (12 dB Return Loss), Typ.	50 MHz	70 MHz	50 MHz	70 MHz	15 MHz
Pushing Figure, +15 VDC Supply, Typ.	6 MHz/V	8 MHz/V	8 MHz/V	8 MHz/V	10 MHz/V
Harmonics, Below Carrier, Typ.	–25 dB	–25 dB	–15 dB	–25 dB	–20 dB
Spurious Output Below Carrier, Min.	–60 dB	–60 dB	–60 dB	–60 dB	–60 dB
Tuning Voltage, Typ.					
Low Frequency	5.5±2 VDC	5.5±2 VDC	8 VDC Min.	5±2.5 VDC	2±1 VDC
High Frequency	24 +3/–4 VDC	24±3 VDC	28 VDC Max.	24+3/–5 VDC	20±5 VDC
Maximum Tuning Voltage	+30 VDC	+30 VDC	+30 VDC	+30 VDC	+30 VDC
Tuning Port Capacitance, Nom.	45 pF	45 pF	45 pF	45 pF	26 pF
Phase Noise, Single Sideband, 1 Hz Bandwidth, Typ.					
50 kHz From Carrier	–90 dBc	–85 dBc	–85 dBc	–85 dBc	–80 dBc
100 kHz From Carrier	–97 dBc	–92 dBc	–92 dBc	–92 dBc	–88 dbc
Input Power +1% Regulation					
Voltage, Nom.	+15 VDC	+15 VDC	+15 VDC	+15 VDC	+15 VDC
Current, Max.	50 mA	50 mA	50 mA	50 mA	100 mA
Case Style	TO–8V	TO–8V	TO–8V	TO–8V	TO–8V

ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications @ 25°C Case Temperature (0° to +65°C Operating Temperature)

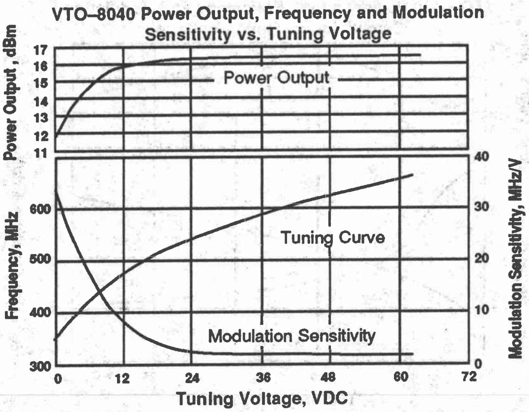
Model No.	VTO–8790	VTO-8810	VTO-8850	VTO–8950	VTO–81000
Frequency Range, Min.	7900–10100 MHz	8100–9100 MHz	8500–9600 MHz	9500–10500 MHz	10000–10250 MHz
Power Output into 50-ohm load, Min.	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm
Power Output Variation @ 25°C., Max.	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB
Operating Case Temperature Range	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C
Frequency Drift Over Operating Temperature, Typ.	130 MHz	110 MHz	110 MHz	160 MHz	160 MHz
Pulling Figure (12 dB Return Loss), Typ.	8 MHz	8 MHz	6 MHz	20 MHz	40 MHz
Pushing Figure, +15 VDC Supply, Typ.	30 MHz/V	12 MHz/V	12 MHz/V	10 MHz/V	30 MHz/V
Harmonics, Below Carrier, Typ.	–10 dB	–15 dB	–25 dB	–20 dB	–15 dB
Spurious Output Below Carrier, Min.	–60 dB	–60 dB	–60 dB	–60 dB	–60 dB
Tuning Voltage, Typ.					
Low Frequency	0 VDC	2 VDC Min.	5±2 VDC	4±1 VDC	0 VDC Min.
High Frequency	3±2 VDC	16 VDC Max.	13±5 VDC	10 VDC Max.	15 VDC Max.
Maximum Tuning Voltage	26±4 VDC	+30 VDC	+30 VDC	+15 VDC	+15 VDC
Tuning Port Capacitance, Nom.	26 pF	26 pF	26 pF	26 pF	26 pF
Phase Noise, Single Sideband, 1 Hz Bandwidth, Typ.					
50 kHz From Carrier	–80 dBc	–80 dBc	–82 dBc	–78 dBc	–78 dBc
100 kHz From Carrier	–88 dBc	–88 dBc	–90 dBc	–85 dBc	–85 dBc
Input Power +1% Regulation					
Voltage, Nom.	+15 VDC	+15 VDC	+15 VDC	+15 VDC	+15 VDC
Current, Max.	100 mA	100 mA	100 mA	100 mA	100 mA
Case Style	TO–8V	TO–8V	TO–8V	TO–8V	TO–8V

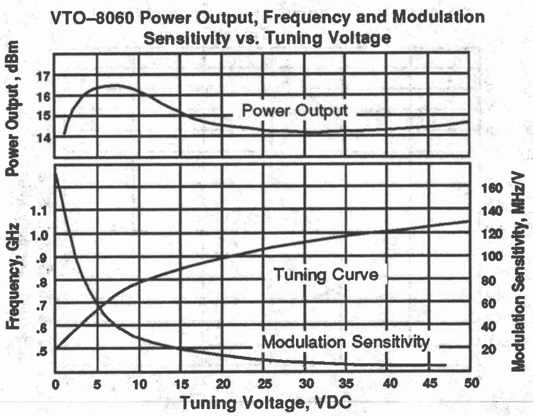
SCHEMATIC

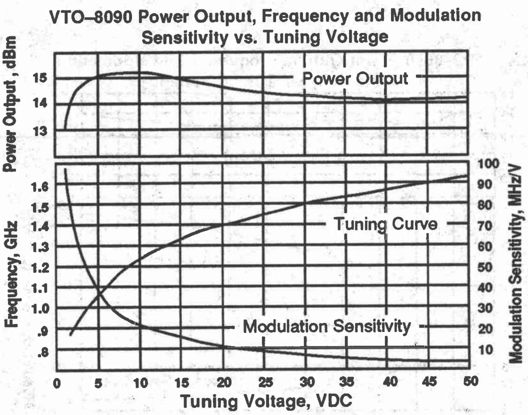


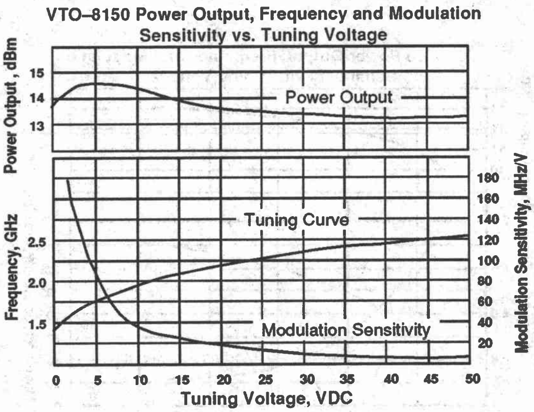
NOTE 1: DC bias lines (not shown) have internal decoupling capacitors.

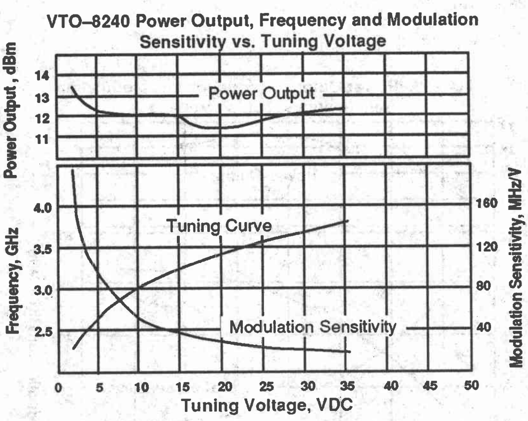
TYPICAL PERFORMANCE @ 25°C Case Temperature

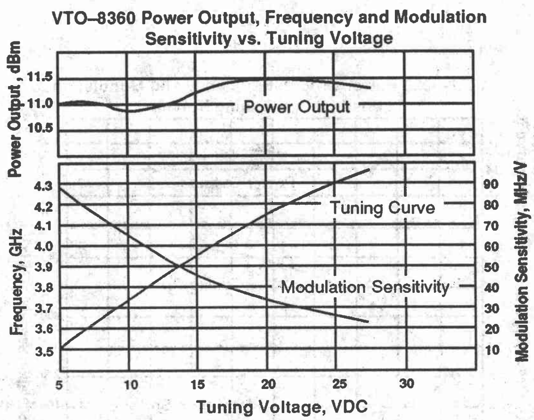






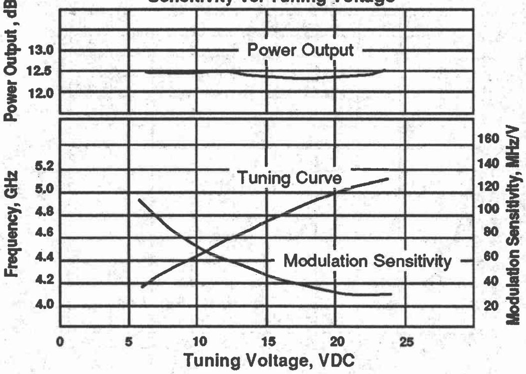




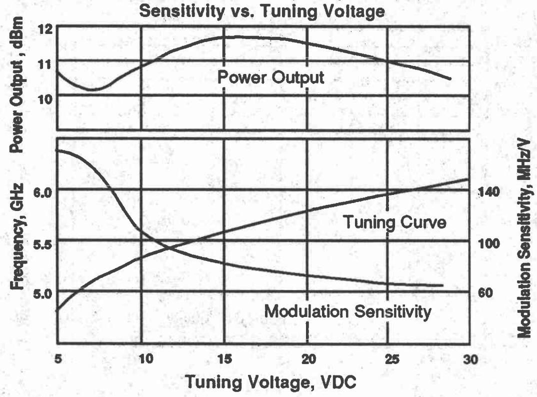


TYPICAL PERFORMANCE (continued)

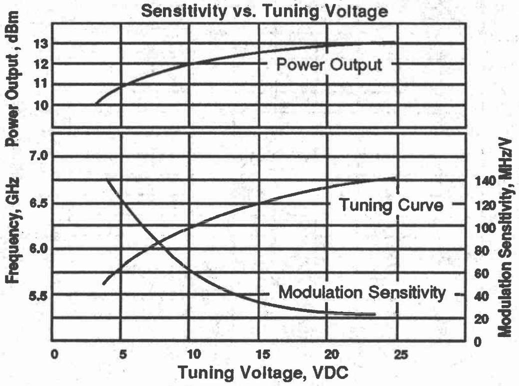
VTO–8420 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



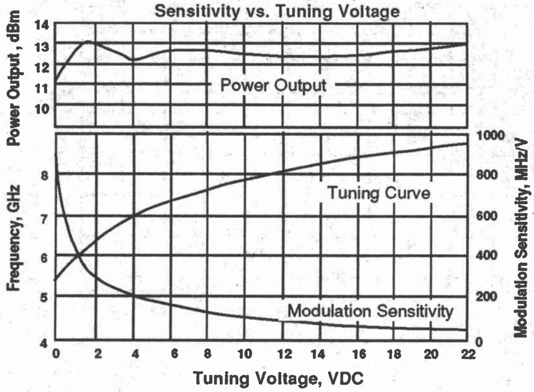
VTO–8490 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



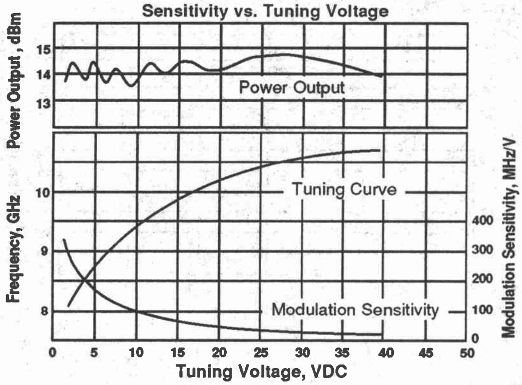
VTO–8580 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



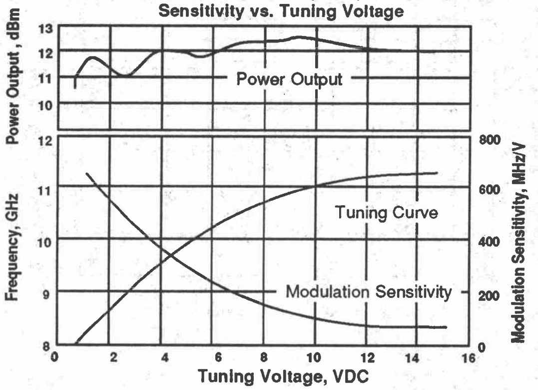
VTO–8650 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



VTO–8850 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage

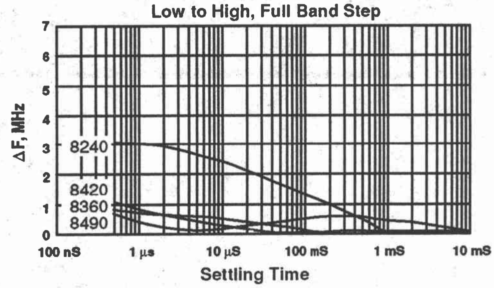


VTO–8950 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage

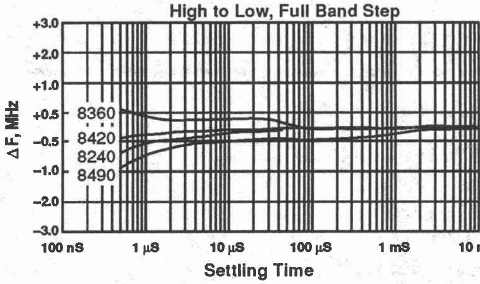


TYPICAL PERFORMANCE (continued)

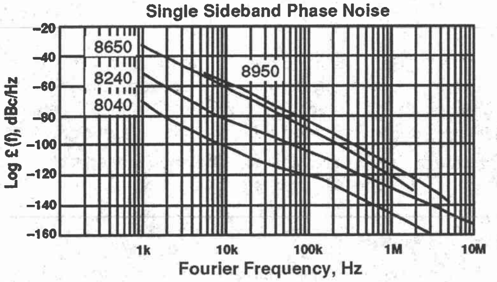
Frequency Changes vs. Settling Time
Low to High, Full Band Step



Frequency Changes vs. Settling Time
High to Low, Full Band Step



Noise Comparison
Single Sideband Phase Noise

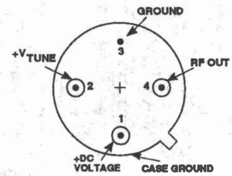


AVANTEK

VTO-9000 Series
Hyperabrupt Varactor-Tuned Oscillators

FEATURES

- 320 MHz to 2.3 GHz Coverage
- Fast Tuning
- Fast Settling Time
- +20 VDC Max Tuning Voltage
- 10 mW Output Power
- ±2.0 dB Output Flatness
- Hermetic Thin-Film Construction



TO-8V, p. 16–49

DESCRIPTION

Avantek® VTO-9000 Hyperabrupt Series oscillators use a silicon transistor chip as a negative resistance oscillator. The oscillation frequency is determined by a silicon hyperabrupt varactor diode acting as a voltage-variable capacitor in a thin-film microstripline resonator. This provides extremely fast tuning speed, limited primarily by the internal impedance of the user-supplied voltage driver.

This family of oscillators is similar to the standard commercial VTO-8000 Series except for the incorporation of a silicon hyperabrupt varactor tuning diode. This enables the oscillator to be tuned over the specified range in less than 20 volts rather than 40 to 50 volts in conventional oscillators.

The VTO-9000 Series VTOs are packaged in TO-8 transistor cans for simple installation in a conventional 50-ohm microstripline PC board. They are ideal for most compact, lightweight commercial and military equipment designs.

Test fixturing is also available for lab bench test applications. See page 15–10 for test fixture outlines.

APPLICATIONS

The VTO-9000 Series oscillators may be used in the same applications as VTO-8000 series oscillators. The VTO-9000 Series is the desired choice for superior linearity and modulation sensitivity requirements.

ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications @ 25°C Case Temperature (0° to +65°C Operating Temperature)

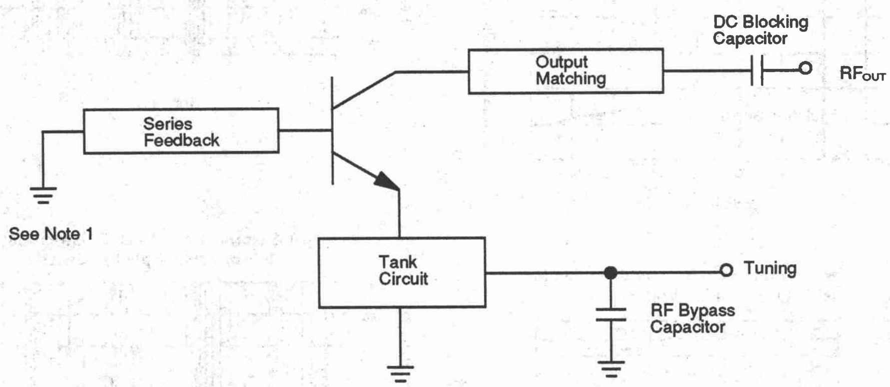
Model No.	VTO-9032	VTO-9050	VTO-9068	VTO-9090
Frequency Range, Min.	320-640 MHz	500-1000 MHz	680-1360 MHz,	900-1600 MHz
Power Output into 50-ohm Load, Min.	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm
Power Output Variation @ 25°C, Max.	±2 dB	±2 dB	±2 dB	±2 dB
Operating Case Temperature Range	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C
Frequency Drift Over Operating Temperature, Typ.	12 MHz	20 MHz	20 MHz	20 MHz
Pulling Figure (12 dB Return Loss), Typ.	20 MHz	20 MHz	25 MHz	25 MHz
Pushing Figure, +15 VDC Supply, Typ.	5 MHz/V	5 MHz/V	6 MHz/V	6 MHz/V
Harmonics, Below Carrier, Typ.	–14 dB	–10 dB	–14 dB	–14 dB
Spurious Output Below Carrier, Min.	–60 dB	–60 dB	–60 dB	–60 dB
Tuning Voltage, Typ.				
Low Frequency, Min.	0 VDC	0 VDC	0 VDC	2 VDC
High Frequency, **Max.**	20 VDC	20 VDC	20 VDC	18 VDC
Maximum Tuning Voltage	+20 VDC	+20 VDC	+20 VDC	+20 VDC
Tuning Port Capacitance, Nom.	200 pF	200 pF	190 pF	190 pF
Phase Noise, Single Sideband, 1Hz Bandwidth, Typ.				
50 kHz From Carrier	–95 dBc	–100 dBc	–95 dBc	–100 dBc
100 kHz From Carrier	–103 dBc	–108 dBc	–103 dBc	–108 dBc
Input Power, ±1% Regulation				
Voltage, Nom.	+15 VDC	+15 VDC	+15 VDC	+15 VDC
Current, Max.	50 mA	50 mA	50 mA	50 mA
Case Style	TO-8V	TO-8V	TO-8V	TO-8V

ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications @ 25°Case Temperature (0° to +65°C Operating Temperature)

Model No.	VTO-9120	VTO-9130	VTO-9140
Frequency Range, Min.	1200-2000 MHz	1300-2300 MHz	1400-2100 MHz
Power Output into 50-ohm load, Min.	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm
Power Output Variation @ 25°C, Max.	±2 dB	±1.5 dB	±1.5 dB
Operating Case Temperature Range	0° to +65°C	0° to +65°C	0° to +65°C
Frequency Drift Over Operating Temperature, Typ.	25 MHz	25 MHz	30 MHz
Pulling Figure (12 dB Return Loss), Typ.	25 MHz	50 MHz	45 MHz
Pushing Figure, +15 VDC Supply, Typ.	10 MHz/V	10 MHz/V	10 MHz/V
Harmonics, Below Carrier, Typ.	–14 dB	–15 dB	–15 dB
Spurious Output Below Carrier, Min.	–60 dB	–60 dB	–60 dB
Tuning Voltage, Typ.			
Low Frequency	3±1 VDC	2 VDC Min.	4±2 VDC
High Frequency	12±2 VDC	20 VDC Max.	10±2 VDC
Maximum Tuning Voltage	+20 VDC	+ 20 VDC	+20 VDC
Tuning Port Capacitance, Nom.	100 pF	100 pF	100 pF
Phase Noise, Single Sideband, 1 Hz, Bandwidth, Typ.			
50 kHz From Carrier	–97 dBc	–97 dBc	–97 dBc
100 kHz From Carrier	–105 dBc	–105 dBc	–105 dBc
Input Power, ±1% Regulation			
Voltage, Nom.	+15 VDC	+15 VDC	+15 VDC
Current, Max.	50 mA	50 mA	50 mA
Case Style	TO-8V	TO-8V	TO-8V

SCHEMATIC



NOTE 1: DC bias lines (not shown) have internal decoupling capacitors.

SELECT
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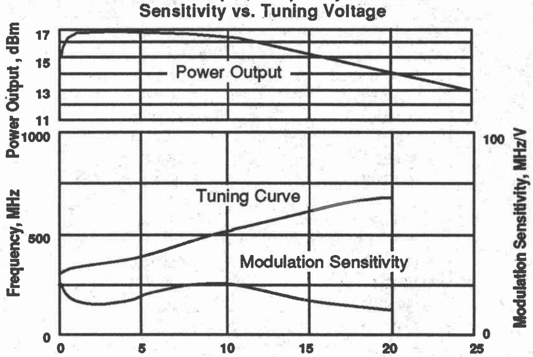
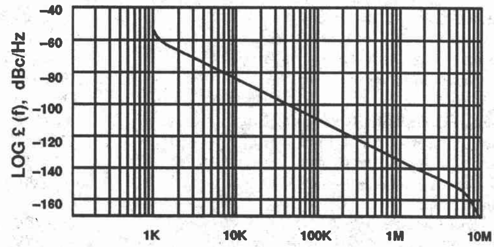
TYPICAL PERFORMANCE @ 25°C Case Temperature

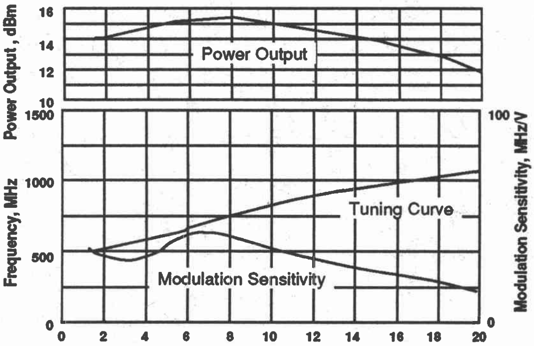
VTO-9032 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



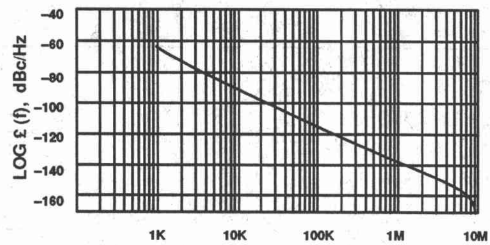
VTO-9032 Normalized Phase Noise @ 640 MHz S.S.B. Power Spectral Density



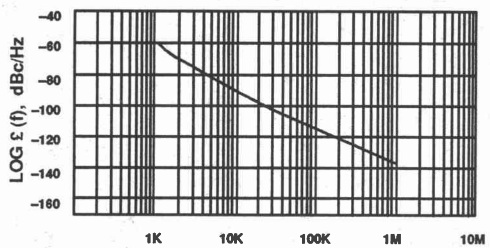
VTO-9050 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



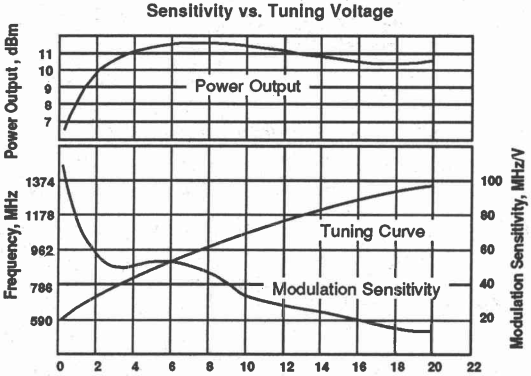
VTO-9050 Normalized Phase Noise @ 1000 MHz S.S.B. Power Spectral Density



VTO-9068 Normalized Phase Noise @ 1360 MHz S.S.B. Power Spectral Density

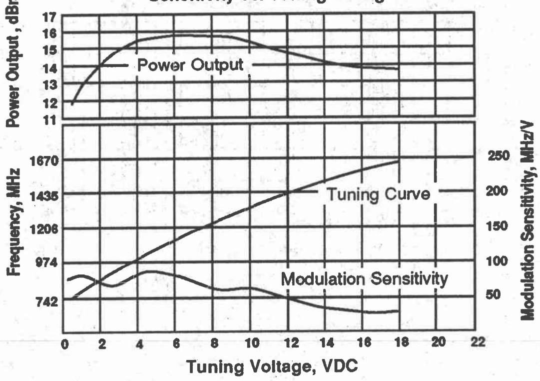


VTO–9068 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage

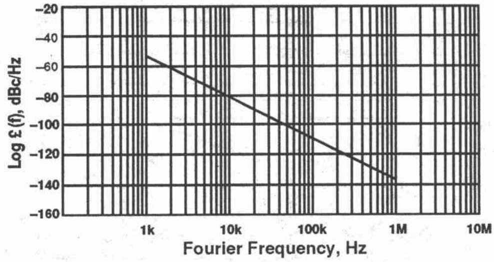


TYPICAL PERFORMANCE @ 25°C Case Temperature (continued)

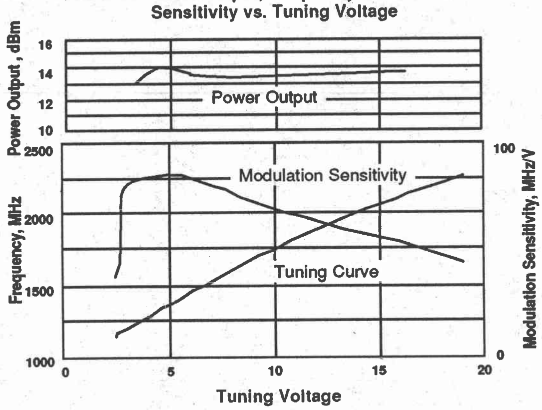
VTO–9090 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



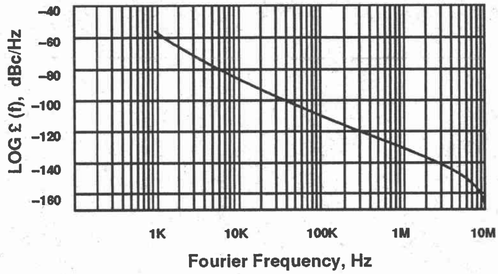
Typical VTO–9090 Noise @ 1000 MHz Single Sideband Phase Noise



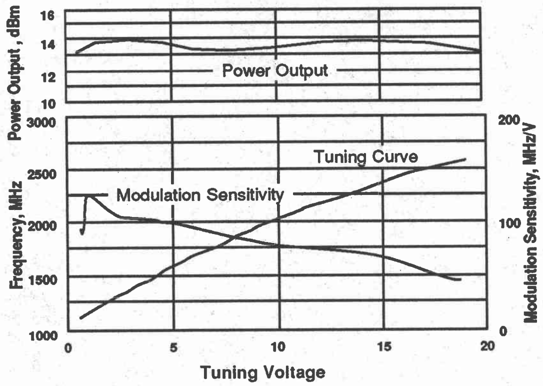
VTO-9120 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



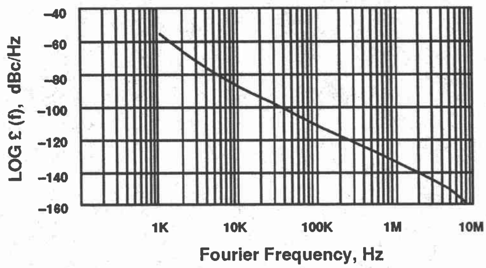
VTO-9120 Normalized Phase Noise @ 2000 MHz S.S.B. Power Spectral Density



VTO-9130 Power Potput, Frequency and Modulation Sensitivity vs. Tuning Voltage

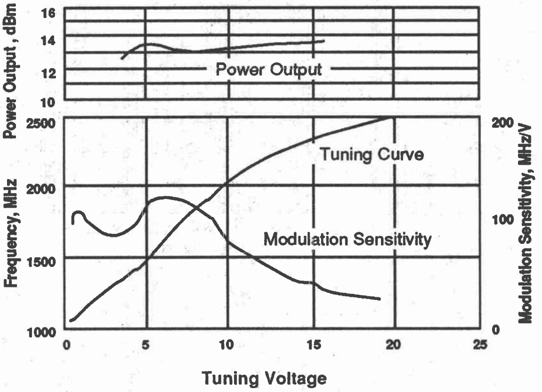


VTO-9130 Normalized Phase Noise @ 2300 MHz S.S.B. Power Spectral Density

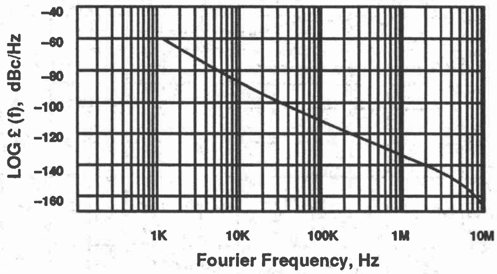


TYPICAL PERFORMANCE @ 25°C Case Temperature (continued)

VTO-9140 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



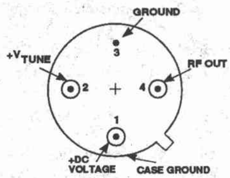
VTO-9140 Normalized Phase Noise @ 2100 MHz S.S.B. Power Spectral Density



MTO-8000 Series
Extended Temperature Range Varactor-Tuned Oscillators

FEATURES

- 400 MHz to 10.5 GHz Coverage
- 10 mW Output Power
- Hermetic Thin-Film Construction
- High Reliability Screening Available
- −54°C to +85°C Temperature Range



TO-8V, p. 16–49

DESCRIPTION

Avantek® MTO-8000 Series oscillators are extended temperature range versions of the widely used VTO-8000 Series commercial varactor-tuned oscillators. They are designed, manufactured, tested and guaranteed to perform over the full temperature range of −54° to +85°C. For applications demanding even higher reliability, screened units ("R" series) are also available.

The MTO-8000 Series varactor-tuned oscillators are packaged in TO-8 transistor cans for simple installation in a conventional 50-ohm microstripline PC board. They are ideal for the most compact, lightweight, commercial and military equipment designs.

APPLICATIONS

Frequency agile systems, such as digitally controlled receivers and active jamming transmitters, often use externally linearized varactor-tuned oscillators. Avantek oscillators are relatively monotonic making external linearization easy using analog (opamp) or digital (EPROM) linearization techniques. The Avantek MTO Series has been designed with a tuning input bypass capacitance which is sufficient to provide the necessary RF filtering action, yet as low as possible to maximize dV/dT characteristics to maintain excellent tuning speeds. Used in a phase locked loop circuit, a MTO Series VTO provides a receiver LO with stability equivalent to the reference oscillator (usually crystal controlled), yet variable in discrete steps or continuously depending on the PLL configuration.

Another important aspect of MTO Series VTOs for LO application is their power vs. frequency and temperature (±2.5 dB). This assures that once a receiver mixer is biased for best dynamic range the local oscillator drive will remain constant throughout the tuning range without complex leveling circuitry.

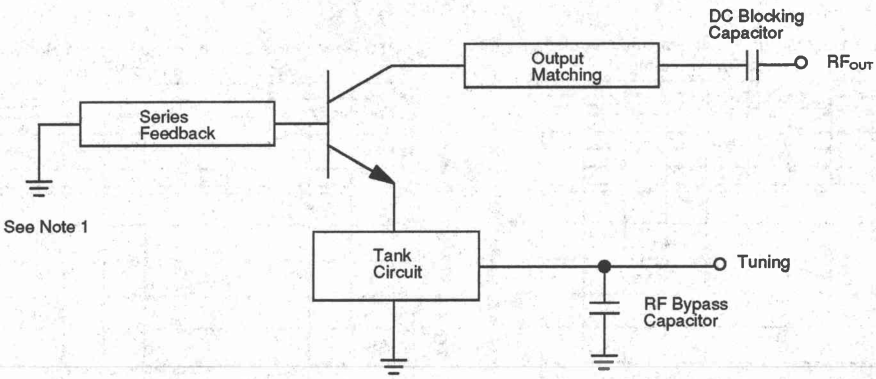
ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications – 54° to +85°C Case Temperature Into a 50-ohm Load

Model No.	MTO-8040	MTO-8060	MTO-8090	MTO-8240
Frequency Range, Min.	400-600 MHz	600-900 MHz	900-1500 MHz	2400-3700 MHz
Power Ouiput into 50-ohm Load, Min.	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm
Power Output Variation, Max.	±2.5 dB	±2.5 dB	±2.5 dB	±2 dB
Operating Case Temperature Range	–54° to +85°C	–54° to +85°C	–54° to +85°C	–54° to +85°C
Frequency Drift Over Operating Temperature, Max.	28 MHz	35 MHz	40 MHz	120 MHz
Pulling Figure (12 dB Return Loss), Max. @ 25°C	40 MHz	20 MHz	20 MHz	55 MHz
Pushing Figure, +15 VDC Supply, Max. @ 25°C	1.5 MHz/V	10 MHz/V	8 MHz/V	7.5 MHz/V
Harmonics, Below Carrier, Typ.	–10 dB	–12 dB	–11 dB	–10dB
Spurious Output Below Carrier, Min.	–60 dB	–60 dB	–60 dB	–60 dB
Tuning Voltage, Typ.				
Low Frequency	3.5±1.5 VDC	3±1 VDC	2±1 VDC	2+2/–1 VDC
High Frequency	38±8 VDC	26+10/–8 VDC	30+10/–8 VDC	30±8 VDC
Maximum Tuning Voltage	+60 VDC	+50 VDC	+50 VDC	+50 VDC
Tuning Port Capacitance, Nom.	190 pF	190 pF	190 pF	50 pF
Phase Noise, Single Sideband, 1 Hz Bandwidth, Typ.				
50 kHz From Carrier	–114 dBc	–110 dBc	–100 dBc	–95 dBc
100 kHz From Carrier	–120 dBc	–117 dBc	–107 dBc	–102 dBc
Input Power, ±1% Regulation				
Voltage, Nom.	+15 VDC	+15 VDC	+15 VDC	+15 VDC
Current, Max.	50 mA	50 mA	50 mA	50 mA
Case Style	TO-8V	TO-8V	TO-8V	TO-8V

Model No.	MTO-8360	MTO-8650	MTO-8950
Frequency Range, Min.	3600-4300 MHz	6500-8600 MHz	9500-10500 MHz
Power Ouiput into 50-ohm Load, Min.	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm
Power Output Variation, Max.	±2 dB	±2 dB	±2.5 dB
Operating Case Temperature Range	–54° to +85°C	–54° to +85°C	–54° to +85°C
Frequency Drift Over Operating Temperature, Max.	80 MHz	185 MHz	260 MHz
Pulling Figure (12 dB Return Loss), Max. @ 25°C	60 MHz	30 MHz	30 MHz
Pushing Figure, +15 VDC Supply, Max. @ 25°C	6 MHz/V	30 MHz/V	20 MHz/V
Harmonics, Below Carrier, Typ.	–22 dB	–18 dB	–20 dB
Spurious Output Below Carrier, Min.	–60 dB	–60 dB	–60 dB
Tuning Voltage, Typ.			
Low Frequency	8±2 VDC	2±1 VDC	4±1.5 VDC
High Frequency	24±4 VDC	20±4 VDC	10 VDC Max.
Maximum Tuning Voltage	+40 VDC	+30 VDC	+15 VDC
Tuning Port Capacitance, Nom.	50 pF	26 pF	26 pF
Phase Noise, Single Sideband, 1 Hz Bandwidth, Typ.			
50 kHz From Carrier	–100 dBc	–80 dBc	–75 dBc
100 kHz From Carrier	–108 dBc	–88 dBc	–82 dBc
Input Power, ±1% Regulation			
Voltage, Nom.	+15 VDC	+15 VDC	+15 VDC
Current, Max.	50 mA	100 mA	100 mA
Case Style	TO-8V	TO-8V	TO-8V

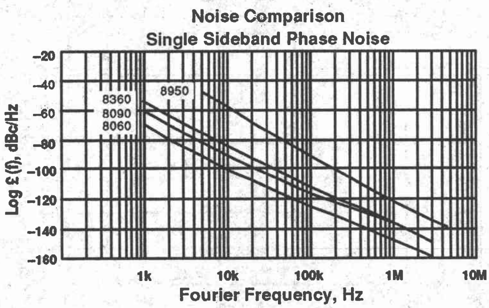
SCHEMATIC

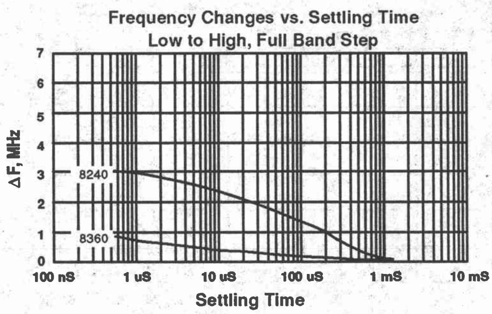


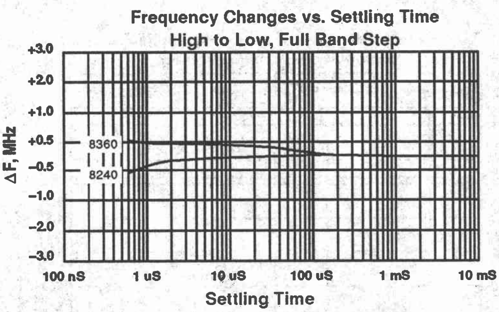
Note 1: DC bias lines (not shown) have internal decoupling capacitors.

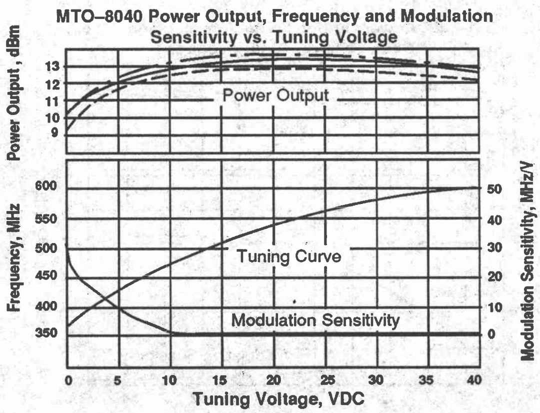
TYPICAL PERFORMANCE @ 25°C Case Temperature

KEY: +25°C ———
+85°C — — —
–54°C —- - —





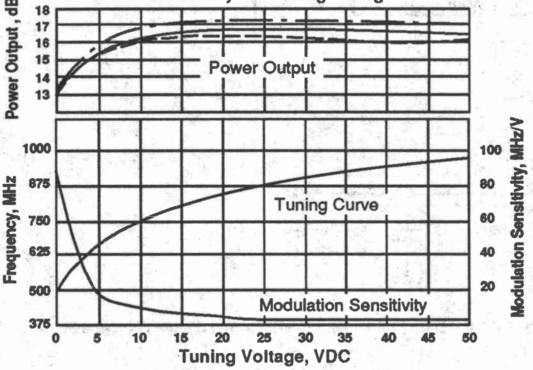




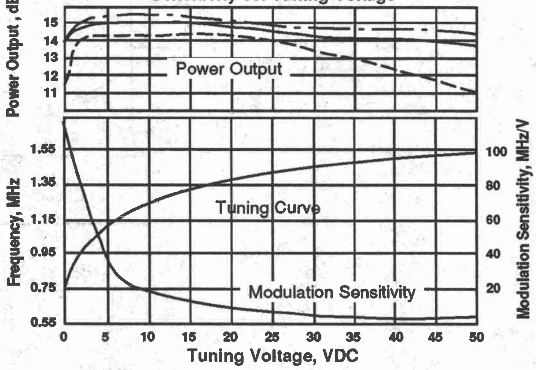
TYPICAL PERFORMANCE (continued)

KEY: +25°C ———
+85°C – – – –
–54°C — · —

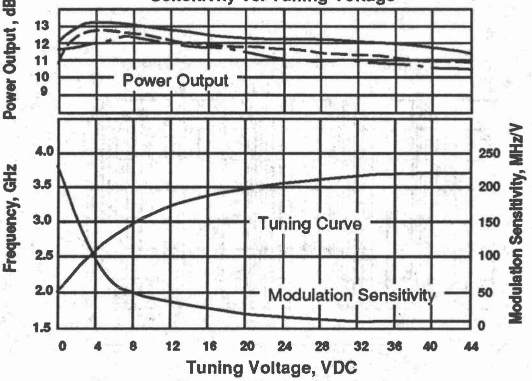
MTO–8060 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



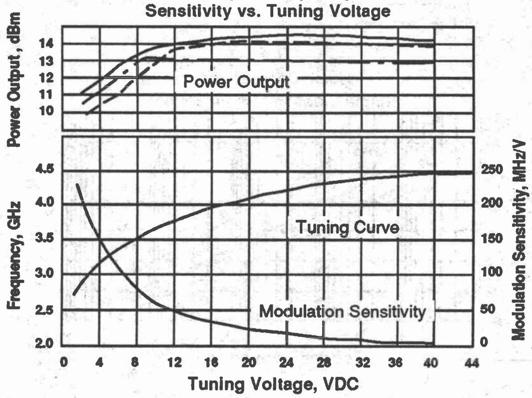
MTO–8090 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



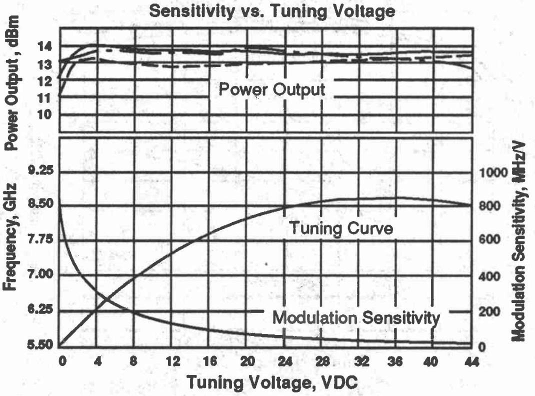
MTO–8240 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



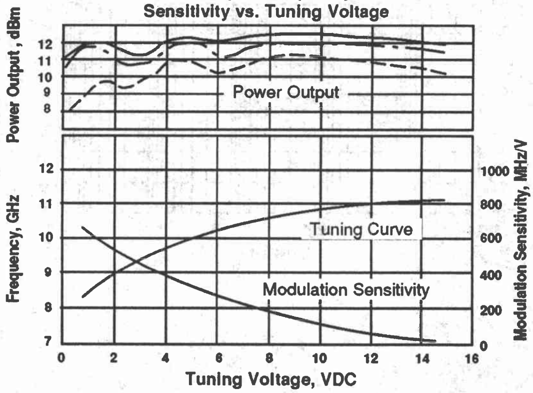
MTO–8360 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



MTO–8650 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



MTO–8950 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage

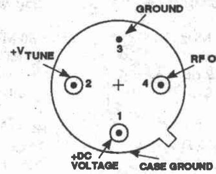


AVANTEK

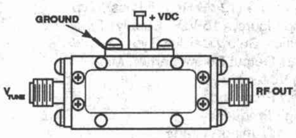
HTO Series
Extended Temperature Hyperabrupt Varactor-Tuned Oscillators

FEATURES

- 900 MHz to 18 GHz Coverage
- Buffered Fundamental Oscillator
- Extremely Fast Tuning
- Low Tuning Voltage (less than 20V)
- 10 mW Minimum Output Power
- Hermetic Thin-Film Construction
- –54°C to +85°C Temperature Range



TO-8V, p. 16–49



OX-2, p. 16–33

DESCRIPTION

Avantek® HTO Series hyperabrupt varactor-tuned fundamental oscillators combine a negative-resistance transistor oscillator with a buffer amplifier (in most models) in a compact, hermetically-welded TO-8 or Avanpak package. The frequency of oscillation is determined by a hyperabrupt varactor diode acting as a voltage-variable capacitor in a thin-film microstripline resonant circuit. As with conventional (or abrupt) varactor-tuned oscillators, this design provides extremely high tuning rates, limited primarily by the internal impedance of the user-supplied tuning voltage source.

An integral buffer amplifier stage isolates the oscillator from variations in load impedance, minimizing frequency pulling while producing a full +10 dBm minimum output power level. This permits the HTO Series oscillator to be used without external amplifiers or isolators. In addition, the combination of lightly-loaded oscillator with matched buffer amplifier produces a clean output signal with low spurious levels.

APPLICATIONS

HTO Series oscillators have the frequency agility and reliability necessary for EW and ECM systems. They can be qualified to high-reliability and military specifications appropriate to thin-film hybrid components.

HTO series oscillators are compatible with digital to analog converters. Their excellent tuning linearity (particularly for small frequency shifts) may eliminate the requirement for external linearizers and support circuits that make tuning slower, increase system costs, and reduce reliability.

ELECTRICAL AND PERFORMANCE SPECIFICATIONS

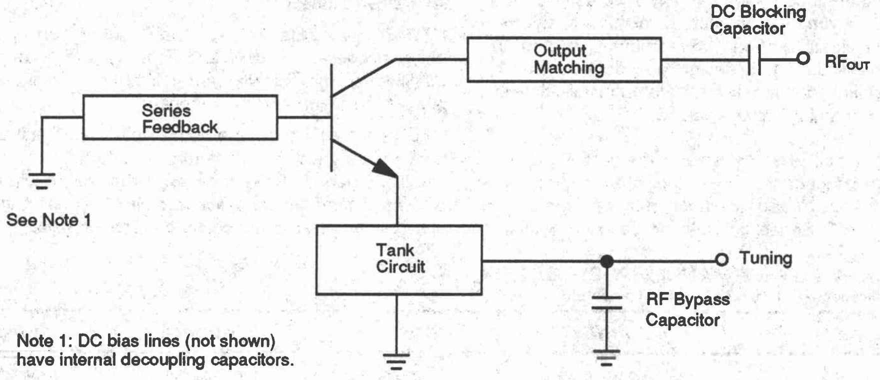
Guaranteed Specifications –54° to +85°C Case Temperature

Model No.	HTO-0900	HTO-1000	HTO-2000	HTO-2600
Frequency Range, Min.	900-1600 MHz	1000-2000 MHz	2000-4000 MHz	2600-5200 MHz
Power Output into 50-ohm Load, Min.	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm
Power Output Variation, Max.	±2.5 dB	±2.5 dB	±2.5 dB	±2.5 dB
Operating Case Temperature Range	–54° to +85°C	–54° to +85°C	–54° to +85°C	–54° to +85°C
Frequency Drift Over Operating Temperature, Typ.	20 MHz	45 MHz	90 MHz	90 MHz
Pulling Figure (12 dB Return Loss), Typ.	25 MHz	25 MHz	10 MHz	18 MHz
Pushing Figure, +15 VDC Supply, Typ.	6 MHz/V	10 MHz/V	15 MHz/V	25 MHz/V
Harmonics, Below Carrier, Typ.	–8 dB	–7 dB	–12dB	–12 dB
Spurious Output Below Carrier, Min.	–60 dB	–60 dB	–60 dB	–60 dB
Tuning Voltage, Typ.				
Low Frequency	3+2/–1 VDC	2±1 VDC	1+2/–0.7 VDC	1+2/–0.7 VDC
High Frequency	16±2 VDC	15+5/–2 VDC	14±4 VDC	14±4 VDC
Maximum Tuning Voltage	+20 VDC	+20 VDC	+20 VDC	+20 VDC
Tuning Port Capacitance, Nom.	190 pF	190 pF	55 pF	55 pF
Phase Noise, Single Sideband, 1 Hz Bandwidth, Typ.				
50 kHz From Carrier	–100 dBc	–90 dBc	–90 dBc	–85 dBc
100 kHz From Carrier	–108 dBc	–98 dBc	–100 dBc	–95 dBc
Input Power, ±1% Regulation				
Voltage, Nom.	+15 VDC	+15 VDC	+15 VDC	+15 VDC
Current, Max.	50 mA	50 mA	100 mA	100 mA
Case Style	TO-8V	TO-8V	TO-8V	TO-8V

ELECTRICAL AND PERFORMANCE SPECIFICATIONS (continued)

Model No.	HTO-4000	HTO-7500	HTO-8000	HTO-12000
Frequency Range, Min.	4000-8000 MHz	7500-11000 MHz	8000-12400 MHz	12400-18000 MHz
Power Output into 50-ohm Load, Min.	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm
Power Output Variation, Max.	±2.5 dB	±2.5 dB	±2.5 dB	±2.5 dB
Operating Case Temperature Range	–54° to +85°C	–54° to +85°C	–54° to +85°C	–54° to +85°C
Frequency Drift Over Operating Temperature, Typ.	130 MHz	250 MHz	250 MHz	400 MHz
Pulling Figure (12 dB Return Loss), Typ.	12 MHz	50 MHz	20 MHz	70 MHz
Pushing Figure, +15 VDC Supply, Typ.	35 MHz/V	45 MHz/V	10 MHz/V	5 MHz/V
Harmonics, Below Carrier, Typ.	–12 dB	–15 dB	–20 dB	–20 dB
Spurious Output Below Carrier, Min.	–60 dB	–60 dB	–60 dB	60 dB
Tuning Voltage, Typ.				
Low Frequency	1+2/–0.5 VDC	1+2/–0.5 VDC	2.5±1.5 VDC	2.5±1.5 VDC
High Frequency	14±4 VDC	14±4 VDC	17±3 VDC	17±3 VDC
Maximum Tuning Voltage	+20 VDC	+20 VDC	+20 VDC	+20 VDC
Tuning Port Capacitance, Nom.	55 pF	50 pF	50 pF	50 pF
Phase Noise, Single Sideband, 1 Hz Bandwidth, Typ,				
50 kHz From Carrier	–80 dBc	–60 dBc	–50 dBc	–48 dBc
100 kHz From Carrier	–90 dBc	–70 dBc	–60 dBc	–57 dBc
Input Power, ±1% Regulation				
Voltage, Nom.	+15 VDC	+15 VDC	+10 to +15 VDC	+10 to +15 VDC
Current, Max.	100 mA	100 mA	150 mA	150 mA
Case Style	TO-8V	TO-8V	OX-2	OX-2

SCHEMATIC

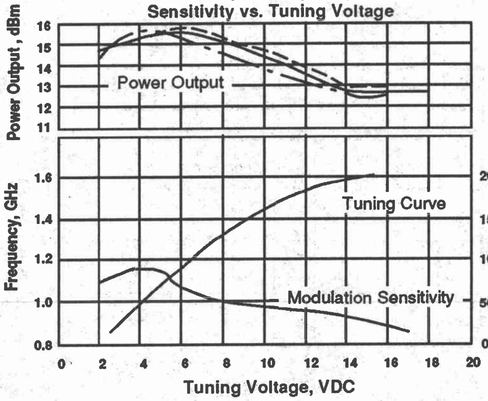


Note 1: DC bias lines (not shown) have internal decoupling capacitors.

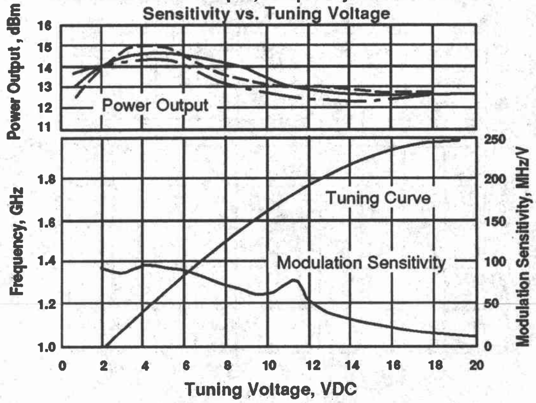
TYPICAL PERFORMANCE @ –54° to +85°C Case Temperature

KEY: +25°C ————
+85°C – – – –
–54°C —– - —–

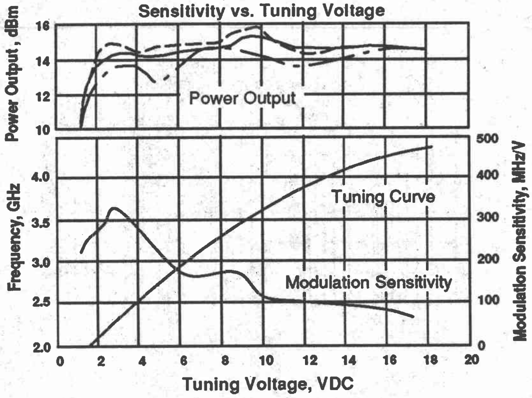
HTO–0900 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



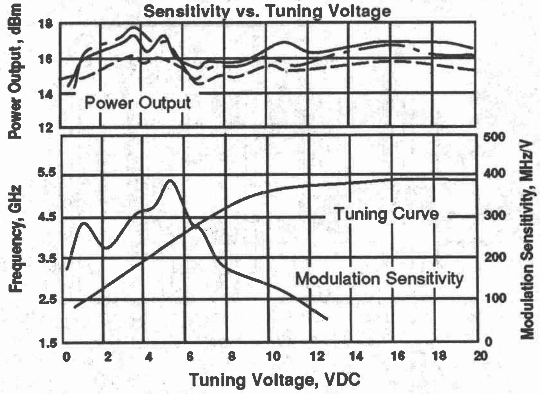
HTO–1000 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



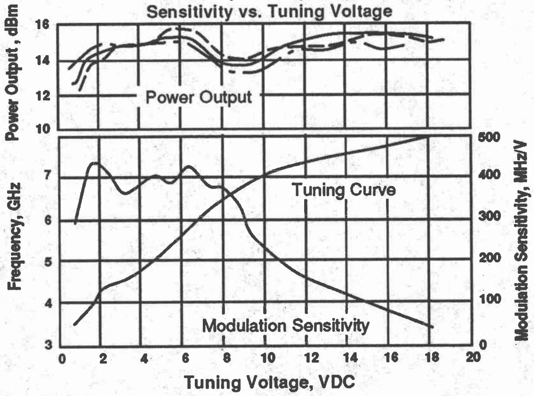
HTO–2000 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



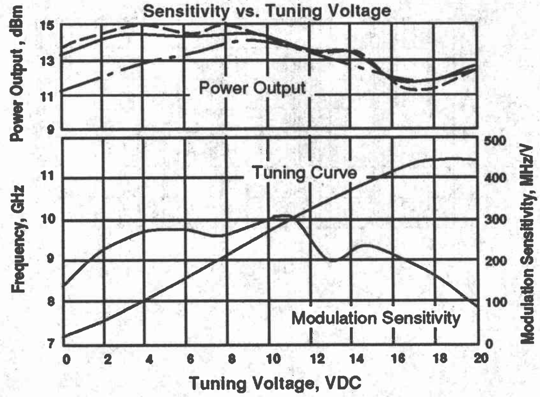
HTO–2600 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



HTO–4000 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



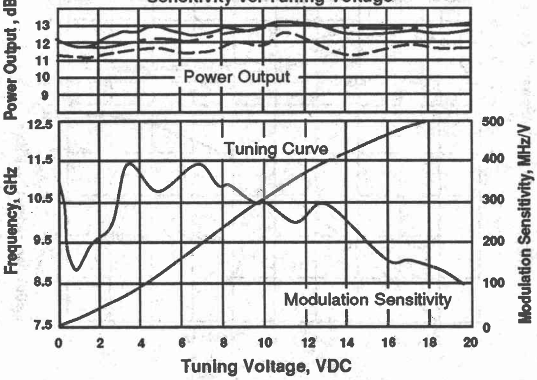
HTO–7500 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



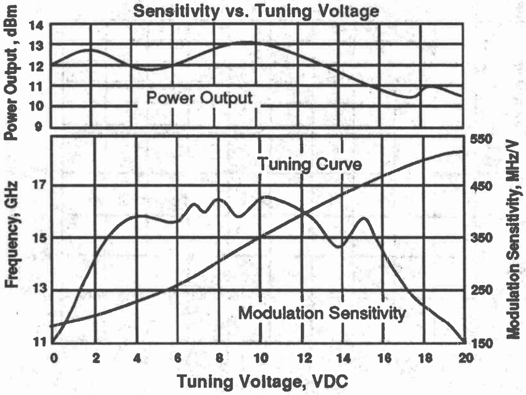
TYPICAL PERFORMANCE (continued)

KEY: +25°C ————
+85°C – – – –
–54°C —– - —–

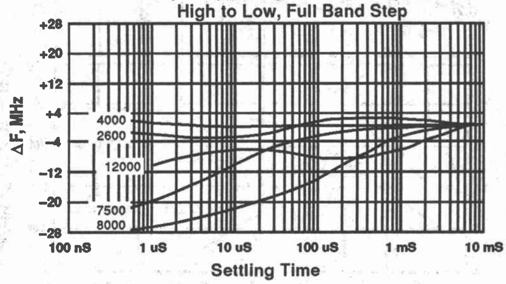
HTO–8000 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



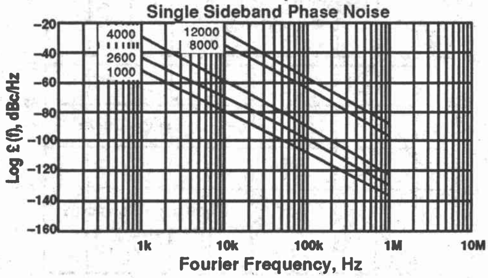
HTO–12000 Power Output, Frequency and Modulation Sensitivity vs. Tuning Voltage



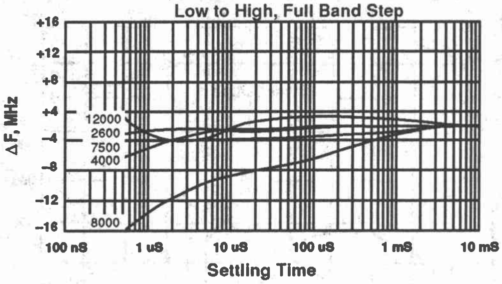
Frequency Changes vs. Settling Time High to Low, Full Band Step



Noise Comparison Single Sideband Phase Noise



Frequency Changes vs. Settling Time Low to High, Full Band Step

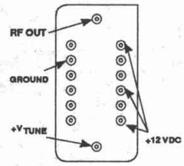


AVANTEK

VTD Series
Buffered Varactor-Tuned Oscillators

FEATURES

- Very Fast Tuning and Settling Rates
- Integral Buffer Stages
- 20 mW Output Power
- Low Harmonic and Spurious Levels
- Minimum Frequency Pulling and Pushing
- Extremely Compact and Lightweight
- Can be Qualified to MIL Specifications



VTD, p. 16–51

DESCRIPTION

The VTD Series silicon abrupt varactor-tuned oscillators with integral buffer amplifiers are packaged in a hermetic dual-inline package 0.97 by 0.498 by 0.2 in., weighing less than 0.2 oz. The oscillator and buffer stages are fabricated on precision-finished alumina substrates using advanced thin-film technology and Avantek silicon transistor chips.

Internal buffering isolates the oscillator from variations in load impedance, minimizing frequency pulling while producing +13 dBm of output power. This permits the VTD to be used without external buffer amplifiers or wideband isolators. In addition, the combination of a lightly-loaded silicon transistor oscillator and a matched buffer provides a clean output signal with low harmonic content and a minimum of spurious signals.

The small size and mass of the VTD permits them to be maintained at their optimum operating temperature with a small, low power heater. This isolates the oscillator from variations in ambient temperature—minimizing frequency drift.

APPLICATIONS

VTD Series oscillators have the frequency agility, fast settling times and dependability required for ECM systems and can be qualified to MIL specifications. They are also ideal for many commercial applications including instrumentation, phase-locked local oscillators and other communications equipment.

Special order versions of the VTD Series are available for operation over the −54° to +85°C temperature range. Low noise versions are also available on special order.

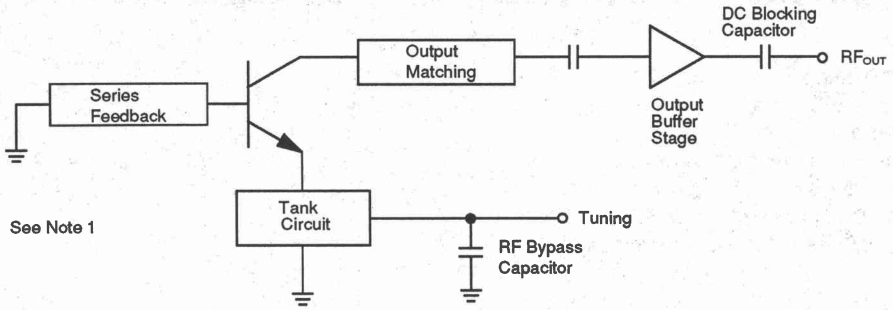
Test fixturing is also available for lab bench test application. See page 15–10 for test fixture outlines.

VTD SERIES SPECIFICATIONS

Guaranteed Specifications 80° ±5°C Case Temperature

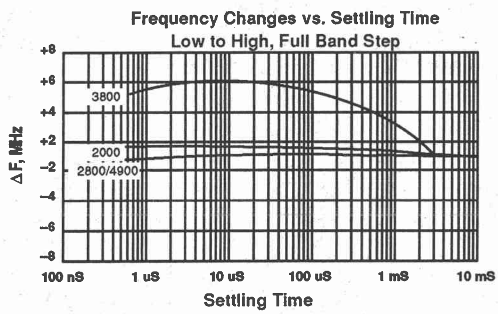
Model No.	VTD-600	VTD-2000	VTD-2800	VTD-3800	VTD-4900
Frequency Range, Min.	600-1000 MHz	2000-2800 MHz	2800-3800 MHz	3800-4900 MHz	4900-6100 MHz
Power Output into 50-ohm Load, Min.	20 mW/+13 dBm	20 mW/+13 dBm	20 mW/+13 dBm	20 mW/+13 dBm	20 mW/+13 dBm
Power Output Variation @ 85°C, Max.	±1.5 dB	±2 dB	±2 dB	±2 dB	±2 dB
Operating Case Temperature Range	+80°±5°C	+80°±5°C	+80°±5°C	+80°±5°C	+80°±5°C
Frequency Drift, Over Temperature, Typ.	−0.6 MHz/°C	−0.6 MHz/°C	−0.6 MHz/°C	−1.0 MHz/°C	−1.0 MHz/°C
Pulling Figure (6 dB Return Loss), Typ.	2 MHz	2 MHz	2 MHz	3 MHz	5 MHz
Pushing Figure, +12 VDC Supply, Typ.	6 MHz/V	6 MHz/V	6 MHzIV	10 MHz/V	10 MHz/V
Harmonics, Below Carrier, Min.	−20 dB	−20 dB	−20 dB	−20 dB	−20 dB
Spurious Output Below Carrier, Min.	−60 dB	−60 dB	−60 dB	−60 dB	−60 dB
Tuning Voltage, Typ.					
Low Frequency	3±1 VDC	4.5±1.5 VDC	4.5±1.5 VDC	4.5±1.5 VDC	4.5±1.5 VDC
High Frequency	40±8 VDC	25±3 VDC	25±3 VDC	25±3 VDC	25±3 VDC
Maximum Tuning Voltage	+60 VDC	+30 VDC	+30 VDC	+30 VDC	+30 VDC
Tuning Port Capacitance, Nom.	190 pF	50 pF	50 pF	50 pF	50 pF
Frequency Settling Time (at < 3 ms) Typ.	1.0 MHz	1.0 MHz	1.0 MHz	1.0 MHz	1.0 MHz
Phase Noise, Single Sideband, 1 Hz Bandwidth, Typ.					
50 kHz From Carrier	−105 dBc	−98 dBc	−97 dBc	−93 dBc	−92 dBc
100 kHz From Carrier	−110 dBc	−106 dBc	−105 dBc	−103 dBc	−100 dBc
Input Power, ±1% Regulation					
Voltage, Nom.	+12 VDC	+12 VDC	+12 VDC	+12 VDC	+12 VDC
Current, Max.	125 mA	125 mA	125 mA	125 mA	125 mA
Case Type	VTD	VTD	VTD	VTD	VTD

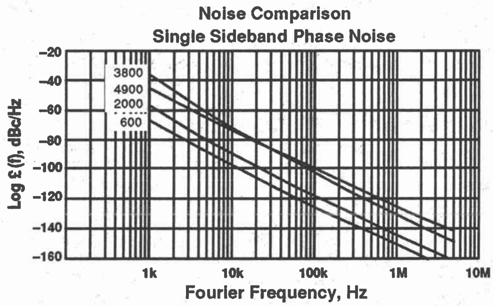
SCHEMATIC

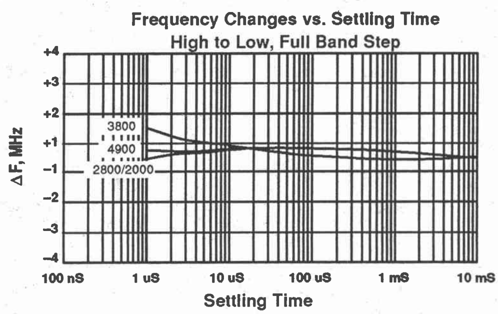


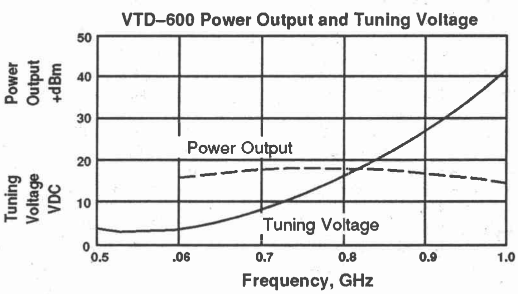
NOTE: DC bias lines (not shown) have internal decoupling capacitors.

TYPICAL PERFORMANCE @ 80° ± 5°C Case Temperature

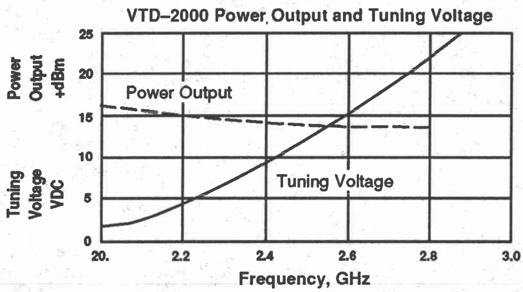


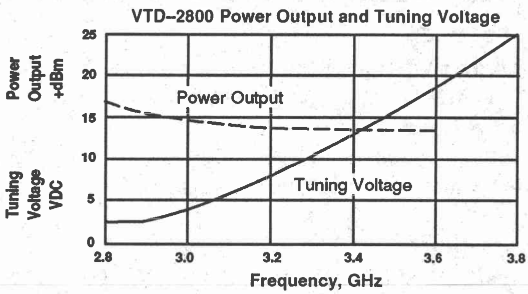


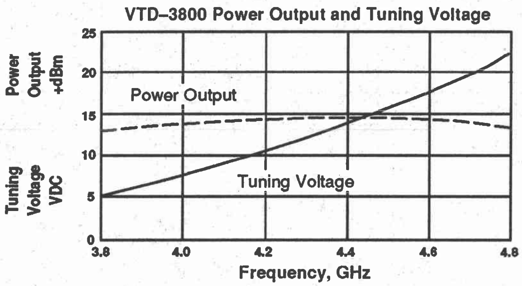


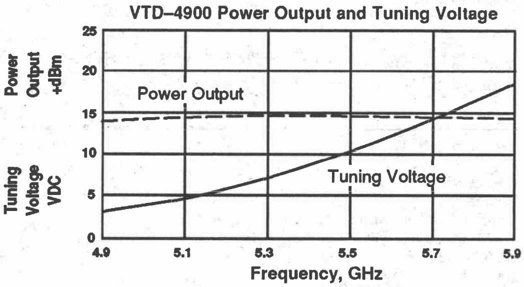


TYPICAL PERFORMANCE (continued)







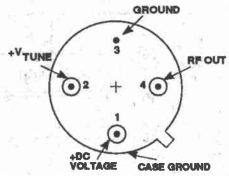


AVANTEK

LNO-550
Low Noise
Varactor-Tuned Oscillator

FEATURES

- Low FM/Phase Noise
- 10 mW Minimum Output Power
- Low Cost
- Reliable Thin-Film Hybrid Construction
- Hermetic TO-8 Miniature Package



TO-8V, p. 16–49

DESCRIPTION

The Avantek® LNO-550 varactor-tuned oscillator has been designed specifically for low noise applications. The oscillator uses a silicon transistor chip with a silicon abrupt tuning varactor in a thin-film microstrip circuit.

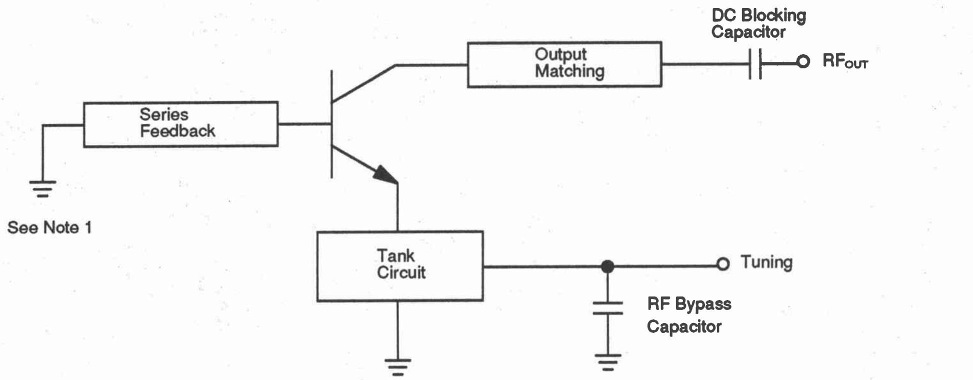
The LNO-550 is packaged in a hermetic TO-8 transistor can for simple installation in conventional 50-ohm microstripline PC boards. It is ideal for compact, lightweight military and commercial equipment designs.

ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications @ –54° to +85°C Case Temperature

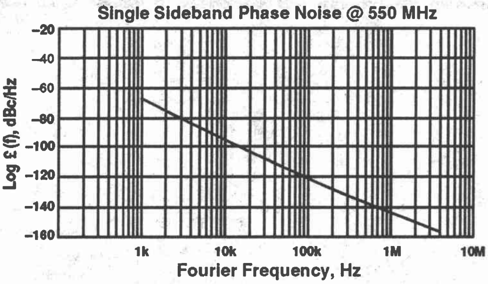
Parameter	Specifications
Frequency Range, Min.	550-775 MHz
Output Power, Min.	+10 dBm
Power Variation, Max.	±2.5 dB
Drift, Max.	20 MHz
Pulling @ 25°C, Max. (12 dB Return Loss)	10 MHz
2nd Harmonics, Min.	–10 dBc
Course Tuning Voltage	+2.5±1 to +17±3 VDC
Maximum Tuning Voltage	+20
Tuning Modulation Sensitivity Range @ 25°C, Max.	45 to 6 MHz/V
Single Sideband Phase Noise @ 25°C	
50 kHz from Carrier, Typ.	–112 dBc/Hz
50 kHz from Carrier, Max.	–110 dBc/Hz
Power Input	
+12 VDC, Max.	50 mA
Case Type	TO-8V

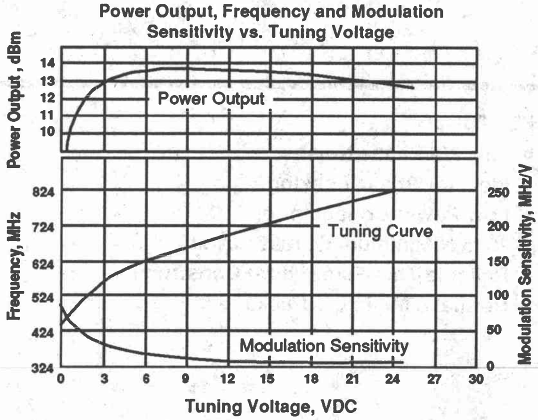
SCHEMATIC



NOTE 1: DC bias lines (not shown) have internal decoupling capacitors.

TYPICAL PERFORMANCE @ 25°C Case Temperature



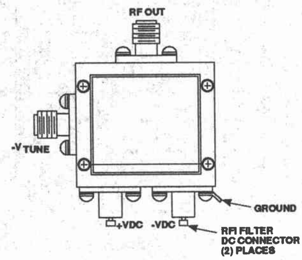


AVANTEK

LNO-7800
Low Noise
Varactor-Tuned Oscillator

FEATURES

- Low FM/Phase Noise
- Ideal for Phase Locking
- Low Power Consumption
- 10 mW Minimum Output Power
- Reliable Thin-Film Hybrid Construction
- Hermetic Miniature Package



LNO-7800, p. 16–22

DESCRIPTION

The Avantek® LNO-7800 varactor-tuned oscillator is specifically designed for low noise performance in the X-Band frequency range. The oscillator utilizes a silicon transistor chip along with a silicon abrupt diode in a thin-film microstrip circuit.

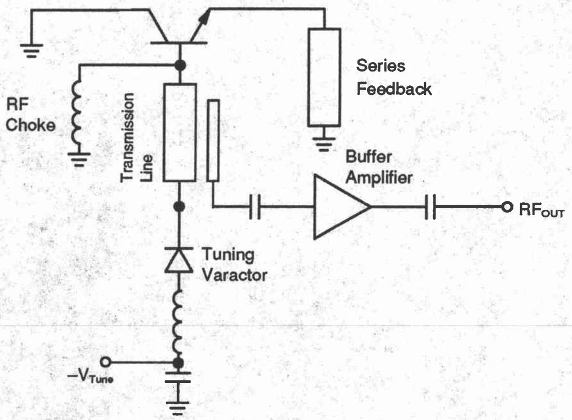
This type of oscillator has comparable noise performance to Gunn oscillators currently in use with significant savings in input power consumption. The LNO-7800 is packaged in a hermetic, low profile Avanpak™ case and is available with or without RF connectors. It is well-suited for military or commercial equipment where size, weight or noise performance is critical.

ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications @ –54° to + 85°C Case Temperature

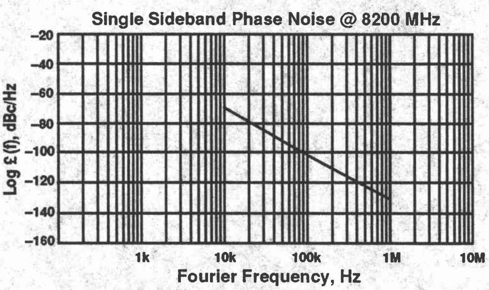
Parameter	Specifications
Frequency Range, Min.	7800–8500 MHz
Output Power, Min.	+10 dBm
Power Variation, Max.	±2.5 dB
Drift, Max.	150 MHz
Pulling Max. (12 dB Return Loss)	8 MHz
2nd Harmonics, Min.	–15 dBc
Tuning Voltage	–2 to –20 VDC
Maximum Tuning Voltage	–25 VDC
Tuning Modulation Sensitivity, Max.	125 MHz/V
Phase Noise	
10 kHz from Carrier, Typ.	–72 dBc/Hz
100 kHz from Carrier, Max.	–98 dBc/Hz
100 kHz from Carrier, Typ.	–100 dBc/Hz
1 MHz from Carrier, Typ.	–128 dBc/Hz
Power Input	
+15 VDC, Max.	100 mA
–15 VDC, Max.	50 mA
Case Type	LNO-7800

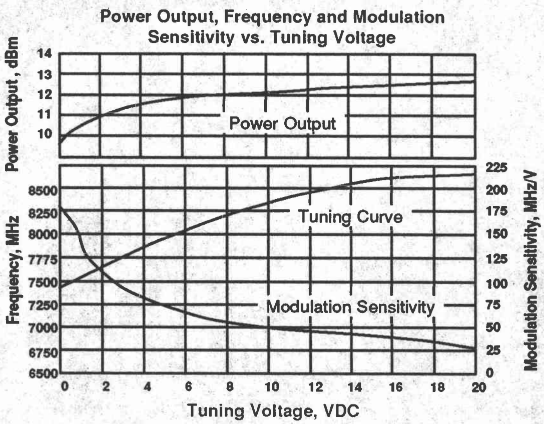
SCHEMATIC

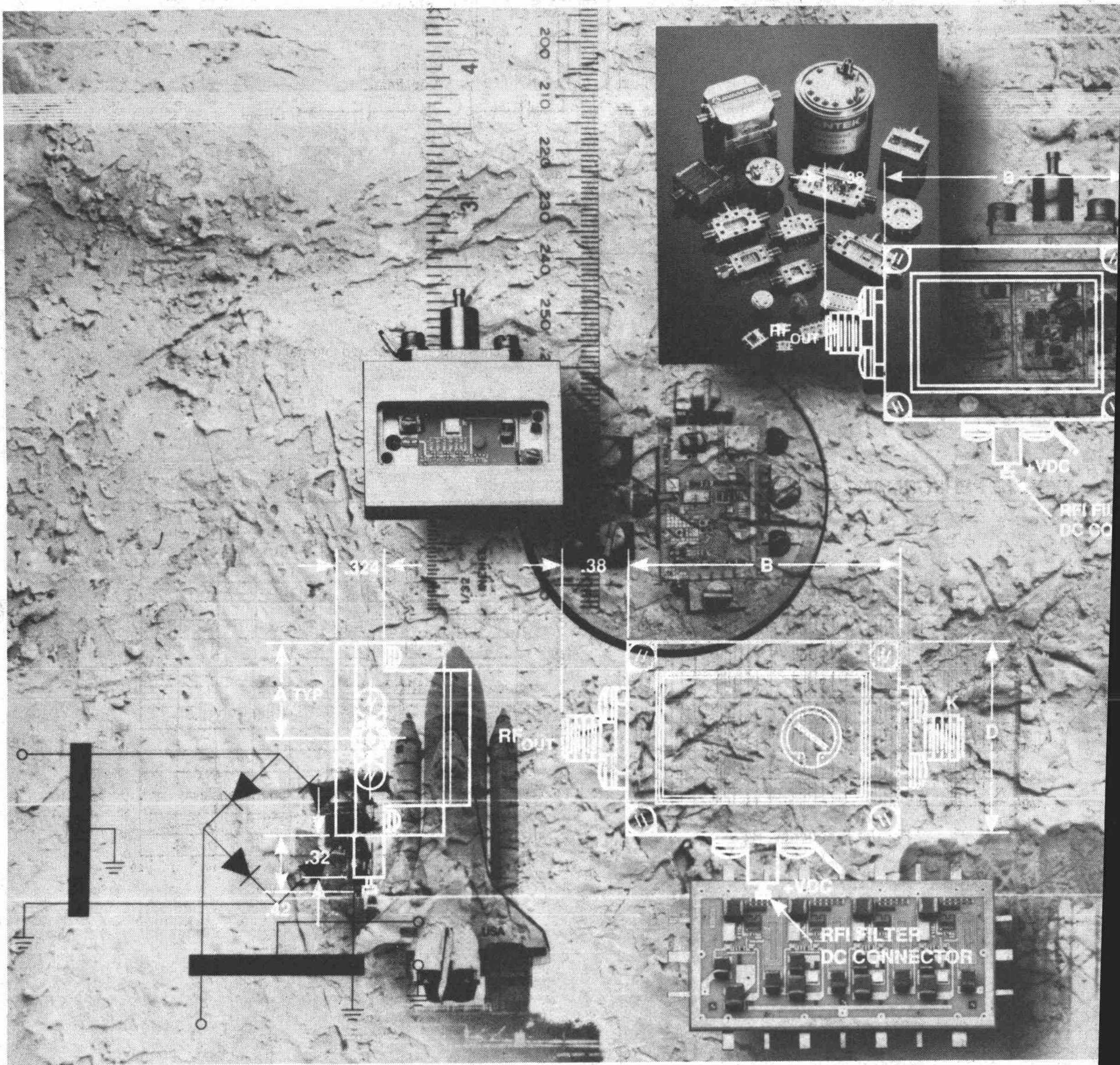


NOTE 1: DC bias lines (not shown) have internal decoupling capacitors.

TYPICAL PERFORMANCE @ 25°C Case Temperature







200
210
220
230
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250
.324
.38
B
A TYP
RF OUT
D
K
.32
.42
+VDC
RFI FILTER
DC CONNECTOR
USA

DIELECTRICALLY-STABILIZED OSCILLATORS

GENERAL DESCRIPTION

The dielectric resonator is, in many ways, similar to the resonant cavity and may be used in the same types of oscillator and filter applications. It is made from a high dielectric-constant material, within which an electromagnetic field can be confined and made to resonate. The resonant frequency is determined by the physical dimensions of the dielectric rectangle or disc, the dielectric constant of the material and, to a varying degree, by the supporting and containing structure.

Mechanical tuning is achieved by bringing the tuning screw closer to the dielectric resonator, thereby modifying the resonant frequency of the $TE_{01\delta}$ mode to an increased value. The reason for such behavior of the resonant frequency is explained in the cavity perturbation theory. Namely, when a metal wall of a cavity is moved inward, the resonant frequency will decrease if the stored energy is predominantly electric. Otherwise, when the stored energy close to the metal wall is mostly magnetic, as is the case in Avantek's shielded $TE_{01\delta}$ dielectric resonators, the resonant frequency increases when the wall moves inward.

In the electronically tuned DSO, a varactor in association with a microstripline is made to resonate around the dielectric resonator frequency. This resonant circuit is electromagnetically coupled to the dielectric resonator, forming a pair of mutually coupled resonant circuits. By varying the varactor capacitance with the bias voltage, the resonant frequency of the dielectric resonator, coupled to a varactor-microstrip on one side and a 50-ohm microstripline on the other, can now be tuned.

The dielectrically-stabilized oscillator (DSO) uses a dielectric resonator as its frequency-determining element. When the dielectric material is properly selected, the variations in dielectric constant vs. temperature and the dimensions of the resonant structure vs. temperature tend to cancel out, providing relatively good temperature-vs.-frequency stability. Essentially, the DSO offers frequency accuracy and stability between that of a crystal oscillator/multiplier chain or crystal-controlled phase-locked oscillator and that of a varactor-tuned oscillator supplied with very well-regulated bias and tuning voltages. It features significantly lower power consumption than a crystal-controlled (multiplier or PLL) oscillator and a significantly higher reliability since it is very simple and uses far fewer components. Its relatively high-Q provides good noise performance and, since the dielectric resonator is a solid structure, is less susceptible to vibration than a cavity-stabilized oscillator.

The Avantek DSO Series oscillators combine the dielectrically-stabilized oscillator with an integral buffer amplifier. This minimizes oscillator-to-load coupling for higher external Q and minimum frequency pulling due to variations in load impedance of phase.

CONSTRUCTION

Avantek fundamental dielectrically-stabilized oscillators are constructed using ceramic substrates and thin-film construction techniques. Discrete transistors and capacitors are bonded directly to the ceramic substrate. All resistors are thin-film tantalum-nitride and are heat treated for stability. Exact resistor values are achieved using laser trimmers.

Hermeticity and reliability are assured by filling each completed oscillator package with an inert atmosphere, welding the lids in place and leak testing. Avantek dielectrically stabilized oscillators can be qualified to high reliability and MIL specifications appropriate to hybrid thin-film components.

APPLICATIONS

Avantek dielectrically stabilized oscillators (DSOs) provide excellent solutions to systems requiring signal sources with low phase noise, high temperature stability, and excellent frequency accuracy.

Microwave systems requiring these high technology devices include built-in test equipment (BITE), ECM receivers, altimeters, weather and airborne radars, missile transponders, telecommunications, and satellite communication systems.

Avantek's DSO-1000 Series is best suited for fixed frequency requirements spanning the 3 GHz to 18 GHz frequency range. The DSO-2000 Series is the choice for applications which require small mechanically-tuned bandwidths (±25 MHz typically).

Model Number Selection Guide

DSO – 112450 – 13 R

DSO Series Indicator
1 = DSO-1000 Series
2 = DSO-2000 Series

Center Frequency
User Specified to the
Megahertz

Power Output Option
10 = +10 dBm Output
13 = +13 dBm Output
20 = +20 dBm Output

Add "R" for Avantek "R"
Series Screening. Leave
Blank if Not Required.

Avantek's DSO Part Number Selection Guide allows the end user to choose the desired DSO Series oscillator, output frequency, and power output option.

Please refer to the respective Series specification sheets when identifying a part number since some units offer a +20 dBm power output option while others are offered at +13 dBm output power only.

Contact your nearest Avantek direct sales engineer, manufacturer's representative, and/or distributor for assistance in ordering Avantek DSO products.

AVANTEK

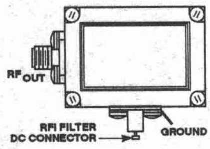
DSO-1000-10 Series Fixed Tuned Dielectrically-Stabilized Oscillators 6 to 18 GHZ

FEATURES

- Customer Specified Fixed Frequencies From 6 to 18 GHz
- Thin-Film Construction
- 10 mW Power Out

APPLICATIONS

- Fixed Tuned Local Oscillators
  - Built-in Test Equipment (BITE)
  - IFM Front-Ends
  - Missile Transponders
  - ECM Receivers
  - Altimeters
- Communication Systems



OD-10, OD-20, p. 16–29

DESCRIPTION

The DSO-1000-10 Series dielectrically-stabilized oscillators use high-Q dielectric resonators and GaAs FET transistors which produce highly stable low noise oscillators that operate over wide temperature ranges and in severe environmental conditions. They use much less power and have far fewer components than crystal oscillators; their high Q provides good noise performance; and, since the dielectric resonator is a solid structure (thin-film hybrid construction is used throughout), they are far less susceptible to vibration than cavity-stabilized VCOs. Oscillator-to-load coupling is minimized by an internal buffer amplifier resulting in higher Q and minimum frequency pulling due to load variations. All Avantek DSOs are housed in hermetically sealed packages with field replaceable SMA connectors.

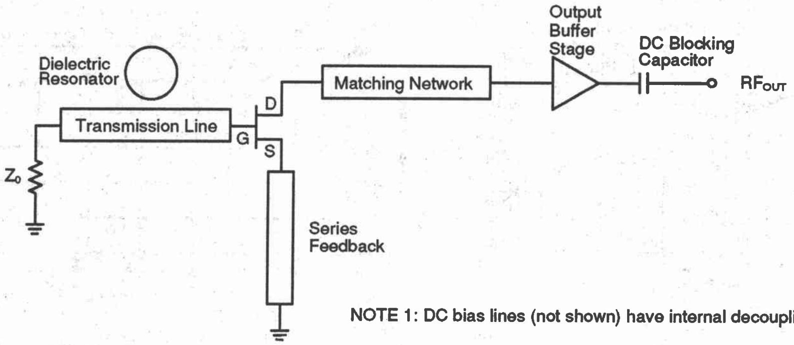
ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications at –54° to +85°C Case Temperature

Model No.	**See Page 11–3 For Model Number Selection**	
Frequency Range[1]	6000–11999 MHz	12000–18000 MHz
Power Output into 50-ohm Load, Min.	10 mW/+10 dBm	10 mW/+10 dBm
Power Output Variation Over Temperature, Max.	3 dB	3 dB
Frequency Accuracy (Under All Conditions) Max.[2]	0.1%	0.1%
Temperature Stability, Max.	±0.05%	±0.05%
Pulling Figure (12 dB Return Loss), Max.	±0.02%	±0.02%
Pushing Figure, +15 VDC Supply, Max.	±0.001%	±0.001%
Harmonics, Below Carrier, Max.	–20 dBc	–20 dBc
Spurious Output Below Carrier, Max.	–60 dBc	–60 dBc
Phase Noise, Single Sideband		
1 Hz Bandwidth, Typical		
10 kHz From Carrier	–90 dBc	–80 dBc
100 kHz From Carrier	–102 dBc	–95 dBc
Input Power		
Voltage	+15±.5 VDC	+15±.5 VDC
Current, Max.	75 mA	75 mA
Case Style	OD-20	OD-10
Weight, Max.	2.5 oz.	2.0 oz.

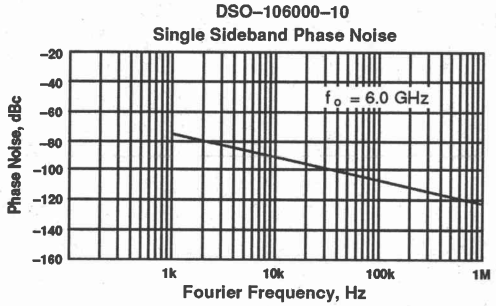
NOTES:
1. Center frequencies are customer selectable and may be specified to the MHz. Center frequencies are set at +25°C See page 11–3 for part number selection.
2. The oscillator will stay within the frequency accuracy of the customer specified frequency under all conditions including the full temperature range, load pulling, frequency pushing, and aging.

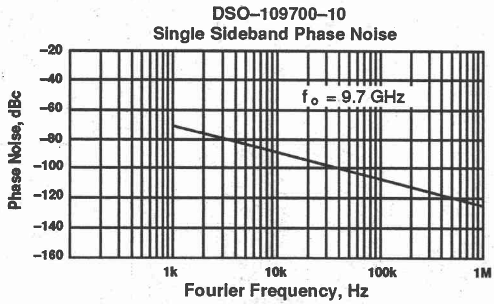
SCHEMATIC

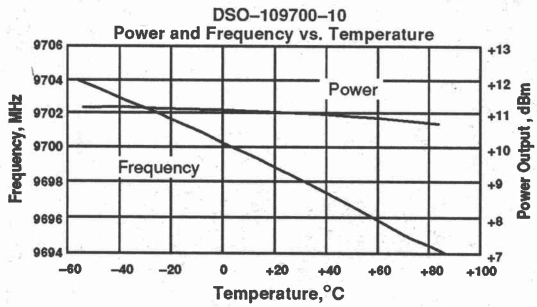


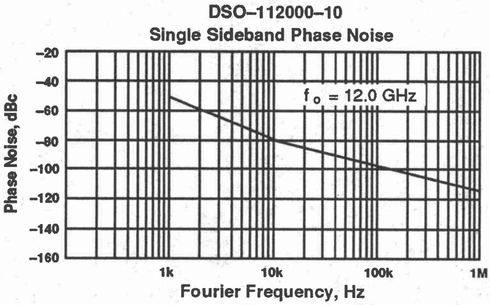
NOTE 1: DC bias lines (not shown) have internal decoupling capacitors.

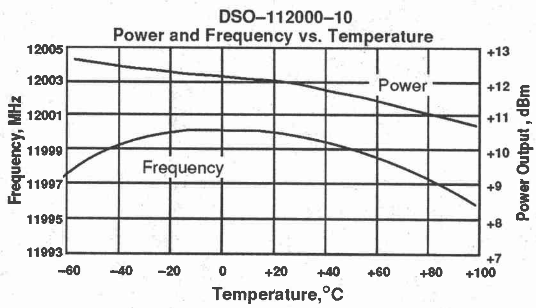
TYPICAL PERFORMANCE @ 25°C Case Temperature





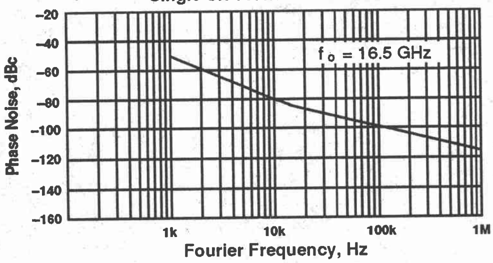




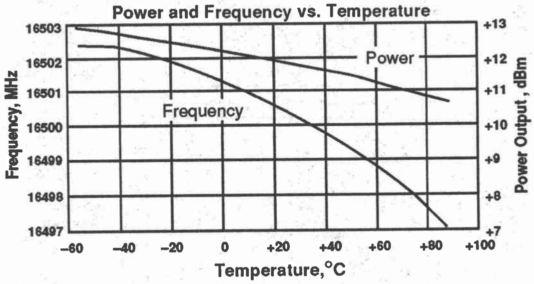


TYPICAL PERFORMANCE (continued)

DSO–116500–10
Single Sideband Phase Noise



DSO–116500–10
Power and Frequency vs. Temperature



AVANTEK

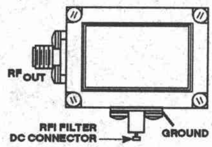
DSO-1000-13 Series Fixed Tuned Dielectrically-Stabilized Oscillators 3 to 12 GHZ

FEATURES

- Customer Specified Fixed Frequencies From 3 to 12 GHz
- Thin-Film Construction
- 20 mW Power Out

APPLICATIONS

- Fixed Tuned Local Oscillators
  - Built-in Test Equipment (BITE)
  - IFM Front-Ends
  - Missile Transponders
  - ECM Receivers
  - Altimeters
- Communication Systems



OD-60, OD-70, OD-80, p. 16–31

DESCRIPTION

The DSO-1000-13 Series dielectrically-stabilized oscillators use high-Q dielectric resonators and silicon bipolar transistors which produce highly stable low noise oscillators that operate over wide temperature ranges and in severe environmental conditions. They use much less power and have far fewer components than crystal oscillators; their high Q provides good noise performance; and, since the dielectric resonator is a solid structure (thin-film hybrid construction is used throughout), they are far less susceptible to vibration than cavity-stabilized VCOs. Oscillator-to-load coupling is minimized by an internal buffer amplifier resulting in higher Q and minimum frequency pulling due to load variations. All Avantek DSOs are housed in hermetically sealed packages with field replaceable SMA connectors.

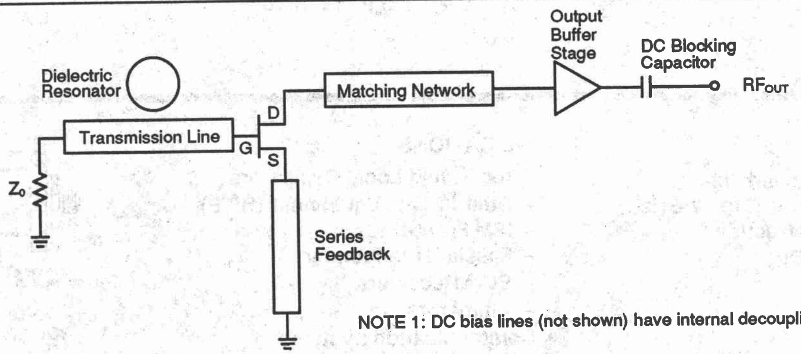
ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications at –54° to +85°C Case Temperature

Model No.	**See Page 11–3 For Model Number Selection**		
Frequency Range[1]	3000–4499 MHz	4500–7999 MHz	8000–11999 MHz
Power Output into 50-ohm Load, Min.	20 mW/+13 dBm	20 mW/+13 dBm	20 mW/+13 dBm
Power Output Variation Over Temperature, Max.	3 dB	3 dB	3 dB
Frequency Accuracy (Under All Conditions) Max.[2]	0.1%	0.1%	0.1%
Temperature Stability, Max.	±0.05%	±0.05%	±0.05%
Pulling Figure (12 dB Return Loss), Max.	±0.02%	±0.02%	±0.02%
Pushing Figure, +15 VDC Supply, Max.	±.001%	±0.001%	±0.001%
Harmonics, Below Carrier, Max.	–20 dBc	–20 dBc	–20 dBc
Spurious Output Below Carrier, Max.	–60 dBc	–60 dBc	–60 dBc
Phase Noise, Single Sideband			
1 Hz Bandwidth, Typical			
10 kHz From Carrier	–100 dBc	–100 dBc	–90 dBc
100 kHz From Carrier	–125 dBc	–125 dBc	–115 dBc
Input Power			
Voltage	+15±.5 VDC	+15±.5 VDC	+15±.5 VDC
Current, Max.	100 mA	75 mA	150 mA
Case Style	OD-60	OD-70	OD-80
Weight, Max.	6.5 oz.	4.5 oz.	3.0 oz.

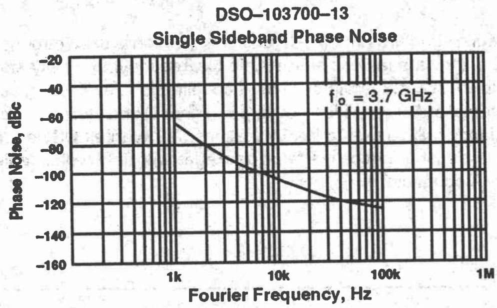
NOTES: 1. Center frequencies are customer selectable and may be specified to the MHz. Center frequencies are set at +25°C See page 11–3 for part number selection.
2. The oscillator will stay within the frequency accuracy of the customer specified frequency under all conditions including the full temperature range, load pulling, frequency pushing, and aging.

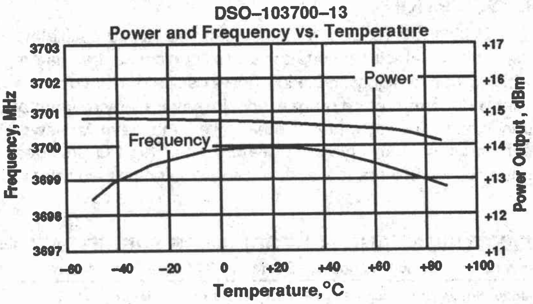
SCHEMATIC

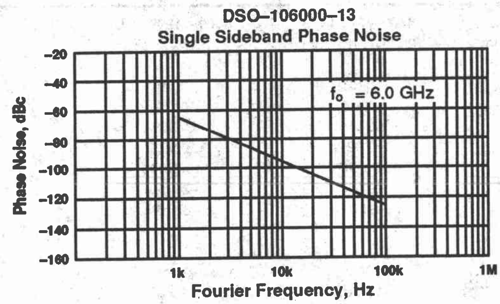


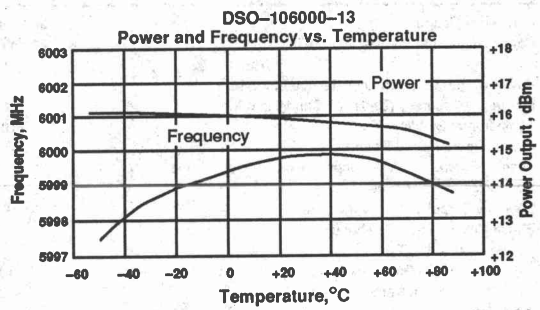
NOTE 1: DC bias lines (not shown) have internal decoupling capacitors.

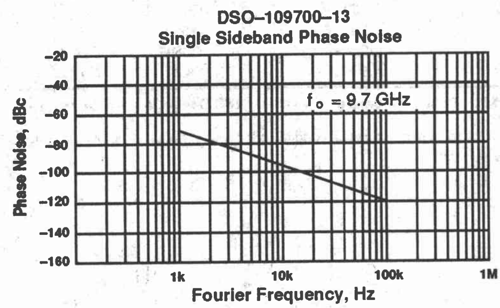
TYPICAL PERFORMANCE @ 25°C Case Temperature

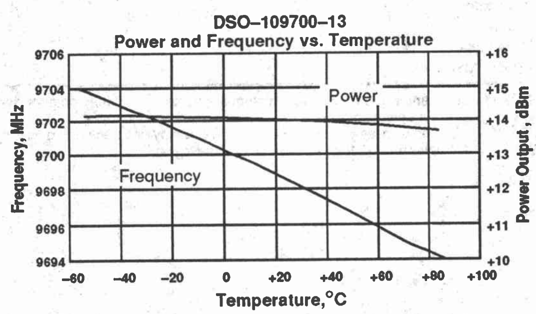












AVANTEK

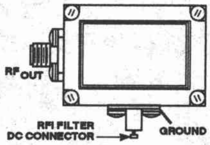
DSO-1000-20 Series Fixed Tuned Dielectrically-Stabilized Oscillators 3 to 12 GHZ

FEATURES

- Customer Specified Fixed Frequencies From 3 to 12 GHz
- Thin-Film Construction
- 100 mW Power Out

APPLICATIONS

- Fixed Tuned Local Oscillators
  - Built-in Test Equipment (BITE)
  - IFM Front-Ends
  - Missile Transponders
  - ECM Receivers
  - Altimeters
- Communication Systems



OD-60, OD-70, OD-80, p. 16–31

DESCRIPTION

The DSO-1000-20 Series dielectrically-stabilized oscillators use high-Q dielectric resonators and silicon bipolar transistors which produce highly stable low noise oscillators that operate over wide temperature ranges and in severe environmental conditions. They use much less power and have far fewer components than crystal oscillators; their high Q provides good noise performance; and, since the dielectric resonator is a solid structure (thin-film hybrid construction is used throughout), they are far less susceptible to vibration than cavity-stabilized VCOs. Oscillator-to-load coupling is minimized by an internal buffer amplifier resulting in higher Q and minimum frequency pulling due to load variations. All Avantek DSOs are housed in hermetically sealed packages with field replaceable SMA connectors.

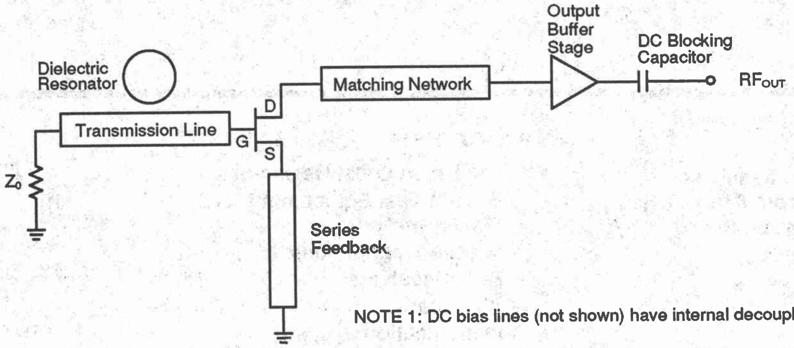
ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications at –54° to +85°C Case Temperature

Model No.	See Page 11–3 For Model Number Selection		
Frequency Range[1]	3000–4499 MHz	4500–7999 MHz	8000–11999 MHz
Power Output into 50-ohm Load, Min.	100 mW/+20 dBm	100 mW/+20 dBm	100 mW/+20 dBm
Power Output Variation Over Temperature, Max.	3 dB	3 dB	3 dB
Frequency Accuracy (Under All Conditions) Max.[2]	0.1%	0.1%	0.1%
Temperature Stability, Max.	±0.05%	±0.05%	±0.05%
Pulling Figure (12 dB Return Loss), Max.	±0.02%	±0.02%	±0.02%
Pushing Figure, +15 VDC Supply, Max.	±.001%	±0.001%	±0.001%
Harmonics, Below Carrier, Max.	–20 dBc	–20 dBc	–20 dBc
Spurious Output Below Carrier, Max.	–60 dBc	–60 dBc	–60 dBc
Phase Noise, Single Sideband			
1 Hz Bandwidth, Typical			
10 kHz From Carrier	–100 dBc	–100 dBc	–90 dBc
100 kHz From Carrier	–125 dBc	–125 dBc	–115 dBc
Voltage	+15±.5 VDC	+15±.5 VDC	+15±.5 VDC
Current, Max.	250 mA	250 mA	300 mA
Case Style	OD-60	OD-70	OD-80
Weight, Max.	6.5 oz.	4.5 oz.	3.0 oz.

NOTES: 1. Center frequencies are customer selectable and may be specified to the MHz. Center frequencies are set at +25°C See page 11–3 for part number selection.
2. The oscillator will stay within the frequency accuracy of the customer specified frequency under all conditions including the full temperature range, load pulling, frequency pushing, and aging.

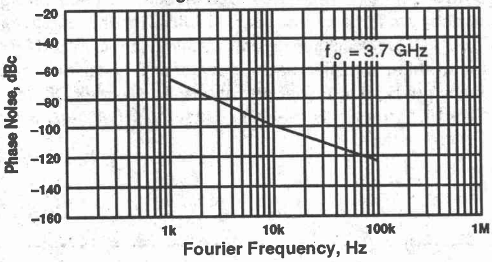
SCHEMATIC



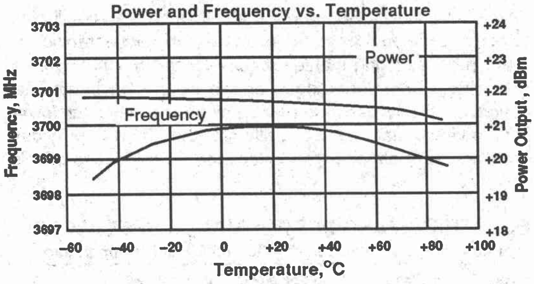
NOTE 1: DC bias lines (not shown) have internal decoupling capacitors.

TYPICAL PERFORMANCE @ 25°C Case Temperature

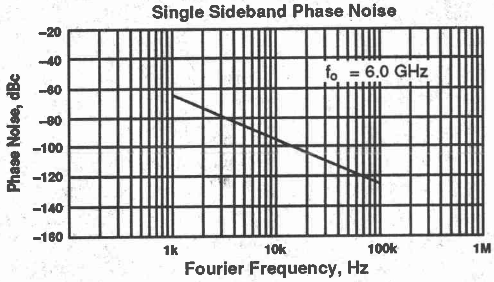
DSO–103700–20
Single Sideband Phase Noise



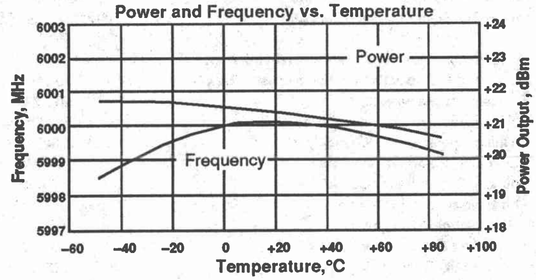
DSO–103700–20
Power and Frequency vs. Temperature



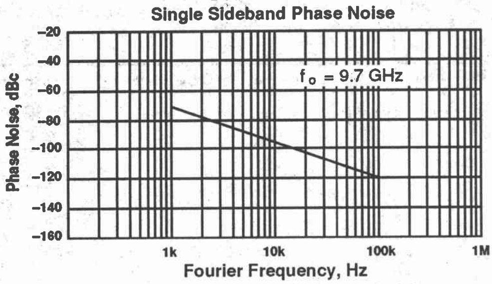
DSO–106000–20
Single Sideband Phase Noise



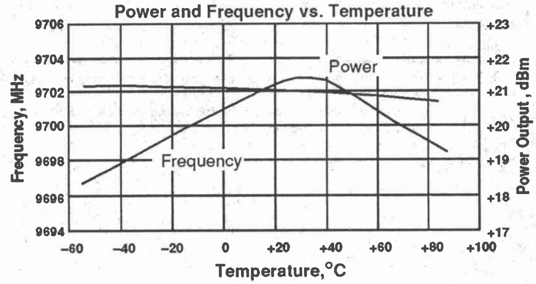
DSO-106000-20
Power and Frequency vs. Temperature



DSO–109700–20
Single Sideband Phase Noise



DSO–109700–20
Power and Frequency vs. Temperature



AVANTEK

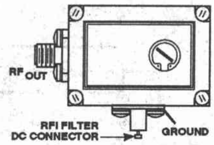
DSO-2000-10 Series Mechanically Tuned Dielectrically-Stabilized Oscillators 6 to 18 GHz

FEATURES

- Customer Selectable Fixed Frequencies from 6 to 18 GHz
- Tuning Range ±10 to ±25 MHz
- Thin-Film Construction
- 10 mW Power Output

APPLICATIONS

- Mechanically Tuned Local Oscillators
  - Built-in Test Equipment (BITE)
  - IFM Front Ends
  - Missile Transponders
  - Radars
  - ECM Receivers
  - Altimeters
- Communication Systems



OD-12, OD-22, p. 16–30

DESCRIPTION

The DSO-2000-10 Series dielectrically-stabilized oscillators are derivatives of the DSO-1000 series of DSOs. These oscillators incorporate a mechanical tuning adjustment allowing up to ±25 MHz of tuning range. The design of the mechanical tuner allows frequency adjustments with better than 1 MHz resolution and virtually no backlash. Frequency stability and susceptibility to shock and vibration are not compromised by this unique, rugged design. Mechanical tuning stops are provided to ensure against tuner damage and loss of package hermeticity. Expected tuner life exceeds 250 cycles.

These DSOs use high-Q dielectric resonators and GaAs FET transistors which operate over wide temperature ranges and in severe environmental conditions. They use much less power and have far fewer components than crystal oscillators; their high Q provides good noise performance; and, since the dielectric resonator is a solid structure (thin-film hybrid construction is used throughout), they are far less susceptible to vibration than cavity stabilized VCOs. Oscillator-to-load coupling is minimized by an internal buffer amplifier resulting in higher Q and minimum frequency pulling due to load variations. Please see page 11–2 for a descriptive explanation of mechanical tuning.

All Avantek DSOs are housed in hermetically sealed packages with field replaceable SMA connectors.

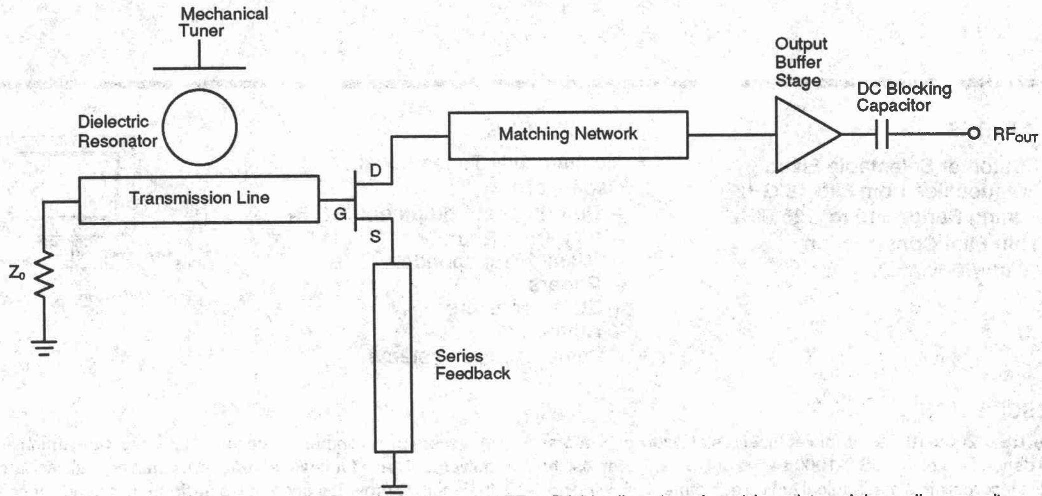
ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications at –54 to +85°C Case Temperature

Model No.	See Page 11–3 For Model Number Selection		
Frequency Range[1]	6000–7999 MHz	8000–11999 MHz	12000–18000 MHz
Mechanical Tuning Range, Min.	±10 MHz	±25 MHz	±25 MHz
Power Output into 50-ohm Load, Min.	10 mW/+10 dBm	10 mW/+10 dBm	10 mW/+10 dBm
Power Output Variation Over Temperature, Max.	3 dB	3 dB	3 dB
Frequency Accuracy (Under All Conditions) Max.[2]	0.1%	0.1%	0.1%
Temperature Stability, Max.	±0.05%	±0.05%	±0.05%
Pulling Figure (12 dB Return Loss), Max.	±0.02%	±0.02%	±0.02%
Pushing Figure, +15 VDC Supply, Max.	±0.001%	±0.001%	±0.001%
Harmonics, Below Carrier, Max.	–20 dBc	–20 dBc	–20 dBc
Spurious Output Below Carrier, Max.	–60 dBc	–60 dBc	–60 dBc
Phase Noise, Single Sideband			
1 Hz Bandwidth, Typical			
10 kHz From Carrier	–90 dBc	–90 dBc	–80 dBc
100 kHz From Carrier	–102 dBc	–102 dBc	–95 dBc
Input Power			
Voltage	+15±.5 VDC	+15±.5 VDC	+15±.5 VDC
Current, Max.	75 mA	75 mA	75 mA
Case Style	OD-22	OD-22	OD-12
Weight, Max.	3.0 oz.	3.0 oz.	2.0 oz.

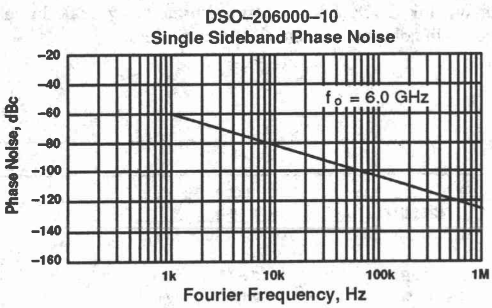
NOTES:
1. Center frequencies are customer selectable and may be specified to the MHz. Center frequencies are set at +25°C. See page 11–3 for part number selection.
2. The oscillator will stay within the frequency accuracy of the customer specified frequency under all conditions including the full temperature range, load pulling, frequency pushing, and aging.

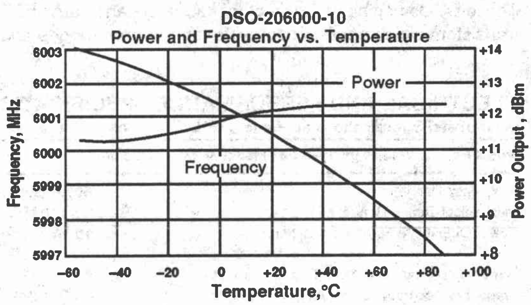
SCHEMATIC

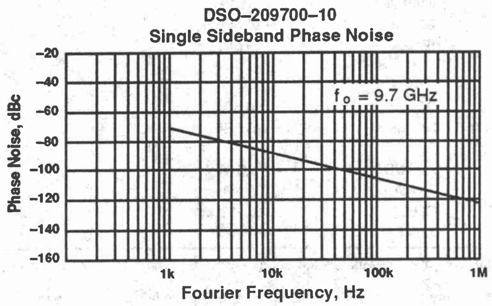


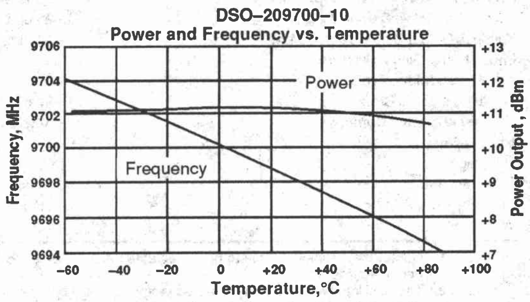
NOTE 1: DC bias lines (not shown) have internal decoupling capacitors.

TYPICAL PERFORMANCE @ 25°C Case Temperature



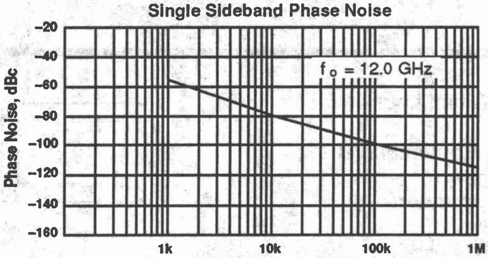




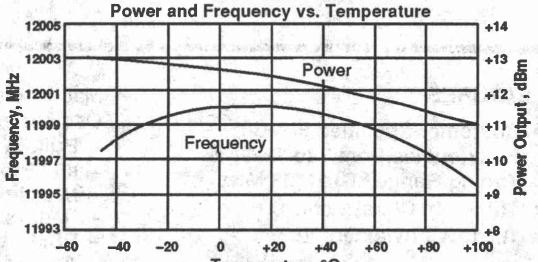


TYPICAL PERFORMANCE (continued)

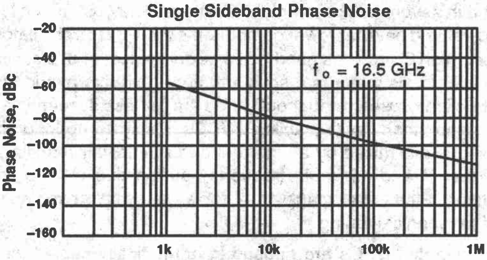
DSO–212000–10
Single Sideband Phase Noise



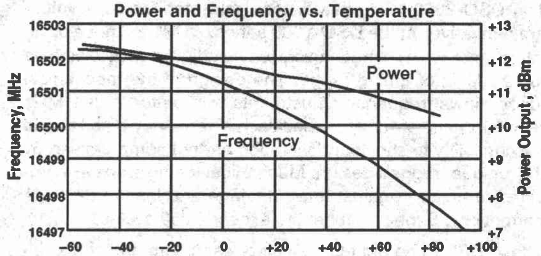
DSO–212000–10
Power and Frequency vs. Temperature



DS0–216500–10
Single Sideband Phase Noise



DS0–216500–10
Power and Frequency vs. Temperature



AVANTEK

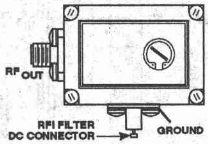
DSO-2000-13 Series Mechanically Tuned Dielectrically-Stabilized Oscillators 3 to 12 GHz

FEATURES

- Customer Specified Fixed Frequencies from 3 to 12 GHz
- Tuning Range ±6 to ±25 MHz
- Thin-Film Construction
- 100 mW Power Output

APPLICATIONS

- Mechanically Tuned Local Oscillators
  - Built-in Test Equipment (BITE)
  - IFM Front Ends
  - Missile Transponders
  - Radars
  - ECM Receivers
  - Altimeters
- Communication Systems



OD-62, OD-72, OD-82, p. 16–32

DESCRIPTION

The DSO-2000-13 Series dielectrically-stabilized oscillators are derivatives of the DSO-1000 series of DSOs. These oscillators incorporate a mechanical tuning adjustment allowing up to ±25 MHz of tuning range. The design of the mechanical tuner allows frequency adjustments with better than 1 MHz resolution and virtually no backlash. Frequency stability and susceptibility to shock and vibration are not compromised by this unique, rugged design. Mechanical tuning stops are provided to ensure against tuner damage and loss of package hermeticity. Expected tuner life exceeds 250 cycles.

These DSOs use high-Q dielectric resonators and silicon bipolar resistors which operate over wide temperature ranges and in severe environmental conditions. They use much less power and have far fewer components than crystal oscillators; their high Q provides good noise performance; and, since the dielectric resonator is a solid structure (thin-film hybrid construction is used throughout), they are far less susceptible to vibration than cavity stabilized VCOs. Oscillator-to-load coupling is minimized by an internal buffer amplifier resulting in higher Q and minimum frequency pulling due to load variations. Please see page 11–2 for a descriptive explanation of mechanical tuning.

All Avantek DSOs are housed in hermetically sealed packages with field replaceable SMA connectors.

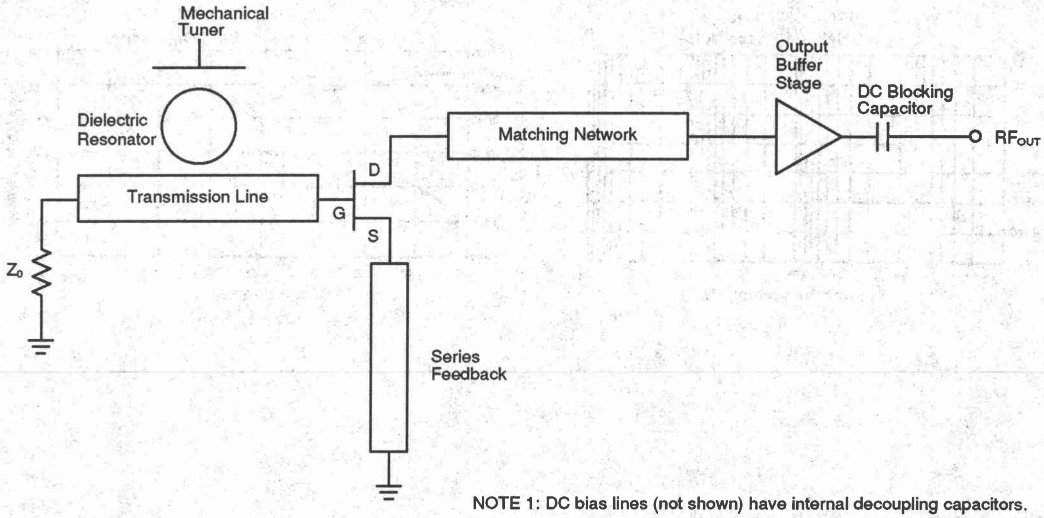
ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications at –54 to +85°C Case Temperature

Model No.	See Page 11–3 For Model Number Selection		
Frequency Range[1]	3000–4499 MHz	4500–7999 MHz	8000–11999 MHz
Mechanical Tuning Range, Min.	±6 MHz	±10 MHz	±25 MHz
Power Output into 50-ohm Load, Min.	20 mW/+13 dBm	20 mW/+13 dBm	20 mW/+13 dBm
Power Output Variation Over Temperature, Max.	3 dB	3 dB	3 dB
Frequency Accuracy (Under All Conditions) Max.[2]	0.1%	0.1%	0.1%
Temperature Stability, Max.	±0.05%	±0.05%	±0.05%
Pulling Figure (12 dB Return Loss), Max.	±0.02%	±0.02%	±0.02%
Pushing Figure, +15 VDC Supply, Max.	±.001%	±0.001%	±0.001%
Harmonics, Below Carrier, Max.	–20 dBc	–20 dBc	–20 dBc
Spurious Output Below Carrier, Max.	–60 dBc	–60 dBc	–60 dBc
Phase Noise, Single Sideband			
1 Hz Bandwidth, Typical			
10 kHz From Carrier	–100 dBc	–100 dBc	–90 dBc
100 kHz From Carrier	–125 dBc	–125 dBc	–115 dBc
Input Power			
Voltage	+15±.5 VDC	+15±.5 VDC	+15±.5 VDC
Current, Max.	100 mA	75 mA	150 mA
Case Style	OD-62	OD-72	OD-82
Weight, Max.	7.5 oz.	5.5 oz.	3.5 oz.

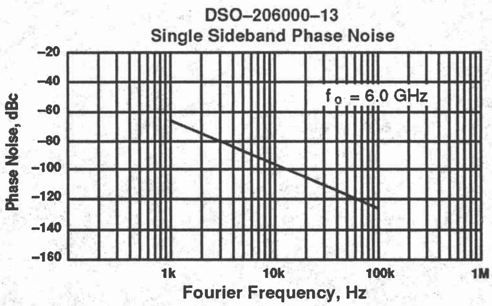
NOTES: 1. Center frequencies are customer selectable and may be specified to the MHz. Center frequencies are set at +25°C. See page 11–3 for part number selection.
2. The oscillator will stay within the frequency accuracy of the customer specified frequency under all conditions including the full temperature range, load pulling, frequency pushing, and aging.

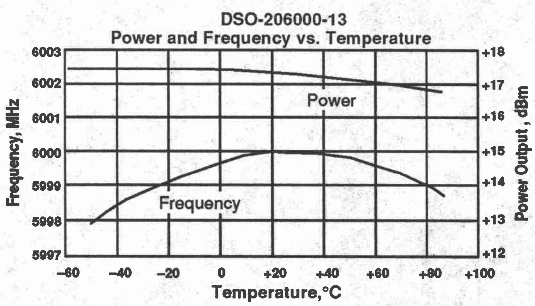
SCHEMATIC

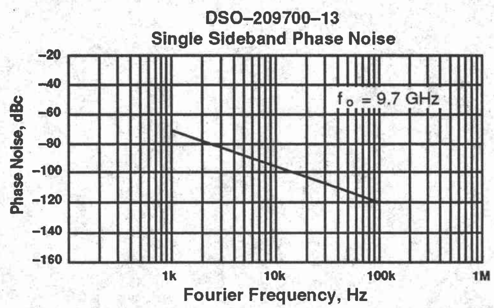


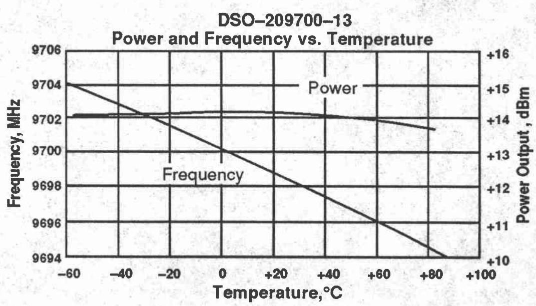
NOTE 1: DC bias lines (not shown) have internal decoupling capacitors.

TYPICAL PERFORMANCE @ 25°C Case Temperature



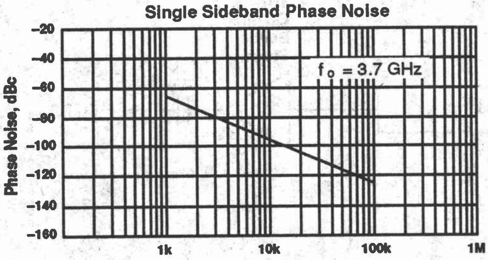




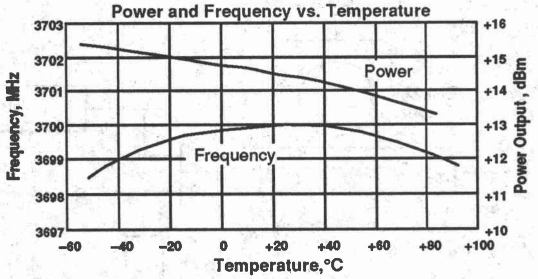


TYPICAL PERFORMANCE (continued)

DSO–203700–13
Single Sideband Phase Noise



DS0–203700–13
Power and Frequency vs. Temperature



AVANTEK

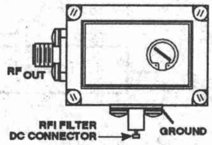
DSO-2000-20 Series Mechanically Tuned Dielectrically-Stabilized Oscillators 3 to 12 GHz

FEATURES

- Customer Specified Fixed Frequencies from 3 to 12 GHz
- Tuning Range ±6 to ±25 MHz
- Thin-Film Construction
- 100 mW Power Output

APPLICATIONS

- Mechanically Tuned Local Oscillators
  - Built-In Test Equipment (BITE)
  - IFM Front Ends
  - Missile Transponders
  - Radars
  - ECM Receivers
  - Altimeters
- Communication Systems



OD-62, OD-72, OD-82, p. 16–32

DESCRIPTION

The DSO-2000-20 Series dielectrically-stabilized oscillators are derivatives of the DSO-1000 series of DSOs. These oscillators incorporate a mechanical tuning adjustment allowing up to ±25 MHz of tuning range. The design of the mechanical tuner allows frequency adjustments with better than 1 MHz resolution and virtually no backlash. Frequency stability and susceptibility to shock and vibration are not compromised by this unique, rugged design. Mechanical tuning stops are provided to ensure against tuner damage and loss of package hermeticity. Expected tuner life exceeds 250 cycles.

These DSOs use high-Q dielectric resonators which operate over wide temperature ranges and in severe environmental conditions. They use much less power and have far fewer components than crystal oscillators; their high Q provides good noise performance; and, since the dielectric resonator is a solid structure (thin-film hybrid construction is used throughout), they are far less susceptible to vibration than cavity stabilized VCOs. Oscillator-to-load coupling is minimized by an internal buffer amplifier resulting in higher Q and minimum frequency pulling due to load variations. Please see page 11–2 for a descriptive explanation of mechanical tuning.

All Avantek DSOs are housed in hermetically sealed packages with field replaceable SMA connectors.

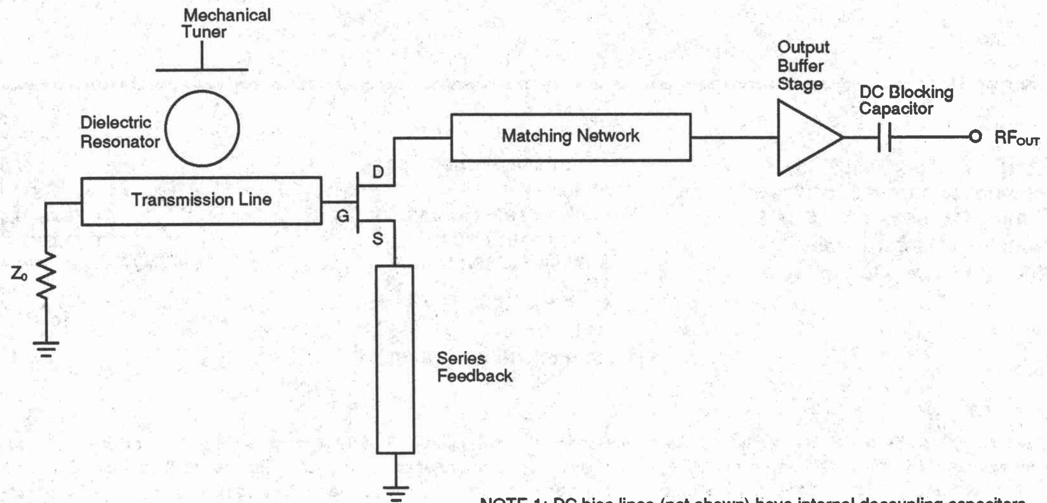
ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications at −54 to +85°C Case Temperature

Model No.	See Page 11–3 For Model Number Selection		
Frequency Range[1]	3000–4499 MHz	4500–7999 MHz	8000–11999 MHz
Mechanical Tuning Range, Min.	±6 MHz	±10 MHz	±25 MHz
Power Output into 50-ohm Load, Min.	100 mW/+20 dBm	100 mW/+20 dBm	100 mW/+20 dBm
Power Output Variation Over Temperature, Max.	3 dB	3 dB	3 dB
Frequency Accuracy (Under All Conditions) Max.[2]	0.1%	0.1%	0.1%
Temperature Stability, Max.	±0.05%	±0.05%	±0.05%
Pulling Figure (12 dB Return Loss), Max.	±0.02%	±0.02%	±0.02%
Pushing Figure, +15 VDC Supply, Max.	±.001%	±0.001%	±0.001%
Harmonics, Below Carrier, Max.	−20 dBc	−20 dBc	−20 dBc
Spurious Output Below Carrier, Max.	−60 dBc	−60 dBc	−60 dBc
Phase Noise, Single Sideband			
1 Hz Bandwidth, Typical			
10 kHz From Carrier	−100 dBc	−100 dBc	−90 dBc
100 kHz From Carrier	−125 dBc	−125 dBc	−115 dBc
Input Power			
Voltage	+15±.5 VDC	+15±.5 VDC	+15±.5 VDC
Current, Max.	250 mA	250 mA	300 mA
Case Style	OD-62	OD-72	OD-82
Weight, Max.	7.5 oz.	5.5 oz.	3.5 oz.

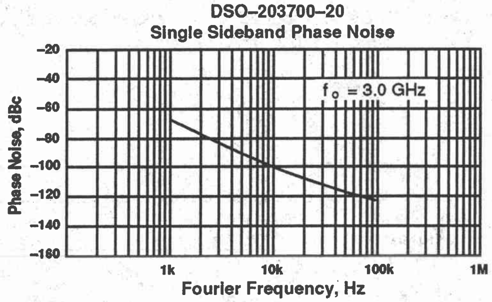
NOTES:
1. Center frequencies are customer selectable and may be specified to the MHz. Center frequencies are set at +25°C. See page 11–3 for part number selection.
2. The oscillator will stay within the frequency accuracy of the customer specified frequency under all conditions including the full temperature range, load pulling, frequency pushing, and aging.

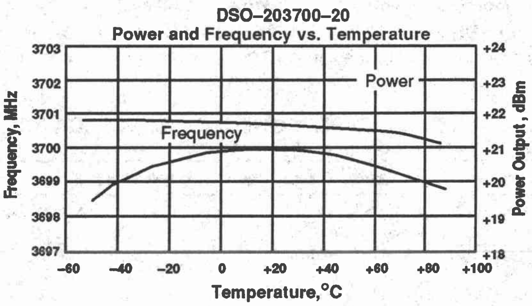
SCHEMATIC

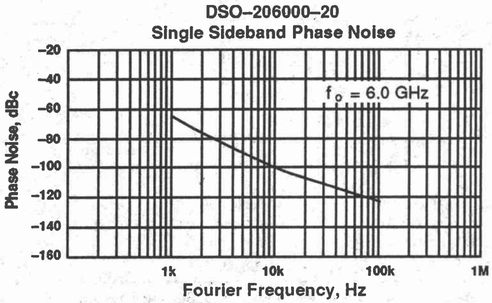


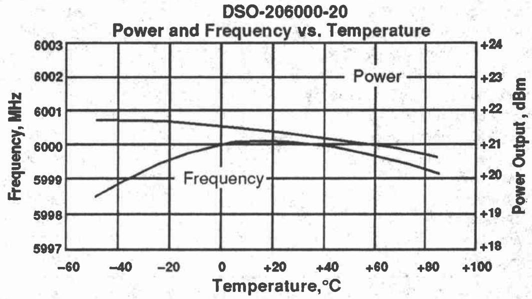
NOTE 1: DC bias lines (not shown) have internal decoupling capacitors.

TYPICAL PERFORMANCE @ 25°C Case Temperature

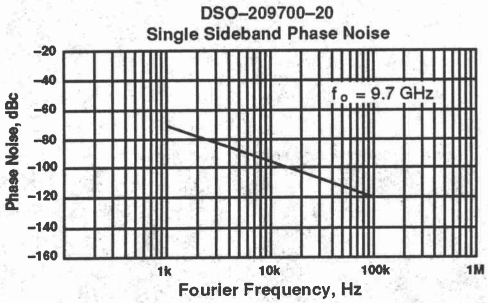


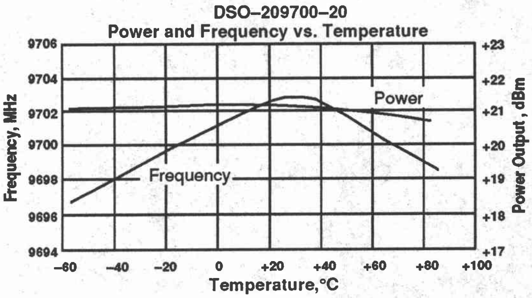


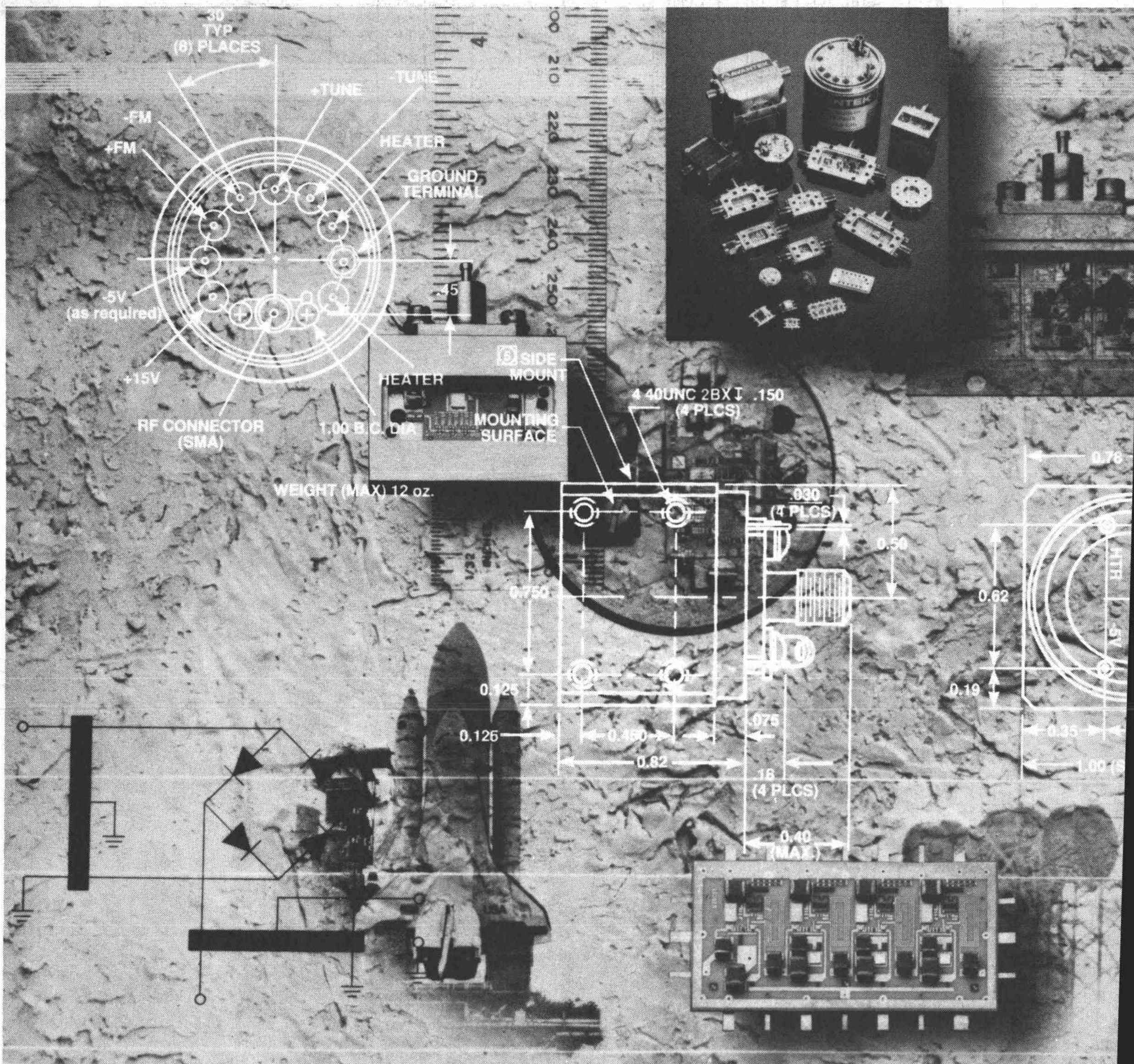




TYPICAL PERFORMANCE (continued)







30°
TYP
(8) PLACES
+TUNE
-TUNE
-FM
+FM
HEATER
GROUND
TERMINAL
-5V
(as required)
+15V
RF CONNECTOR
(SMA)
1.00 B.C. DIA
HEATER
SIDE
MOUNT
MOUNTING
SURFACE
WEIGHT (MAX) 12 oz.
4 40UNC 2BX ↧ .150
(4 PLCS)
.030
(4 PLCS)
0.50
0.750
0.125
0.126
0.450
0.82
.075
.16
(4 PLCS)
0.40
(MAX)
0.62
0.19
0.35
0.78

YIG-TUNED OSCILLATORS

PRODUCT DESCRIPTION

Avantek offers an ever expanding line of YIG-Tuned Oscillators in two temperature ranges with frequency expansion into the millimeter band. Frequency coverage from 0.5 to 50 GHz, combined with the industry's highest output power levels, lowest phase noise, harmonics, and smallest package size make these YTOs unique.

All Avantek YIG-Tuned fundamental transistors, used in both commercial and military applications, share a number of unique features which add to the performance and assured reliability under severe conditions. All are built using thin-film construction which offers uniformity and repeatability. Packaging is in a hermetically sealed case filled with a dry inert atmosphere to exclude all moisture and corrosive elements from the internal components.

Tuning curves, I_{tuning} vs. f_{out}, for the Avantek YTOs are extremely linear with deviation typically between ±0.05% and 0.2%. In addition to the main tuning coil, each YTO has a low inductance FM tuning coil. This coil is in close proximity to the YIG sphere and is used to fine-tune the oscillator frequency, to phase lock the YTO, or to frequency modulate the output signal. The sensitivity of this port is much less than that of the main tuning coil, but it has a much wider 3 dB bandwidth and permits input modulation or control signals to deviate the output frequency by as much as 15 to 100 MHz at up to a 1 MHz rate. Also, the rate can be increased to greater than 10 MHz with the removal of the FM feedthrough capacitors.

The power output remains flat within 3.0 to 6.0 dB over the entire tuning range.

Series

The entire Avantek YTO line is divided into several series depending on the application or requirement.

A brief description is provided for each series, as well as a quick selection guide to determine the series vs. frequency range, and catalog page number.

YIG-Tuned Oscillators: Standard Temperature Range(0° to +65°C)

Frequency coverage is from 0.5 to 18 GHz in octave band, multi-octave band, and wideband segments. This series also includes the low phase noise bipolar oscillators, low harmonic oscillators and oscillators with tracking filter units. Included in the multi-octave band region is the new one-inch cube packaged unit initially covering the 4 to 12.4 GHz band.

All units are designed for wideband applications in receivers and instruments where tuning linearity, phase noise, and spectral purity are crucial. They make ideal oscillators for frequency agile receivers and spectrum analyzers, and are excellent as signal sources for microwave sweep generators and synthesizers.

YIG-Tuned Oscillators: Millimeter Band

These YTOs provide frequency coverage from 18.0 GHz up to 50.0 GHz in both the 0° to +65°C, T_{case} (18-50 GHz) and –54° to +85°C, T_{case} (18 to 26.5 and 26.5 to 40 GHz) versions.

The Avantek millimeter series oscillators are all fundamental output GaAs FET units offering similar advantages as the lower frequency units.

The frequency ranges are divided into various bands such as 18 to 26.5 GHz, 26.5 to 40 GHz and 33 to 50 GHz for standard use. Other ranges offered are ideal for applications with a doubler or tripler to meet the higher frequency standard waveguide bands.

Avantek millimeter units offer the advantage of low power consumption (3.0W) compared to the approximately 15W necessary to power a GUNN or Impatt diode oscillator in similar frequencies.

Overall, the Avantek Millimeter Band YTOs are an excellent choice for all applications where efficiency, tuning linearity and spectral purity are important. They are ideal local oscillators for frequency agile receivers and spectrum analyzers, and make excellent signal sources for microwave sweep generators and synthesizers.

YIG-Tuned Oscillators: Extended Temperature Range (–54° to +85°C)

Avantek extended temperature range YTOs are designed and manufactured to offer excellent performance and high MTBFs over the –54° to +85C° temperature range. They also meet the environmental conditions of MIL-E-5400 and MIL-E-16400.

This family of YTOs offers complete 1 to 18 GHz frequency coverage and are ideal for systems requiring signal sources with moderate power levels, excellent tuning linearity, low spurious outputs, and flat power output vs. frequency characteristics.

YIG-TUNED OSCILLATORS SELECTION GUIDE

OCTAVE BAND OSCILLATORS

Guaranteed Specifications @ 0° to +65°C Case Temperature

Model Number	Frequency Range (GHz)	Power Output @ 25°C (dBm) Minimum	Power Variation (dB) Maximum	Frequency Drift Over Temperature (MHz) Maximum	Second Harmonic Below Carrier @ 25°C Minimum	Page Number
AV-7104	1.0–2.2	+16	3	10	–15	12–6
AV-7203	2–4	+14	3	10	–12	12–6
AV-7204	2–4	+16	3	10	–20	12–6
AV-7224	2–4	+20	3	10	–12	12–6
AV-7403	4–8	+13	6	20	–12	12–7
AV-7453	4–8	+17	6	20	–12	12–7
AV-7443	4–8	+20	6	20	–12	12–7
AV-77011	7–11	+17.8	6	25	–12	12–7
AV-7871	8–12.4	+14.8	6	25	–12	12–7
AV-7872	8–12.4	+17.8	6	25	–12	12–7
AV-7873	8–12.4	+20	6	25	–12	12–7
AV-71241	12–18	+13	6	40	–12	12–7
AV-71251	12–18	+16	6	40	–12	12–7
AV-71261	12–18	+19	6	40	–12	12–7

MULTI-OCTAVE BAND OSCILLATORS

Guaranteed Specifications @ 0° to +65°C Case Temperature

Model Number	Frequency Range (GHz)	Power Output @ 25°C (dBm) Minimum	Power Variation (dB) Maximum	Frequency Drift Over Temperature (MHz) Maximum	Second Harmonic Below Carrier @ 25°C (dBc) Minimum	Page Number
AV-70502	0.5–2	+14.8	6	10	–10	12–10
AV-7124	1–4	+14.8	6	10	–12	12–10
AV-7236	2–6	+13	6	15	–12	12–10
AV-7288	2–8	+20	6	20	–8	12–10
AV-7238	2–8	+14.8	6	20	–12	12–10
AV-72B8	2–8	+23	6	20	10	12–11
AV-72010	2–10	+14	6	20	–12	12–11
AV-74010	4–10	+16	6	20	–12	12–11
AV-76018	6–18	+14.8	6	40	–10	12–11
AV-77016	7–16	+17	6	40	–12	12–11
AV-78318	8–18	+10	6	40	–12	12–11
AV-78218	8–18	+14.8	6	40	–12	12–11
AV-78518	8–18	+17.8	6	40	–12	12–11
AV-78020	8–20	+13	8	40	–12	12–11
AV-71220	12–20	+16	6	40	–15	12–11

MULTI-OCTAVE BAND OSCILLATORS—ONE-INCH CUBE PACKAGE

Guaranteed Specifications @ 0° to +65°C Case Temperature

Model Number	Frequency Range (GHz)	Power Output @ 25°C (dBm) Minimum	Power Variation (dB) Maximum	Frequency Drift Over Temperature (MHz) Maximum	Second Harmonic Below Carrier @ 25°C Minimum	Page Number	
AV-7134	1.2–4.0	+13	6	15	–12	12–13	New
AV-74012	4–12.4	+16	6	20	–12	12–13	
AV-12218	12–18	+16	6	30	–20	12–13	New

WIDEBAND OSCILLATORS

Guaranteed Specifications @ 0° to +65°C Case Temperature

Model Number	Frequency Range (GHz)	Power Output @ 25°C (dBm) Minimum	Power Variation (dB) Maximum	Frequency Drift Over Temperature (MHz) Maximum	Second Harmonic Below Carrier @ 25°C Minimum	Page Number
AV-74018	4–18	17	6	40	–10	12–16
AV-73018	3–18	13	6	40	–8	12–16
AV-72018	2–18	13	6	30	–8	12–16
AV-72012	2–12.4	16	6	25	–10	12–16

YIG-TUNED OSCILLATORS SELECTION GUIDE (continued)

LOW NOISE BIPOLAR OSCILLATORS
Guaranteed Specifications @ 0° to +65°C Case Temperature

Model Number	Frequency Range (GHz)	Power Output @ 25°C (dBm) Minimum	Power Variation (dB) Maximum	Frequency Drift Over Temperature (MHz) Maximum	Second Harmonic @ 25°C Below Carrier (dBc) Minimum	Noise dBc/Hz @ 20 kHz	Page Number
AV-7298	2–8	+14.8	6	20	–12	–108	12–20
AV-72810	2–10	+14.0	6	20	–12	–108	12–20
AV-12018	12–18	+17	6	40	–20	–100 (12–16 GHz)*	12–20
AV-76318	6–18	+16	6	40	–10	–100 (6–16 GHz)*	12–20
AV-78012	8–12.4	+17.8	6	25	–12	–105	12–20
AV-78718	8–18	+16	6	40	–15	–100 (8–16 GHz)*	12–20

*Refer to actual specifications for additional phase noise information.

LOW HARMONIC OSCILLATORS
Guaranteed Specifications @ 0° to +65°C CaseTemperature

Model Number	Frequency Range (GHz)	Power Output @ 25°C (dBm) Minimum	Power Variation (dB) Maximum	Frequency Drift Over Temperature (MHz) Maximum	Second Harmonic Below Carrier @ 25°C Maximum	Page Number
AV-7104–9	1.0–2.2	+16	3	10	–20	12–22
AV-7224–9	2–4	+20	3	10	–20	12–22
AV-7238-9	2-8	+14.8	6	20	–20	12–22
AV-7403–9	4–8	+13	6	20	–20	12–22
AV-7453–9	4–8	+16	6	20	–20	12–22
AV-7443–9	4–8	+17.8	6	20	–20	12–23
AV-7871–9	8–12.4	+14.8	6	25	–20	12–23
AV-7872–9	8–12.4	+17.8	6	20	–20	12–23
AV-7873–9	8–12.4	+20	6	25	–20	12–23
AV-78020-9	8-20	+13	8	40	–20	12–23
AV-71241–9	12–18	+13	6	40	–20	12–23
AV-71251–9	12–18	+14.8	6	40	–20	12–23
AV-71261–9	12–18	+17	6	40	–20	12–23

OSCILLATOR WITH TRACKING YIG FILTER
Guaranteed Specifications @ 0° to +65°C Case Temperature

Model Number	Frequency Range (GHz)	Power Output @ 25°C (dBm) Minimum	Power Variation (dB) Maximum	Frequency Drift Over Temperature (MHz) Maximum	Second Harmonic Below Carrier @ 25°C Maximum	Page Number
AV-7248	2–8	+14.8	6	20	40	12–25

MILLIMETER BAND OSCILLATORS
Guaranteed Specifications @ 0° to +65°C CaseTemperature

Model Number	Frequency Range (GHz)	Power Output @ 25°C (dBm) Minimum	Power Variation (dB) Maximum	Frequency Drift Over Temperature (MHz) Maximum	Second Harmonic Below Carrier @ 25°C Maximum	Page Number
AV-71826	18–26.5	+13	6	60	—	12–28
AV-718226	18–26.5	+16	6	60	—	12–28
AV-18326	18–26.5	+17.8	6	40	—	12–28
AV-18030	18–30	+16	6	60	—	12–28
AV-20030	20–30	+16	6	60	—	12–28
AV-25037M/W	25–37.5	+13	4	60	—	12–28
AV-26040M/W	26.5–40	+10	6	60	—	12–28
AV-26240M/W	26.5–40	+13	4	60	—	12–29
AV-30045	30–45	+10	6	60	—	12–29
AV-33050	33–50	+7	6	60	—	12–29

YIG-TUNED OSCILLATORS SELECTION GUIDE (continued)

OCTAVE BAND OSCILLATORS—EXTENDED TEMPERATURE RANGE

Guaranteed Specifications @ –54° to +85°C Case Temperature

Model Number	Frequency Range (GHz)	Power Output Over Temperature & Frequency (dBm) Minimum	Power Output Over Temperature & Frequency (dBm) Maximum	Frequency Drift Over Temperature (MHz) Maximum	Second Harmonic Below Carrier (dBc), Minimum	Page Number
AV-7214	2–4	+17	+23	20	–12	12–34
AV-7413	4–8	+8	+20	40	–12	12–34
AV-7418	4–8	+14.8	+23	40	–12	12–34
AV-77111	7–11	+17	+24	40	–12	12–34
AV-7814	8–12.4	+13	+24	50	–10	12–34
AV-78112	8–12.4	+19	+24	50	–12	12–34
AV-12118	12–18	+16	+23	60	–15	12–34

MULTI-OCTAVE BAND OSCILLATORS—EXTENDED TEMPERATURE RANGE

Guaranteed Specifications –54° to +85°C Case Temperature

Model Number	Frequency Range (GHz)	Power Output Over Temperature & Frequency (dBm) Minimum	Power Output Over Temperature & Frequency (dBm) Maximum	Frequency Drift Over Temperature (MHz) Maximum	Second Harmonic Below Carrier (dBc) Minimum	Page Number
AV-7114	1–4	+13	+21	20	12	12–36
AV-7246	2–6	+16	+23	30	8	12–36
AV-7218	2–8	+5	+17	40	5	12–36
AV-7278	2–8	+14.8	+23	40	8	12–36
AV-76118	6–18	+13	+23	60	8	12–36
AV-77116	7–16	+16	+24	50	12	12–36
AV-78418	8–18	+13	+24	70	10	12–36
AV-78618	8–18	+16	+24	60	10	12–36

MILLIMETER BAND OSCILLATORS—EXTENDED TEMPERATURE RANGE

Guaranteed Specifications @ –54° to +85°C Case Temperature

Model Number	Frequency Range (GHz)	Power Output Over Temperature & Frequency (dBm) Minimum	Power Output Over Temperature & Frequency (dBm) Maximum	Frequency Drift Over Temperature (MHz) Maximum	Second Harmonic Below Carrier (dBc) Minimum	Page Number
AV-18126	18–26.5	+16	+23	60	—	12–29
AV-26140M/W	26.5–40	+13	+19	60	—	12–29

LOW COST OSCILLATORS—LUCY SERIES

Guaranteed Specifications @ 0° to +50°C Case Temperature

Model Number	Frequency Range (GHz)	Power Output @ 25°C (dBm) Minimum	Power Variation (dB) Maximum	Frequency Drift Over Temperature (MHz) Maximum	Second Harmonic Below Carrier @ 25°C Maximum	Page Number
AV-7028	2–8	+13	6	10	8	12–30
AV-7036	3–6	+13	4	5	8	12–30

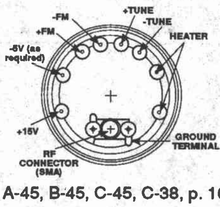
New

AVANTEK

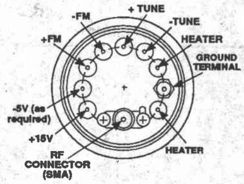
Octave Band YIG-Tuned Oscillators

FEATURES

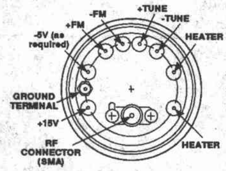
- **Full 1.0 to 18 GHz Coverage**
- **Rugged Hermetic Packaging**
- **Reliable Thin-Film Construction**
- **±0.05% to ±0.2% Tuning Linearity**
- **0° to +65°C, Temperature Range**



A-45, B-45, C-45, C-38, p. 16–2



M4-45, p. 16–24



M3-45, M3-60, p. 16–24

DESCRIPTION

Avantek® Octave Band Series YIG-tuned fundamental transistor oscillators are compact and lightweight and are cost-effective for commercial instrument applications. They are built using the same Avantek thin-film construction and hermetic packaging that has proven itself ultimately reliable under severe military and aerospace environmental conditions.

This family of oscillators is designed for wideband applications in receivers and instruments where tuning linearity and spectral purity are crucial. They make ideal local oscillators for frequency-agile receivers and spectrum analyzers, and are excellent as signal sources for microwave sweep generators and synthesizers.

The tuning curves (I_{tuning} vs. f_{out}) for this series of YTOs are linear, and will deviate from the ideal straight line only ±0.05% to ±0.2% (typically). The power output remains flat within ±1.5 to ±3.0 dB over the entire tuning range.

These oscillators have compatible tuning port characteristics of 20 MHz/mA and 5 kHz bandwidth up to 12.4 GHz. This helps to simplify the design of multiband equipment and minimizes the number of current drives necessary. All Octave Band Series oscillators have a low inductance FM tuning coil in addition to the main tuning coil. This coil is in close proximity to the YIG sphere and is used to fine-tune the oscillator frequency, to phase lock the YTO or to frequency modulate the output signal. The sensitivity of this port is much less than that of the main tuning coil, but it has a much wider 3 dB bandwidth and permits input modulation or control signals to deviate the output frequency by as much as 15 to 100 MHz at a rate up to 1 MHz.

ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications at 0° to +65°C Case Temperature (Unless Otherwise Noted)

Model No.	AV–7104	AV–7203	AV–7204	AV–7224
Frequency Range, Min.	1-2.2 GHz	2-4 GHz	2-4 GHz	2-4 GHz
Power Output into 50-ohm Load, Min. at 25°C	40 mW/+16 dBm	25 mW/+14 dBm	40 mW/+16 dBm	100 mW/+20 dBm
Power Output Variation vs. Frequency, Max.	3.0 dB	3.0 dB	3.0 dB	3.0 dB
Operating Case Temperature Range	0° to +65°C	0° to +65°C	0° to +65°C	0°to +65°C
Frequency Drift Over Operating Temperature, Max.	10 MHz	10 MHz	10 MHz	10 MHz
Pulling Figure (12 dB Return Loss), Typ.	.01 MHz	0.5 MHz	0.5 MHz	0.5 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.5 MHz/V	0.5 MHz/V	0.5 MHz/V	0.1 MHz//V
–5 VDC Supply, Typ.	N/A	N/A	N/A	1.5 MHz/V
Magnetic Susceptibility @ 60 Hz, Typ.	70 kHz/Gauss	70 kHz/Gauss	70 kHz/Gauss	70 kHz/Gauss
2nd Harmonic, @ 25°C, Min.	–15 dBc	–12 dBc	–20 dBc	–12 dBc
3rd Harmonic, @ 25°C, Min.	–20 dBc	–20 dBc	–20 dBc	–12 dBc
Spurious Output, Min.	–60 dBc	–60 dBc	–60 dBc	–60 dBc
Main Tuning Port Characteristics				
Sensitivity	20±1 MHz/mA	20±1 MHz/mA	20±1 MHz/mA	20±1 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	5 kHz	5 kHz	5 kHz
Linearity, Typ	±.1%	±.05%	±.05%	±.05%
Hysteresis, Typ.	1.7 MHz	3 MHz	3 MHz	3 MHz
Input Impedance @ 1 kHz, Typ.	10 ohms in series with 95 mH	10 ohms in series with 95 mH	10 ohms in series with 95 mH	10 ohms in series with 95 mH
FM Port Characteristics				
Sensitivity, Typ.	310 kHz/mA	310 kHz/mA	310 kHz/mA	310 kHz/mA
3 dB Bandwidth, Typ.	800 kHz	800 kHz	800 kHz	800 kHz
Deviation at 3 dB Bandwidth, Max.	15 MHz	20 MHz	20 MHz	20 MHz
Input Impedance @ 1 MHz, Typ.	1 ohm in series with 1.7 µH	1 ohm in series with 1.7 µH	1 ohm in series with 1.7 µH	1 ohm in series with 1.7 µH
DC Circuit Power, Max.				
+15±0.5V	150 mA	100 mA	90 mA	150 mA
–5±0.1V	—	—	$+V_C$@ 35 mA*	60 mA
YIG Heater Power				
Input Voltage Range	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC
Power @ 25°C, Max.	1.5 watts	1.5 watts	1.5 watts	1.5 watts
Power @ 0°C, Max.	2.0 watts	2.0 watts	2.0 watts	2.0 watts
Weight, Max.	10 oz.	10 oz.	10 oz.	10 oz.
Case Style	A-45	A-45	B-45	C-45

*Terminal V_C requires a linear voltage ramp proportional to frequency. The voltage at 2 GHz is factory selected within the range +7 to +13 volts and the voltage at 4 GHz is +15.0 volts.

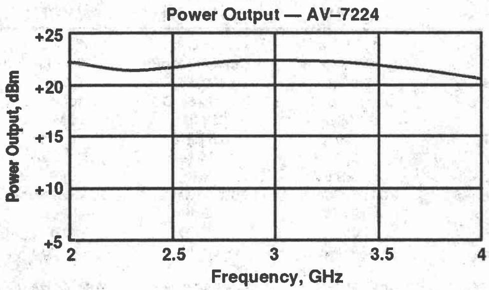
ELECTRICAL AND PERFORMANCE SPECIFICATIONS (continued)

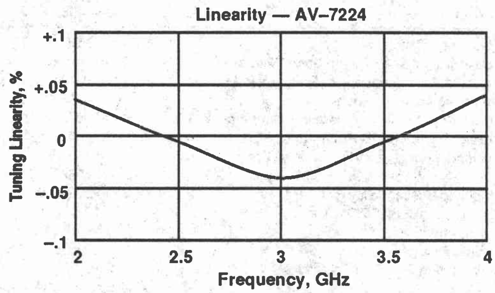
Guaranteed Specifications at 0 to +65°C Case Temperature (Unless Otherwise Noted)

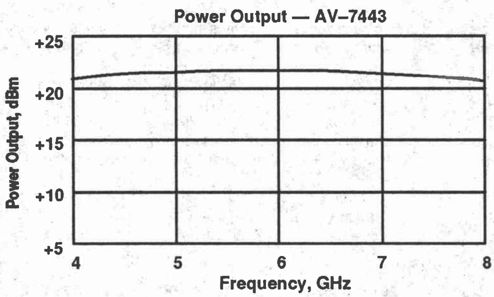
Model No.	AV–7403	AV–7453	AV–7443	AV–77011	AV–7871
Frequency Range, Min.	4–8 GHz	4–8 GHz	4–8 GHz	7-11 GHz	8–12.4 GHz
Power Output into 50-ohm Load, Min. at 25°C	20 mW/+13 dBm	50 mW/+17 dBm	100 mW/+20 dBm	60 mW/+17.8 dBm	30 mW/+14.8 dBm
Power Output Variation vs. Frequency, Max.	6.0 dB	6.0 dB	6.0 dB	6.0 dB	6.0 dB
Operating Case Temperature Range	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C
Frequency Drift Over Operating Temperature, Max.	20 MHz	20 MHz	20 MHz	25 MHz	25 MHz
Pulling Figure (12 dB Return Loss), Typ.	2.0 MHz	0.5 MHz	0.2 MHz	0.5 MHz	5.0 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.5 MHz/V	0.1 MHz/V	0.1 MHz/V	0.1 MHz//V	0.1 MHz/V
–5 VDC Supply, Typ.	1.5 MHz/V	1.5 MHz/V	2.0 MHz/V	N/A	N/A
Magnetic Susceptibility @ 60 Hz, Typ.	70 kHz/Gauss	70 kHz/Gauss	70 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss
2nd Harmonic, @ 25°C, Min.	–12 dBc	–12 dBc	–12 dBc	–12 dBc	–12 dBc
3rd Harmonic, @ 25°C, Min.	–20 dBc	–20 dBc	–20 dBc	–15 dBc	–20 dBc
Spurious Output, Min.	–60 dBc	–60 dBc	–60 dBc	–60 dBc	–60 dBc
Main Tuning Port Characteristics					
Sensitivity	20±1 MHz/mA	20±1 MHz/mA	20±1 MHz/mA	20±1 MHz/mA	20±1 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	5 kHz	5 kHz	5 kHz	5 MHz
Linearity, Typ.	±.05%	±.05%	±.05%	±.01%	±.01%
Hysteresis, Typ.	6 MHz	6 MHz	6 MHz	6 MHz	6 MHz
Input Impedance @ 1 kHz, Typ.	10 ohms in series with 95 mH	10 ohms in series with 95 mH	10 ohms in series with 95 mH	9 ohms in series with 60 mH	9 ohms in series with 60 mH
FM Port Characteristics					
Sensitivity, Typ.	310 kHz/mA	310 kHz/mA	310 kHz/mA	450 kHz/mA	450 kHz/mA
3 dB Bandwidth, Typ.	800 kHz	800 kHz	800 kHz	400 kHz	400 kHz
Deviation at 3 dB Bandwidth, Max.	40 MHz	40 MHz	40 MHz	70 MHz	40 MHz
Input Impedance @ 1 MHz, Typ.	1 ohm in series with 1.7 µH	1 ohm in series with 1.7 µH	1 ohm in series with 1.7 µH	.5 ohm in series with 2 µH	.5 ohm in series with 2 µH
DC Circuit Power, Max. +15±0.5V	40 mA	150 mA	200 mA	—	—
–5±.0.1V	40 mA	60 mA	60 mA	—	—
+15+0.5/–3.5V	—	—	—	300 mA	125 mA
YIG Heater Power					
Input Voltage Range	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC
Power @ 25°C, Max.	1.5 watts	1.5 watts	1.5 watts	1.5 watts	1.5 watts
Power @ 0°C, Max.	2.0 watts	2.0 watts	2.0 watts	2.0 watts	2.0 watts
Weight, Max.	10 oz.	10 oz.	10 oz.	12 oz.	12 oz.
Case Style	C–38	C–38	C–45	M4–45	M4–45

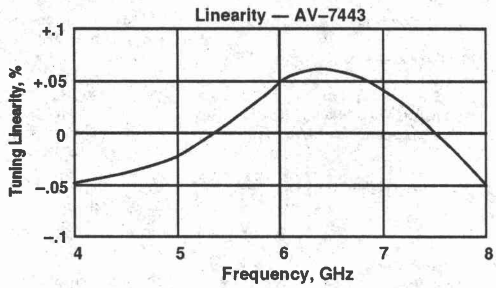
Model No.	AV–7872	AV–7873	AV–71241	AV–71251	AV–71261
Frequency Range, Min.	8–12.4 GHz	8–12.4 GHz	12–18 GHz	12–18 GHz	12–18 GHz
Power Output into 50-ohm Load, Min. at 25°C	60 mW/+17.8 dBm	100 mW/+20 dBm	20 mW/+13 dBm	40 mW/+16 dBm	80 mW/+19 dBm
Power Output Variation vs. Frequency, Max.	6.0 dB	6.0 dB	6.0 dB	6.0 dB	6.0 dB
Operating Case Temperature Range	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C	0° to 65°C
Frequency Drift Over Operating Temperature, Max.	25 MHz	25 MHz	40 MHz	40 MHz	40 MHz
Pulling Figure (12 dB Return Loss), Typ.	1 MHz	1 MHz	5 MHz	1 MHz	0.5 MHz
Pushing Figure,+15 VDC Supply, Typ.	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V	0.1 MHz//V	0.1 MHz/V
–5 VDC Supply, Typ.	N/A	N/A	N/A	N/A	N/A
Magnetic Susceptibility @ 60 Hz, Typ.	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss
2nd Harmonic, @ 25°C, Min.	–12 dBc	–12 dBc	–12 dBc	–12 dBc	–12 dBc
3rd Harmonic, @ 25°C, Min.	–20 dBc	–20 dBc	—	—	—
Spurious Output, Min.	–60 dBc	–60 dBc	–60 dBc	–60 dBc	–60 dBc
Main Tuning Port Characteristics					
Sensitivity	20±1 Hz/mA	20±1 MHz/mA	18±1 MHz/mA	18±1 MHz/mA	18±1 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	5 kHz	5 kHz	5 kHz	5 kHz
Linearity, Typ.	±.1%	±.1%	±.1%	±.1%	±.1%
Hysteresis, Typ.	6 MHz	6 MHz	9 MHz	9 MHz	9 MHz
Input Impedance @ 1 kHz, Typ.	9 ohms in series with 60 mH	9 ohms in series with 60 mH	6 ohms in series with 73 mH	6 ohms in series with 73 mH	6 ohms in series with 73 mH
FM Port Characteristics					
Sensitivity, Typ.	450 kHz/mA	450 kHz/mA	450 kHz/mA	450 kHz/mA	450 kHz/mA
3 dB Bandwidth, Typ.	400 kHz	400 kHz	1 MHz	1 MHz	1 MHz
Deviation at 3 dB Bandwidth, Max.	40 MHz	40 MHz	70 MHz	70 MHz	70 MHz
Input Impedance @ 1 MHz, Typ.	.5 ohm in series with 2.0 µH	.5 ohm in series with 2.0 µH	.5 ohm in series with 2.3 µH	.5 ohm in series with 2.3 µH	.5 ohm in series with 2.3 µH
DC Circuit Power, Max. +15+0.5/–3.5V	250 mA	250 mA	125 mA	150 mA	200 mA
YIG Heater Power					
Input Voltage Range	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC
Power @ 25°C, Max.	1.5 watts	1.5 watts	1.5 watts	1.5 watts	1.5 watts
Power @ 0°C, Max.	2.0 watts	2.0 watts	2.0 watts	2.0 watts	2.0 watts
Weight, Max.	12 oz.	12 oz.	17 oz.	17 oz.	17 oz.
Case Style	M4–45	M4–45	M3–45	M3–60	M3–60

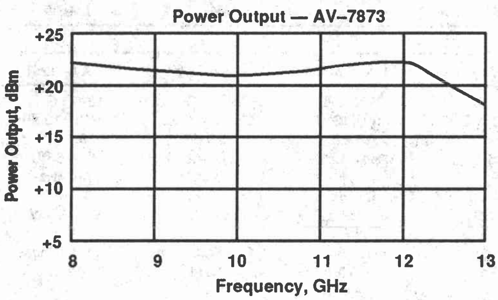
OCTAVE BAND TYPICAL PERFORMANCE GRAPHS

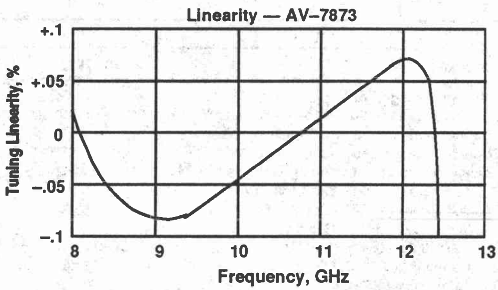


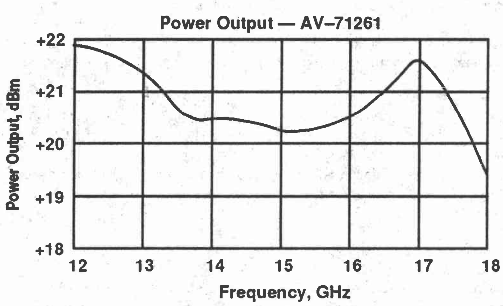


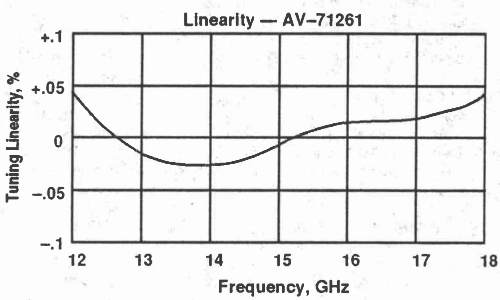






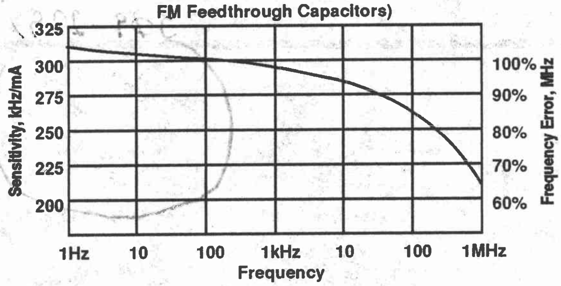




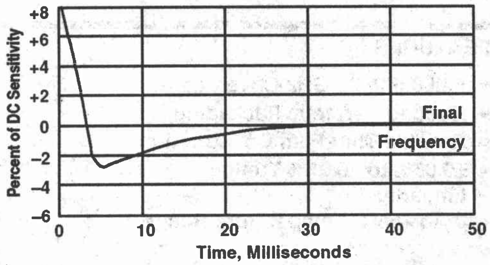


OCTAVE BAND TYPICAL PERFORMANCE GRAPHS (continued)

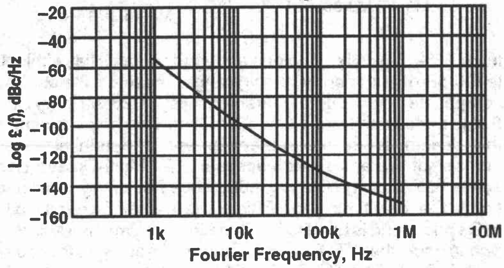
FM Port Sensitivity vs. Modulation Frequency
(Typical All AV Series Without
FM Feedthrough Capacitors)



AV–7224 Settling Time, Full Band Step



Typical Single Sideband
Phase Noise @ 4 GHz



AVANTEK

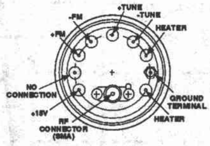
Multi-Octave YIG-Tuned Oscillators

47Øm/1ØG = ~21.3 MHz/m

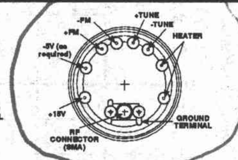
5Ø9-2291

FEATURES

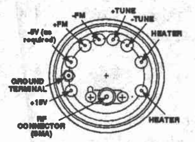
- Full 0.5 to 20 GHz Coverage
- Rugged Hermetic Packaging
- Reliable Thin-Film Construction
- ±0.05% to ±0.25% Tuning Linearity
- 0° to +65°C Temperature Range



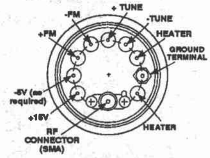
M1-45, p. 16–23



A-45, C-45, C-60, p. 16–2



M3-45, M3-60, p. 16–24



M4-45, p. 16–24

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The tuning curves (I_{tuning} vs. f_{out}) for this series of YTOs are linear, and will deviate from the ideal straight line only ±0.05% to ±0.25% (typically). The power output remains flat within 3.0 to 6.0 dB over the entire tuning range. These oscillators have compatible tuning port characteristics of 20 MHz/mA and 5 kHz bandwidth from 1.0 to 12.4 GHz. This helps to simplify the design of multi-band equipment and minimizes the number of current drives necessary. All Multi-Octave Band series oscillators have a low inductance FM tuning coil in addition to the main tuning coil. This coil is in close proximity to the YIG sphere and is used to fine-tune the oscillator frequency, to phase lock the YTO or to frequency modulate the output signal. The sensitivity of this port is much less than that of the main tuning coil, but it has a much wider 3 dB bandwidth and permits input modulation or control signals to deviate the output frequency by as much as 15 to 100 MHz at a rate up to 1 MHz.

ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications at 0° to +65°C Case Temperature (Unless Otherwise Noted)

Model No.	AV–70502	AV–7124	AV–7236	AV–7288	AV–7238
Frequency Range, Min.	0.5–2 GHz	1–4 GHz	2–6 GHz	2–8 GHz	2–8 GHz
Power Output into 50-ohm Load, Min. at 25°C	30 mW/+14.8 dBm	30 mW/+14.8 dBm	20 mW/+13 dBm	100 mW/+20 dBm	30 mW/+14.8 dBm
Power Output Variation vs. Frequency, Max.	6.0 dB	6.0 dB	6.0 dB	6.0 dB	6.0 dB
Operating Case Temperature Range	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C	0° to 65°C
Frequency Drift Over Operating Temperature, Max.	10 MHz	10 MHz	15 MHz	20 MHz	20 MHz
Pulling Figure (12 dB Return Loss), Typ.	0.5 MHz	0.5 MHz	.01 MHz	0.2 MHz	0.2 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.5 MHz/V	0.5 MHz/V	0.1 MHz/V	0.1 MHz//V	0.1 MHz/V
–5 VDC Supply, Typ.	N/A	1.5 MHz/V	N/A	2.0 MHz/V	2.0 MHz/V
Magnetic Susceptibility @ 60 Hz, Typ.	50 kHz/Gauss	70 kHz/Gauss	70 kHz/Gauss	70 kHz/Gauss	70 kHz/Gauss
2nd Harmonic, @ 25°C, Min.	–10 dBc	–12 dBc	–12 dBc	–8 dBc	–12 dBc
3rd Harmonic, @ 25°C, Min.	–10 dBc	–12 dBc	–15 dBc	–8 dBc	–12 dBc
Spurious Output, Min.	–60 dBc	–60 dBc	–60 dBc	–60 dBc	–60 dBc
Main Tuning Port Characteristics					
Sensitivity	15±.08 MHz/mA	20±1 MHz/mA	20±1 MHz/mA	20±1 MHz/mA	20±1 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	5 kHz	5 kHz	5 kHz	5 MHz
Linearity, Typ.	±0.2%	±.0.15%	±0.05%	±0.1%	±0.1%
Hysteresis, Typ.	2 MHz	3 MHz	5 MHz	9 MHz	9 MHz
Input Impedance @ 1 kHz, Typ.	10 ohms in series with 42 mH	10 ohms in series with 95 mH	10 ohms in series with 95 mH	10 ohms in series with 95 mH	10 ohms in series with 95 mH
FM Port Characteristics					
Sensitivity, Typ.	310 kHz/mA	310 kHz/mA	310 kHz/mA	310 kHz/mA	310 kHz/mA
3 dB Bandwidth, Typ.	400 kHz	800 kHz	800 kHz	800 kHz	800 kHz
Deviation at 3 dB Bandwidth, Max.	15 MHz	15 MHz	30 MHz	40 MHz	40 MHz
Input Impedance @ 1 MHz, Typ.	1 ohm in series with 1.25 μH	1 ohm in series with 1.7 μH	1 ohm in series with 1.7 μH	1 ohm in series with 1.7 μH	1 ohm in series with 1.7 μH
DC Circuit Power, Max. ,+15±0.5V	200 mA	150 mA	175 mA	250 mA	200 mA
–5.0±0.1V	—	50 mA	—	60 mA	60 mA
YIG Heater Power					
Input Voltage Range	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC
Power @ 25°C, Max.	1.5 watts	1.5 watts	1.5 watts	1.5 watts	1.5 watts
Power @ 0°C, Max.	2.0 watts	2.0 watts	2.0 watts	2.0 watts	2.0 watts
Weight, Max.	8 oz.	10 oz.	10 oz.	10 oz.	10 oz.
Case Style	M1–45	C–45	A–45	C–45	C–45

ELECTRICAL AND PERFORMANCE SPECIFICATIONS (continued)

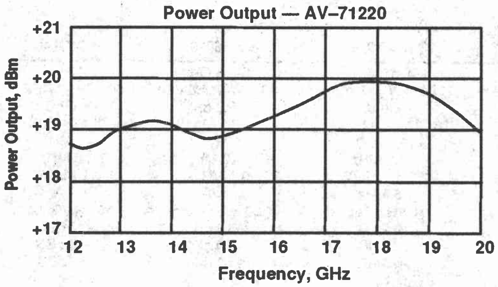
Guaranteed Specifications at 0° to +65°C Case Temperature (Unless Otherwise Noted)

Model No.	AV-72B8	AV-72010	AV-74010	AV-76018	AV-77016
Frequency Range, Min.	2–8 GHz	2–10 GHz	4–10 GHz	6–18 GHz	7–16 GHz
Power Output into 50-ohm Load, Min. at 25°C	200 mW/+23 dBm	25 mW/+14 dBm	40 mW/+16 dBm	30 mW/+14.8 dBm	50 mW/+17 dBm
Power Output Variation vs. Frequency, Max.	6.0 dB	6.0 dB	6.0 dB	6.0 dB	6.0 dB
Operating Case Temperature Range	0° to 65°C	0° to 65°C	0° to +65°C	0° to +65°C	0° to +65°C
Frequency Drift Over Operating Temperature, Typ.	20 MHz	20 MHz	20 MHz	40 MHz	40 MHz
Pulling Figure (12 dB Return Loss), Typ.	0.2 MHz	0.1 MHz	0.1 MHz	1.0 MHz	0.5 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V
–5 VDC Supply, Typ.	N/A	1.0 MHz/V	1.5 MHz/V	N/A	N/A
Magnetic Susceptibility @ 60 Hz, Typ.	70 kHz/Gauss	70 kHz/Gauss	70 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss
2nd Harmonic, @ 25°C, Min.	10 dB	–12 dBc	–12 dBc	–10 dBc	–12 dBc
3rd Harmonic, @ 25°C, Min.	10 dB	–12 dBc	–15 dBc	–10 dBc	–15 dBc
Spurious Output, Min.	60 dBc	–60 dBc	–60 dBc	–60 dBc	–60 dBC
Main Tuning Port Characteristics					
Sensitivity		20±1.0 MHz/mA	20±1.0 MH/mA	20±1.0 MHz/mA	18±1.0 MHz/mA
18±.1.0 MHz/mA					
3 dB Bandwidth, Typ.	5 MHz	5 MHz	5 kHz	5 kHz	5 kHz
Linearity, Typ.	±0.1%	±0.1%	±0.1%	±0.25%	±0.1%
Hysteresis, Typ.	9 MHz	8 MHz	9 MHz	18 MHz	8 MHz
Input Impedance @ 1 kHz, Typ.	10 ohms in series with 95 mH	10 ohms in series with 95 mH	10 ohms in series with 95 mH	6 ohms in series with 51 mH	9 ohms in series with 60 mH
FM Port Characteristics					
Sensitivity. Typ.	310 kHz/mA	310 kHz/mA	310 kHz/mA	450 kHz/mA	450 kHz/mA
3 dB Bandwidth, Typ.	400 kHz	800 kHz	800 kHz	1 MHz	400 kHz
Deviation at 3 dB Bandwidth, Max.	40 MHz	40 MHz	40 MHz	90 MHz	70 MHz
Input Impedance @ 1 MHz, Typ.	1 ohm in series with 1.25 µH	1 ohm in series with 1.7 µH	1 ohm in series with 2.3 µH	.5 ohm in series with 2.3 µH	.5 ohm in series with 2.3 µH
DC Circuit Power, Max., +15.0±0.5V	350 mA	200 mA	200 mA	—	—
–5.0±0.1V	60 mA	60 mA	60 mA	—	—
+15+.5/–3.5V	—	—	—	275 mA	300 mA
YIG Heater Power					
Input Voltage Range	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC
Power @ 25°C, Max.	1.5 watts	1.5 watts	1.5 watts	1.5 watts	1.5 watts
Power @ 0°C, Max.	2.0 watts	2.0 watts	2.0 watts	2.0 Watts	2.0 watts
Weight, Max.	10 oz.	10 oz.	10 oz.	17 oz.	12 oz.
Case Style	C-60	C–45	C–45	M3–60	M4–45

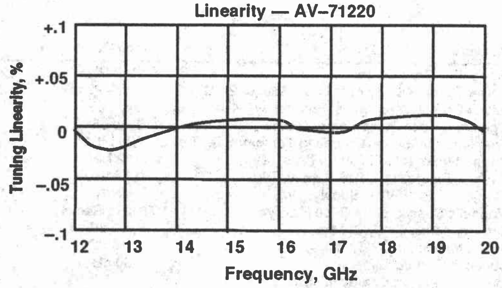
Model No.	AV-78318	AV-78218	AV-78518	AV-78020	AV-71220
Frequency Range, Min.	8–18 GHz	8–18 GHz	8–18 GHz	8–20 GHz	12–20 GHz
Power output into 50-ohm Load, Min. @ 25°C	10 mW/+10 dBm	30 mW/+14.8 dBm	60 mW/+17.8 dBm	20 mW/+13 dBm	40 mW/+16 dBm
Power Output Variation vs. Frequency, Max.	6.0 dB	6.0 dB	6.0 dB	8.0 dB	6.0 dB
Operating Case Temperature Range	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C
Frequency Drift Over Operating Temperature, Typ.	40 MHz	40 MHz	40 MHz	40 MHz	40 MHz
Pulling Figure (12 dB Return Loss), Typ.	5 MHz	0.5 MHz	1 MHz	1 MHz	0.5 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V
–5 VDC Supply, Typ.	N/A	N/A	N/A	N/A	N/A
Magnetic Susceptibility @ 60 Hz, Typ.	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss
2nd Harmonic. @ 25°C, Min.	12 dBc	–12 dBc	–12 dBc	–12 dBc	–15 dBc
3rd Harmonic, @ 25°C, Min.	—	—	—	—	—
Spurious Output, Min.	60 dBc	–60 dBc	–60 dBc	–60 dBc	–60 dBc
Main Tuning Port Characteristics					
Sensitivity	18±.1 MHz/mA	18±1 MHz/mA	18±1 MHz/mA	20±1 MHz/mA	18±1 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	5 kHz	5 kHz	5 kHz	5 kHz
Linearity, Typ.	±0.1%	±0.1%	±0.1%	±0.1%	±0.15%
Hysteresis, Typ.	10 MHz	15 MHz	18 MHz	18 MHz	12 MHz
Input Impedance @ 1 kHz, Typ.	6 ohms in series with 73 mH	6 ohms in series with 73 mH	6 ohms in series with 51 mH	7 ohms in series with 73 mH	6 ohms in series with 73 mH
FM Port Characteristics					
Sensitivity, Typ.	450 kHz/mA	450 kHz/mA	450 kHz/mA	450 kHz/mA	450 kHz/mA
3 dB Bandwidth, Typ.	1 MHz	1 MHz	1 MHz	1 MHz	1 MHz
Deviation at 3 dB Bandwidth, Max.	70 MHz	90 MHz	90 MHz	90 MHz	70 MHz
Input Impedance @ 1 MHz, Typ.	.5 ohm in series with 2.3 µH	.5 ohm in series with 2.3 µH	.5 ohm in series with 2.3 µH	.5 ohm in series with 2.3 µH	.5 ohm in series with 2.3 µH
DC Circuit Power, Max., +15+0.5/–3.5V	100 mA	175 mA	275 mA	275 mA	200mA
YIG Heater Power					
Input Voltage Range	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC
Power @ 25°C, Max.	1.5 watts	1.5 watts	1.5 watts	1.5 watts	1.5 watts
Power @ O°C, Max.	2.0 watts	2.0 watts	2.0 watts	2.0 watts	2.0 watts
Weight, Max.	17 oz.	17 oz.	17 oz.	17 oz.	17 oz.
Case Style	M3–45	M3–45	M3–60	M3–60	M3–60

MULTI-OCTAVE BAND TYPICAL PERFORMANCE GRAPHS

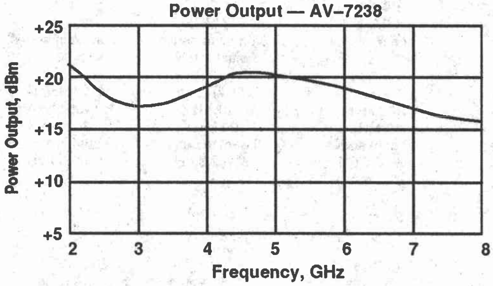
Power Output — AV-71220



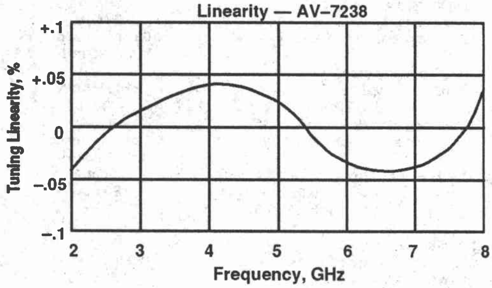
Linearity — AV-71220



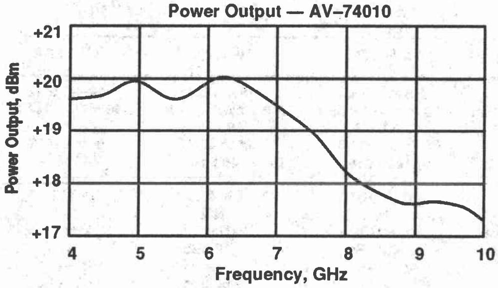
Power Output — AV-7238



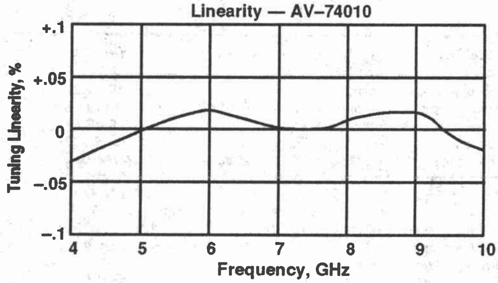
Linearity — AV-7238



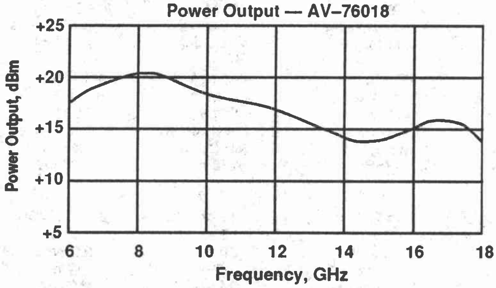
Power Output — AV-74010



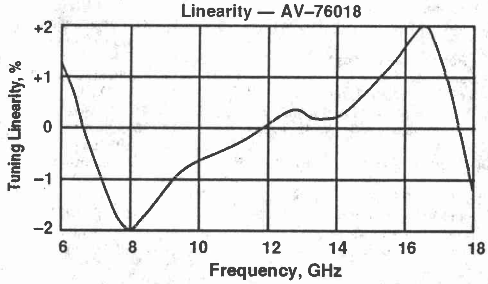
Linearity — AV-74010



Power Output — AV-76018



Linearity — AV-76018



AVANTEK

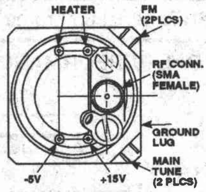
One Inch Cube
1.2 to 18 GHz

FEATURES

- 1.00-inch Cube Package
- Low Main Coil Inductance
- Light Weight: 3 oz./85 grams

APPLICATIONS

- Test and Measurement Instrumentation
- Portable/Lightweight Systems
- Military Electronic Receivers, Jammers



MM1, p. 16–28

DESCRIPTION

The Avantek one-inch cube series of YIG-tuned oscillators has been designed for both military and commercial applications where space is at a premium. These small, lightweight units are an excellent alternative to the more conventional 2.0 inch diameter units currently available.

The units consist of a Yttrium Iron Garnet sphere coupled with a state of the art Avantek Silicon Bipolar transistor for the 1.2 to 4.0 and 4 to 12.4 GHz frequency bands and an Avantek GaAs FET for the 12 to 18 GHz band. Inherent to the small size is the low inductance which provides for tuning speeds 4 to 5 times faster than conventional YTO's.

This family of YTO's is hermetically sealed to provide for long-term protection from moisture and corrosive gases and liquids even under severe environments.

ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications at 0 to +65°C Case Temperature (unless otherwise noted)

Model No.	AV–7134	AV–74012	AV–12218
Frequency Range, Min.	1.2 to 4.0 GHz	4.0 to 12.4 GHz	12.0 to 18.0 GHz
Power Output (50-ohm load)	+13 dBm/20 mW	+16 dBm/40 mW	+16 dBm/40 mW
Power Variation (Over Frequency Range) Max.	6 dB	6 dB	6 dB
Frequency Drift Over Temperature, Max.	15 MHz	20 MHz	30 MHz
Pulling Figure (12 dB Return Loss), Typ.	0.1 MHz	0.2 MHz	0.4 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.5 MHz/V	0.1 MHz/V	0.1 MHz/V
–5 VDC Supply, Typ.	1.5 MHz/V	1.5 MHz/V	N/A
Magnetic Susceptibility @ 60 Hz, Typ.	110 kHz/Gauss	110 kHz/Gauss	110 kHz/Gauss
2nd Harmonic, Min.–12 dBc	–12 dBc	–20 dBc	
3rd Harmonic, Min. –12 dBc	–12 dBc	–20 dBc	
Spurious Output, Min.	–60 dBc	–60 dBc	–60 dBc
Main Tuning Port Characteristics			
Sensitivity	20±1 MHz/mA	20±1 MHz/mA	20±1 MHz/mA
Bandwidth (3 dB), Typ.	5 kHz	5 kHz	5 kHz
Linearity, Typ. ±0.1%	±0.1%	±0.1%	
Hysteresis, Typ.	3 MHz	9 MHz	6 MHz
Input Impedance, Typ.	7 ohms in series with 24 mH	6 ohms in series with 15 mH	6 ohms in series with 15 mH
FM Port Characteristics			
Sensitivity, Typ.	310 kHz/mA	310 kHz/mA	310 kHz/mA
Bandwidth (3 dB), Typ.	400 kHz	400 kHz	400 kHz
Deviation at 3 dB Bandwidth, Max.	40 MHz	40 MHz	40 MHz
Input Impedance, Typ. at 1 MHz	3.5 ohms in series with 2 µH	1.6 ohms in series with 1 µH	1.6 ohms in series with 1 µH
DC Circuit Power, +15V±0.5V Max.	150 mA Max.	200 mA	250 mA
–5V±.1V	40 mA	40 mA	—
Input Voltage Range	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC
Power @ 25°C, Max.	1.5 watts	1.5 watts	1.5 watts
Power @ 0°C, Max.	2.0 watts	2.0 watts	2.0 watts
Weight, Max.	3.0 oz.	3.0 oz.	3.0 oz.
Case Style	MM1	MM1	MM1

MAXIMUM RATINGS

DC Voltage	+15 VDC Typ., +20 VDC, Max., –5 VDC Typ., –5.25 VDC Max.*
FM Tuning Current, Max.	300 mA max.
Operating Case Temperature	–54°C to +85°C
Storage Temperature	–54°C to +100°C

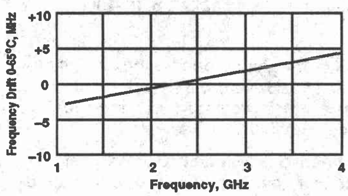
* Not Required for Model AV-12218

WEIGHT: 3 oz./85 grams

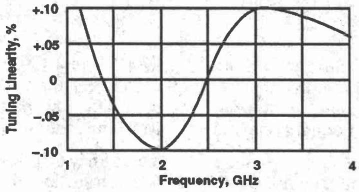
TYPICAL PERFORMANCE GRAPHS AV-7134

KEY:
0° C
+25° C
+65° C

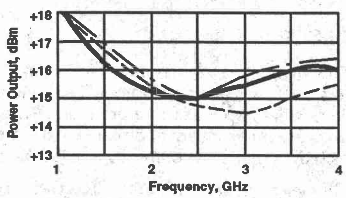
FREQUENCY DRIFT



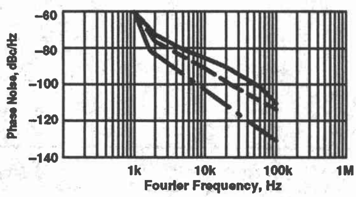
LINEARITY @ 25°C



POWER OUTPUT

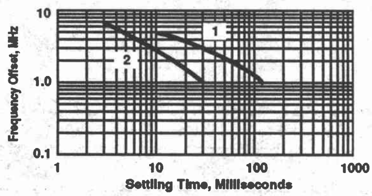


SINGLE SIDEBAND PHASE NOISE @ 25°C



KEY:
1.2 GHz
2.6 GHz
4.0 GHz

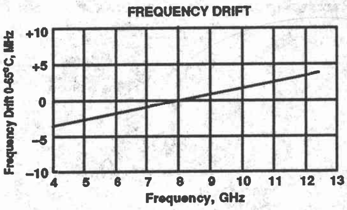
FREQUENCY OFFSET vs. TIME @ 25°C

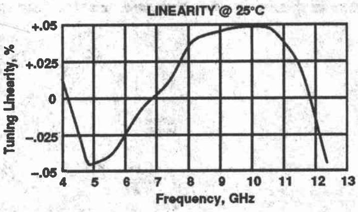


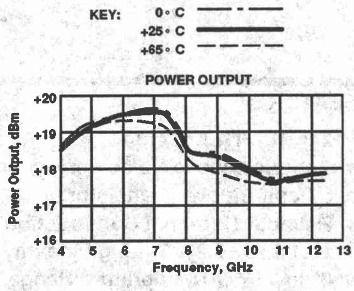
1. Standard 2-in. Yig Oscillator, Inductance 65–70 mH, typ.
2. 1-in. Cube Yig Oscillator, Inductance 24 mH, typ.

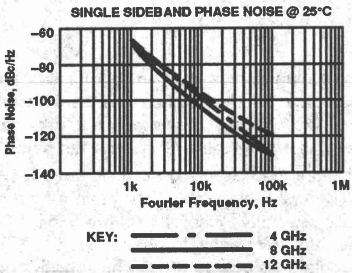
NOTES:
A. Same frequency step size (1.5 GHz Step).
B. Use of fast driver.

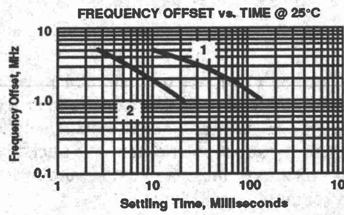
TYPICAL PERFORMANCE GRAPHS AV-74012







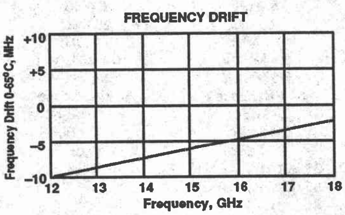


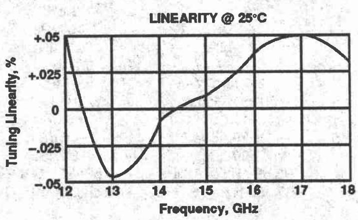


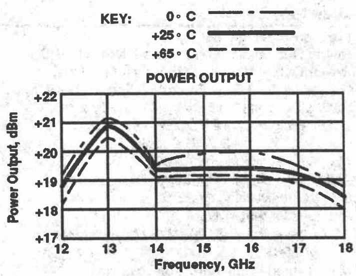
1. Standard 2-In. Yig Oscillator, Inductance 65–70 mH, typ.
2. 1-In. Cube Yig Oscillator, Inductance 15 mH, typ.

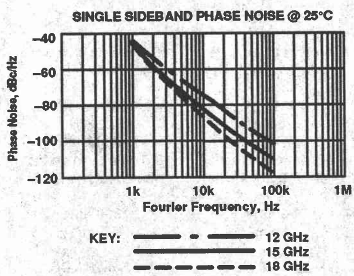
NOTES:
A. Same frequency step size (1.5 GHz Step).
B. Use of fast driver.

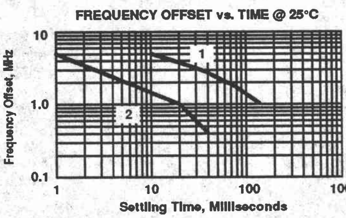
TYPICAL PERFORMANCE GRAPHS AV-12218











1. Standard 2-In. Yig Oscillator, Inductance 65–70 mH, typ.
2. 1-In. Cube Yig Oscillator, Inductance 15 mH, typ.

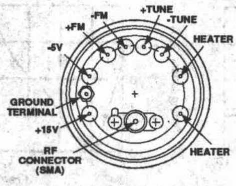
NOTES:
A. Same frequency step size (1.5 GHz Step).
B. Use of fast driver.

AVANTEK

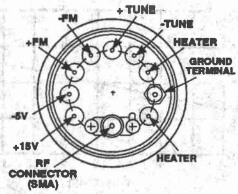
Wideband YIG-Tuned Oscillators

FEATURES

- 2 to 18 GHz Coverage
- Superior Phase Noise Performance
- Silicon Bipolar Transistor
- Reliable Thin-Film Construction
- ±0.1% to ±0.2% Tuning Linearity
- 0° to +65°C Temperature Range



M3-45, M3-60, p. 16–24



M4-45, p. 16–24

DESCRIPTION

Avantek® Wideband Series YIG-tuned fundamental transistor oscillators are compact, lightweight, and are cost-effective for commercial instrument applications. They are built using the same Avantek thin-film construction and hermetic packaging that has proven itself ultimately reliable under severe military and aerospace environmental conditions.

This family of oscillators is designed for wideband applications in receivers and instruments where tuning linearity and spectral purity are crucial. They make ideal local oscillators for frequency-agile receivers and spectrum analyzers, and are excellent as signal sources for microwave sweep generators and synthesizers.

The tuning curves (I_{tuning} vs. f_{out}) for this series of YTOs are linear, and will deviate from the ideal straight line only ±0.1% to ±0.2% (typically). The power output remains flat within 6 dB over the entire tuning range and temperature.

All Wideband Series oscillators have a low inductance FM tuning coil in addition to the main tuning coil. This coil is in close proximity to the YIG sphere and is used to fine-tune the oscillator frequency, to phase lock the YTO or to frequency modulate the output signal. The sensitivity of this port is much less than that of the main tuning coil, but it has a much wider 3 dB bandwidth and permits input modulation or control signals to deviate the output frequency by as much as 70 MHz.

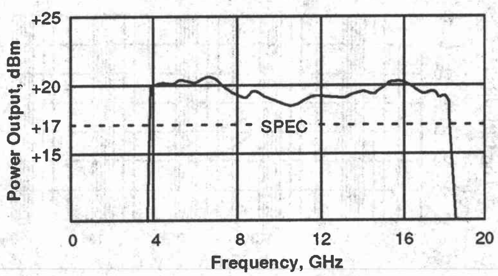
ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications at 0° to +65°C Case Temperature (Unless Otherwise Noted)

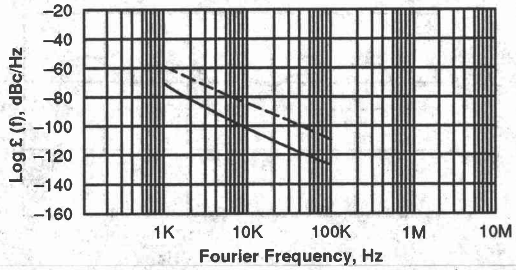
Model No.	AV–74018	AV–73018	AV-72018	AV–72012
Frequency Range, Min.	4–18 GHz	3–18 GHz	2–18 GHZ	2–12.4 GHz
Power Output into 50-ohm Load, Min. @ 25°C	50 mW/+17 dBm	20 mW/+13 dBm	20 mW/+13 dBm	40 mW/+16 dBm
Power Output Variation vs. Frequency, Max.	6.0 dB	6.0 dB	6.0 dB	6.0 dB
Frequency Drift Over Operating Temperature, Max.	40 MHz	40 MHz	40 MHz	25 MHz
Pulling Figure (12 dB Return Loss), Typ.	0.1 MHz	0.1 MHz	0.1 MHz	0.5 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V
–5 VDC Supply, Typ.	2.0 MHz/V	5.0 MHz/V	5.0 MHz/V	1.5 MHz/V
Magnetic Susceptibility @ 60 Hz, Typ.	50 kHz/Gauss	50 kHz/Gauss	50 KHz/Gauss	50 kHz/Gauss
2nd Harmonic, Min., @ 25°C	–10 dBc	–8 dBc	–8 dBc	–10 dBc
3rd Harmonic, Min., @ 25°C	–10 dBc	–10 dBc	–10 dBc	–10 dBc
Spurious Output, Min.	–60 dBc	–60 dBc	–60 dBc	–60 dBc
SSB Phase Noise @ 20 kHz Off Carrier, Min.	–95 dBc/Hz ≤16 GHz	–95 dBc/Hz, ≤16 GHz	–95 dBc/Hz, ≤16 GHz	–95 dBc/Hz
@ 25°C	–85 dBc/Hz, >16 GHz	–85 dBc/Hz, >16 GHz	–85 dBc/Hz, >16 GHz	—
Main Tuning Port Characteristics				
Sensitivity	18±1 Hz/mA	18±1 MHz/mA	18±1 MHz/mA	20±1 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	5 kHz	5 kHz	5 kHz
Linearity, Typ.	±0.1%	±0.2%	±0.2%	±0.1%
Hysteresis, Typ.	16 MHz	18 MHz	20 MHz	10 MHz
Input Impedance , Typ.	6 ohms dc in series with 73 mH (1kHz)	6 ohms dc in series with 73 mH (1kHz)	6 ohms dc in series with 73 mH (1kHz)	9 ohms dc in series with 60 mH (1kHz)
FM Port Characteristics				
Sensitivity, Typ.	450 kHz/mA	450 kHz/mA	450 kHz/mA	450 kHz/mA
3 dB Bandwidth, Typ.	200 kHz	200 kHz	200 kHz	200 MHz
Deviation at 3 dB Bandwidth, Max.	70 MHz	70 MHz	70 MHz	40 MHz
Input Impedance @ 1 MHz, Typ.	0.5 ohm dc in series with 2.0 μH (1MHz)	0.5 ohm dc in series with 2.0 μH (1MHz)	0.5 ohm dc in series with 2.0 μH (1 MHZ)	0.5 ohm dc in series with 2.0 μH (1 MHZ)
DC Circuit Power, Max., +15±0.5V	350 mA	300mA	300 mA	175 mA
–5.0±0.1V	30 mA	30 mA	30 mA	25 mA
YIG Heater Power				
Input Voltage Range	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC
Power @ 25°C, Max.	1.5 watts	1.5 watts	1.5 watts	1.5 watts
Power @ 0°C, Max.	2.0 watts	2.0 watts	2.0 watts	2.0 watts
Weight, Max.	17 oz.	17 oz.	17 oz.	12 oz.
Case Style	M3–60	M3–45	M3-45	M4–45

TYPICAL OCTAVE BAND PERFORMANCE

Power Output — AV-74018 @ 25°C

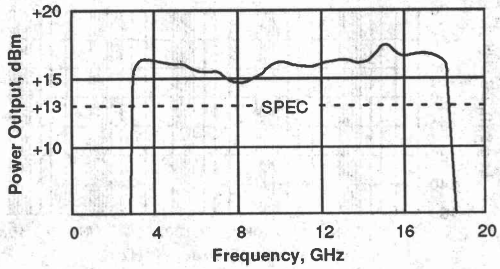


AV-74018, Single Sideband Phase Noise @ 25°C

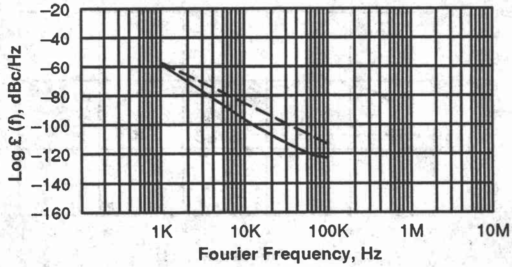


KEY: ——— 4 GHz
— — — 18 GHz

Power Output — AV-73018 @ 25°C



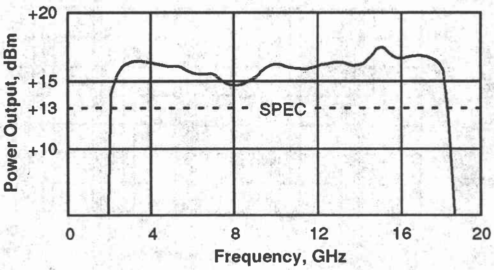
AV-73018, Single Sideband Phase Noise @ 25°C



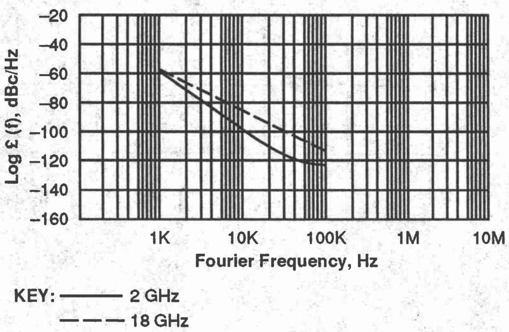
KEY: ——— 3 GHz
— — — 18 GHz

TYPICAL OCTAVE BAND PERFORMANCE (continued)

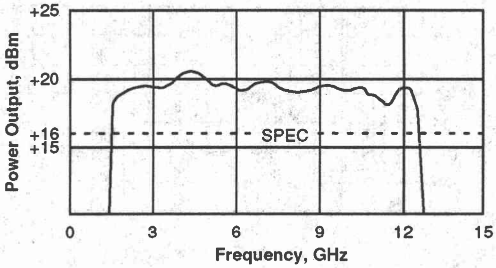
Power Output — AV-72018 @ 25°C



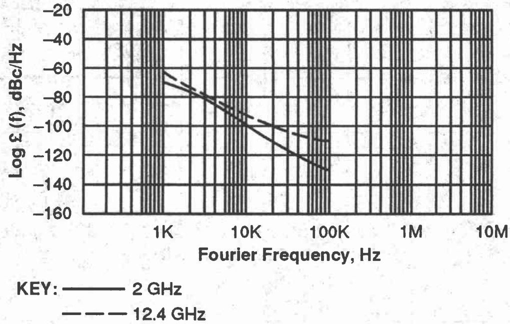
AV-72018, Single Sideband Phase Noise @ 25°C



Power Output — AV-72012 @ 25°C

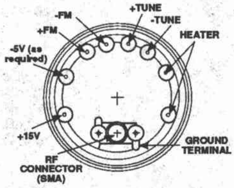


AV-72012, Single Sideband Phase Noise @ 25°C

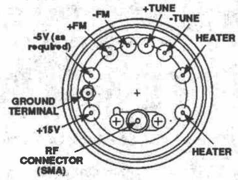


FEATURES

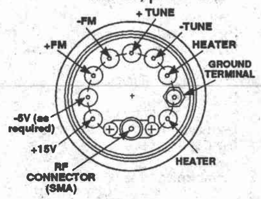
- 2 to 18 GHz Coverage
- Excellent Phase Noise Performance
- Rugged Hermetic Packaging
- Reliable Thin-Film Construction
- Silicon Bipolar Transistors
- 0° to +65°C Temperature Range



C-45, p. 16–2



M3-60, p. 16–24



M4-45, p. 16–24

DESCRIPTION

The new Avantek® Low Noise Series YIG-tuned fundamental transistor oscillators are compact, lightweight, and cost-effective for commercial instrument applications. They are built using silicon bipolar transistors which yield a 10-15 dB noise improvement over other available commercial FET oscillators.

This family of oscillators is designed for wideband application in receivers and instruments where tuning linearity and spectral purity are crucial. They make ideal local oscillators for frequency-agile receivers and spectrum analyzers, and are excellent as signal sources for microwave generators and synthesizers.

ELECTRICAL AND PERFORMANCE SPECIFICATIONS

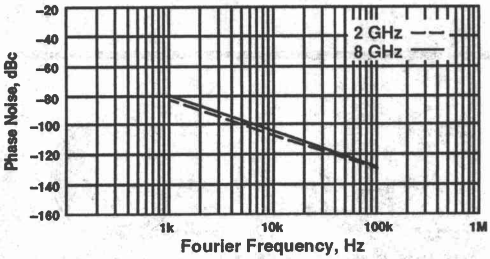
Guaranteed Specifications at 0° to +65°C Case Temperature (Unless Otherwise Noted)

Model No.	AV-7298	AV-72810	AV-12018
Frequency Range, Min.	2–8 GHz	2–10 GHz	12–18 GHz
Power Output into 50-ohm Load, Min. at 25°C	30 mW/+14.8 dBm	25 mW/+14.0 dBm	50 mW/+17 dBm
Power Output Variation vs. Frequency, Max.	6.0 dB	6.0 dB	6.0 dB
Operating Case Temperature Range	0° to +65°C	0° to +65°C	0° to +65°C
Frequency Drift Over Operating Temperature, Max.	20 MHz	20 MHz	40 MHz
Pulling Figure (12 dB Return Loss), Typ.	0.1 MHz	0.1 MHz	0.1 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V
–5 VDC Supply, Typ.	1.0 MHz/V	1.0 MHz/V	1.5 MHz/V
Magnetic Susceptibility @ 60 Hz, Typ.	70 kHz/Gauss	70 kHz/Gauss	50 kHz/Gauss
2nd Harmonic, Min., @ 25°C	–12 dBc	–12 dBc	–20 dBc
3rd Harmonic, Min., @ 25°C	–12 dBc	–12 dBc	–20 dBc
Spurious Output, Min.	–60 dBc	–60 dBc	–60 dBc
SSB Phase Noise @ 20 kHz Off Carrier, Min., @ 25°C	–108 dBc/Hz	–108 dBc/Hz	–100 dBc/Hz @ 12–16 GHz –95 dBc/Hz @ 16–18 GHz
Main Tuning Port Characteristics			
Sensitivity	20±1 MHz/mA	20±1 MHz/mA	18±1 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	5 kHz	5 kHz
Linearity, Typ.	±0.1%	±0.1%	±0.1%
Hysteresis, Typ.	6 MHz	8 MHz	6 MHz
Input Impedance @ 1 kHz, Typ.	10 ohms in series with 95 mH	10 ohms in series with 95 mH	6 ohms in series with 73 mH
FM Port Characteristics			
Sensitivity, Typ.	310 kHz/mA	310 kHz/mA	425 kHz/mA
3 dB Bandwidth, Typ.	800 kHz	800 kHz	1 MHz
Deviation at 3 dB Bandwidth, Max.	40 MHz	40 MHz	90 MHz
Input Impedance @ 1 MHz, Typ.	1 ohm in series with 1.7 μH	1 ohm in series with 1.7 μH	0.5 ohm in series with 2.3 μH
DC Circuit Power, Max., +15±0.5V	200 mA	200 mA	350 mA.
–5.0±0.1V	60 mA	25mA	30 mA
YIG Heater Power			
Input Voltage Range	20 to 28 VDC	20 to 28 VDC	—
Power @ 25°C, Max.	1.5 watts	1.5 watts	—
Power @ 0°C, Max.	2.0 watts	2.0 watts	—
Weight, Max.	10 oz.	10 oz.	17 oz.
Case Style	C-45	C-45	M3–60

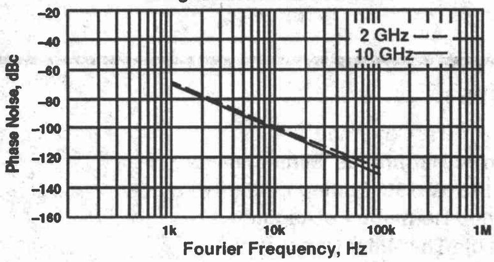
Model No.	AV-76318	AV-78012	AV-78718
Frequency Range, Min.	6–18 GHz	8–12.4 GHz	8–18 GHz
Power Output into 50-ohm Load, Min. at 25°C	40 mW/+16 dBm	60 mW/+17.8 dBm	40 mW/+16 dBm
Power Output Variation vs. Frequency, Max.	6.0 dB	6.0 dB	6.0 dB
Operating Case Temperature Range	0° to +65°C	0° to +65°C	0° to +65°C
Frequency Drift Over Operating Temperature, Max.	40 MHz	25 MHz	40 MHz
Pulling Figure (12 dB Return Loss), Typ.	0.1 MHz	0.5 MHz	0.1 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.1 MHz//V	0.1 MHz/V	0.1 MHz/V
–5 VDC Supply, Typ.	1.5 MHz/V	1.5 MHz/V	1.5 MHz/V
Magnetic Susceptibility @ 60 Hz, Typ.	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss
2nd Harmonic, Min., @ 25°C	–10 dBc	–12 dBc	–15 dBc
3rd Harmonic, Min., @ 25°C	–12 dBc	–20 dBc	–20 dBc
Spurious Output, Min.	–60 dBc	–60 dBc	–60 dBc
SSB Phase Noise @ 20 kHz Off Carrier, Min., @ 25°C	–100 dBc/Hz @ 6–16 GHz –95 dBc/Hz @ 16–18 GHz	–105 dBc/Hz	–100 dBc/Hz @ 8–16 GHz –95 dBc/Hz @ 16–18 GHz
Main Tuning Port Characteristics			
Sensitivity	18±1 MHz/mA	20±1 MHz/mA	18±1 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	5 kHz	5 kHz
Linearity, Typ	±0.1%	±0.05%	±0.1%
Hysteresis, Typ.	12 MHz	5 MHz	10 MHz
Input Impedance @ 1 kHz, Typ.	6 ohms in series with 73 mH	9 ohms in series with 60 mH	6 ohms in series with 73 mH
FM Port Characteristics			
Sensitivity, Typ.	425 kHz/mA	450 kHz/mA	425 kHz/mA
3 dB Bandwidth, Typ.	1 MHz	400 kHz	1 MHz
Deviation at 3 dB Bandwidth, Max.	90 MHz	40 MHz	90 MHz
Input Impedance @ 1 MHz, Typ.	0.5 ohm in series with 2.3 μH	0.5 ohm in series with 2.0 μH	0.5 ohm in series with 2.3 μH
DC Circuit Power, Max., +15±0.5V	350 mA	250 mA.	350 mA
–5.0±0.1V	30 mA	40 mA	30mA
YIG Heater Power			
Input Voltage Range	—	20 to 28 VDC	—
Power @ 25°C, Max.	—	1.5 watts	—
Power @ 0°C, Max.	—	2.0 watts	—
Weight, Max.	17 oz.	12 oz.	17 oz.
Case Style	M3–60	M4-45	M3-60

TYPICAL PERFORMANCE GRAPHS

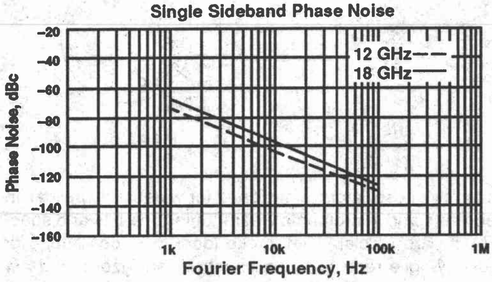
AV–7298
Single Sideband Phase Noise



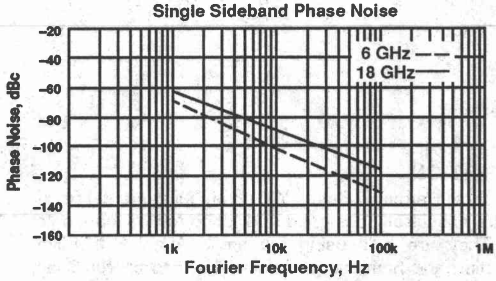
AV–72810
Single Sideband Phase Noise



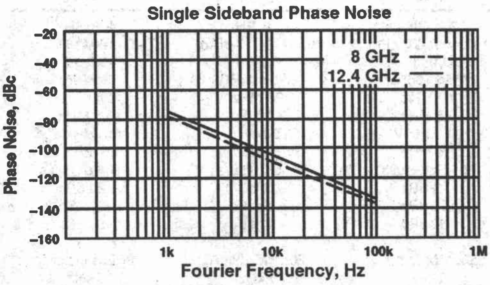
AV–12018
Single Sideband Phase Noise



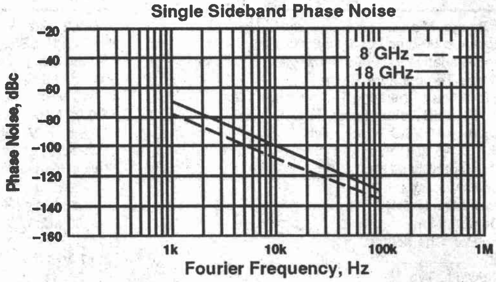
AV–76318
Single Sideband Phase Noise



AV–78012
Single Sideband Phase Noise



AV–78718
Single Sideband Phase Noise

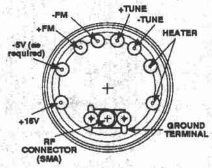


AVANTEK

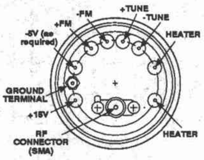
Low Harmonic YIG-Tuned Oscillators

FEATURES

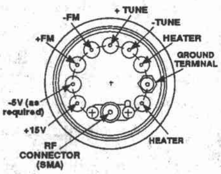
- 1 to 20 GHz Coverage
- –20 dBc Harmonics, Minimum
- ±0.01 to ±0.15% Tuning Linearity
- Rugged Hermetic Packaging
- Reliable Thin-Film Construction
- 0° to +65°C, Temperature Range



A-45, B-45, C-45, C-38, p. 16–2



M3-45, M3-60, p. 16–24



M4-45, p. 16–24

DESCRIPTION

Avantek Low Harmonic Series YIG-tuned fundamental oscillators are specifically designed and tuned for low harmonic levels. They are built using the same Avantek thin-film construction and hermetic packaging that has proven itself ultimately reliable under severe military and aerospace environmental conditions.

This family of oscillators is designed for wideband application in receivers and instruments where tuning linearity and spectral purity are crucial. They make ideal local oscillators for frequency-agile receivers and spectrum analyzers, and are excellent as signal sources for microwave generators and synthesizers.

ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications at 0° to +65°C Case Temperature (Unless Otherwise Noted)

Model No.	AV–7104–9	AV–7224–9	AV–7403–9	AV–7453–9
Frequency Range, Min.	1–2.2 GHz	2–4 GHz	4–8 GHz	4–8 GHz
Power Output into 50-ohm Load, @ 25°C, Min.	25 mW/+16 dBm	100 mW/+20 dBm	20 mW/+13 dBm	40 mW/+16 dBm
Power Output Variation vs. Frequency, Max.	3.0 dB	3.0 dB	6.0 dB	6.0 dB
Operating Case Temperature Range	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C
Frequency Drift Over Operating Temperature, Max.	10 MHz	10 MHz	20 MHz	25 MHz
Pulling Figure (12 dB Return Loss), Typ.	0.01 MHz	0.5 MHz	2.0 MHz	0.5 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.5 MHz/V	0.1 MHz/V	0.5 MHz/V	0.1 MHz/V
–5 VDC Supply, Typ.	N/A	1.5 MHz	1.5 MHz/V	1.5 MHz/V
Magnetic Susceptibility @ 60 Hz, Typ.	70 kHz/Gauss	70 kHz/Gauss	70 kHz/Gauss	70 kHz/Gauss
2nd Harmonic, Min., @ 25°C	–20 dBc	–20 dBc	–20 dBc	–20 dBc
3rd Harmonic, Min., @ 25°C	–20 dBc	–20 dBc	–20 dBc	–20 dBc
Spurious Output , Min.	–60 dBc	–60 dBc	–60 dBc	–60 dBc
Main Tuning Port Characteristics				
Sensitivity	20±1 MHz/mA	20±1 MHz/mA	20±1 MHz/mA	20±1 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	5 kHz	5 kHz	5 kHz
Linearity, Typ.	±.1%	±.05%	±.05%	±.05%
Hysteresis, Typ.	1.7 MHz	3 MHz	6 MHz	6 MHz
Input Impedance @ 1 kHz, Typ.	10 ohms in series with 95 mH	10 ohms in series with 95 mH	10 ohms in series with 95 mH	10 ohms in series with 95 mH
FM Port Characteristics				
Sensitivity, Typ.	310 kHz/mA	310 kHz/mA	310 kHz/mA	310 kHz/mA
3 dB Bandwidth, Typ.	800 kHz	800 kHz	800 kHz	800 kHz
Deviation at 3 dB Bandwidth, Max.	15 MHz	20 MHz	40 MHz	40 MHz
Input Impedance @ 1 MHz, Typ.	1 ohm in series with 1.7 µH	1 ohm in series with 1.7 µH	1 ohm in series with 1.7 µH	1 ohm in series with 1.7 µH
DC Circuit Power, Max.				
+15±.0.5 VDC	150 mA	150 mA	—	150 mA
–5±.1 VDC	60 mA	60 mA	—	60 mA
+15+0.5/–3.5 VDC	—	—	300 mA	—
YIG Heater Power				
Input Voltage Range	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC
Power @ 25°C, Max.	1.5 watts	1.5 watts	1.5 watts	1.5 watts
Power @ 0°C, Max.	2.0 watts	2.0 watts	2.0 watts	2.0 watts
Weight, Max.	10 oz.	10 oz.	10 oz.	10 oz.
Case Style	A-45	C-45	C-38	C-38

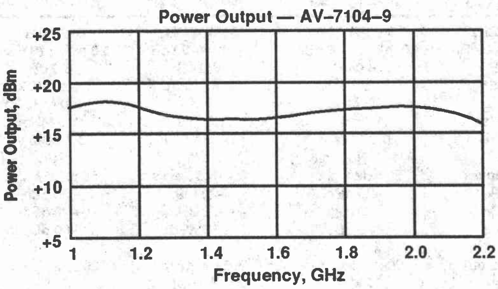
ELECTRICAL AND PERFORMANCE SPECIFICATIONS (continued)

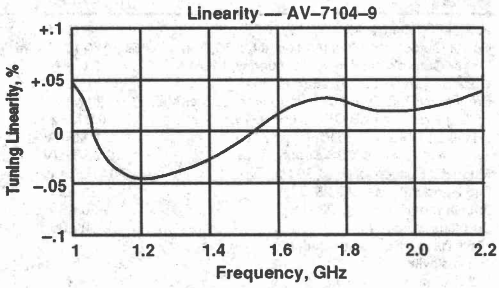
Guaranteed Specifications at 0° to +65°C Case Temperature (Unless Otherwise Noted)

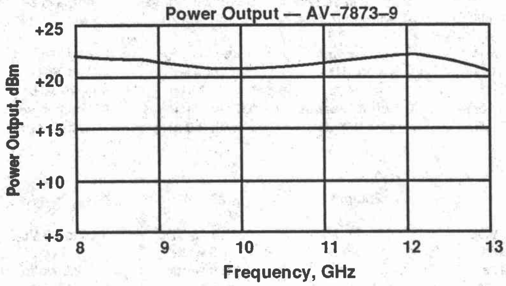
Model No.	AV–7443–9	AV–7871–9	AV–7872–9	AV–7873–9	AV–78020–9
Frequency Range, Min.	4–8 GHz	8–12.4 GHz	8–12.4 GHz	8–12.4 GHz	8–20 GHz
Power Output into 50-ohm Load, @ 25°C, Min.	60 mW/+17.8 dBm	30 mW/+14.8 dBm	60 mW/+17.8 dBm	100 mW/+20 dBm	20 mW/+13 dBm
Power Output Variation vs. Frequency, Max.	6.0 dB	6.0 dB	6.0 dB	6.0 dB	8.0 dB
Operating Case Temperature Range	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C	0° to +65°C
Frequency Drift Over Operating Temperature, Max.	20 MHz	25 MHz	25 MHz	25 MHz	40 MHz
Pulling Figure (12 dB Return Loss), Typ.	0.2 MHz	5.0 MHz	1.0 MHz	1.0 MHz	1.0 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V
–5 VDC Supply, Typ.	2.0 MHz/V	N/A	N/A	N/A	N/A
Magnetic Susceptibility @ 60 Hz, Typ.	70 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss
2nd Harmonic, Min., @ 25°C	–20 dBc	–20 dBc	–20 dBc	–20 dBc	–20 dBc
3rd Harmonic, Min., @ 25°C	–20 dBc	–20 dBc	–20 dBc	–20 dBc	–20 dBc
Spurious Output, Min.	–60 dBc	–60 dBc	–60 dBc	–60 dBc	–60 dBc
Main Tuning Port Characteristics					
Sensitivity	20±1 MHz/mA	20±1 MHz/mA	20±1 MHz/mA	20±1 MHz/mA	20±1 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	5 kHz	5 kHz	5 kHz	5 kHz
Linearity, Typ.	±0.1%	±0.1%	±0.1%	±0.1%	±0.15%
Hysteresis, Typ.	6 MHz	6 MHz	6 MHz	6 MHz	18 MHz
Input Impedance @ 1 kHz, Typ.	10 Ohms in series with 95 mH	9 ohms in series with 60 mH	9 ohms in series with 60 mH	9 ohms in series with 60 mH	7 ohms in series with 73 mH
FM Port Characteristics					
Sensitivity, Typ.	310 kHz/mA	450 kHz/mA	450 kHz/mA	450 kHz/mA	450 kHz/mA
3 dB Bandwidth, Typ.	800 kHz	400 kHz	400 kHz	400 kHz	1 MHz
Deviation at 3 dB Bandwidth, Max,	40 MHz	40 MHz	40 MHz	40 MHz	90 MHz
Input Impedance @ 1 MHz, Typ.	1 ohm in series with 1.7 µH	0.5 ohm in series with 1.7 µH	0.5 ohm in series with 2.0 µH	0.5 ohm in series with 2.0 µH	0.5 ohm in series with 2.3 µH
DC Circuit Power, Max.					
+15±.5 VDC	200 mA	125 mA	—	—	—
–5±.1 VDC	60mA	—	—	—	—
+15+0.5, –3.5 VDC	—	—	250 mA	250 mA	275 mA
YIG Heater Power					
Input Voltage Range	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC
Power @ 25°C, Max.	1.5 watts	1.5 watts	1.5 watts	1.5 watts	1.5 watts
Power @ 0°C, Max.	2.0 watts	2.0 watts	2.0 watts	2.0 watts	2.0 watts
Weight, Max.	10 oz.	12 oz.	12 oz.	12 oz.	17 oz.
Case Style	C–45	M4–45	M4–45	M4–45	M3–60

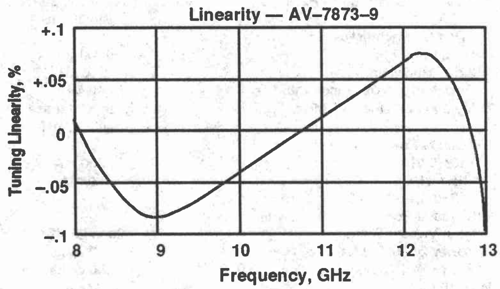
Model No.	AV–71241–9	AV–71251–9	AV–71261–9
Frequency Range, Min.	12–18 GHz	12–18 GHz	12–18 GHz
Power Output into 50-ohm Load, @ 25°C, Min.	20 mW/ +13 dBm	30 mW/ +14.8 dBm	50 mW/ +17 dBm
Power Output Variation vs. Frequency, Max.	6.0 dB	6.0 dB	6.0 dB
Operating Case Temperature Range	0° to +65°C	0° to +65°C	0° to +65°C
Frequency Drift Over Operating Temperature, Max.	40 MHz	40 MHz	40 MHz
Pulling Figure (12 dB Return Loss), Typ.	5.0 MHz	1.0 MHz	0.5 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V
–5 VDC Supply, Typ.	N/A	N/A	N/A
Magnetic Susceptibility @ 60 Hz, Typ.	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss
2nd Harmonic, Min., @ 25°C	–20 dBc	–20 dBc	–20 dBc
3rd Harmonic, Min., @ 25°C	–20 dBc	–20 dBc	–20 dBc
Spurious Output, Min.	–60 dBc	–60 dBc	–60 dBc
Main Tuning Port Characteristics			
Sensitivity	18±1 MHz/mA	18±1 MHz/mA	18±1 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	5 kHz	5 kHz
Linearity, Typ.	±.1%	±.1%	±.1%
Hysteresis, Typ.	9 MHz	9 MHz	9 MHz
Input Impedance @ 1 kHz, Typ.	6 ohms in series with 73 mH	6 ohms in series with 73 mH	6 ohms in series with 73 mH
FM Port Characteristics			
Sensitivity, Typ.	450 kHz/mA	450 kHz/mA	450 kHz/mA
3 dB Bandwidth, Typ.	1 MHz	1 MHz	1 MHz
Deviation at 3 dB Bandwidth, Max,	70 MHz	70 MHz	70 MHz
Input Impedance @ 1 MHz, Typ.	0.5 ohm in series with 2.3 µH	0.5 ohm in series with 2.3 µH	0.5 ohm in series with 2.3 µH
DC Circuit Power, Max.			
+15±0.5 VDC	—	—	—
–5±0.1 VDC	—	—	—
+15 +0.5, –3.5 VDC	125 mA	150 mA	200 mA
YIG Heater Power			
Input Voltage Range	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC
Power @ 25°C, Max.	1.5 watts	1.5 watts	1.5 watts
Power @ 0°C, Max.	2.0 watts	2.0 watts	2.0 watts
Weight, Max.	17 oz.	17 oz.	17 oz.
Case Style	M3–45	M3–60	M3–60

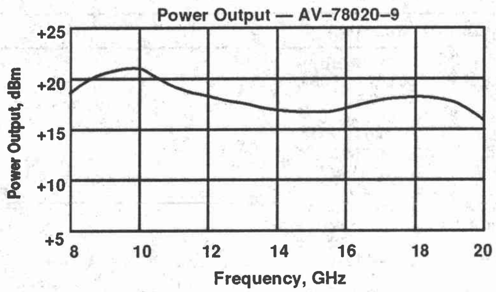
TYPICAL PERFORMANCE GRAPHS

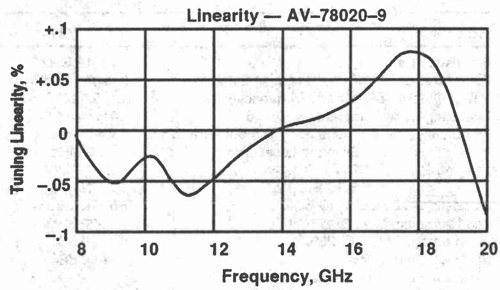










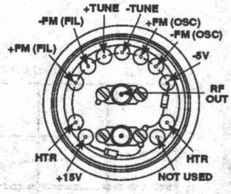


AVANTEK

YIG-Tuned Oscillators With Tracking YIG Filter

FEATURES

- 2 to 8 GHz Coverage
- –40 dBc Minimum Harmonics
- 30 mW Minimum Output Power
- Automatic Filter Tracking
- ±0.1% Tuning Linearity
- FM/Phase-Lock Port
- 0° to +65°C Temperature Range



F-1, p. 16–16

DESCRIPTION

The Avantek AV-7248 is a fundamental output, buffered YIG-tuned transistor oscillator with an integral tracking YIG filter providing –40 dBc minimum harmonic output over the 2 to 8 GHz frequency range. It offers +14.8 dBm (30 mW) minimum output power with 6.0 dB maximum variation and ±0.1% tuning linearity over the full operating band. This complete YIG-tuned silicon bipolar transistor oscillator, two-stage GaAs FET buffer amplifier and high-Q tracking YIG filter is packaged in a compact hermetic case with a 2-inch diameter and 1.4-inch length, weighing approximately 17 oz.

An AV-7248 is ideal as the swept signal source in a laboratory signal generator due to its low harmonic output, extremely linear tuning curve and excellent frequency resettability. It may also be used as a local oscillator in spectrum analyzers and microwave receivers.

In the AV-7248, both the frequency-determining oscillator YIG sphere and the filter YIG sphere are under the same pole piece in the same magnetic circuit. Since the mechanical configuration of the magnetic circuit is carefully optimized, the tracking between oscillator and filter is inherently very close. For most applications, the unit is simply used as a conventional YIG-tuned transistor oscillator and no further design work is required. However, by applying current to the special filter fine-tuning (FM) coil provided on the AV-7248, the output power may be increased by approximately 1 dB at a particular frequency (approximately 100 mA at 8 GHz). This current may be fixed—for example to peak the output power at the high end of the frequency range to overcome external circuit losses—or swept with the main tuning current as desired.

As with all other Avantek AV-7000 Series YIG-tuned oscillators, the AV-7248 also includes a low-inductance FM tuning coil as a standard feature. This small coil is in close proximity to the YIG sphere and may be used to fine-tune the oscillator frequency, to phase lock the oscillator or to frequency modulate the output signal. The tuning sensitivity of this coil is less than that of the main tuning coil, but it has an 800 kHz, 3 dB bandwidth and can vary the output frequency as much as 40 MHz.

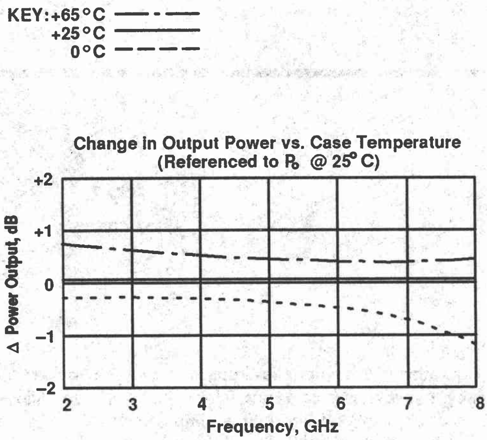
ELECTRICAL AND PERFORMANCE SPECIFICATIONS

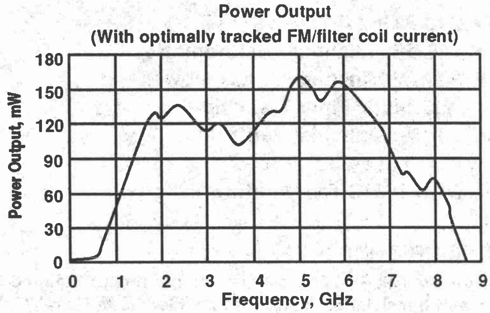
Guaranteed Specifications at 0° to +65°C Case Temperature (Unless Otherwise Noted)

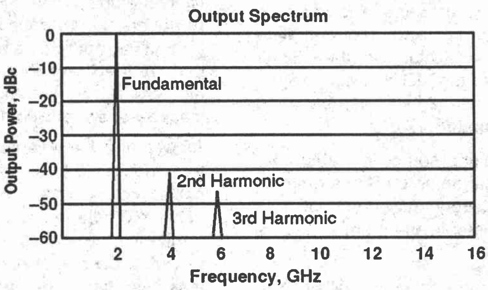
Parameters	Spec.	Parameters	Spec.
Frequency Range, Min.	2 to 8 GHz	Third Harmonic @ 25°C, Min.	–40 dBc
Power Output (50-ohm Load) @ 25°C, Min.	30 mW +14.8 dBm	Spurious Output, Min.	–60 dBc
Power Output Variation, Max.	6.0 dB	FM Port Characteristics (Oscillator and Filter)	
Operating Temperature Range (Case Temperature)	0 to 65°C	Sensitivity	310 kHz/mA
Frequency Drift Over Operating Temp., Max.	20 MHz	Bandwidth (3 dB), Typ.	800 kHz
Pulling Figure (12 dB Return Loss), Typ.	0.2 MHz	Deviation @ 3 dB Bandwidth, Max.	40 MHz
Pushing Figure, Typ.		Input Impedance Typ.	1 ohm in series with 1.7 µH
+15 VDC Supply	0.1 MHz/V	Filter Tracking Current[2]	300 mA @ 8 GHz
–5 VDC Supply	2.0 MHz/V	+15 VDC Circuit Current, Max.	200 mA
Magnetic Susceptibility, Typ. @ 60 Hz	50 kHz/Gauss[1]	–5 VDC Circuit Current, Max.	60 mA
Second Harmonic @ 25°C, Min.	–40 dBc	YIG-Heater Power	20 to 28 VDC 4W max @ 25°C 6W max @ 0°C
Main Tuning Port Characteristics		Weight Nom.	17 oz.
Sensitivity, Typ.	20±1 MHz/mA	Case Type	F-1
Bandwidth (3dB), Typ.	5 kHz		
Linearity, Typ.±0.1%			
Hysteresis, Typ.	8 MHz		
Input Impedance, Typ.	9 ohms in series with 130 mH		

NOTES: 1. 20 kHz/Gauss with optional mu-metal shield.
2. Maximum (applied to filter FM port)

TYPICAL PERFORMANCE @ 25°C Case Temperature (Unless Otherwise Noted)

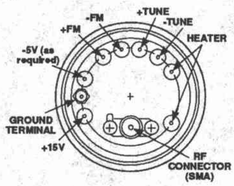




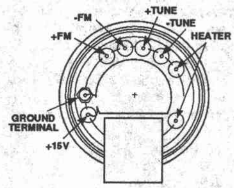


FEATURES

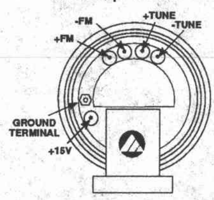
- 18 to 50 GHz Frequency Coverage
- 10 to 60 mW Minimum Output Power
- ±0.05% Tuning Linearity (Typ.)
- Integral FM/Phase Lock Port
- GaAs FET Buffer Amplifiers
- Hermetic Package
- Thin-Film Hybrid Construction
- 0° to +65°C and –54° to +85°C Temperature Range Versions



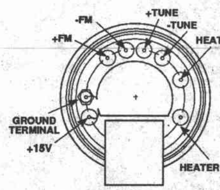
M5-60, p. 16–24



M5-60WR28, p. 16–25



M5-45WR22, p. 16–25



M5-45WR28, p. 16–25

DESCRIPTION

The Avantek® AV Series millimeter oscillators are fundamental-output, buffered GaAs FET YIG-tuned oscillators which provide a choice of +17.8 dBm, +16 dBm, +13 dBm or +10 dBm minimum output power over the 18 to 26.5 GHz frequency range and +13 dBm or +10 dBm 26.5 to 40 GHz range. They offer the features associated with lower-frequency YIG-tuned transistor oscillators, including ±.05% tuning linearity, 0.5 MHz typical pulling over all phases of a 12 dB (1.67:1 VSWR) return loss, 0.1 MHz/V typical pushing the +15 VDC supply line and spurious outputs at least 60 dB below the selected carrier.

The oscillators are powered from a single +15 VDC source and require either 200 mA or 150 mA (not including YIG heater or coil current)—a maximum of 3.0W compared to the approximately 15W necessary to power a Gunn or Impatt-diode oscillator at similar frequencies. The variation in output power vs. frequency is also far lower with the GaAs FET oscillator than the equivalent two-terminal signal source.

This makes Avantek Millimeter Band YTOs an excellent choice for all applications where efficiency, tuning linearity and spectral purity are important. They are ideal local oscillators for frequency agile receivers and spectrum analyzers, and make excellent signal sources for microwave sweep generators and synthesizers. Each model includes a low-inductance FM tuning coil which may be used for fine-tuning, phase-lock or to frequency-modulate the output signal.

All Avantek AV Series YIG-tuned oscillators are built with thin-film hybrid construction. With components such as transistors and capacitors, in unpackaged chip form, are bonded directly to the ceramic substrate. The cases are filled with a dry, inert atmosphere, hermetically welded, and leak tested to assure long-term protection from moisture and corrosive gases—even under severe humidity and vibration conditions.

Avantek microwave oscillators are built under a quality program that meets the requirements of MIL-Q-9858A. Qualification to the environmental specifications of MIL-E-5400 and MIL-E-16400, as well as other applicable military specifications, is available.

ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications at 0° to +65°C Case Temperature (Unless Otherwise Noted)

Model No.	AV–71826	AV–718226	AV–18326	AV–18030
Frequency Range, Min.	18–26.5 GHz	18–26.5 GHz	18–26.5 GHz	18–30 GHz
Power Output into 50-ohm Load, Min. at 25°C	20 mW/+13 dBm	40 mW/+16 dBm	60 mW/+17.8 dBm	40 mW/+16 dBm
Power Output Variation vs. Frequency, Max.	6.0 dB	6.0 dB	6.0 dB	6.0 dB
Operating Case Temperature Range	0° to 65°C	0° to 65°C	0° to 65°C	0° to 65°C
Frequency Drift Over Operating Temperature, Max.	60 MHz	60 MHz	40 MHz	60 MHz
Pulling Figure (12 dB Return Loss), Typ.	0.5 MHz	0.5 MHz	1.0 MHz	1.0 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V
Magnetic Susceptibility @ 60 Hz, Typ.	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss
Spurious Output, Min.	–60 dBc	–60 dBc	–60 dBc	–60 dBc
Main Tuning Port Characteristics				
Sensitivity	30±1.5 MHz/mA	30±1.5 MHz/mA	30±1.5 MHz/mA	30±1.5 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	5 kHz	5 kHz	5 kHz
Linearity, Typ.	±0.05%	±0.05%	±0.05%	±0.1%
Hysteresis, Typ.	12 MHz	12 MHz	10 MHz	18 MHz
Input Impedance @ 1 kHz, Typ.	6.5 ohms in series with 95 mH	10 ohms in series with 150 mH	6.5 ohms in series with 95 mH	6.5 ohms in series with 95 mH
FM Port Characteristics				
Sensitivity, Typ.	425 kHz/mA	375 kHz/mA	425 kHz/mA	425 kHz/mA
3 dB Bandwidth, Typ.	400 kHz	800 kHz	400 kHz	400 kHz
Deviation at 3 dB Bandwidth, Max.	90 MHz	90 MHz	90 MHz	90 MHz
Input Impedance @ 1 MHz, Typ.	0.35 ohm in series with 2 μH	0.4 ohm in series with 1.2 μH	0.35 ohm in series with 2 μH	0.35 ohm in series with 2 μH
DC Circuit Power, Max., +8.0/+15.5V Min/Max +15+.5/–3.5V	150 mA	150 mA	200 mA	200 mA
YIG Heater Power				
Input Voltage Range	—	20 to 28 VDC	—	—
Power @ 25°C, Max.	—	1.5 watts	—	—
Power @ 0°C, Max.	—	2.0 watts	—	—
Weight, Max.	19 oz.	20 oz.	20 oz.	20 oz.
Case Style	M5–60	M5–60	M5–60	M5–60

Model No.	AV–20030	AV–25037M/W	AV–26040M/W
Frequency Range, Min.	20–30 GHz	25.0–37.5 GHz	26.5–40 GHz
Power Output into 50-ohm Load, Min. at 25°C	40 mW/+16 dBm	20 mW/+13 dBm	10 mW/+10 dBm
Power Output Variation vs. Frequency, Max.	6.0 dB	4.0 dB	6.0 dB
Operating Case Temperature Range	0° to 65°C	0° to 65°C	0° to 65°C
Frequency Drift Over Operating Temperature, Max.	60 MHz	60 MHz	60 MHz
Pulling Figure (12 dB Return Loss), Typ.	1.0 MHz	0.5 MHz	0.5 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V
Magnetic Susceptibility @ 60 Hz, Typ.	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss
Spurious Output, Min.	–60 dBc	–60 dBc	–60 dBc
Main Tuning Port Characteristics			
Sensitivity	30±1.5 MHz/mA	40±2.0 MHz/mA	40±2 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	2 kHz	2 kHz
Linearity, Typ.	±0.05%	±0.1%	±0.1%
Hysteresis, Typ.	16 MHz	40 MHz	40 MHz
Input Impedance @ 1 kHz, Typ.	6.5 ohms in series with 95 mH	6 ohms in series with 90 mH	10.5 ohms in series with 125 mH
FM Port Characteristics			
Sensitivity, Typ.	425 kHz/mA	430 kHz/mA	500 kHz/mA
3 dB Bandwidth, Typ.	400 kHz	50 kHz	100 kHz
Deviation at 3 dB Bandwidth, Max.	90 MHz	100 MHz	100 MHz
Input Impedance @ 1 MHz, Typ.	0.35 ohm in series with 2 μH	0.3 ohm in series with 0.5 μH	0.4 ohm in series with 2 μH
DC Circuit Power, Max., +8/+15.5V Min/Max +15+0.5/–3.5V	200 mA	200 mA	150 mA
YIG Heater Power			
Input Voltage Range	—	—	—
Power @ 25°C, Max.	—	—	—
Power @ 0°C, Max.	—	—	—
Weight, Max.	20 oz.	20 oz.	20 oz.
Case Style	M5–60	M5–60WR28	M5-45WR28

ELECTRICAL AND PERFORMANCE SPECIFICATIONS (continued)

Guaranteed Specifications at 0° to +65°C Case Temperature (Unless Otherwise Noted)

Model No.	AV–26240M/W	AV–30045	AV–33050
Frequency Range, Min.	26.5–40 GHz	30–45 GHz	33–50 GHz
Power Output into 50-ohm Load, Min. at 25°C	20 mW/+13 dBm	10 mW/+10 dBm	5 mW/+7 dBm
Power Output Variation vs. Frequency, Max.	4.0 dB	6.0 dB	6.0 dB
Operating Case Temperature Range	0° to 65°C	0° to 65°C	0° to 65°C
Frequency Drift Over Operating Temperature, Max.	60 MHz	60 MHz	60 MHz
Pulling Figure (12 dB Return Loss), Typ.	0.5 MHz	0.1 MHz	0.1MHz
Pushing Figure, +15 VDC Supply, Typ.	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V
Magnetic Susceptibility @ 60 Hz, Typ.	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss
Spurious Output, Min.	–60 dBc	–60 dBc	–60 dBc
Main Tuning Port Characteristics			
Sensitivity	40±2.0 MHz/mA	50.0±3.0 MHz/mA	50.0±3.0 MHz/mA
3 dB Bandwidth, Typ.	2 kHz	2 kHz	2 kHz
Linearity, Typ.	±0.1%	±0.15%	±0.2%
Hysteresis, Typ.	40 MHz	65 MHz	65 MHz
Input Impedance @ 1 kHz, Typ.	6 ohms in series with 90 mH	10.5 ohms in series with 130 mH	10.5 ohms in series with 130 mH
FM Port Characteristics			
Sensitivity, Typ.	430 kHz/mA	400 kHz/mA	400 kHz/mA
3 dB Bandwidth, Typ.	50 kHz	100 kHz	100 kHz
Deviation at 3 dB Bandwidth, Max.	100 MHz	100 MHz	100 MHz
Input Impedance @ 1 MHz, Typ.	0.3 ohm in series with 0.5 µH	0.3 ohm in series with 1 µH	0.3 ohm in series with 1 µH
DC Circuit Power, Max., +8.0/+15.5V Min/Max	150 mA	150 mA	150 mA
YIG Heater Power			
Input Voltage Range	—	—	—
Power @ 25°C, Max.	—	—	—
Power @ 0°C, Max.	—	—	—
Weight, Max.	20 oz.	20 oz.	20 oz.
Case Style	M5–60WR28	M5–45WR22	M5–45WR22

Guaranteed Specifications at –54° to +85°C Case Temperature (Unless Otherwise Noted)

Model No.	AV–18126	AV–26140M/W
Frequency Range, Min.	18–26.5 GHz	26.5–40 GHz
Power Output into 50-ohm Load, Min. /Max.	+16 dBm/+23 dBm	+13 dBm/+19 dBm
Operating Case Temperature Range	–54° to 85°C	–54° to 85°C
Frequency Drift Over Operating Temperature, Max.	60 MHz	60 MHz
Pulling Figure (12 dB Return Loss), Typ.	1.0 MHz	0.5 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.1 MHz/V	0.1 MHz/V
Magnetic Susceptibility @ 60 Hz, Typ.	50 kHz/Gauss	50 kHz/Gauss
Spurious Output, Min.	–60 dBc	–60 dBc
Main Tuning Port Characteristics		
Sensitivity	30.0±1.5 MHz/mA	40.0±2.0 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	2 kHz
Linearity, Typ.	±0.1%	±0.1%
Hysteresis, Typ.	10 MHz	40 MHz
Input Impedance @ 1 kHz, Typ.	6.5 ohms in series with 90 mH	6 ohms in series with 90 mH
FM Port Characteristics		
Sensitivity, Typ.	425 kHz/mA	430 kHz/mA
3 dB Bandwidth, Typ.	400 kHz	50 kHz
Deviation at 3 dB Bandwidth, Max.	90 MHz	100 MHz
Input Impedance @ 1 MHz, Typ.	0.35 ohm in series with 2 µH	0.3 ohm in series with 0.5 µH
DC Circuit Power, Max.		
+8.0/+15.5V Min./Max.	200 mA	150 mA
Input Voltage Range	—	—
Power @ 25°C, Max.	—	—
Power @ –54°C, Max.	—	—
Weight, Max.	20 oz.	20 oz.
Case Style	M5–60	M5–60WR28

TEK

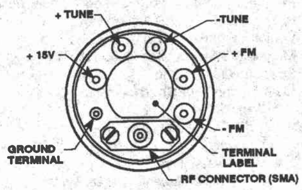
Low Unit Cost YIG-Tuned Oscillators 2 to 8 GHz

...URES

- 1.00-inch Dia. Package
- Low Coil Inductance: 32 mH (typ.)
- Light Weight: 1.8 oz./51 grams
- Low Prime Power Consumption
- Fast Tuning Speed
- Single +15 VDC Bias

APPLICATIONS

- Test and Measurement Instrumentation
- Portable/Lightweight Systems
- Special Antenna Range Measurement Systems
- Laboratory Test Bench Microwave Source



LC–1, p. 16–21

DESCRIPTION

The Avantek Low Unit Cost series of YIG-tuned oscillators has been designed specifically for the next generation commercial applications. These small, lightweight, low–cost units are an excellent alternative to the more conventional 1.75 inch diameter units.

The units consist of a Yttrium Iron Garnet sphere coupled with an Avantek silicon bipolar transistor followed by an Avantek GaAs FET MMIC amplifier for +13 dBm minimum power output. This low cost Yig-tuned oscillator series has been designed with single input bias and requires no Yig heater power. Inherent to the small size is the low coil inductance which provides for tuning speeds two to three times faster than conventional 1.75" dia. YTOs.

ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications at +25°C Case Temperature (unless otherwise noted)

Model No.	AV–7036	AV–7028
Frequency Range, Min:	3.0 to 6.0 GHz	2.0 to 8.0 GHz
Power Output (50-ohm load), Min:	+13 dBm	+13 dBm
Power Variation (Over Frequency Range) Max:	4.0 dB	6.0 dB
Operating Temperature Range (Case Temperature):	0 to +50°C	0 to +50°C
Frequency Drift Over Temperature, Typ:	5.0 MHz	10.0 MHz
Pulling Figure (12 dB Return Loss), Typ:	0.2 MHz	0.2 MHz
Pushing Figure, +15 VDC Supply, Typ:	0.1 MHz/V	0.1 MHz/V
Magnetic Susceptibility @ 60 Hz, Typ:	150 kHz/Gauss	150 kHz/Gauss
2nd Harmonic, Min:	–8 dBc	–8 dBc
3rd Harmonic, Typ:	–14 dBc	–14 dBc
Spurious Output, Min:	–50 dBc	–50 dBc
SSB Phase Noise (@ 20 KHz From Carrier), Typ:	–100 dBc/Hz	–100 dBc/Hz
(@ 100 KHz From Carrier), Typ:	–120 dBc/Hz	–120 dBc/Hz
Main Tuning Port Characteristics		
Sensitivity:	20 MHz/mA ± 15%	20MHz/mA ± 15%
Bandwidth (3 dB), Typ:	5 kHz	5 kHz
Linearity, Typ:	±0.02%	±0.10%
Hysteresis, Typ:	5 MHz	8 MHz
Input Impedance, Typ. @ 1kHz:	7.3 ohms in series with 32 mH	7.3 ohms in series with 32 mH
FM Port Characteristics		
Sensitivity, Typ:	310 kHz/mA	310 kHz/mA
Bandwidth (3 dB), Typ:	200 kHz	200 kHz
Deviation at 3 dB Bandwidth, Max:	40 MHz	40 MHz
Input Impedance, Typ.:	0.3 ohms in series with 1.4 µH	0.3 ohms in series with 1.4 µH
DC Circuit Power, Max +15V DC ± 0.5V DC:	100 mA	100 mA
Weight, Max:	1.8 oz.	1.8 oz.
Case Style:	LC–1	LC–1

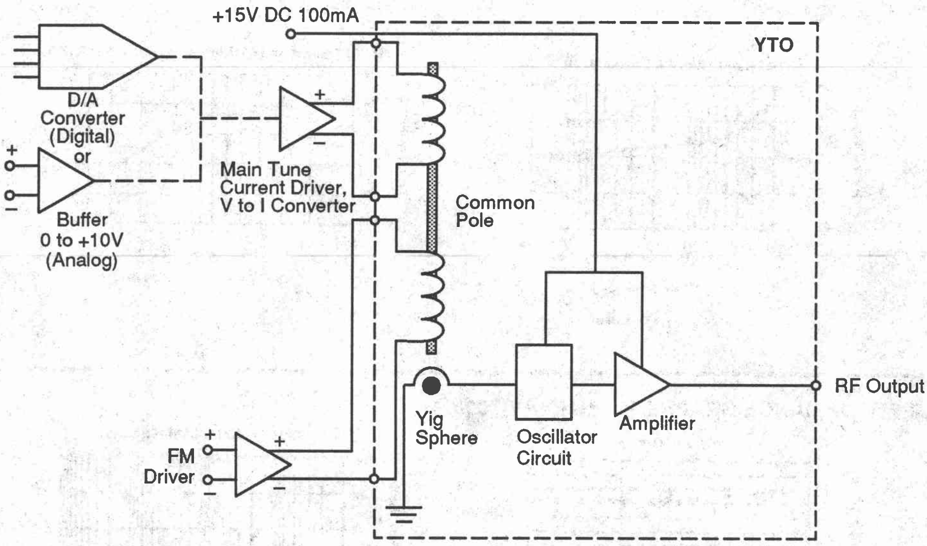
MAXIMUM RATINGS

DC Voltage .... +20 VDC, Max.
FM Tuning Current, Max. .... 300 mA Max.
Operating Case Temperature.................... 0°C to +50°C
Storage Temperature .... –10°C to +65°C

WEIGHT: 1.8 oz./51 grams

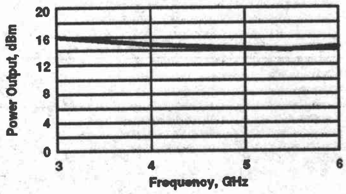
BLOCK DIAGRAM

Basic Digital/Analog Driver Hookup to a YTO

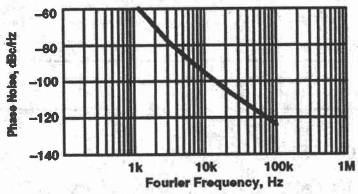


TYPICAL PERFORMANCE GRAPHS @ +25°C AV -7036

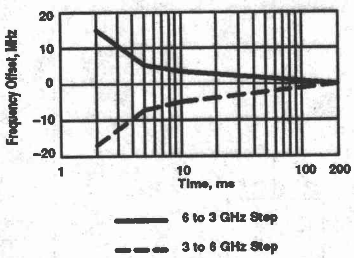
POWER OUTPUT



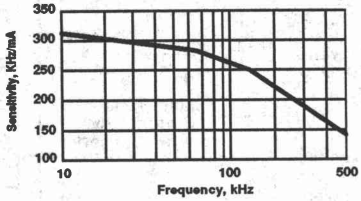
SINGLE SIDEBAND PHASE NOISE



SETTLING TIME, FULL BAND STEP

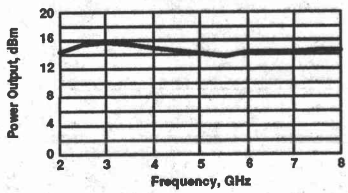


FM PORT SENSITIVITY VS. MODULATION FREQUENCY

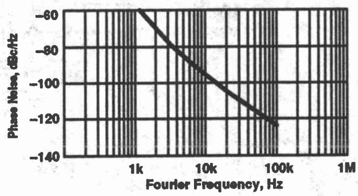


TYPICAL PERFORMANCE GRAPHS @ +25°C AV-7028

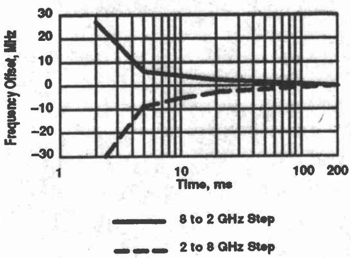
POWER OUTPUT



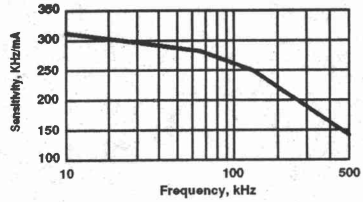
SINGLE SIDEBAND PHASE NOISE



SETTLING TIME , FULL BAND STEP



FM PORT SENSITIVITY VS. MODULATION FREQUENCY

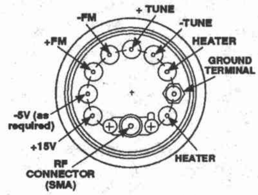


AVANTEK

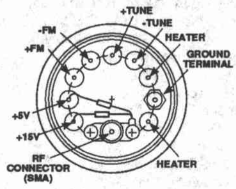
YIG-Tuned Oscillators
Extended Temperature Range
Octave Band

FEATURES

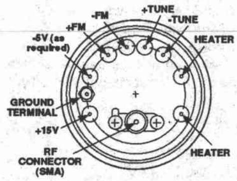
- 2 to 18 GHz Frequency Coverage
- Designed to MIL-E1-5400 and -16400
- Rugged Hermetic Thin-Film Construction
- ±0.05% to +0.2% Tuning Linearity
- High Rate FM and Phase Lock Capability
- Frequency Stable Under Severe Vibration
- –54° to +85°C Temperature Range



M4–45, p. 16–24



M4–38, p. 16–23



M3-60, p. 16–24

DESCRIPTION

The Avantek® AV Series Extended Temperature Range fundamental oscillators are extremely compact and light-weight, yet are designed and manufactured to offer excellent performance and high MTBFs over the –54° to +85°C temperature range. They meet the environmental conditions of MIL-E-5400 and MIL-E-16400.

This family of truly ruggedized YTOs offers complete 2 to 18 GHz frequency coverage. They are ideal for systems requiring signal sources with moderate power levels, excellent tuning linearity, low spurious outputs and a flat power out vs. frequency characteristic.

Greater Than 70,000 Hours MTBF Under Missile Launch Conditions

As an indication of the inherent reliability of the Avantek family of these YTOs, the MTBF of the AV-7214 (2 to 4 GHz) is calculated at 73,900 hours at 71°C under the most severe condition of MIL-HDBK-217B (M_L—missile launch). Even at temperatures which exceed the normal guaranteed operating range, the MTBF still remains high. For example, under the same M_L conditions, the MTBF of the AV-7214 is 46,600 hours at 100°C.

Resistant To Shock And Vibration

Under the conditions of MIL-STD-810C (method 516.2, procedure 4, figure 516.2-2), with a shock of 50G for 11 ms or 300G for 3 ms, there is no degradation, before and after, of the performance of the AV-7214. The incidental frequency stability of the AV-7214 is equal to or better than 200 kHz with a vibration of 10-2500 Hz at 45G, MIL-STD-202, method 204, test condition E. Note that the mounting and cabling of the oscillator during the vibration test is critical—consult the Avantek factory for information on the procedures for duplicating this test.

YIG-TUNED OSCILLATORS, EXTENDED TEMPERATURE RANGE, OCTAVE BAND

Guaranteed Specifications at –54° to +85°C Case Temperature (Unless Otherwise Noted)

Model No.	AV–7214	AV–7413	AV–7418	AV–77111
Frequency Range, Min.	2–4 GHz	4–8 GHz	4–8 GHz	7–11 GHz
Power Output into 50-ohm Load, Min./Max.	+17 dBm/+23 dBm	+8 dBm/+20 dBm	+14.8 dBm/+23 dBm	+17 dBm/+24 dBm
Frequency Drift Over Operating Temperature, Max.	20 MHz	40 MHz	40 MHz	40 MHz
Pulling Figure (12 dB Return Loss), Typ.	0.5 MHz	0.5 MHz	0.5 MHz	0.5 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.1 MHz/V	0.5 MHz/V	0.1 MHz/V	0.1 MHz/V
–5 VDC Supply, Typ.	1.5 MHz/V	1.5 MHz/V	1.5 MHz/V	N/A
Magnetic Susceptibility @ 60 Hz, Typ.	70 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss
2nd Harmonic, Min.	–12 dBc	–12 dBc	–12 dBc	–12 dBc
3rd Harmonic, Min.	–20 dBc	–15 dBc	–12 dBc	–15 dBc
Spurious Output, Min.	–60 dBc	–60 dBc	–60 dBc	–60 dBc
Main Tuning Port Characteristics				
Sensitivity	15±0.8 MHz/mA	15±0.8 MHz/mA	15±0.8 MHz/mA	20±1 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	5 kHz	5 kHz	5 kHz
Linearity, Typ.	±0.05%	±0.05%	±0.1%	±.0.1%
Hysteresis, Typ.	3 MHz	6 MHz	6 MHz	6 MHz
Input Impedance @ 1 kHz, Typ.	7 ohms in series with 51 mH	7 ohms in series with 51 mH	7 ohms in series with 51 mH	7 ohms in series with 60 mH
FM Port Characteristics				
Sensitivity, Typ.	310 kHz/mA	310 kHz/mA	310 kHz/mA	450 kHz/mA
3 dB Bandwidth, Typ.	400 kHz	400 kHz	400 kHz	400 kHz
Deviation at 3 dB Bandwidth, Max.	60 MHz	60 MHz	60 MHz	70 MHz
Input Impedance @ 1 MHz, Typ.	1 ohm in series with 1.7 µH	1 ohm in series with 1.7 µH	1 ohm in series with 1.7 µH	.5 ohm in series with 2.0 µH
DC Circuit Power, Max.,	200 mA	120 mA	200 mA	
+15±0.5V	60 mA	60 mA	60 mA	300 mA
–5.0±0.1V				
+15+0.5/–3.5V				
YIG Heater Power				
Input Voltage Range	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC
Power @ 25°C, Max.	1.5 watts	1.5 watts	1.5 watts	1.5 watts
Power @ –54°C, Max.	2.5 watts	2.5 watts	2.5 watts	2.5 watts
Weight, Max.	12 oz.	12 oz.	12 oz.	12 oz.
Case Style	M4–45	M4–38	M4–45	M4–45

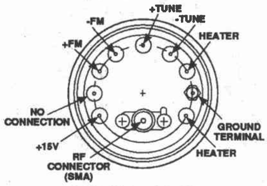
Model No.	AV–7814	AV–78112	AV–12118
Frequency Range, Min.	8–12.4 GHz	8–12.4 GHz	12–18 GHz
Power Output into 50-ohm Load, Min./Max.	+13 dBm/+24 dBm	+19 dBm/+24 dBm	+16 dBm/+23 dBm
Frequency Drift Over Operating Temperature, Max.	50 MHz	50 MHz	60 MHz
Pulling Figure (12 dB Return Loss), Typ.	0.5 MHz	1.0 MHz	1.0 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V
–5 VDC Supply, Typ.	N/A	N/A	N/A
Magnetic Susceptibility @ 60 Hz, Typ.	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss
2nd Harmonic, Min.	–10 dBc	–12 dBc	–15 dBc
3rd Harmonic, Min.	–15 dBc	–15 dBc	—
Spurious Output, Min.	–60 dBc	–60 dBc	–60 dBc
Main Tuning Port Characteristics			
Sensitivity	18±1 MHz/mA	18±1 MHz/mA	18±1 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	5 kHz	5 kHz
Linearity, Typ.	±0.05%	±0.1%	±0.1%
Hysteresis, Typ.	6 MHz	6 MHz	9 MHz
Input Impedance @ 1 kHz, Typ.	6 ohms in series with 60 mH	6 ohms in series with 73 mH	6 ohms in series with 73 mH
FM Port Characteristics			
Sensitivity, Typ.	450 kHz/mA	450 kHz/mA	450 kHz/mA
3 dB Bandwidth, Typ.	1 MHz	1 MHz	1 MHz
Deviation at 3 dB Bandwidth, Max.	70 MHz	90 MHz	90 MHz
Input Impedance @ 1 MHz, Typ.	1 ohm in series with 2.3 µH	.5 ohm in series with 2.3 µH	.5 ohm in series with 2.3 µH
DC Circuit Power, Max.			
+15+0.5V/–3.5V	175 mA	275 mA	275 mA
YIG Heater Power			
Input Voltage Range	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC
Power @ 25°C, Max.	1.5 watts	1.5 watts	1.5 watts
Power @ –54°C, Max.	2.5 watts	2.5 watts	2.5 watts
Weight, Max.	17 oz.	17 oz.	17 oz.
Case Style	M3–60	M3–60	M3–60

AVANTEK

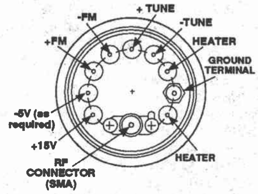
YIG-Tuned Oscillators
Extended Temperature Range
Multi-Octave Band

FEATURES

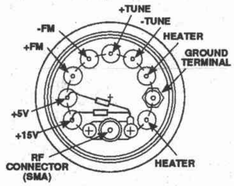
- 2 to 18 GHz Frequency Coverage
- Designed to MIL-E1-5400 and -16400
- Rugged Hermetic Thin-Film Construction
- ±0.05% to +0.2% Tuning Linearity
- High Rate FM and Phase-Lock Capability
- Frequency Stable Under Severe Vibration
- –54° to +85°C Temperature Range



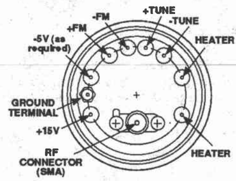
M1-45, p. 16–23



M4-45, p. 16–24



M4-38, p. 16–23



M3-45, M3-60, p. 16–24

DESCRIPTION

The Avantek® AV Series Extended Temperature Range fundamental oscillators are extremely compact and lightweight, yet are designed and manufactured to offer excellent performance and high MTBFs over the –54° to +85°C temperature range. They meet the environmental conditions of MIL-E-5400 and MIL-E-16400.

This family of truly ruggedized YTOs offers complete 2 to 18 GHz frequency coverage. They are ideal for systems requiring signal sources with moderate power levels, excellent tuning linearity, low spurious outputs and a flat power out vs. frequency characteristic.

Greater Than 70,000 Hours MTBF Under Missile Launch Conditions

As an indication of the inherent reliability of the Avantek family of these YTOs, the MTBF of the AV-7246 (2 to 6 GHz) is calculated at 73,900 hours at 71°C under the most severe condition of MIL-HDBK-217B (M_L—missile launch). Even at temperatures which exceed the normal guaranteed operating range, the MTBF still remains high. For example, under the same M_L conditions, the MTBF of the AV-7246 is 46,600 hours at 100°C.

Resistant To Shock and Vibration

Under the conditions of MIL-STD-810C (method 516.2, procedure 4, figure 516.2-2), with a shock of 50G for 11 ms or 300G for 3 ms, there is no degradation, before and after, of the performance of the AV-7246. The incidental frequency stability of the AV-7246 is equal to or better than 200 kHz with a vibration of 10-2500 Hz at 45G, MIL-STD-202, method 204, test condition E. Note that the mounting and cabling of the oscillator during the vibration test is critical—consult the Avantek factory for information on the procedures for duplicating this test.

ELECTRICAL AND PERFORMANCE SPECIFICATIONS

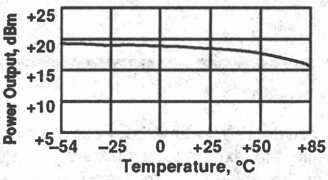
Guaranteed Specifications at –54° to +85°C Case Temperature (Unless Otherwise Noted)

Model No.	AV–7114	AV–7246	AV–7218	AV–7278
Frequency Range, Min.	1–4 GHz	2–6 GHz	2–8 GHz	2–8 GHz
Power Output into 50-ohm Load, Min./Max.	+13 dBm/+21 dBm	+16 dBm/+23 dBm	+5 dBm/+17 dBm	+14.8 dBm/+23 dBm
Frequency Drift Over Operating Temperature, Max.	20 MHz	30 MHz	40 MHz	40 MHz
Pulling Figure (12 dB Return Loss), Typ.	0.5 MHz	0.5 MHz	0.5 MHz	0.5 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.5 MHz/V	0.1 MHz/V	0.5 MHz/V	0.1 MHz/V
–5 VDC Supply, Typ.	1.5 MHz/V	1.5 MHz/V	1.5 MHz/V	1.5 MHz/V
Magnetic Susceptibility @ 60 Hz, Typ.	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss
2nd Harmonic, Min.	–12 dBc	–8 dBc	–5 dBc	–8 dBc
3rd Harmonic, Min.	–20 dBc	–12 dBc	–15 dBc	–12 dBc
Spurious Output, Min.	–60 dBc	–60 dBc	–60 dBc	–60 dBc
Main Tuning Port Characteristics				
Sensitivity	+15±0.8 MHz/mA	15±.8 MHz/mA	15±0.8 MHz/mA	15±.8 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	5 kHz	5 kHz	5 kHz
Linearity, Typ.	±.15%	±0.1%	±0.1%	±.0.1%
Hysteresis, Typ.	3 MHz	6 MHz	9 MHz	9 MHz
Input Impedance @ 1 kHz, Typ.	10 Ohms in series with 42 mH	7 ohms in series with 51 mH	7 ohms in series with 51 mH	7 ohms in series with 60 mH
FM Port Characteristics				
Sensitivity, Typ.	310 kHz/mA	310 kHz/mA	310 kHz/mA	310 kHz/mA
3 dB Bandwidth, Typ.	800 kHz	800 kHz	800 kHz	800 kHz
Deviation at 3 dB Bandwidth, Max.	50 MHz	60 MHz	60 MHz	60 MHz
Input Impedance @ 1 kHz, Typ.	1 ohm in series with 1.7 µH	1 ohm in series with 1.7 µH	1 ohm in series with 1.7 µH	1 ohm in series with 1.7 µH
DC Circuit Power, Max.,				
+15±0.5V	150 mA	200 mA	120 mA	200 mA
–5±0.1V	50 m/A	60 mA	60 mA	60 mA
YIG Heater Power				
Input Voltage Range	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC
Power @ 25°C, Max.	1.5 watts	1.5 watts	1.5 watts	1.5 watts
Power @ –54°C, Max.	2.5 watts	2.5 watts	2.5 watts	2.5 watts
Weight, Max.	8 oz.	12 oz.	12 oz.	12 oz.
Case Style	M1–45	M4–45	M4–38	M4–45

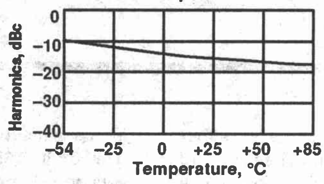
Model No.	AV-76118	AV-77116	AV-78418	AV-78618
Frequency Range, Min.	6–18 GHz	7–16 GHz	8–18 GHz	8–18 GHz
Power Output into 50-ohm Load, Min./Max.	+13 dBm/+23 dBm	+16 dBm/+24 dBm	+13 dBm/+24 dBm	+16 dBm/+24 dBm
Frequency Drift Over Operating Temperature, Max.	60 MHz	50 MHz	70 MHz	60 MHz
Pulling Figure (12 dB Return Loss), Typ.	1.0 MHz	0.5 MHz	0.5 MHz	1.0 MHz
Pushing Figure, +15 VDC Supply, Typ.	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V	0.1 MHz/V
Magnetic Susceptibility @ 60 Hz, Typ.	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss	50 kHz/Gauss
2nd Harmonic, Min.	–8 dBc	–12 dBc	–10 dBc	–10 dBc
3rd Harmonic, Min.	–8 dBc	–15 dBc	–15 dBc	–15 dBc
Spurious Output, Min.	–60 dBc	–60 dBc	–60 dBc	–60 dBc
Main Tuning Port Characteristics				
Sensitivity	+18±1 MHz/mA	20±1 MHz/mA	18±1 MHz/mA	18±1 MHz/mA
3 dB Bandwidth, Typ.	5 kHz	5 kHz	5 kHz	5 kHz
Linearity, Typ.	±0.25%	±0.1%	±0.1%	±.0.1%
Hysteresis, Typ.	18 MHz	13 MHz	15 MHz	15 MHz
Input Impedance @ 1 kHz, Typ.	6 ohms in series with 73 mH	9 ohms in series with 60 mH	6 ohms in series with 73 mH	6 ohms in series with 73 mH
FM Port Characteristics				
Sensitivity, Typ.	450 kHz/mA	450 kHz/mA	450 kHz/mA	450 kHz/mA
3 dB Bandwidth, Typ.	1 MHz	400 kHz	1 MHz	1 MHz
Deviation at 3 dB Bandwidth, Max.	90 MHz	70 MHz	90 MHz	90 MHz
Input Impedance @ 1 kHz, Typ.	.5 ohm in series with 2.3 µH	.5 ohm in series with 2.0 µH	0.5 ohm in series with 2.3 µH	.5 ohm in series with 2.3 µH
DC Circuit Power, Max.				
+15+0.5/–3.5V	275 mA	300 mA	175 mA	275 mA
YIG Heater Power				
Input Voltage Range	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC	20 to 28 VDC
Power @ 25°C, Max.	1.5 watts	1.5 watts	1.5 watts	1.5 watts
Power @ –54°C, Max.	2.5 watts	2.5 watts	2.5 watts	2.5 watts
Weight, Max.	17 oz.	12 oz.	17 oz.	17 oz.
Case Style	M3–60	M4–45	M3–45	M3–60

TYPICAL PERFORMANCE @ 25°C Case Temperature

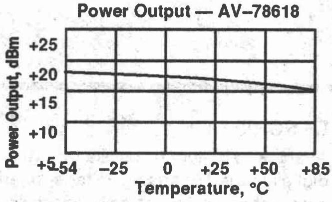
Power Output — AV-7278



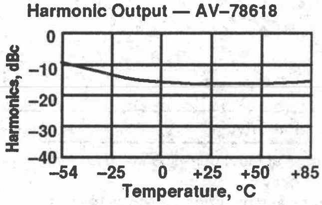
Harmonic Output — AV-7278



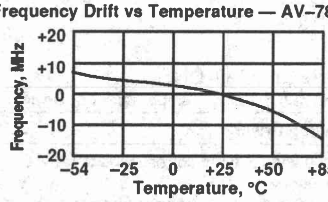
Power Output — AV-78618



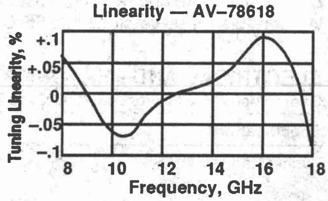
Harmonic Output — AV-78618



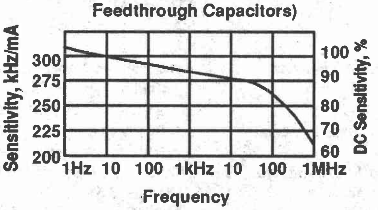
Frequency Drift vs Temperature — AV-78618



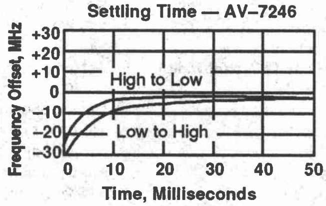
Linearity — AV-78618



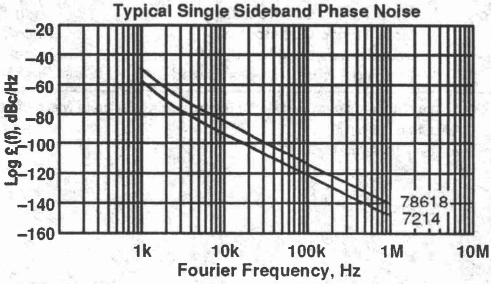
FM Port Sensitivity vs. Modulation Frequency
(Typical all AV Series Without FM
Feedthrough Capacitors)



Settling Time — AV-7246



Typical Single Sideband Phase Noise



DESCRIPTION

Avantek YIG-tuned oscillators are available with either digitally-tuned or analog voltage-tuned drivers. These drivers control the main tuning coil current via 12-bit digital logic or via an analog voltage, thus eliminating the need to build and align tuning current sources.

Both the digital and analog drivers are available in two temperature range version; 0° to 65°C and –54° to +85°C. The former is used with any Avantek YIG-tuned devices specified over 0° to +65°C, while the extended temperature range version will meet all of the environmental specifications of Avantek's militarized YIG-tuned devices, including operation over the –54° to +85°C temperature range.

ELECTRICAL AND PERFORMANCE SPECIFICATIONS

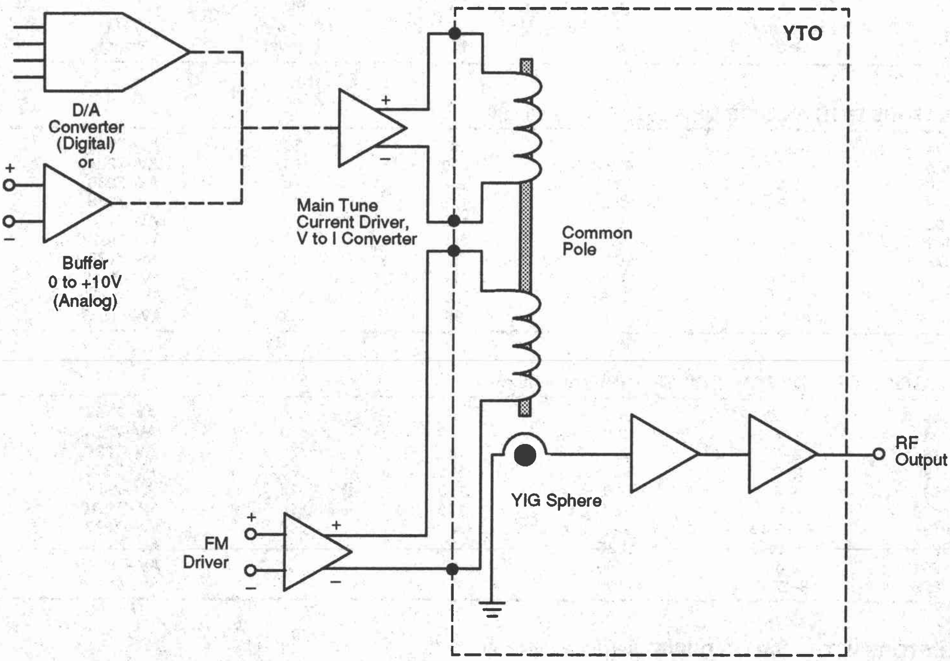
Guaranteed Specifications at 25°C Case Temperature (Operating Temperature Per Device)

Specification[1]	Analog Driver	Digital Driver
Tuning Range	0.000 volts at input corresponds to lowest frequency 10.000 volts at input corresponds to highest frequency	All zeros at input corresponds to lowest frequency All ones at input corresponds to highest frequency
Tuning Accuracy: at 25°C on baseplate, 1/2 hour after turn-on, excluding hysteresis and non-linearity	±(0.1% of frequency +2 MHz)	±(0.1% of frequency +2 MHz)
Resolution	NA	12 bit positive true logic for increasing frequency
Interface Logic	NA	TTL or CMOS
Tuning Input Resistance	≥10 kΩ	NA
Common Mode Rejection	≥40 dB	NA
Residual FM: (15 Hz-15 kHz bandwidth)	4×10^{-8} of oscillator frequency in hertz +40 kHz, typ.	4×10^{-8} of oscillator frequency in hertz +40 kHz, typ.
Non-Linearity	Device specification applies	±(1/2 bit + device non-linearity)
Pushing: +15 Volts:	±(0.01% of frequency +1 MHz + oscillator pushing)/volt. typ.	±(0.001% of frequency +0.1 MHz + oscillator pushing)/volt, typ.
–15 Volts:	±(0.01% of frequency +1 MHz)/volt, typ.	±(0.001% of frequency +1 MHz)/volt, typ.
Power Supply Voltage:	±15 volts: ±5%	±15 volts: ±5%
Power Supply Current:[2]		
+15 Volts:	Oscillator bias current + tuning current at max freq +30 mA	Oscillator bias current + tuning current at max freq +40 mA
–15 Volts:	(Current requirement of –5 volts of oscillator if present +30 mA)	(Current requirement of –5 volts of oscillator if present +40 mA)
Weight	Oscillator weight +12 oz.	Oscillator weight +13 oz.
Device Specifications That Do Not Apply	Main Tuning Coil Sensitivity Main Tuning Coil Input Impedance at 1 kHz Pushing Figure, –5 volts if used	Main Tuning Coil Sensitivity Main Tuning Coil Input Impedance at 1 kHz Pushing Figure, –5 volts if used

NOTES: 1. These specifications are in addition to the standard specifications for the basic YIG device to which the driver is coupled except as noted.

2. Tuning current at max freq is: $\frac{\text{Max freq (MHz)}}{\text{Sensitivity (MHz/mA)}} = \text{Max current (mA)}$

Block Diagram



Basic Digital/Analog Driver Hookup to a YTO

YIG-TUNED OSCILLATORS WITH DRIVERS

Guaranteed Specifications at 25°C Case Temperature (Operating Temperature Per Device)

Model Number	Frequency (GHz)	Power Supply Current (mA), Max. +15 V	Power Supply Current (mA), Max. –15 V	Residual FM (kHz, p-p) Typical	YTO Model	Case Type
OSCILLATORS WITH ANALOG DRIVERS (Partial Listing)[1]						
AVD–7104	1–2.2	300	30	50	AV–7104	AD 1
AVD–7224	2–4	400	100	60	AV–7224	AD 1
AVD–7236	2–6	500	30	70	AV–7236	AD 1
AVD–7238	2–8	625	125	75	AV–7238	AD 1
AVD–7453	4–8	600	100	75	AV–7453	AD 1
AVD–74010	4–10	725	100	80	AV–74010	AD 1
AVD–7873	8–12.4	900	30	90	AV–7873	AD 2
AVD–78218	8–18	1200	30	120	AV–78218	AD 2
AVD–71261	12–18	1225	30	120	AV–71261	AD 2
AVD–71826	18–26.5	1075	30	150	AV–71826	AD 2
OSCILLATORS WITH DIGITAL DRIVERS (Partial Listing)[1]						
ADD–7104	1–2.2	300	40	50	AV–7104	DD 1
ADD–7224	2–4	400	100	60	AV–7224	DD 1
ADD–7236	2–6	525	40	70	AV–7236	DD 1
ADD–7238	2–8	650	125	75	AV–7238	DD 1
ADD–7453	4–8	600	100	75	AV–7453	DD 1
ADD–74010	4–10	750	100	80	AV–74010	DD 1
ADD–7873	8–12.4	925	40	90	AV–7873	DD 2
ADD–78218	8–18	1225	40	120	AV–78218	DD 2
ADD–71261	12–18	1250	40	120	AV–71261	DD 2
ADD–71826	18–26.5	1100	40	150	AV–71826	DD 2
OSCILLATORS WITH ANALOG DRIVERS (Partial Listing)[1]						
AVD–7214	2–4	400	100	60	AV–7214	AD 2
AVD–7218	2–8	700	100	75	AV–7218	AD 2
AVD–7413	4–8	700	100	75	AV–7413	AD 2
AVD–7814	8–12.4	900	40	90	AV–7814	AD 2
AVD–78418	8–18	1225	40	120	AV–78418	AD 2
AVD–71214	12–18	1225	40	120	AV–71214	AD 2
OSCILLATORS WITH DIGITAL DRIVERS (Partial Listing)[1]						
ADD–7214	2–4	400	125	60	AV–7214	DD 2
ADD–7218	2–8	725	125	75	AV–7218	DD 2
ADD–7413	4–8	725	125	75	AV–7413	DD 2
ADD–7814	8–12.4	925	50	90	AV–7814	DD 2
ADD–78418	8–18	1225	50	120	AV–78418	DD 2
ADD–71214	12–18	1225	50	120	AV–71214	DD 2

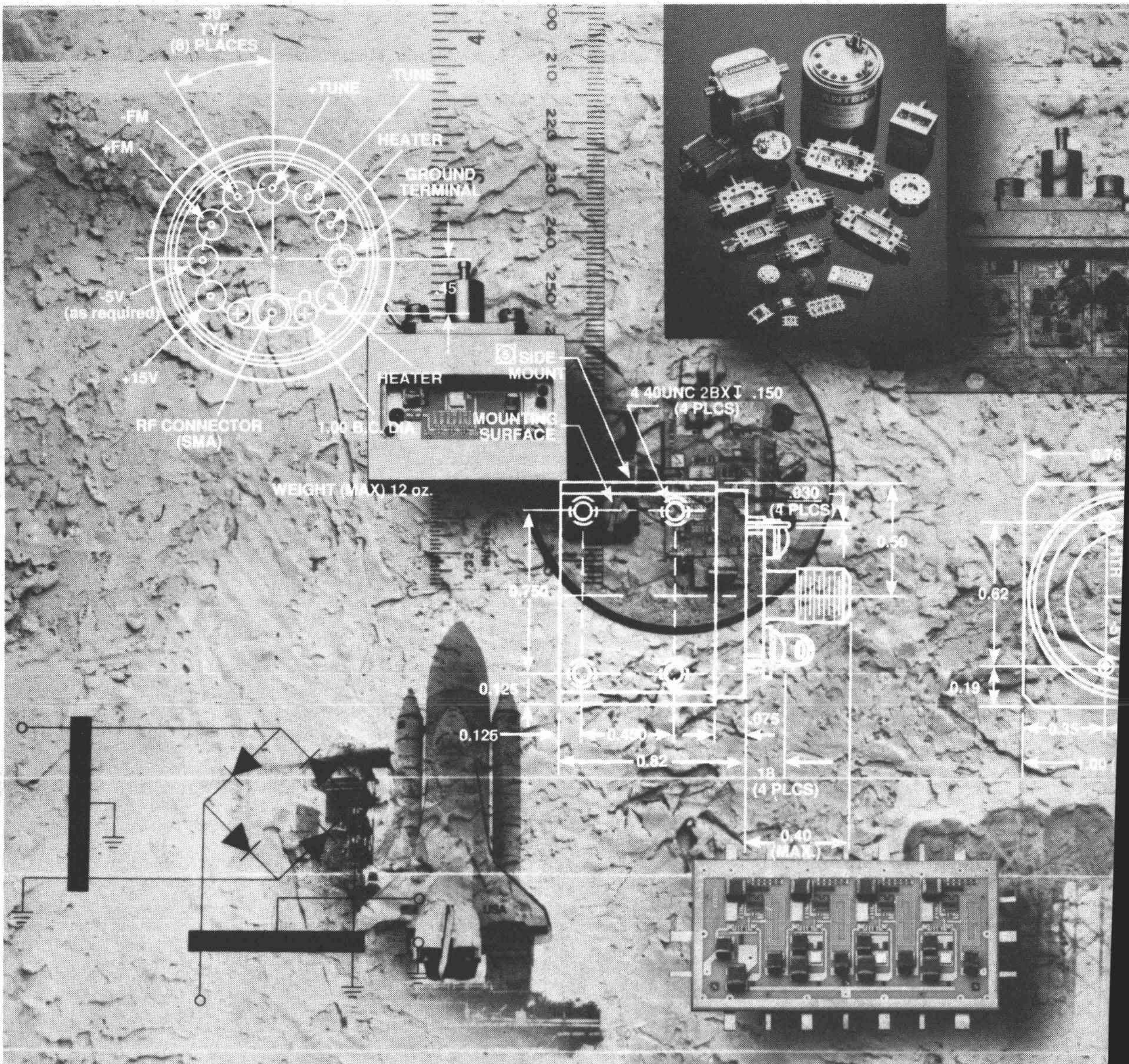
NOTE: 1. Due to the large number of YTOs available with drivers, only a partial listing is provided with a selection of units covering a broad frequency spectrum.

UNITS NOT AVAILABLE WITH ANALOG OR DIGITAL DRIVER

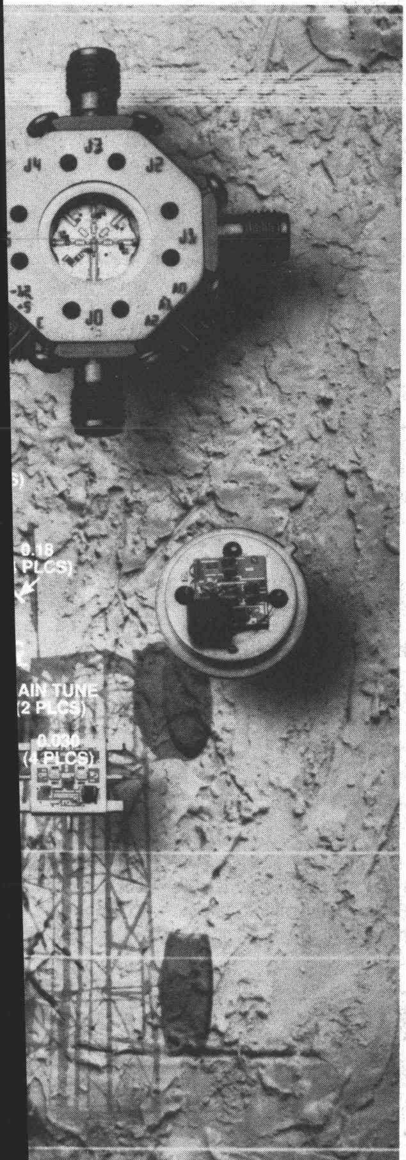
AV–7204
AV–26040 (Available in digital only as special request)
AV–33050

AV–7298
AV–72810
AV–12018
AV–76318
AV–78012
AV–78718

$\left.\right\}$ CONSULT FACTORY


30°
TYP
(8) PLACES
-FM
+FM
+TUNE
-TUNE
HEATER
GROUND
TERMINAL
-5V
(as required)
+15V
RF CONNECTOR
(SMA)
HEATER
1.00 B.C. DIA
5 SIDE
MOUNT
MOUNTING
SURFACE
4 40UNC 2BX ↧ .150
(4 PLCS)
WEIGHT (MAX) 12 oz.
.030
(4 PLCS)
0.50
0.750
0.125
0.126
0.450
0.82
.075
.18
(4 PLCS)
0.40
(MAX)
0.78
0.62
0.19
0.35
1.00
USA

YIG-TUNED FILTERS



PRODUCT DESCRIPTION

Avantek YIG-tuned Bandpass Filters offer performance equivalent to high-Q cavity resonators, but may be tuned over multi-octave frequency ranges by varying the current through their magnetic coils.

These filters tune in octave and multi-octave frequency ranges of 0.5 to 2 GHz, 2 to 8 GHz, 8 to 18 GHz, 1 to 18 GHz, 2 to 18 GHz, and 2 to 26.5 GHz. They are divided into three series based on the 3 dB bandwidth of the filter and size. Avantek YIG-tuned filters are available in one, two, three, and four sphere (stage) versions to offer a choice of skirt selectivity, off-resonance isolation and insertion loss, with all versions optimized to provide approximately maximally flat response.

YIG-Tuned Filters
Frequency vs. Stages Matrix

	Number of Stages (Spheres)			
Frequency	1	2	3	4
0.5–2 GHz			AFP–30221	
2–8 GHz		AFP–20821	AFP–30821	AFP–40821
8–18 GHz		AFP–21821 AFW–21821	AFP–31821 AFW–31821	AFP–41821 AFW–41821 AFM–41821
1–18 GHz		AFP–21851		AFP–41851
2–18 GHz		AFP–21841	AFP–31841	AFP–41841
2–26.5 GHz	AFP–12641		AFP–32641	

Each unit is designed and manufactured for reliability under severe operating conditions and is qualifiable to the environmental conditions of MIL-STD-810.

The advantages of increasing the number spheres is seen in the skirt selectivity (steepness), which improves by 6 dB/stage/octave of the 3 dB bandwidth, and the off-resonance resolution which increases 20 dB per sphere. However, there are sacrifices when increasing the number of stages: increased insertion loss and higher heater current. Therefore, a careful consideration of the tradeoffs must be made when deciding how many stages a filter requires.

All Avantek YIG-tuned filters use the same basic magnetic circuit and tuning coils as the YIG-tuned oscillators, so that these filters offer equivalent dynamic tuning characteristics to simplify the design of tracking oscillator/filter combinations.

Internally, the YIG spheres are mounted on mechanically-stable, nonconducting ceramic rods that position the spheres at the optimum position within the RF coupling loops and in relation to the magnetic field. The temperature of each sphere is maintained at a constant value above ambient with a self-regulating, positive-temperature-coefficient heating element. For higher reliability, no thermostat or other moving parts are used. Temperature regulation minimizes frequency drift with temperature, as well as minimizing the introduction of amplitude ripple within the filter passband.

To minimize magnetic susceptibility, the filters use a re-entrant electromagnetic structure that both minimizes the external magnetic field and provides self-shielding against external axial magnetic fields.

Applications

Avantek YIG-tuned bandpass filters are primarily designed for use as preselectors for superheterodyne receivers, instruments such as spectrum analyzers, special harmonic filtering in microwave synthesizers, and as filters to reduce the harmonic output of YIG-tuned oscillators. YIG filters are also used in military applications such as RWRs, ESM and ECM equipment.

AFP Series

The AFP Series YIG-tuned filters are compact, light weight, high-Q filters covering multi-octave and broadband frequencies. The AFP Series is characterized by a 3 dB bandwidth which is on the order of 15 to 25 MHz minimum. All the major features of the AFP line are highlighted below:

- 0.5 to 26.5 GHz Coverage
- Excellent Tuning Linearity
- 1, 2, 3, or 4 Sphere Versions
- Low Insertion Loss
- 15 to 26 MHz Bandwidth (Min.)

AFW Series

Avantek's AFW Series offers similar performance as the AFP Series in an ultra-wide 3 dB bandwidth range of 250 to 400 MHz. All versions feature low insertion loss, approximately maximally-flat response, and a minimum of +5 dBm RF limiting level. All the major features of the AFW line are highlighted below:

- 8.0 to 18 GHz Coverage
- Excellent Tuning Linearity
- 2, 3, or 4 Sphere Versions
- Low Insertion Loss
- 250 to 400 MHz Bandwidth (Min.)

AFM Series

Avantek's newest YIG-tuned filter line is the AFM series. The AFM Series is a derivative of the AFP series. It's major advantage is it's 1-1/4 in. case style which offers a truly compact, lightweight filter package. All the major features of the AFM line are highlighted below:

- 8.0 to 18 GHz Coverage
- Low Insertion Loss
- Compact Size: 1.25 in.
- Light Weight: <230 grams
- Excellent Tuning Linearity

YIG-TUNED FILTERS SELECTION GUIDE

AFP SERIES MULTI-OCTAVE FILTERS

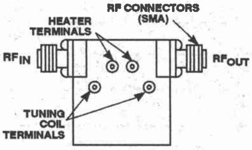
Model	Frequency Range (GHz)	3 dB Bandwidth (MHz) Minimum	Insertion Loss (dB) Maximum	Resonance Isolation (DB) Minimum	Ripple & Spurious (dB) Maximum	Page No.
0.5 to 2 GHz						
AFP-30221	0.5-2.0	15	6	70	2.0	13–4
2 to 8 GHz						
AFP-20821	2-8	25	3	45	2.0	13–4
AFP-30821	2-8	25	4	70	2.0	13–4
AFP-40821	2-8	20	5	80	2.0	13–4
8 to 18 GHz						
AFP-21821	8-18	25	3	45	2.0	13–4
AFP-31821	8-18	25	5	70	2.5	13–5
AFP-41821	8-18	25	5	80	2.5	13–5
AFP SERIES BROADBAND						
1 to 18 GHz						
AFP-21851	1-18	20	6	45	2.5	13–5
AFP-41851	1-18	20	9	80	2.5	13–5
2 to 18 GHZ						
AFP-21841	2-18	25	4	45	2.5	13–5
AFP-31841	2-18	25	5	70	2.5	13–5
AFP-41841	2-18	20	8	80	2.5	13–5
2 to 26 GHz						
AFP-12641	2-26.5	20	5	25	1.0	13–5
AFP-32641	2-26.5	25	7	70	2.5	13–5
AFM SERIES MULTI-OCTAVE 1-1/4 CUBE						
8 to 18 GHz						
AFM-41821	8-18	25	5	80	2.5	13–9
AFW SERIES ULTRA-WIDE BANDWIDTH FILTERS						
8 to 18 GHz						
AFW-21821	8-18	250	4	45	2.0	13–10
AFW-31821	8-18	300	5	70	2.5	13–10
AFW-41821	8-18	400	7	80	2.5	13–10

AVANTEK

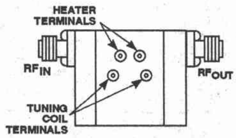
AFP Series
Multi-Octave and Broadband
YIG Bandpass Filters

FEATURES

- 0.5 to 26.5 GHz Coverage
- Excellent Tuning Linearity
- 1, 2,3, or 4 Sphere Versions
- Low Insertion Loss
- 15 to 25 MHz Bandwidth (Min.)



FIL-1, p. 16–18



FIL-2, p. 16–18

DESCRIPTION

Avantek® AFP Series current-tuned YIG bandpass filters are compact, lightweight, high-Q filters for the 0.5 to 2.0, 2 to 8, 8 to 18, 1 to 18, 2 to 18 and 2 to 26.5 GHz frequency bands. Available in one-, two-, three-, and four-sphere configurations, AFP Series YIG filters offer 3 dB bandwidths on the order of 20 MHz, and carefully-selected combinations of skirt selectivity and off-resonance isolation. All versions feature low insertion loss, approximately maximally-flat phase response and minimum +10 dBm RF limiting levels, combined with the excellent tuning linearity of YIG filters.

Specifically designed and manufactured for reliability under severe operating conditions, AFP Series YIG filters are qualifiable to the environmental conditions of MIL-STD-810.

AFP Series YIG filters are current-tuned, providing an extremely linear (±3 to ±5 MHz, typical) current-vs.-frequency tuning curve due to the careful design of a magnetic circuit that maintains a constant average permeability throughout the tuning current range. Most AFP Series filters have a typical tuning sensitivity of 20 MHz/mA to permit simple tracking of multiple filters, with low hysteresis to assure accurate tuning.

AFP SERIES ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications at 25°C Case Temperature (+10° to +60°C Operating Temperature)

Model No.	AFP-30221	AFP-20821	AFP-30821	AFP-40821	AFP-21821
Number of Stages	3	2	3	4	2
Frequency Range, Min.	0.5–2 GHz	2-8 GHz	2–8 GHz	2–8 GHz	8–18 GHz
Bandwidth (3 dB), Min.[1]	15 MHz	25 MHz	25 MHz	20 MHz	25 MHz
Insertion Loss, Max.	6 dB	3 dB	4 dB	5 dB	3 dB
Off-Resonance Isolation, Min.	70 dB	45 dB	70 dB	80 dB	45 dB
Off-Resonance Spurious, Min.	40 dB	20 dB	40 dB	50 dB	20 dB
Combined Passband Spurious and Ripple, Max.	2 dB	2.0 dB	2.0 dB	2.0 dB	2.0 dB
Passband VSWR, Typ.	2.0:1	2.0:1	2.0:1	2.0:1	2.0:1
Limiting Level, Min.	+10 dBm	+10 dBm	+10 dBm	+10 dBm	+10 dBm
Linearity, Typ.	±6 MHz	±6 MHz	±6 MHz	±6 MHz	±8 MHz
Hysteresis, Typ.	6 MHz	8 MHz	8 MHz	8 MHz	15 MHz
Operating Case Temperature	10° to 60°C	10° to 60°C	10° to 60°C	10° to 60°C	10° to 60°C
Frequency Drift Over Operating Temperature, Typ.	8 MHz	8 MHz	8 MHz	8 MHz	15 MHz
Tuning Coil:					
Sensitivity, Typ.	20 MHz/mA	20 MHz/mA	20 MHz/mA	20 MHz/mA	20 MHz/mA
Resistance, Typ.	18 ohms	10 ohms	10 ohms	10 ohms	4 ohms
Inductance, Typ.	180 mH	90 mH	90 mH	90 mH	75 mH
Heater Power:					
Voltage, Nom.	20–28 VDC	20–28 VDC	20–28 VDC	20–28 VDC	20–28 VDC
Current (Surge/Steady-State), Typ.	900 mA/120 mA	600 mA/80 mA	900 mA/120 mA	1200 mA/160 mA	600 mA/80 mA
Case Style	FIL 1	FIL 1	FIL 1	FIL 1	FIL 2

NOTE: 1. Modified 3 dB bandwidths are available on special order.

AFP SERIES ELECTRICAL AND PERFORMANCE SPECIFICATIONS (continued)

Guaranteed Specifications at 25°C Case Temperature (+10° to +60°C Operating Temperature)

Model No.	AFP-31821	AFP-41821	AFP-21851	AFP-41851	AFP-21841
Number of Stages	3	4	2	4	2
Frequency Range, Min	8–18 GHz	8–18 GHz	1–18 GHz	1–18 GHz	2–18 GHz
Bandwidth (3 dB), Min..[1]	25 MHz	25 Mhz	20 MHz	20 MHz	25 MHz
Insertion Loss, Max.	5 dB	5 dB	6 dB	9 dB	4 dB
Off-Resonance Isolation, Min.	70 dB	80 dB	45 dB	80 dB	45 dB
Off-Resonance Spurious, Min.	40 dB	50 dB	20 dB	50 dB	20 dB
Combined Passband Spurious and Ripple, Max.	2.5 dB	2.5 dB	2.5 dB	2.5 dB	2.5 dB
Passband VSWR, Typ.	2.0:1	2.5	2.5:1	2.5:1	2.0:1
Limiting Level, Min.[2]	+10 dBm	+10 dBm	+10 dBm	+10 dBm	+10 dBm
Linearity, Typ.	±8 MHz	±8 MHz	±10 MHz	±10 MHz	±10 MHz
Hysteresis, Typ.	15 MHz	15 MHz	24 MHz	24 MHz	24 MHz
Operating Case Temperature	10° to 60°C	10° to 60°C	10° to 60°C	10° to 60°C	10° to 60°C
Frequency Drift Over Operating Temperature, Typ.	15 MHz	15 MHz	20 MHz	20 MHz	20 MHz
Tuning Coil:					
Sensitivity, Typ.	20 MHz/mA	20 MHz/mA	20 MHz/mA	20 MHz/mA	20 MHz/mA
Resistance, Typ.	4 ohms	4 ohms	6 ohms	6 ohms	4 ohms
Inductance, Typ.	75 mH	75 mH	70 mH	70 mH	75 mH
Heater Power:					
Voltage, Nom.	20–28 VDC	20–28 VDC	20–28 VDC	20–28 VDC	20–28 VDC
Current (Surge/Steady-State), Typ.	1200 mA/120 mA	1200 mA/160 mA	600 mA/80 MA	1200 mA/160 mA	600 mA/80 mA
Case Style	FIL 2	FIL 2	FIL 2	FIL 2	FIL 2

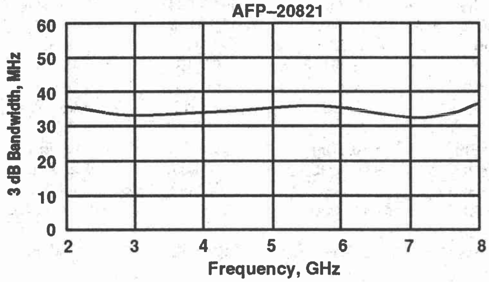
NOTE: 1. Modified 3 dB bandwidths are available on special order.
2. All 1–18 GHz units have a limiting level of +6 dBm min. between 1-2 GHz.

Model No.	AFP-31841	AFP-41841	AFP-12641	AFP-32641
Number of Stages	3	4	1	3
Frequency Range, Min	2–18 GHz	2–18 GHz	2–26.5 GHz	2–26.5 GHz
Bandwidth (3 dB), Min..[1]	20 MHz	20 MHz	20 MHz	25 MHz
Insertion Loss, Max.	6 dB	8 dB	5 dB	7 dB
Off-Resonance Isolation, Min.	70 dB	80 dB	25 dB	70 dB
Off-Resonance Spurious, Min.	40 dB	50 dB	15 dB	40 dB
Combined Passband Spurious and Ripple, Max.	2.5 dB	1.0 dB	2.5 dB	2.5 dB
Passband VSWR, Typ.	2.0:1	2.0:1	2.0:1	2.5:1
Limiting Level, Min.[2]	+10 dBm	+10 dBm	+10 dBm	+10 dBm
Linearity, Typ.	±10 MHz	±10 MHz	±10 MHz	±20 MHz
Hysteresis, Typ.	24 MHz	24 MHz	30 MHz	30 MHz
Operating Case Temperature	10° to 60°C	10° to 60°C	10° to 60°C	10° to 60°C
Frequency Drift Over Operating Temperature, Typ.	20 MHz	20 MHz	30 MHz	20 MHz
Tuning Coil:				
Sensitivity, Typ.	20 MHz/mA	20 MHz/mA	30 MHz/mA	30 MHz/mA
Resistance, Typ.	4 ohms	4 ohms	10 ohms	10 ohms
Inductance, Typ.	75 mH	75 mH	70 mH	130 mH
Heater Power:				
Voltage, Nom.	20–28 VDC	20–28 VDC	20–28 VDC	20–28 VDC
Current (Surge/Steady-State), Typ.	900 mA/120 mA	1200 mA/160 mA	200 mA/40 mA	900 mA/120 mA
Case Style	FIL 2	FIL 2	FIL 2	FIL 2

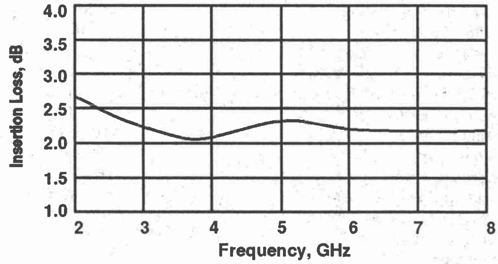
NOTE: 1. Modified 3 dB bandwidths are available on special order.
2. All 1–18 GHz units have a limiting level of +6 dBm min. between 1-2 GHz.

TYPICAL PERFORMANCE @ 25°C CASE TEMPERATURE

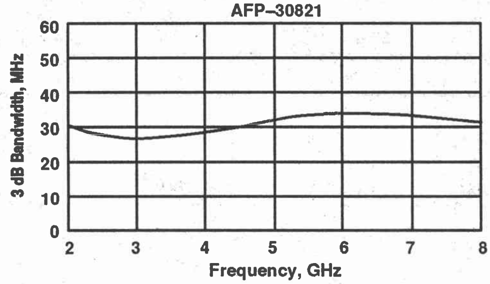
3 dB Bandwidth
AFP–20821



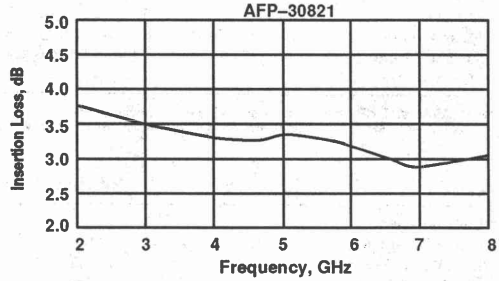
Insertion Loss
AFP–20821



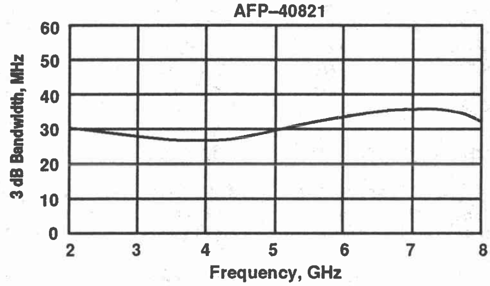
3 dB Bandwidth
AFP–30821



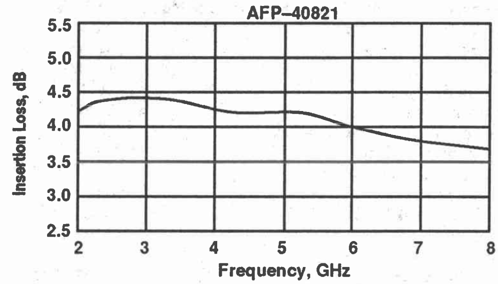
Insertion Loss
AFP–30821



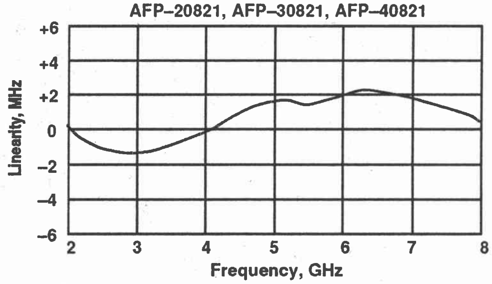
3 dB Bandwidth
AFP–40821



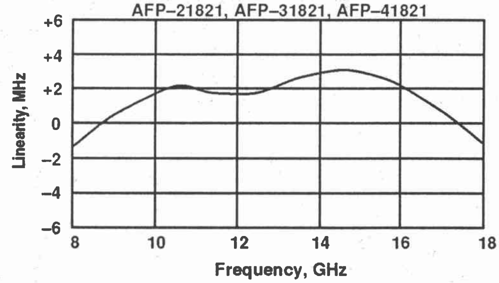
Insertion Loss
AFP–40821



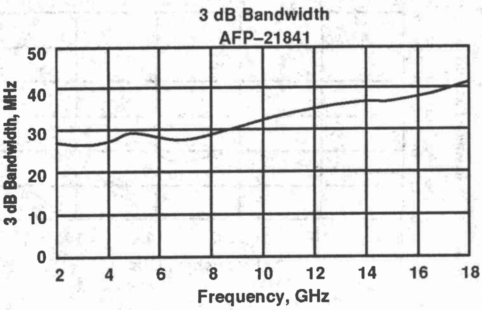
Linearity
AFP–20821, AFP–30821, AFP–40821

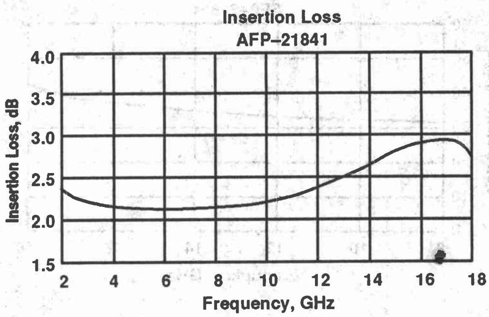


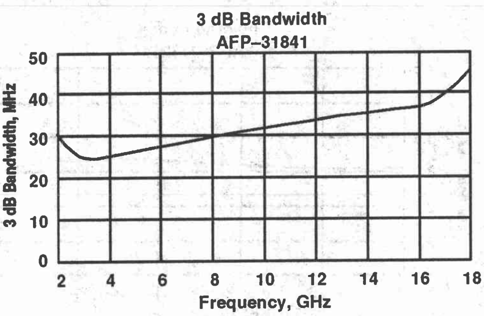
Linearity
AFP–21821, AFP–31821, AFP–41821

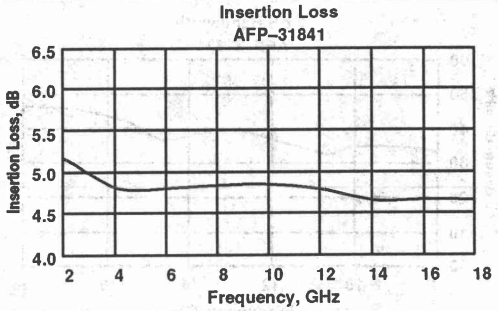


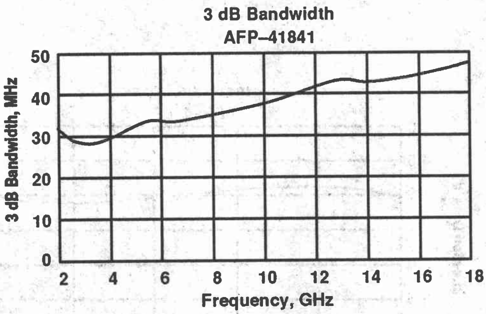
TYPICAL PERFORMANCE (continued)

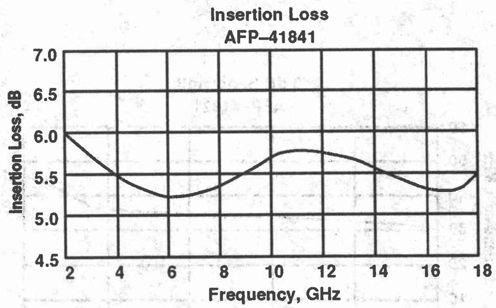


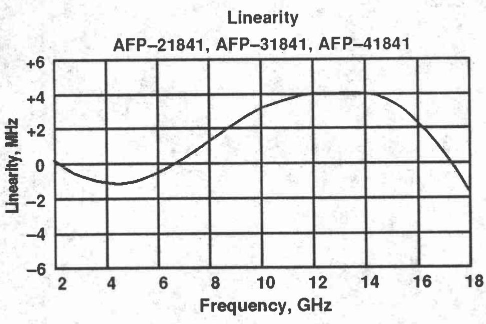






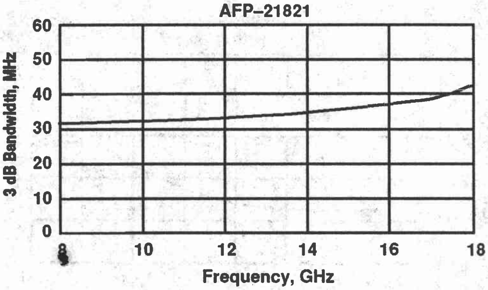




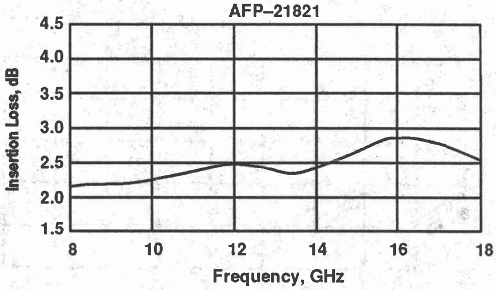


TYPICAL PERFORMANCE (continued)

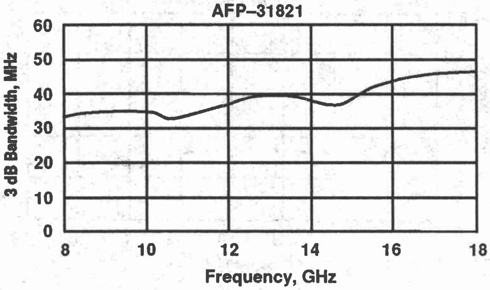
3 dB Bandwidth
AFP–21821



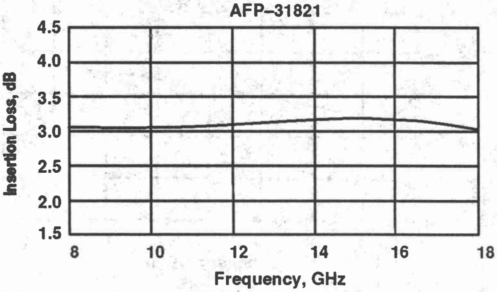
Insertion Loss
AFP–21821



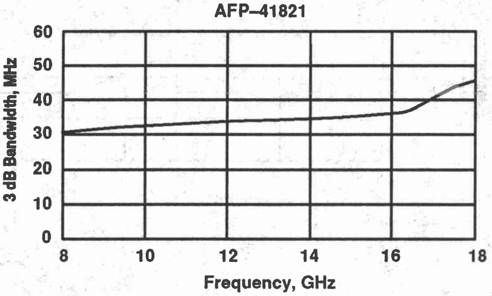
3 dB Bandwidth
AFP–31821



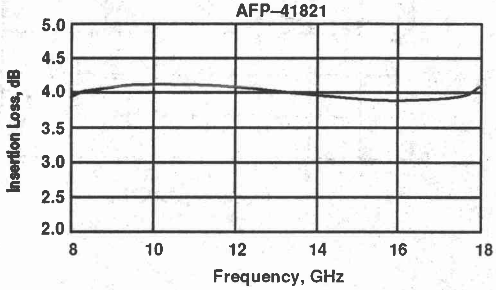
Insertion Loss
AFP–31821



3 dB Bandwidth
AFP–41821



Insertion Loss
AFP–41821

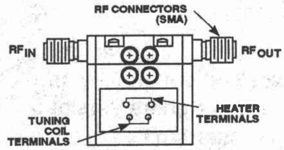


AVANTEK

AFM Multi-Octave YIG Bandpass Filter

FEATURES

- 8.0 to 18 GHz Coverage
- Low Insertion Loss
- Compact Size: 1.25 in.
- Light Weight: <230 grams
- Excellent Tuning Linearity



FIL-4, p. 16–19

DESCRIPTION

Avantek® AFM current-tuned YIG bandpass filter is a compact, lightweight, high-Q filter for the 8 to 18 GHz frequency band. The four-sphere configuration of the AFM YIG filter offers a 3 dB bandwidth on the order of 25 MHz. This version features low insertion loss, approximately maximally-flat phase response and a minimum +10 dBm RF limiting level, combined with the excellent tuning linearity of YIG filters.

Specifically designed and manufactured for reliability under severe operating conditions, the AFM YIG filter is qualifiable to the environmental conditions of MIL-STD-810.

The AFM YIG filter has an extremely linear (±5 MHz, typical) current-vs.-frequency tuning curve due to the careful design of a magnetic circuit that maintains a constant average permeability throughout the tuning current range. The AFM filter has a typical tuning sensitivity of 20 MHz/mA to permit the simple tracking of multiple filters, with low hysteresis to assure accurate tuning.

AFM ELECTRICAL AND PERFORMANCE SPECIFICATIONS

Guaranteed Specifications at 25°C Case Temperature (+10° to +60°C Operating Temperature)

Model No.	AFM-41821
Number of Stages	4
Frequency Range, Min.	8–18 GHz
Bandwidth (3 dB), Min.[1]	25 MHz
Insertion Loss, Max.	5 dB
Off-Resonance Isolation, Min.	80 dB
Off-Resonance Spurious, Min.	50 dB
Combined Passband Spurious and Ripple, Max.	1.5 dB
Limiting Level, Min.	+10 dBm
Linearity, Typ.	±8 MHz
Hysteresis, Typ.	15 MHz
Operating Case Temperature	10° to 60°C
Frequency Drift Over Operating Temperature, Typ.	15 MHz
Tuning Coil:	
Sensitivity, Typ.	20 MHz/mA
Resistance, Typ.	7 ohms
Inductance, Typ.	50 mH
Heater Power:	
Voltage, Nom.	20–28 VDC
Current (Surge/Steady-State), Typ.	1200 mA/160 mA
Case Style	FIL 4

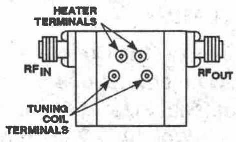
NOTE: 1. Modified 3 dB bandwidths are available on special order.

AVANTEK

AFW Series Multi-Octave YIG Bandpass Filters

FEATURES

- 8.0 to 18 GHz Coverage
- Excellent Tuning Linearity
- 2, 3, or 4 Sphere Versions
- Low Insertion Loss
- 250 to 400 MHz Bandwidth (Min.)



FIL-2, p. 16–18

DESCRIPTION

Avantek® AFW Series current-tuned YIG bandpass filters are compact, lightweight, high-Q filters for the 8 to 18 GHz frequency band. Available in two-, three-, and four-sphere configurations, AFW Series YIG filters offer 3 dB bandwidths on the order of 250 MHz, and carefully-selected combinations of skirt selectivity and off-resonance isolation. All versions feature low insertion loss, approximately maximally-flat phase response and minimum +5 dBm RF limiting levels, combined with the excellent tuning linearity of YIG filters.

Specifically designed and manufactured for reliability under severe operating conditions, AFW Series YIG filters are qualifiable to the environmental conditions of MIL-STD-810.

AFW Series YIG filters have an extremely linear (±14 MHz, typical) current-vs.-frequency tuning curve due to the careful design of a magnetic circuit that maintains a constant average permeability throughout the tuning current range. All AFW Series filters have a typical tuning sensitivity of 20 MHz/mA to permit the simple tracking of multiple filters, with low hysteresis to assure accurate tuning.

In all AFW Series YIG filters, the YIG spheres are mounted on mechanically-stable, nonconducting ceramic rods that position the spheres at the optimum position within the RF coupling loops and in relation to the magnetic field. The temperature of each sphere is maintained at a constant value above ambient with a self-regulating, positive-temperature-coefficient heating element, which has no thermostat or other moving parts for higher reliability. Temperature regulation minimizes frequency drift with temperature, as well as minimizing the introduction of amplitude ripple within the filter passband.

To minimize magnetic susceptibiity, the filters use a re-entrant electromagnetic structure that both minimizes the external magnetic field and provides self-shielding against external axial magnetic fields.

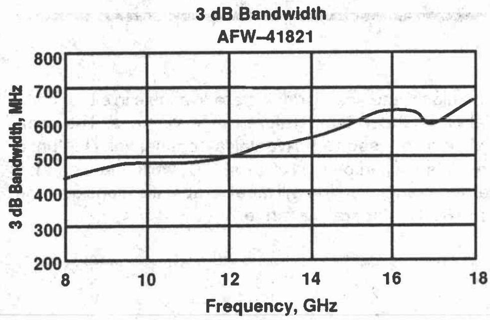
AFM ELECTRICAL AND PERFORMANCE SPECIFICATIONS

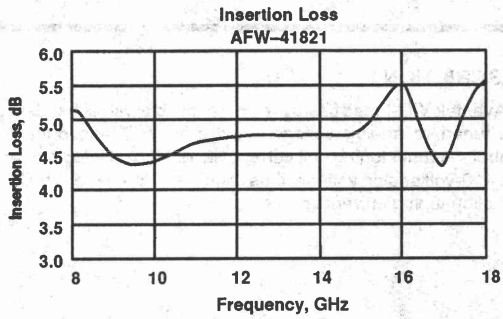
Guaranteed Specifications at 25°C Case Temperature (+10° to +60°C Operating Temperature)

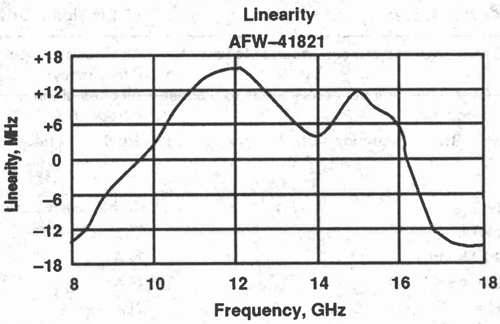
Model No.	AFW-21821	AFW-31821	AFW-41821
Number of Stages	2	3	4
Frequency Range, Min	8–18 GHz	8–18 GHz	8–18 GHz
Bandwidth (3 dB), Min.[1]	250 MHz	300 MHz	400 MHz
Insertion Loss, Max.	4 dB	5 dB	7 dB
Off-Resonance Isolation, Min.	45 dB	70 dB	80 dB
Off-Resonance Spurious, Min.	20 dB	25 dB	40 dB
Combined Passband Spurious and Ripple, Max.	2.0 dB	2.5 dB	2.5 dB
Limiting Level, Min.	+5 dBm	+5 dBm	+5 dBm
Linearity, Typ.	±30 MHz	±30 MHz	±30 MHz
Hysteresis, Typ.	15 MHz	15 MHz	15 MHz
Operating Case Temperature	10° to 60°C	10° to 60°C	10° to 60°C
Frequency Drift Over Operating Temperature, Typ.	30 MHz	30 MHz	30 MHz
Tuning Coil:			
Sensitivity, Typ.	20 MHz/mA	20 MHz/mA	20 MHz/mA
Resistance, Typ.	6 ohms	6 ohms	6 ohms
Inductance, Typ.	70 mH	70 mH	70 mH
Heater Power:			
Voltage, Nom.	20–28 VDC	20–28 VDC	20–28 VDC
Current (Surge/Steady-State), Typ.	600 mA/80 mA	900 mA/120 mA	1200 mA/160 mA
Case Style	FIL 2	FIL 2	FIL 2

NOTE: 1. 3 dB bandwidths from 100 to 500 MHz for frequency bands >6 GHz are available on special order.

TYPICAL PERFORMANCE (continued)







AVANTEK

AFPA, AFMA, AFPD, AFWA, AFMD and AFWD Series YIG-Tuned Bandpass Filters With Analog or Digital Drivers

DESCRIPTION

All Avantek YIG-tuned filters are now available with either digitally-tuned or analog voltage-tuned drivers. These drivers control the main tuning coil current via 12 bit digital logic or a 0 to +10-volt analog voltage, thus eliminating the need to build and align tuning current sources.

Both the digital and analog drivers are available in either commercial or extended temperature range versions. The commercial version, used with Avantek's commercial YIG-tuned devices, is specified over +10° to +60°C, while the extended temperature range version will meet all specifications over the –54° to +85°C temperature range.

DRIVER SELECTION GUIDE

Guaranteed Specifications at 25°C Case Temperature (+10° to +60°C Operating Temperature)

Specification[1]	Analog Driver	12-Bit Digital Driver
Tuning Range	0.000 volts at input corresponds to lowest frequency 10.000 volts at input corresponds to highest frequency	All zeroes at input corresponds to lowest frequency All ones at input corresponds to highest frequency
Tuning Accuracy: @ 25°C on baseplate, 1/2 hour after turn-on, excluding hysteresis and non-linearity	±(0.08% of frequency +2 MHz)	±(0.08% of frequency + 2 MHz)
Resolution	N/A	12-bit positive true logic for increasing frequency
Interface Logic	N/A	TTL or CMOS
Tuning Input Resistance	≥10 kohm	N/A
Common Mode Rejection	≥40 dB	N/A
Residual FM: (15 Hz to 15 kHz bandwidth)	N/A	N/A
Non-Linearity:	Device specification applies	±(1/2 bit + device non-linearity)
Pushing:		
+15 Volts:	±(0.1% of frequency + 1 MHz)/volt, typ.	±(0.001% of frequency + 0.1 MHz)/volt, typ.
–15 Volts:	±(0.1% of frequency + 1 MHz)/volt, typ.	±(0.001% of frequency + 0.1 MHz)/volt, typ.
Power Supply Voltage:	±15 volts at ±5%	±15 volts at ±5%
Power Supply Current:[2]		
+15 Volts:	Tuning coil current at max. frequency +30 mA	Tuning coil current at max. frequency + 40 mA
–15 Volts:	30 mA	40 mA
Weight	Filter weight +10 oz.	Filter weight +10 oz.
Device Specifications That Do Not Apply	Tuning Sensitivity Tuning Coil Resistance Tuning Coil Inductance	Tuning Sensitivity Tuning Coil Resistance Tuning Coil Inductance

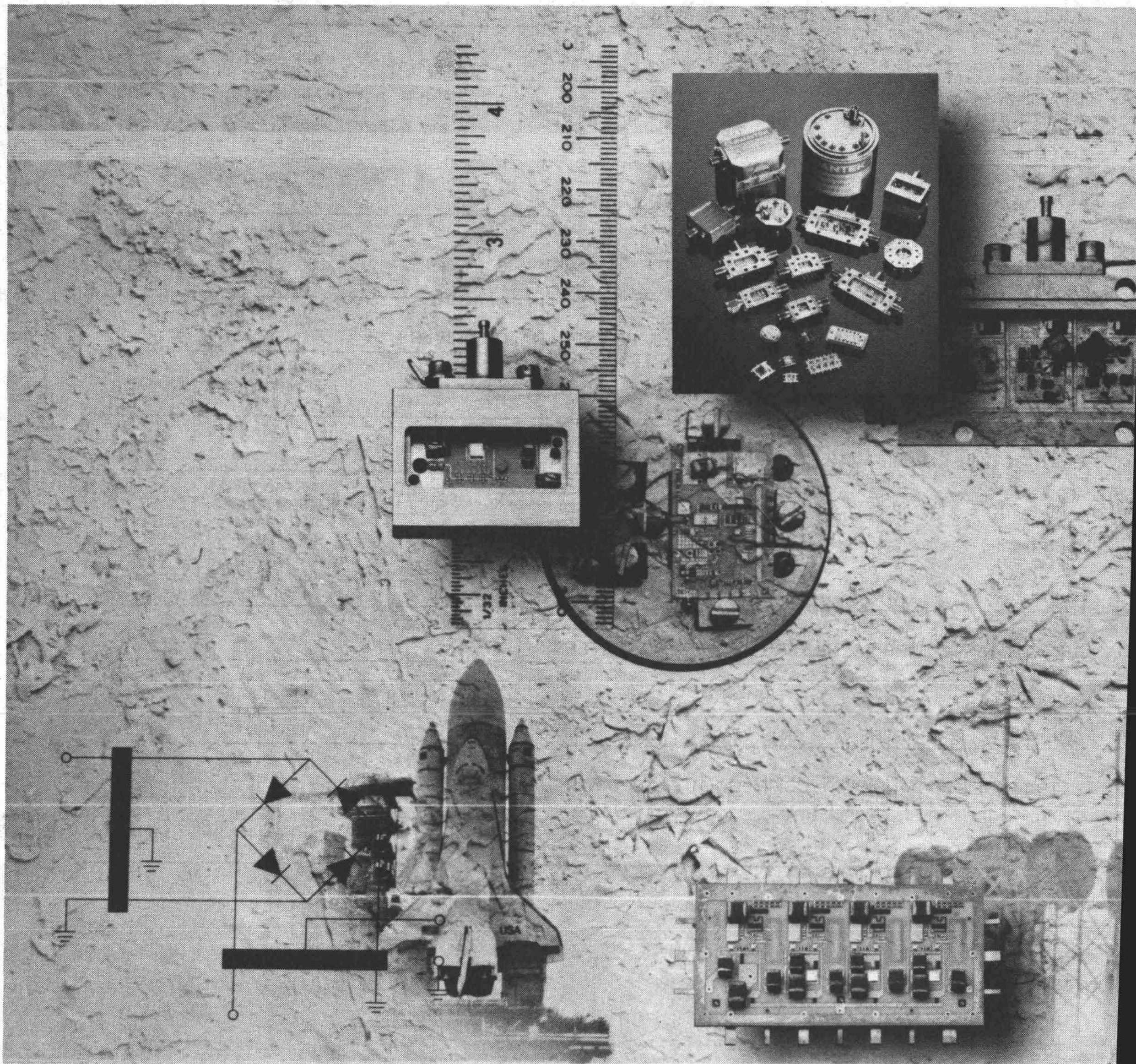
NOTES: 1. These specifications are in addition to the standard specifications for the basic YIG device to which the driver is coupled except as noted.

2. Tuning current at maximum frequency is: $\frac{\text{Max freq (MHz)}}{\text{Sensitivity (MHz/mA)}} = \text{Max current (mA)}$

YIG-TUNED FILTERS WITH DRIVERS

Guaranteed Specifications at 25°C Case Temperature

Model Number	Frequency (GHz)	Off Resonance Isolation (dB) Min.	Power Supply Current (mA), Max. 15V	Power Supply Current (mA), Max. −15V	YTF Model	Case Type
MULTI-OCTAVE COMMERCIAL FILTERS WITH ANALOG DRIVERS						
AFPA-30221	0.5–2	70	150	50	AFP-30221	FPD 1
AFPA-20821	2–8	45	450	50	AFP-20821	FPD 1
AFPA-30821	2–8	70	450	50	AFP-30821	FPD 1
AFPA-40821	2–8	80	450	50	AFP-40821	FPD 1
AFPA-21821	8–18	45	950	50	AFP-21821	FPD 2
AFPA-31821	8–18	70	950	50	AFP-31821	FPD 2
AFPA-41821	8–18	80	950	50	AFP-41821	FPD 2
BROADBAND COMMERCIAL FILTERS WITH ANALOG DRIVERS						
AFPA-21841	2-18	45	950	50	AFP-21841	FPD 2
AFPA-31841	2–18	70	950	50	AFP–31841	FPD 2
AFPA-41841	2–18	80	950	50	AFP–41841	FPD 2
AFPA-32641	2–26.5	70	930	50	AFP-32641	FPD 2
ULTRA WIDE 3 dB BANDWIDTH COMMERCIAL FILTERS WITH ANALOG DRIVERS						
AFWA-21821	8–18	45	950	50	AFW-21821	FPD 2
AFWA-31821	8–18	70	950	50	AFW–31821	FPD 2
AFWA-41821	8–18	80	950	50	AFW–41821	FPD 2
MULTI-OCTAVE COMMERCIAL FILTERS WITH DIGITAL DRIVERS						
AFPD-30221	0.5–2	70	150	50	AFP-30221	FDD 1
AFPD-20821	2–8	45	450	50	AFP-20821	FDD 1
AFPD-30821	2–8	70	450	50	AFP-30821	FDD 1
AFPD-40821	2–8	80	450	50	AFP-40821	FDD 1
AFPD-21821	8–18	45	950	50	AFP-21821	FDD 2
AFPD-31821	8–18	70	950	50	AFP-31821	FDD 2
AFPD-41821	8–18	80	950	50	AFP-41821	FDD 2
BROADBAND COMMERCIAL FILTERS WITH DIGITAL DRIVERS						
AFPD-21841	2-18	45	950	50	AFP-21841	FDD 2
AFPD-31841	2–18	70	950	50	AFP–31841	FDD 2
AFPD-41841	2–18	80	950	50	AFP–41841	FDD 2
AFPD-32641	2–26.5	70	930	50	AFP-32641	FDD 2
ULTRA WIDE 3 dB BANDWIDTH COMMERCIAL FILTERS WITH DIGITAL DRIVERS						
AFWD-21821	8–18	45	950	50	AFW-21821	FDD 2
AFWD-31821	8–18	70	950	50	AFW–31821	FDD 2
AFWD-41821	8–18	80	950	50	AFW–41821	FDD 2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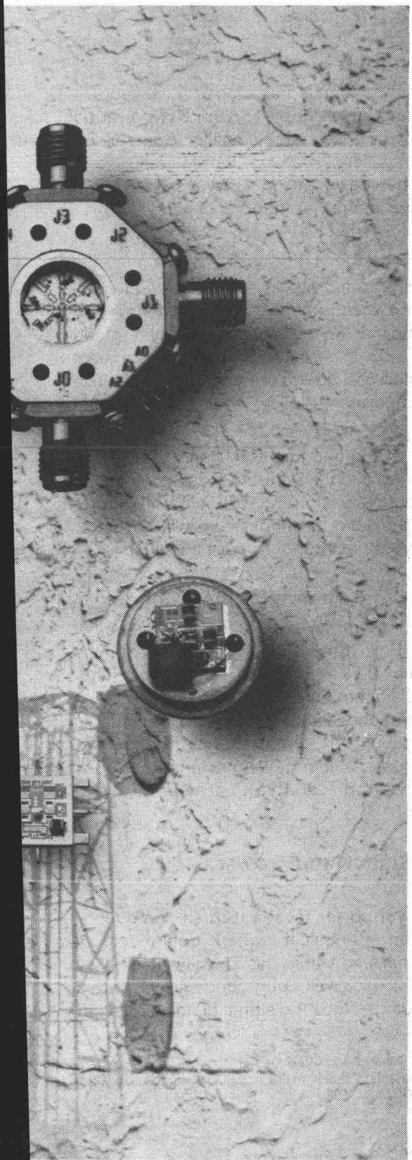
APPLICATION NOTES



CASCADABLE AMPLIFIER CHARACTERISTICS

All parameters indicated on the amplifier data sheets as "minimum" or "maximum" are tested as an integral part of the production process. All specifications indicated as "typical" are sample tested on a regular basis and serve as an approximate indication of the performance of the units.

Bandwidth Limitation With External Filtering

The guaranteed frequency range of all cascadable thin-film amplifiers represents the range in which all guaranteed performance parameters are met. However, they will continue to exhibit useful gain over a much wider bandwidth. If response to out-of-band frequencies is a problem in a circuit design, it may be necessary to provide external filtering. The following book is recommended by some Avantek engineers as an "excellent" source for filter design information: Matthaei, George L., et al, *Microwave Filters, Impedance Matching Networks, and Coupling Structures*, New York, McGraw-Hill Book Company, Inc., 1964.

Low Frequency Gain (Outside Guaranteed Bandwidth)

The low frequency behavior of the input circuitry of many of the UTO amplifiers follows the curve plotted in Figure 1. At some point below the lower guaranteed frequency response limit, the gain will gradually decrease until at approximately 300 kHz, it will drop at a rate of approximately 6 dB per octave until unity gain is reached.

Designing circuits around UTO modules at low frequencies must be done on a case-by-case basis since changes in input impedance, VSWR and other parameters will appear when the units are operated outside the normal guaranteed bandwidth. Avantek applications engineers can provide answers to specific applications questions.

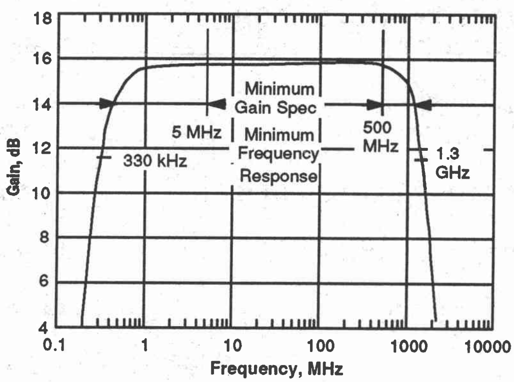


Figure 1. Typical Gain Response of UTO-502 (Between Unity Gain Points)

High Frequency Performance (Outside Guaranteed Bandwidth)

Figure 1 indicates how a UTO-502 (guaranteed to 500 MHz) varies in gain through 2 GHz. In applications where UTO modules are to be used above their guaranteed upper frequency limit, variations in input impedance, VSWR and other performance parameters will have to be taken into consideration.

Maximum Power Input

To prevent possible permanent degradation of noise figure, it is recommended that not more than +13 dBm CW power be applied to the input of any cascadable amplifier Some of the high-output-power amplifiers such as the UTO-561 and UTO-2025 have a higher maximum input power specification, but these are the exception rather than the general rule.

Maximum Temperature

The maximum operating temperature over which Avantek will guarantee performance for most cascadable amplifiers is –55 to +125°C. Most amplifier characteristics are guaranteed over 0 to 50°C and –55 to +85°C. Upon special request amplifiers can be tested and guaranteed up to +125°C. The maximum storage temperature of most Avantek cascadable amplifiers is –62 to +150°C.

The "R" Series burn-in temperature is chosen so that the amplifier's transistor junction temperature is as close to 150°C as possible during the burn-in. In some cases, for higher power units, the burn-in temperature will be below 100°C, but is typically 100 to 125°C on most amplifiers.

Power Dissipation And Thermal Considerations

When operating under normal bias conditions, Avantek amplifier modules will dissipate as little as 55 mW for the GPD-252 to as much as 2.85 W for the UTO-561. For higher power units that will be operated at high case temperatures, care should be taken in choosing a circuit board material to prevent excessive junction temperatures. For more information on board material thermal characteristics, please see the application note on PlanarPak package mounting techniques.

Minimum Usable Signal Input Power — Amplifier Sensitivity[1]

The lowest input signal power level which will produce a detectable output from an amplifier stage is determined by the thermal noise generated within the amplifier itself. Any signal below the "noise floor" will not produce any apparent change in amplifier output, since the signal to noise ratio becomes unity.

Note 1: For more detailed information see Design Feature article "Where Lies The Thermal Noise Floor?" at the end of this section published in *Microwave & RF*, July, 1984

The following equation can be used to determine the thermal "noise floor", and thus the minimum signal level that can be amplified by a cascadable amplifier stage.

$P_N = -114 \text{ dBm} + 10 \log B + 10 \log (10^{NF/10} - 1)$

Where P_N = effective input noise power, or minimum amplifiable signal level. B = Bandwidth of amplifier system (in MHz); B is the 3 dB bandwidth of the amplifier, or of any filter that is used ahead of the amplifier to limit overall bandwidth.

Referring to Figure 1, the 3 dB bandwidth of a UTO-502 is approximately 1.3 GHz, and its guaranteed maximum noise figure (0–50°C) is 4.0 dB.

So, for its full bandwidth,

$P_N = -114 + 10 \log (1.3 \times 10^3) + 10 \log (10^{.4} - 1) = -81.1 \text{dBm}$

or if the bandwidth is limited to 1 MHz,

$P_N = -114 + 10 \log (1) + 10 \log (10^{4} - 1) = -112.2 \text{ dBm}$

In many applications, the actual noise floor of the UTO amplifier is increased due to thermal noise produced by the input circuitry, transmission lines, etc. For example, if the input circuitry ahead of the UTO-502 introduces 3.5 dB of loss, the loss would add directly to the noise figure; therefore, the effective noise figure of the stage would be 7.5 dB.

Note: For communications engineers working with noise temperature rather than noise figure, the effective noise temperature (Te) of a UTO amplifier in K can be found from:

$Te = 290(10^{NF/10} - 1)$

Intercept Point

If the fundamental input power vs. output power response of an amplifier is plotted on a log-log scale, it will have a 1:1 slope (see Fig. 2) in the linear operating region. It has been determined that a plot of the second-order intermodulation products of the amplifier, plotted on the same scale, will have a slope of 2:1 and the third-order products a slope of 3:1.

Since the third-order spurious products are the most troublesome, falling within the bandpass of even moderate bandwidth amplifiers, the intercept point is generally defined as the point where extensions of the first- and third-order responses intersect on the output power scale. Note that the second-order response plot will generally intersect at the same point as well, unless the amplifier design suppresses even-order responses (for example, push-pull stages).

The plot of amplifier responses is a set of straight lines on the log-log scale. The slope of the line depends on the order; the fundamental has a slope of 1, the second-order has a slope of 2 and the third-order has a slope of 3. The intersection of the fundamental and third-order yields the intercept point.

When the amplifier is operating in the linear amplification range (i.e., below the 1 dB gain compression point), the levels of the spurious responses can be estimated accurately with a simple calculation or by using the nomograph.

Referring to the typical amplifier response curve of Figure 2, the output power at 1 dB gain compression is +20 dBm and

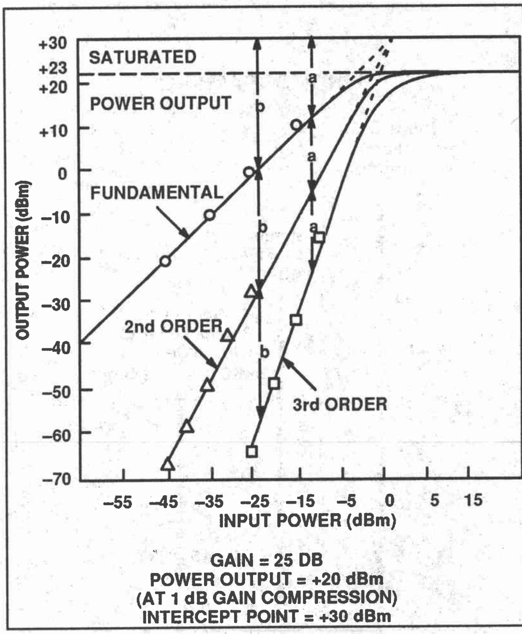


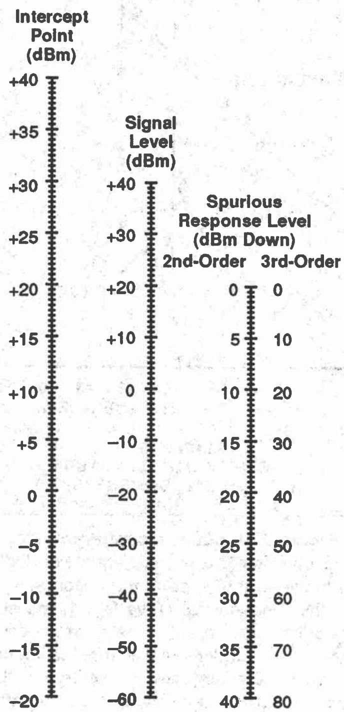
Figure 2. Input Intercept Point Graph

the intercept point is +30 dBm, a difference of 10 dB. Since the difference between the slope of the second-order response curve and the fundamental curve is 1:1, the second-order spurious products will be the same distance down from the fundamental as the fundamental is from the intercept point at any output power. Similarly, since the difference between the slope of the third-order curve and the fundamental is 2:1, the third-order products will be twice the distance down from the fundamental as the fundamental is from the intercept point at any output power in the linear range. For example, if the amplifier is driven to +15 dBm output power, the second-order product will be suppressed to 15 dB below the output signal and the third-order product will be an additional 15 dB below the second-order product (a to a to a on Figure 2). If the amplifier was driven to provide 0 dBm output power, the suppression of the second-order product relative to the output signal would be 30 dB and the third-order product would be an additional 30 dB or 60 dB below the desired output (b to b to b on Figure 2).

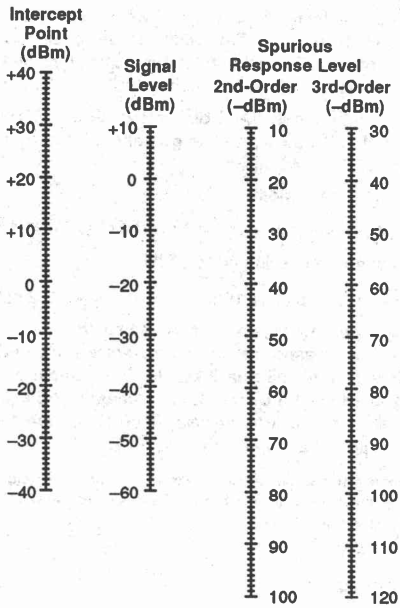
AUTOMATIC NETWORK ANALYZER CHARACTERIZATIONS OF CASCADABLE AMPLIFIERS

The data sheet for each amplifier has a printout from an automatic network analyzer. The measurements were made on random samples taken from current production runs and can be considered, within normal production variations, as typical of the characteristics of units currently being shipped.

NOMOGRAPH NO. 1



NOMOGRAPH NO. 2



EXAMPLE 1

Given Intercept Point +30 dBm
Output Signal Level –10 dBm

Find Third-Order IM Level

Line up ruler on +30 on Intercept Point Scale and –10 dBm on Signal Level Scale. Read –90 dBm on Nomograph 2 or 80 dB down on Nomograph 1. The spurious responses are at –90 dBm, or 80 dB down from the signals at –10 dBm.

The intercept point is given for the output level. When input levels are being considered, the amplifier gain must be taken into consideration.

EXAMPLE 2

Given Intercept Point +30 dBm
Input Signal –30 dBm
Amplifier Gain 30 dB

Find Third-Order Spurious Level at the Output

At the output, the two signals will be at 0 dBm (–30 dBm +30 dB).

Line up ruler on +30 dBm on the Intercept Point Scale and 0 dBm on the Signal Level Scale. Read –60 dBm on Nomograph 2 or 60 dB down on Nomograph 1.

Unequal signals must be converted to equivalent equal signals by subtracting from the stronger signal one third of the difference between the two signals measured in dB.

EXAMPLE 3

Given Intercept Point +30 dBm
Output Signals at –3 dBm and at –18 dBm

Find Third-Order Spurious Response

Step 1. Find equivalent equal signal level

The difference between two signals at –3 dBm and –18 dBm is 15 dB. One third of 15 dB is 5 dB. Subtract 5 dB from –3 dBm. The resultant signal level, –8 dBm, is the equivalent equal signal level.

Line up ruler with +30 dBm on the Intercept Point Scale and –8 dBm on the Signal Level Scale. Read 76 dB down on Nomograph 1, or –84 dBm on Nomograph 2.

Figure 3. Dynamic Range Nomographs

S-Parameter Printouts

The action of the automatic network analyzer in measuring the S-Parameters of a cascadable amplifier can be explained by the extremely simplified schematic shown in Figure 4. Two directional couplers are placed at the input and one at the output of the cascadable amplifier, and the power levels and phase angles are measured at each of the terminals.

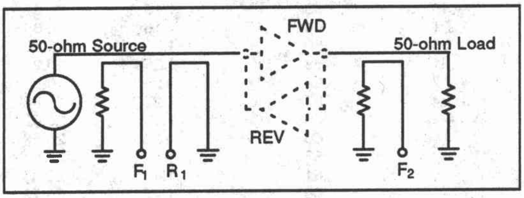


Figure 4. S-Parameter Measurements.

If the amplifier is placed in the circuit in the forward direction:

$$S_{11} = \frac{|R_1|}{|F_1|} \angle \phi R_1 - \phi F_1$$

$$S_{21} = \frac{|F_2|}{|F_1|} \angle \phi F_2 - \phi F_1$$

S_{11} = input reflection coefficient, expressed at a ratio and angle —

$\therefore \rho$ forward (dB) = 10 log $|S_{11}|^2$

$|S_{21}|^2$ = forward insertion gain

$\therefore$ gain (dB) = 10 log $S_{21}{}^2$, and $\angle S_{21}$ = insertion phase shift Φ

By reversing the UTO in the setup —

$$S_{12} = \frac{|F_2|}{|F_1|} \angle \phi F_2 - \phi F_1$$

and

$$S_{22} = \frac{|R_2|}{|F_1|} \angle \phi R_2 - \phi F_1$$

and S_{22} = output reflection coefficient, expressed as a ratio and angle.

$\therefore \rho$ rev (dB) = 10 log $|S_{11}|^2$

$|S_{12}|^2$ = reverse insertion gain

$\therefore$ reverse isolation (dB) = 10 log $|S_{12}|^2$

Shown below is the typical S-Parameter data for the UTO-502 amplifier.

S-PARAMETERS — **BIAS = 15 VOLTS**

FREQ MHz	S_{11} Mag	S_{11} Ang	S_{21} dB	S_{21} Ang	S_{12} dB	S_{12} Ang	S_{22} Mag	S_{22} Ang
100.00	.030	73.6	14.66	157.7	–20.54	–5.4	.025	–153.0
200.00	.056	69.3	14.55	139.9	–20.63	–12.2	.040	–164.0
300.00	.073	63.1	14.59	119.8	–20.54	–19.8	.062	178.5
400.00	.079	59.3	14.50	99.4	–20.72	–27.0	.086	161.3
500.00	.074	62.4	14.59	80.1	–20.54	–35.8	.116	143.5
600.00	.066	84.8	14.68	59.7	–20.72	–43.4	.139	126.3
700.00	.093	115.5	14.83	38.1	–20.54	–51.7	.164	106.3
800.00	.173	125.4	14.73	16.9	–20.82.	–61.9	.177	86.0
900.00	.293	120.1	14.76	–8.3	–21.11	–74.6	.179	60.4
1000.00	.438	108.3	14.47	–32.7	–21.51	–86.9	.154	31.5

At 300 MHz the UTO-502 S-Parameters were:

S_{11} = input reflection coefficient
= .073 $\angle 63.1$

S_{21} = forward insertion gain
= 5.365 $\angle 119.8$

S_{12} = reverse insertion gain
= .094 $\angle -19.8$

S_{22} = output reflection coefficient
= .073 $\angle 178.5$

Other-Parameter Printouts

The second printout for each amplifier type indicates the gain, phase angle, deviation from the computed linear phase vs. frequency curve, gain flatness, group delay, VSWR and reverse isolation for the specific sample.

An example of the typical numerical readings data provided for each amplifier is shown below.

AUTOMATIC NETWORK ANALYZER MEASUREMENTS (Typical production unit at +25°C ambient)

NUMERICAL READINGS — BIAS = 15.00 VOLTS

FREQ MHz	VSWR IN	GAIN dB	PHASE DEG	PHASE DEV	PHASE DEV	GROUP DELAY ns	VSWR OUT	ISOL dB
100.0	1.06	14.88	159.07	−1.71	−.72	—	1.06	20.91
150.0	1.11	14.78	149.98	−.35	.35	.53	1.10	20.51
200.0	1.13	14.74	140.11	.21	.65	.59	1.12	21.06
250.0	1.14	14.74	128.87	−.58	−.40	.58	1.15	20.82
300.0	1.17	14.81	119.31	.30	.21	.54	1.16	20.69
350.0	1.18	14.67	109.49	.90	.55	.59	1.21	21.10
400.0	1.19	14.68	98.24	.10	−.51	.58	1.25	20.98
450.0	1.19	14.79	88.51	.81	−.07	.55	1.25	20.81
500.0	1.19	14.76	78.37	1.11	−.04	.57	1.29	20.89
550.0	1.19	14.81	68.04	1.23	—	.59	1.35	20.52
600.0	1.18	14.83	57.17	.79	—	.60	1.38	20.58
650.0	1.23	14.74	46.35	.41	—	.63	1.40	21.01
700.0	1.29	14.85	34.54	−.94	—	.61	1.41	20.86
750.0	1.41	14.89	24.51	−.54	—	.60	1.45	20.78
800.0	1.56	14.77	12.88	−1.73	—	.67	1.45	21.09
850.0	1.77	14.71	.23	—	—	.68	1.43	21.20
900.0	2.02	14.62	−11.75	—	—	.69	1.39	21.26
950.0	2.41	14.32	−24.58	—	—	.72	1.38	21.47
1000.0	2.82	14.15	−37.67	—	—	.70	1.33	22.11
1050.0	3.34	13.77	−49.83	—	—	.64	1.29	21.94
1100.0	4.20	13.26	−60.89	—	—	.66	1.27	22.13
1150.0	5.33	12.88	−73.51	—	—	.70	1.27	23.24
1200.0	6.49	12.10	−86.00	—	—	.68	1.29	23.94
LINEARIZATION RANGE				100.0 MHz to 800.0 MHz	100.0 MHz to 500.0 MHz			

Note that there are two phase deviation columns, measured over different frequency ranges. Differences in phase deviation figures between the two columns results from the fact that the network analyzer calculates the linear phase/frequency curve based only on the points measured within the specified frequency range (refer to Phase Linearity for additional explanation).

For a more complete discussion of both the operation of the automatic network analyzer and the meaning and use of S-Parameters, a good reference is *S-Parameters...Circuit Analysis and Design, Application Note 95,* which is available from Hewlett-Packard.

Group Delay

If a single frequency signal is applied to the input port of any device, active or passive, its relative phase at the output port will be shifted by an amount related to the time it takes to propagate through the device. This single-frequency phase delay may be expressed by the identity:

$$t_f = \frac{\Delta\phi}{\omega}$$

In an ideal device, phase delay would be directly proportional to frequency and the t_f term would *always* remain constant, regardless of the frequency (or multiple frequencies) of the applied signals.

In actual devices, the propagation velocity (and, therefore, the phase delay) always has a non-linear relationship to the applied frequency. If two frequencies are applied to the input port of an actual device, each will be propagated at a different velocity and the modulation envelope (caused by the beating of the two frequencies) will be propagated at a third—the envelope or *group* velocity.

The group delay of a device is directly related to the rate of change of phase shift vs. frequency, and can be expressed in units of time with the identity:

$$t_d = \frac{d\,\phi}{d\,\omega}$$

Group delay may be measured by varying the frequency of the signal in small increments, measuring the corresponding change in phase of the output signal:

$$t_d = \frac{\Delta\phi\, n}{360°\, fn}$$

Alternatively, if the input waveform consists of an amplitude modulated carrier, the group delay is directly related to the phase shift of the modulation envelope as the carrier is swept through the bandwidth of interest. The group delay measured in this manner can be expressed by:

$$t_d = \frac{\phi\, n}{f_M \times 360°}$$

It will be seen from the automatic network analyzer printouts that the group delays of the production sample amplifiers are less than 1 ns per stage (the UTO-504, -521 and -523 have two stages) and relatively constant over the entire operating bandwidth.

Since there is no appreciable interaction between the group delay of UTO, UTF and UTL devices when they are operated in a conventional 50-ohm microstrip environment, the total group delay of a cascade of these modules will be approximately equal to the sum of their individual group delays (plus the group delay introduced by transmission line sections), t_d cascade $\cong t_{d_1} + ... + t_{d_n}$.

In applications where the modules are used in other than 50-ohm circuits, where the impedances they see vary widely with frequency or when the cascade group delay must be determined precisely, the group delay of the complete cascade should be measured using a swept modulated signal source and vector voltmeter set-up or with an automatic network analyzer.

t_f = single frequency phase delay (in seconds)
t_d = group delay (in seconds)
ϕ = carrier phase shift (in degrees)
f = carrier frequency (Hz)
ω = carrier frequency (radians/second)
$\Delta\phi$ = modulation envelope phase shift (in degrees)
f_m = modulation frequency (Hz)

Phase Linearity

As previously discussed (see *Group Delay*), an ideal active device, such as an amplifier, would exhibit a linear relationship between signal frequency and phase shift. A plot of this "ideal" relationship would result in a straight line curve with slope dependent on the effective electrical length of the device. In practical situations, the curve will not be a perfectly straight line, but will exhibit perturbations of a few degrees to either side of linear.

Phase linearity of a device is usually expressed as the maximum deviation from the linear curve within the band of interest or simply by reference to a listing of the phase deviation at a number of discrete frequencies. Such a listing is presented for most amplifiers, and it will be seen that the phase deviation is never more than a few degrees from linear.

In producing the phase deviation data, the automatic network analyzer first measures the relative phase shift through the amplifier at a number of frequencies specified by the programmer. Next, using the method of least squares, it fits the actual data points to a straight-line curve which becomes the "ideal" curve for the particular amplifier. Finally, it prints out the deviation from this straight line at each of the specified frequencies. This process of fitting accounts for the differences in deviation in the two "PHASE DEV" columns of each ANA printout—in each case the number of points (and the values of some of them) over which the "fit" was made differs.

Curves in Figures 5a, 5b, 5c and 5d show the typical phase shift of several UTO amplifiers as a function of input power.

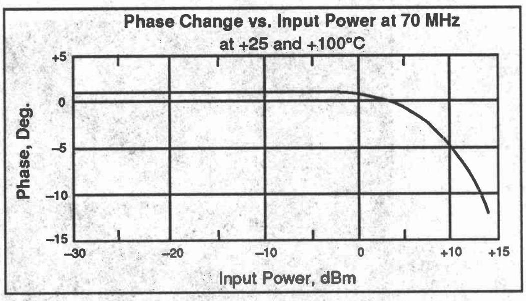


Figure 5a. UTO-501 Phase Change

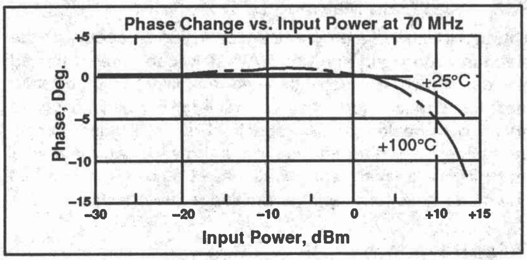


Figure 5b. UTO-513 Phase Change

For both of the above amplifiers the typical output compression point was approximately +0.5 dBm. The gain of the UTO-501 is typically 15.1 dB at 70 MHz, and the gain of the UTO-511 is typically 17.4 dB at 70 MHz. Input compression points would be −14.6 dBm for the UTO-501 and −16.9 dB for the UTO-511. In both cases no phase shift took place until the input level approached 0 dBm.

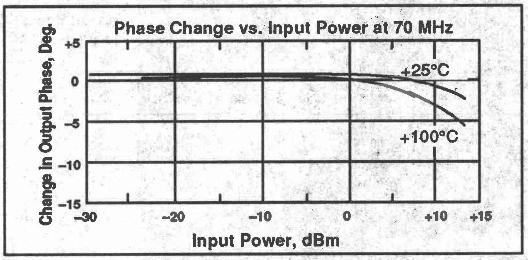


Figure 5c. UTO-513 Phase Change with DC Bias of +15 Volts

At 15-volt bias, the output compression level of the UTO-513 is +10 dBm and its gain is 16.5 dB at 70 MHz. Input compression would be −6.5 dBm. Although its phase began to shift with a 0 dBm input power, its phase shift is only −2.5° at +10 dBm (100°C) compared to −5.0° for the UTO-501 and −511.

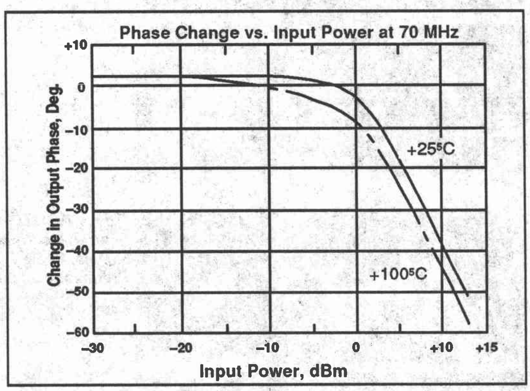


Figure 5d. UTO-521 Phase Shift

The UTO-521 has an input compression point of −23.5 dBm and consequently starts to exhibit a phase shift with input powers exceeding −17 dBm.

Phase and Gain Matched UTO Modules

Through the use of a programmed selection procedure on the automatic network analyzer, Avantek can offer selected groups of two or more thin-film amplifiers with closely-matched phase and/or gain characteristics, or with phase and/or gain tracking over a specified range. Please contact the factory for further information on how we can meet your matching or tracking specifications, whether you need just one set or have long-term production requirements.

Pulse Response

Cascadable amplifiers are ideally suited for pulse amplification applications because of their extremely wide bandwidth. Shown below are some oscilloscope photographs showing the rise time and fall time of the UTO-1002 (Figures 6a, 6b and 6c) and UTO-1521 (Figures 7a, 7b and 7c) amplifiers under pulsed conditions. The response is shown for input levels both below and above the 1 dB gain compression level. The bracketed number following the model number indicates how far the input signal has driven the output of the amplifier being characterized relative to the 1 dB gain compression point, i.e., the notation (–10 dB) indicates that the amplifier output is 10 dB below the 1 dB gain compression point. Unless otherwise indicated, the horizontal scale is 20 nsec/division.

The UTO-1002 is a single-stage amplifier with a specified frequency response of 5 to 1000 MHz, a typical gain of 14.5 dB and a typical 1 dB output compression point of +8.5 dBm. The UTO-1521 is a three-stage amplifier with a frequency response of 1 to 1500 MHz and a typical 1 dB output compression point of + 16 dBm.

It should be noted that the performance of an amplifier module in pulse operation is strongly influenced by the characteristics of the external circuitry. Any transmission line sections, stray reactances and electrical lengths have their individual effects, as does the particular circuit layout surrounding the amplifier module.

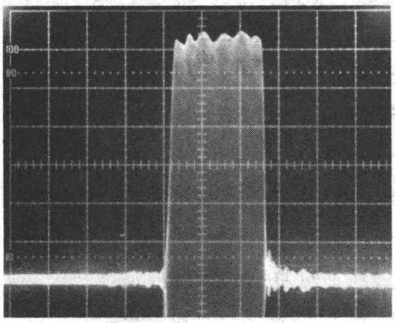


Figure 6a. UTO-1002 (–10 dB)
Input Pulse Width = 50 ns
Vertical Scale = 20 mW/div
Frequency = 100 MHz

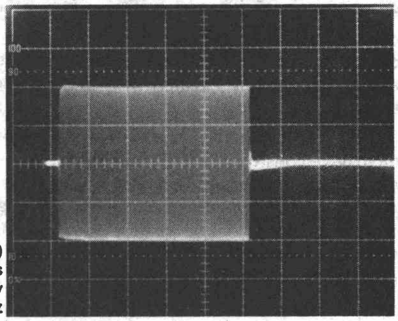


Figure 6b. UTO-1002 (1 dB GCP)
Input Pulse Width = 50 ns
Vertical Scale = 0.1 V/div
Frequency = 100 MHz

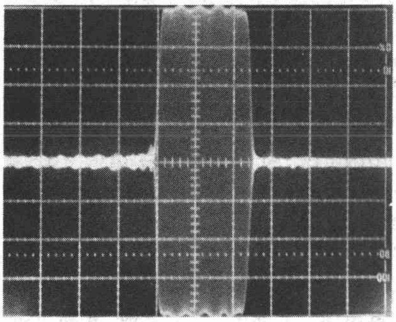


Figure 6c. UTO-1002 (+3 dB)
Input Pulse Width = 50 ns
Vertical Scale = 0.1V/div
Frequency = 100 MHz

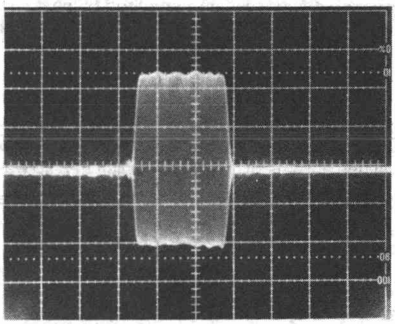


Figure 7a. UTO-1521 (1 dB GCP)
Input Pulse Width = 1 μs
Vertical Scale = 0.1 V/div
Frequency = 100 MHz

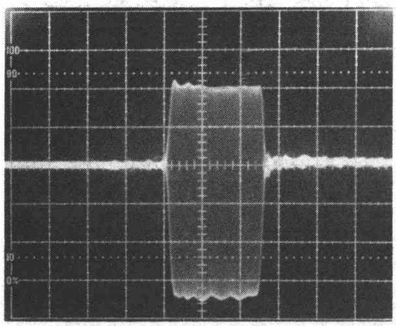


Figure 7b. UTO-1521 (+ GCP)
Input Pulse Width = 1 μs
Vertical Scale = 0.1 V/div
Frequency = 100 MHz

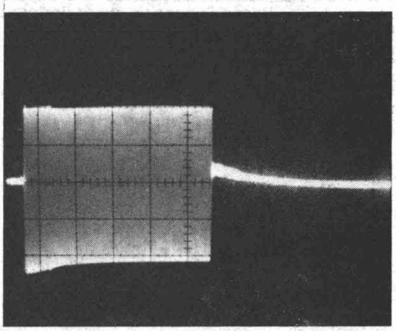


Figure 7c. UTO-1521 (+5 dB)
Input Pulse Width = 50 ns
Vertical Scale = 0.1 V/div
Horizontal Scale = 0.2 μs/div
Frequency = 100 MHz

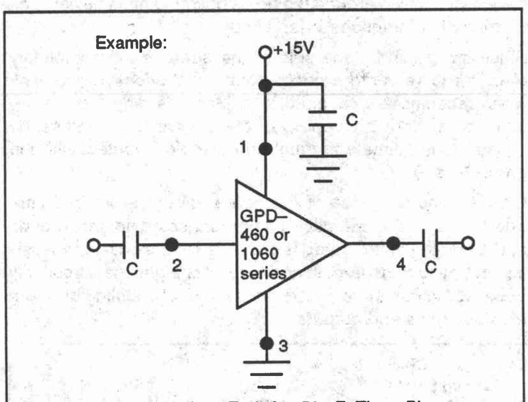
Calculating The Low Frequency Response Of A GPD Amplifier

Neither the 460 nor the 1060 series GPD amplifiers have internal coupling capacitors. These, along with the DC bias bypass capacitor, must be provided in the external circuit. By selecting the values of the capacitors, the low frequency roll-off point may be set as close to DC as required.

The design curves of Figures 8b and 8c can be used to determine the proper input, output and bias bypass capacitor values. Figure 8b provides the required capacitor value for the desired frequency response. Figure 8c will provide the gain roll-off.

For example, to produce a flat frequency response to 200 Hz, from Figure 8b, a capacitive value of 50 µF should be used.

From Figure 8c it can be seen that if 50 µF capacitors are used the gain of the amplifier will only be reduced by 0.05 dB at 200 Hz. At 100 Hz the roll-off would be 0.2 dB, at 50 Hz the roll-off would be 0.85 dB and at 30 Hz the gain would be reduced by 3 dB.



eg. 200 Hz Low End, C = 50 µF. Three Places.

Figure 8a. GPD Circuit

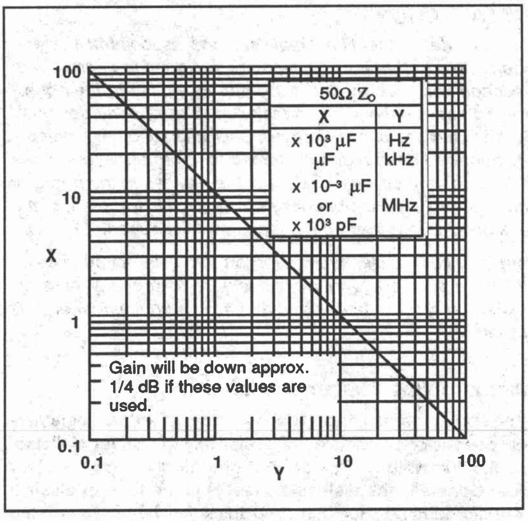


Figure 8b. Capacitor Values for Amplifier Low Frequency Response

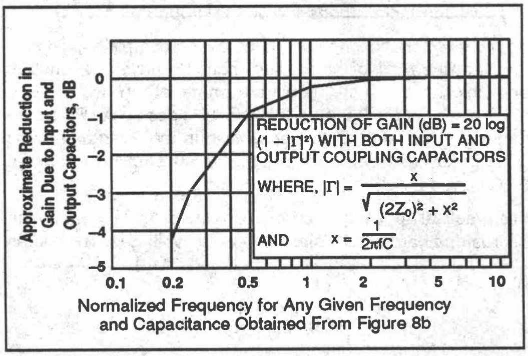


Figure 8c.

INSTALLATION

All cascadable thin-film amplifiers and associated limiters, attenuators and AGC amplifiers are designed to operate with unconditional stability and performance similar to their guaranteed specifications when installed in a properly designed 50-ohm microstripline PC board. Oscillation or other problems encountered can be directly traced to improper layout of the PC board, improper grounding of the devices to the board or the board to the case or chassis in which it is installed, or the lack of RF bypassing on DC leads when required.

In this section basic information on microstrip circuit design will be presented to allow a designer to properly plan his custom microstrip board to avoid any "surprises" when it is turned on.

Microstripline Characteristics

A microstrip transmission line is fabricated with a single narrow conductor on one side of a relatively thin sheet of dielectric medium with a large area of ground plane on the other side. Generally the dielectric sheet is in the form of either a ceramic substrate for thin- and thick-film hybrid integrated circuits or PC board material for assemblies.

Electrically, a microstripline behaves like a two-wire transmission line with the second conductor formed by the image of the physical conductor appearing on the ground plane.

The characteristic impedance of a microstripline is determined by the width of the conductor and the dielectric constant and thickness of the substrate material on which it is fabricated. For the 0.062 in. thick, G-10 glass epoxy PC board material (1 oz. clad, both sides) used in the Avantek boards (and widely used elsewhere), a 50-ohm stripline is always 0.10 in. wide.

In a practical application, other conductors also appear on the microstrip board for DC bias and control voltages. The widths of these conductors are relatively unimportant so long as they are narrow compared to the large grounded areas which make up the bulk of the conductor side of the board to provide as much shielding and isolation as possible.

Figure 9 is the layout of the Avantek TB-4 microstrip circuit board, which can accept up to four modular devices with provisions for all RF and DC bias and control voltage connections to any Avantek TO-8 modules. There are also provisions for the dropping resistors required when 24-volt, 15-volt, and 5-volt modules are mixed in one cascade.

The figure shows how the modules are installed and connections made. Position A shows the connections to a UTF attenuator; position B, to a UTL limiter amplifier; position C, to a UTO requiring a dropping resistor to lower the available supply voltage; and position D, to a UTO operating directly from the available supply voltage. Note the use of jumpers when dropping resistors are not required.

All connections to the pins on the modular devices are made via conductors on the bottom, or circuit, side of the board. The top, or ground plane, is left completely clad except for the clearances milled around the holes drilled to pass device pins to prevent unintentional short circuits.

Since the ground plane side of the board is left completely clad, it assures both a good ground and effective heat sink when modules are clamped to it. Modules may also be secured with conductive epoxy or other means, so long as the cases are in intimate thermal and electrical contact with the ground plane.

On the conductor side of the board, all of the unused conductor areas are effectively interconnected to the ground plane and the entire board is grounded to the case or chassis via mounting hardware. In addition, a "straight line" circuit layout assures that there will be a minimum of coupling between module inputs and outputs.

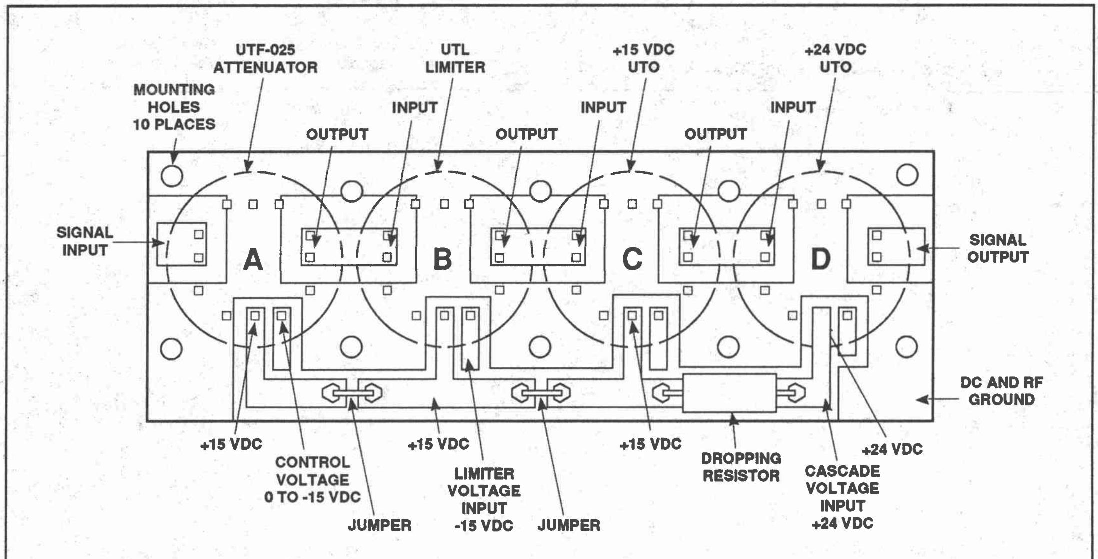


Figure 9. Avantek TB-4 Microstrip Board (Showing Connections to Modules)

Bypassing Of DC Leads

It is always a good practice to provide RF bypassing of power and control leads entering the PC board, particularly when the power supply and control circuitry is located some distance away. This practice will prevent unwanted signals and externally-generated noise from entering the cascade.* RF chokes or ferrite beads on the input power and control leads as well as noninductive bypassing capacitors of approximately 0.001 to 0.1 μF installed at the bias pins of each of the modules should prevent any possibility of noise ingress or RF feedback.**

*Bias and control pins of Avantek TC series cases, and UTC factory-assembled and packaged cascades are provided with by–passing.

**In a few cases, small chokes or ferrite beads on the jumpers carrying power between modules on the PC board may be advisable as well—particularly on high-gain cascades where feedback between stages is occasionally experienced.

ASSEMBLY INSTRUCTIONS FOR AVANTEK TB BOARD AND TC CASE

The steps listed below and Figures 10a, b and c apply to the assembly of TO-8 modules into Avantek TB Series printed circuit boards and TC Series cases.

1. Cut all four pins to a length of approximately 3/16 inch.
2. Insert modules into TB Series printed circuit board. As the board is viewed from the circuit side, (see Figure 10), the module selected for input is placed on the left.
3. Bend the module leads slightly to hold the unit loosely to the board. Do not solder until after Step 7.
4. Place the board, with module attached, into the TC Series case in the manner shown in Figure c.
5. With the 0–80 x 3/16 stainless pan head screws provided, secure the board firmly to the case. (This step ensures proper contact between the module and the circuit board ground plane for both RF stability and heat dissipation.)
6. Install the DC feedthrough(s), ground terminal and connectors.
7. Bend module leads flat against the printed circuit (see Figure 10b, then solder.
8. Wiring:
   a. If only modules with the same DC supply voltage are used, simply solder jumper wires between the DC voltage lines of the adjacent stages. Then, solder another wire between the DC voltage feedthrough and the DC voltage line adjacent to it.
   b. If modules of different supply voltages are cascaded, varying DC bias voltages become a factor. If all units are biased from the same supply, provision must be made to drop the high voltage supplied to the lower voltage. The appropriate resistor is soldered on the DC voltage line between stages where the high to low voltage transition occurs. Then, jumper wires are soldered between the DC voltage lines of the other adjacent stages. Finally, a wire is soldered between the DC voltage feedthrough and the DC voltage line adjacent to it.

Assembly Instructions For Customer-Supplied Circuit Board

The steps below apply only to the assembly of Avantek modules into microstrips or stripline circuits other than Avantek TB Series printed circuit boards. CAUTION: The Avantek modules are designed for use in a 50-ohm microstrip system and the package must be adequately grounded!

1. After cutting the pins per Step 1, install the module directly on the circuit board ground plane with the RF Input, RF Output and DC Voltage pins (see Figure 10) passing through the board to the circuit on the other side. Be careful that these pins do not short out to the ground plane.
2. Using the clamp provided, secure the module firmly to the ground plane. Figures 10d and 10e show the proper positioning and installation of the mounting clamp. (This step ensures positive contact between the module package and the ground plane so that no problems with VSWR or oscillation in a multistage system will be encountered.)
3. Bend the RF Input, RF Output, DC Voltage and GND pins flat against the proper portions of the printed circuit, then solder in place.

Figure 10a

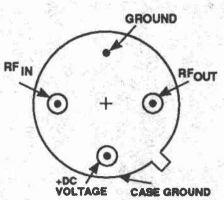
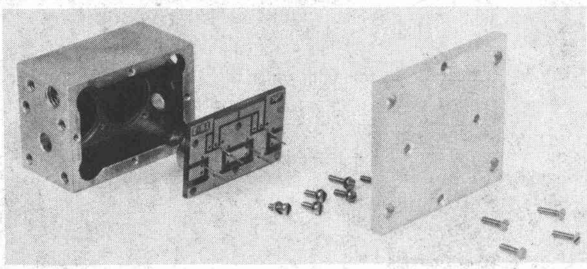


Figure 10c



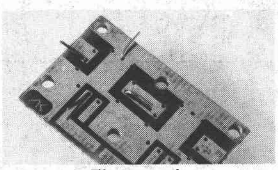


Figure 10b

Figure 10d

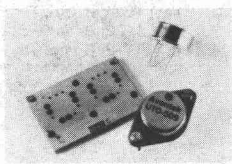


Figure 10e

Figure 10. Assembly Procedures for MICamp Amplifier Cascades

Materials Supplied

Customers can purchase modules, printed circuit boards (see Figure 11) and cases individually or as factory-integrated assemblies (see Figure 12). Materials Supplied with specific orders are as follows:

If you order	Shipment will include*
1. Individual modules	Module Mounting Clamp Clamp Screws, Nuts, Washers
2. TB Series Circuit Board(s)	Circuit Board(s) Circuit Board Mounting Screws
3. TC Series Case(s)	Case(s) Case Cover Mounting Screws DC Feedthrough, Washer Ground Terminal, Washer, RF Connectors (specify type)

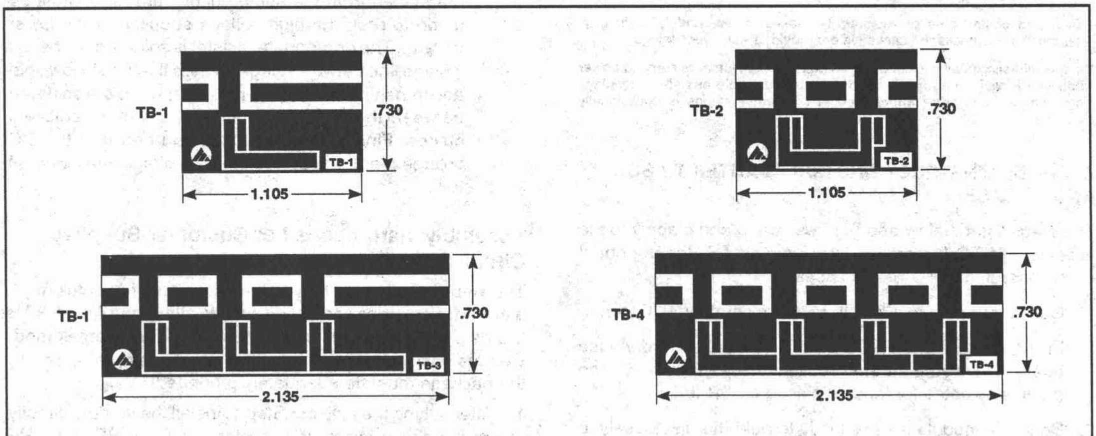
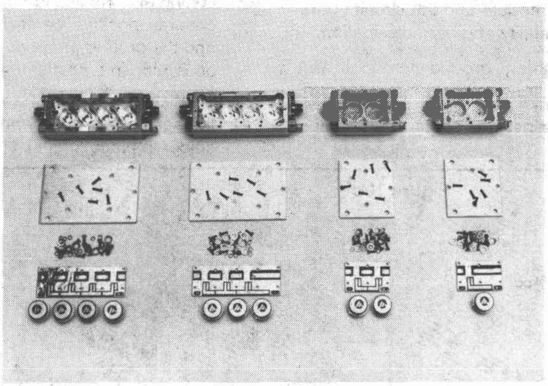


Figure 11. Circuit Boards (shown actual size)



1. Case, TC-4; Board, TB-4
2. Case, TC-4; Board, TB-3
3. Case, TC-2; Board, TB-2
4. Case, TC-2; Board, TB-1

Figure 12. Typical Assemblies

CASCADED PERFORMANCE

With over 100 Avantek thin-film amplifier modules from which to choose, it is simple to design a cascade offering practically any required combination of performance characteristics. Figure 13 shows a typical cascade.

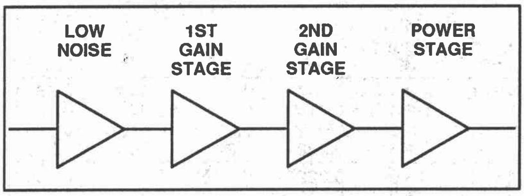


Figure 13. Typical Cascade of Amplifier Modules.

In most cases, the first module is selected to provide the required cascade noise figure and the final module to provide the necessary cascade output power. If additional gain is required, intermediate modules are included—taking care to assure that the power output of each intermediate module is high enough to sufficiently drive the following stage, yet not so high that it will cause saturation. The entire cascade design process is very straightforward, with quite accurate results possible by simply using a few "rules of thumb," as listed below:

Bandwidth

Since cascading does not affect the bandwidth of the individual modules, the overall bandwidth of a cascade will be defined by the module having the *smallest* bandwidth. Note, though, that the bandwidths specified for each modular amplifier is the guaranteed operating frequency range, and that the modules will provide significant amounts of gain at much lower and usually much higher frequencies.

Gain

The minimum gain of a cascade will be the sum of the minimum gains of each of the cascaded modules *so long as none of the modules are driven into saturation* by signal levels applied to the cascade.

Gain Flatness

The following table (Figure 14) provides a conservative estimate of the overall gain flatness of a cascade, based on the number and type of modules used.

	Bandpass Flatness in dB No. of Gain Stages		
UTO Series	2	3	4
500	±1.0	±1.5	±2.0
1000	±1.0	±1.5	±2.0
1500	±1.0	±1.5	±2.0
2000	±1.5	±2.0	±2.5

Figure 14. Approximate Gain Flatness of Avantek Modular Amplifiers.

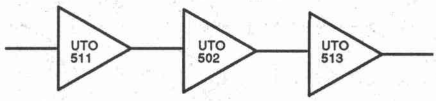
NOISE FIGURE

The noise figure of a cascade can be calculated from the equation:

$$F_C = F_1 + \frac{F_2 - 1}{G_1} + \frac{F_3 - 1}{G_1 G_2} + \ldots + \frac{F_N - 1}{G_1 G_2 \ldots G_{N-1}}$$

Where F_1 and F_N are the noise figures (in numeric form, $F = \log^{-1} \frac{NF_{dB}}{10}$) of the 1st and Nth stages respectively and G_1 and G_N are the gains (in numeric form, $G = \log^{-1} \frac{G_{dB}}{10}$) of the 1st and Nth stages.

Referring to the noise figure equation, the noise figure of a cascade consisting of a UTO-511, UTO-502 and UTO-513 is:



UTO-511 G = 31.62 (15 dB)
NF = 2.5 dB, F = 1.778
UTO-502 G = 25.12 (14 dB)
NF = 5.5 dB, F = 3.55
UTO-513 G = 39.81 (16 dB)
NF = 6.0 dB, F = 3.98

$$F_C = 1.778 + \frac{3.55 - 1}{31.62} + \frac{3.98 - 1}{(31.62)(25.12)} + 1.862$$

$NF_n = 2.701 dB$

Overall gain = 15 dB + 14 dB + 16 dB = 45 dB

The first stage of a cascade contributes the bulk of the noise figure. In this case,

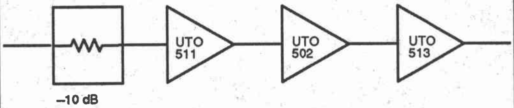
First stage NF contribution = 2.5 dB (2.5 dB NF amplifier)

Second stage contribution = 0.192 dB (5.5 dB NF amplifier)

Third stage contribution = 0.009 dB (6.0 dB NF amplifier)

When a fixed, variable or electrically-variable attenuator (such as one of the UTF Series) or an unintentional loss is inserted in an amplifier cascade, its overall effect on the system noise figure will vary with its position in the cascade. The loss of the attenuator (in dB) adds directly to the noise figure of the succeeding amplifier stage. For example, a 2.5 dB NF UTO-511 preceded by 10 dB of loss will exhibit an overall 12.5 dB noise figure. This effect is demonstrated in the following example, which consists of the same UTO cascade as previously investigated, with the addition of a 10 dB attenuator placed in various positions.

1st STAGE

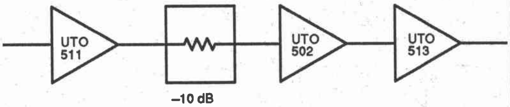


NF UTO-511 = 10 dB + 2.5 dB = 12.5 dB F = 17.78

$$F_C = 17.78 + \frac{3.55 - 1}{31.62} + \frac{3.98 - 1}{(31.62)(25.12)} + 17.86$$

NF_C = 12.5 dB G_C = 35 dB

2nd STAGE

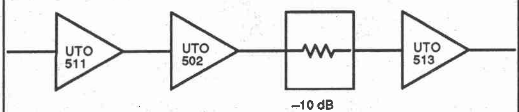


NF UTO-502 = 10 dB + 5.5 dB = 15.5 dB F = 39.81

$$F_C = 1.778 + \frac{35.4 - 1}{31.62} + \frac{3.98 - 1}{(31.62)(25.12)} + 2.871$$

NF_C = 4.58 dB G_C = 35 dB

3rd STAGE

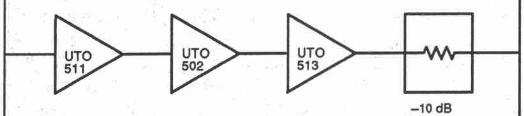


NF UTO-513 = 10 dB + 6.0 dB = 16 dB F = 39.81

$$F_C = 1.78 + \frac{3.55 - 1}{31.62} + \frac{39.81 - 1}{(31.62)(25.12)} + 2.87$$

NF_C = 2.8 dB G_C = 35 dB

4th STAGE



NF = same as w/o attenuator

G_C = 35 dB

As a general rule, the noise figure contribution of subsequent stages will be rather small if the gain of the first module is greater than approximately 15 dB. (See Figure 15.)

First Stage Gain dB	First Stage Noise Figure dB	Second Stage Noise Figure 3 dB	5 dB	8 dB	10 dB
20 dB	8.0	0.007	0.015	0.040	0.060
	5.0	0.014	0.03	0.070	0.120
	3.0	0.022	0.05	0.110	0.190
	1.5	0.039	0.07	0.160	0.270
15 dB	8.0	0.022	0.047	0.114	0.190
	5.0	0.043	0.093	0.225	0.370
	3.0	0.068	0.146	0.351	0.580
	1.5	0.096	0.205	0.488	0.800
10 dB	8.0	0.07	0.150	0.350	0.580
	5.0	0.14	0.290	0.670	1.090
	3.0	0.21	0.450	1.030	1.620
	1.5	0.30	0.620	1.390	2.140
7 dB	8.0	0.140	0.290	0.670	1.090
	5.0	0.270	0.560	1.260	1.950
	3.0	0.410	0.850	1.850	2.790
	1.5	0.570	1.160	2.430	3.560

Figure 15. Second Stage Noise Contribution.

If the gain of the first stage is less than 15 dB, the noise figure of the second stage will make a significant contribution to the overall noise figure of the cascade. For example, if a UTO-509 is cascaded with a UTO-544, its noise contribution would be 0.52 dB and the noise figure of the cascade would be 3.52 dB.

Model Number	Noise Figure	Gain
UTO-544	3.0 dB	10 dB
UTO-509	5.5 dB	13 dB

On the other hand, if a higher-gain amplifier such as the UTO-517 is cascaded with the UTO-509 the second stage contribution is not as great.

Model Number	Noise Figure	Gain
UTO-517	3.0 dB	22 dB
UTO-509	5.5 dB	13 dB

The second stage contribution would only be approximately 0.03 dB and the noise figure of the cascade would be 3.03 dB.

Mathematically, the overall noise figure of a cascade of amplifiers will always be lower if the second stage amplifier is also a low-noise amplifier. However such a cascade will not provide a higher output compression, and most important will not be as stable over temperature. For example, the UTO-502 has a gain variation of only 0.3 dB over the –55 to + 85°C temperature at 400 MHz whereas the UTO-510 has a 0.8 dB gain variation. Moreover, the reduction in noise figure in going from a UTO-510/UTO-510 cascade to a UTO-510/UTO-502 is only 0.07 dB.

The need to cascade two low-noise, low-level amplifiers would be in those applications where current drain is critical or where the second stage amplifier is expected to provide some limiting.

Power Output

In the usual cascade, when the amplifier modules are arranged in order of ascending output power (i.e., the output power of each stage matches the input power requirements of the following stage), the minimum output power of the cascade will be approximately 1 dB less than the guaranteed output power of the last module alone. For example, if the following two amplifiers were cascaded:

Model Number	Power Output 1 dB Comp. (dBm)	Gain (dB)	Input Power 1 dB Comp. (dBm)
UTO-502	+7.0	13	–6.0
UTO-509	+20.0	12	+8.0

the estimated 1 dB compression point for the cascade would be +19.0 dBm.

On the other hand, if there is a differential between the output power of the driver amplifier and the input compression point of the following stage, then the power output of the last stage needs to be degraded by the differential plus 1.0 dB. For example, if the following two amplifiers were cascaded:

Model Number	Power Output 1 dB Comp. (dBm)	Gain (dB)	Input Power 1 dB Comp. (dBm)
UTO-543	+6.0	9	–3.0
UTO-509	+20.0	12	+8.0

the estimated 1 dB compression point for the cascade would be +18 dBm.

Theoretically if the driver amplifier provides sufficient input power, there should be *no degradation* in output power of the last amplifier in a cascade. However, this requires driver amplifiers having an output power approximately *5 dB greater* than the input compression point (guaranteed output power *minus* module gain) of the following module. For example, if a UTO-503 is to be driven to its full +13 dBm output power, the input power should be [+13 dBm –9 dB (stage gain) +5 dB (excess drive)].

Input Power

In the previous noise figure cascade, suppose the fixed 10.0 dB attenuator is replaced by the UTF-025 voltage controlled attenuator. Attenuation can then be varied over a 2 to 35 dB attenuation range to maintain the output power of the cascade at a constant +14 dBm (1 dB compression point for the UTO-513). Locating the attenuator near the input port of the cascade controls the signal power level applied to the entire cascade, while moving it toward the output will permit earlier stages to saturate on high input signals. The location will prove important in AGC loop and other gain leveling applications. (See the tables in Figure 16.)

For such a cascade, we assume that:

1. UTF-025 is varied through the 2 to 35 dB attenuation range;
2. No stage may be permitted to provide more than its 1 dB gain compression point output power (i.e., no stage may approach saturation).

In summary, the maximum input power range is obtained when the UTF-025 attenuator is placed between the first and second gain stages.

Location of UTF-025 in the Cascade	Input Power Level Range (dBm)	Attenuation Range (dB)	Output Power (dBm)
1st Stage	–29 to +4	33	+14
2nd Stage	–29 to –17	12	+14
3rd Stage	–29 to –22	7	+14

Third-Order Two-Tone Intercept Point

When cascading amplifiers, a 3 dB reduction in the output intercept point of the output stage will occur if the driving amplifier output intercept point is equal to the input intercept point of the output amplifier. As a conservative rule, a 5 dB differential is required between the output intercept point of the driving amplifier and the input intercept point of the output amplifier to preserve the output intercept point of the cascade. To calculate the overlap, refer to the typical curves of the third-order, two-tone intercept point for each amplifier. The intercept point is often quite sensitive to frequency and should be calculated on a "worst case frequency" basis.

VSWR

Avantek cascadable amplifiers have been designed to operate in a 50-ohm system. Both the input and output impedance of each amplifier is carefully matched to 50 ohms by using internal feedback. Resistive values are stabilized through high temperature heat treating, and very precisely set with laser trimming. Impedance matching at the upper frequencies is achieved through LC matching and reactive feedback compensation. In cascade applications, there may be some VSWR degradation in the upper frequencies of the band. However, in the lower portion of the amplifier's bandwidth there is virtually no VSWR degradation due to cascading several amplifiers.

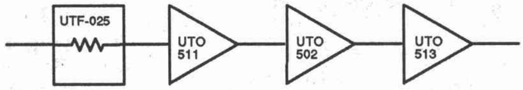
Phase Linearity

When several amplifier stages are cascaded, the phase response deviations are algebraically additive. The deviations will tend to cancel at certain frequencies and add at others.

As a rule of thumb: The worst case phase nonlinearity of a cascade of UTO, UTF and UTL modules will be approximately equal to the sum of the average phase nonlinearities of the individual modules. For example, if three modules are added with typical phase nonlinearities of ±2°, ±3° and ±4°, an estimate of the overall phase nonlinearity as ±9° will represent the worst case.

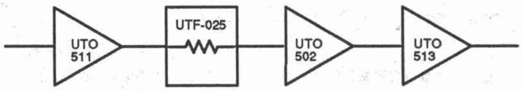
For a more accurate determination of the actual phase characteristics of a cascade, the completed cascade should be measured using the automatic network analyzer or other technique.

1st STAGE



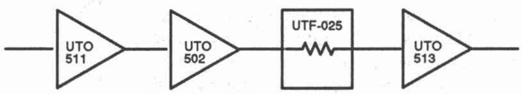
Gain (dB)		−2 to −35		15		14		16	
Output Power (dBm)		—		−2		+7		+14	
Input Power (dBm)		—		−17		−7		−2	
Input Power of Cascade for +14 dBm Power Output (dBm)									
For Min Attn	+29		−31		−16		−2		+14
For Max Attn	+4		−31		−16		−2		+14

2nd STAGE



Gain (dB)		15		−2 to −14		14		18	
Output Power (dBm)		−2		—		+7		+14	
Input Power (dBm)		−17		—		−7		−2	
Input Power of Cascade for +14 dBm Power Output (dBm)									
For Min Attn	+29		−14		−16		−2		+14
For Max Attn	−17		−2		−16		−2		+14

3rd STAGE



Gain (dB)		15		14		−2 to −9		16	
Output Power (dBm)		−2		+7		—		+14	
Input Power (dBm)		−17		−7		—		−2	
Input Power of Cascade for +14 dBm Power Output (dBm)									
For Min Attn	+29		−14		0		−2		+14
For Max Attn	+22		−7		+7		−2		+14

Figure 16. Effects of a Voltage Controlled Attenuator in a Cascade.

Group Delay

The group delays of typical UTO amplifiers are less than 1 ns per stage and relatively constant over the entire operating bandwidth.

Since there is no appreciable interaction between the group delay of UTO, UTF and UTL devices when they are operated in a conventional 50-ohm microstrip environment, the total group delay of a cascade of these modules will be approximately equal to the sum of their individual group delays (plus the group delay introduced by transmission line sections), $t_d \cong t_{d_1} + \dots + t_{d_n}$.

DC Bias

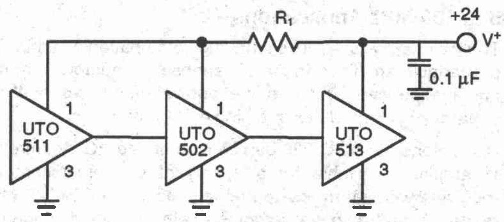
The minimum and maximum specification of any cascadable amplifier is guaranteed only when the bias voltage is supplied at the rated value ±1% regulation. Other bias voltages may be used, allowing the designer to tailor the performance of the amplifier to his requirements. For example, referring to the typical gain curves for UTO-503 on page 3–44, it can be seen that by decreasing the input voltage of a UTO-503 from its rated 24 volts to 15 and 12 volts, the noise figure can be reduced from 6.0 dB at 800 MHz to approximately 5.5 and 5.1 dB respectively. However, this noise figure reduction is accompanied by a reduction in output power available from 16.1 dBm (1 dB gain compression point) to 11.1 and 8.0 dBm.

When several amplifiers requiring different bias voltage are used in a cascade, they may be powered from a single input voltage, so long as the power source provides a voltage equal to or higher than the highest required by the modules and is capable of supplying the total current requirements of the cascade. Each amplifier or amplifier cascade requiring a lower input voltage can be supplied by dropping the voltage with a series resistor. Since each amplifier behaves as a constant current sink under normal linear operating conditions, the resistor will not affect power supply regulation.

The value of the dropping resistor may be determined from $R = E/I$, where the E is the voltage required by amplifier or amplifiers subtracted from the source voltage and I is the total current consumed by the stages being supplied at that voltage. The power dissipation of the resistor may be determined by $P = I^2R$.

As an example (Figure 1), referring to the cascade presented previously, the UTO-513 operates from 24 VDC, and the UTO-502 and 511 from 15 VDC.

When such dropping resistors are used, it is recommended that a 0.1 µF capacitor be installed (with the shortest possible leads) between the module power terminal and ground to assure adequate RF bypassing.



For UTO-511 and UTO-502

I = 15V

I = 10 mA + 10 mA = 20 mA

$$R_1 = \frac{24-15}{20 \times 10^{-3}} + \frac{9}{20 \times 10^{-3}} = 450\Omega$$

Figure 1

The UTO, UTL and UTF modules do not contain over-voltage or reverse-voltage protection, so in instances where there is a possibility of reverse voltage being applied to a cascade, it may be advisable to add a series diode (Figure 2).

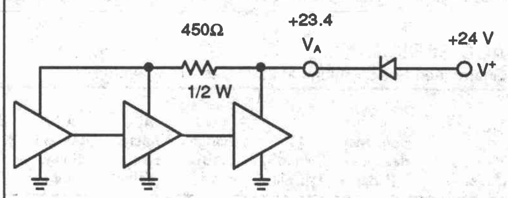


Figure 2

If a series silicon diode is used, the approximately 0.6V drop may usually be ignored, since the UTO current drain is constant and a 0.6V decrease in input voltage will not have appreciable effect on performance (in this example the available voltage has only decreased by 2.5%).

The bias lead of all amplifiers except for the "60 Series" GPD and 3-pin header GPD amplifier have an internal 6800 pF bypassing capacitor. In some applications, such as cascades with extremely large gains (in excess of 60 dB), further bypassing of the bias supply leads of individual modules may be required to eliminate cascade oscillation. Placement of a 0.1 µF capacitor (noninductive) on the bias line to ground is recommended.

DESCRIPTION

5 to 300 MHz Applications

The Avantek® AGC-330 is a unique combination of a thin-film cascadable amplifier and fast response attenuator. Compact and inexpensive, it offers the equivalent of two or three separate TO-8 modules in a single TO-3 package.

Used alone the AGC-330 can be a complete AGC-controlled IF amplifier, suitable for a variety of extremely compact receivers with intermediate frequencies in the 5 to 300 MHz range. It may also be combined with additional stages of wideband modular amplifier modules, such as the Avantek UTO-500 or GPD Series, to produce a voltage-controlled amplifier with any reasonable amount of gain and power output. Used with modular amplifiers, the AGC-330 will not degrade the frequency response of a cascade.

10 to 1000 MHz Applications

The Avantek AGC-553 and AGC-1053 are thin-film amplifiers with a wide range of voltage-controlled gain, in very compact hermetically sealed TO-8 packages. Model AGC-553 has a frequency range of 10 to 500 MHz, provides 44 dB of small signal gain, an AGC range of 45 dB, typical output power of 0 dBm at 1 dB gain compression and has a typical noise figure of 6 dB. AGC-1053 has a frequency range of 10 to 1000 MHz, provides 22 dB of small signal gain with an AGC range of 35 dB, has output power of typically 8 dBm at 1 dB gain compression and has a typical noise figure of 11 dB.

Both amplifiers are built with three cascaded Avantek MODAMP™ silicon monolithic amplifier chips (MMICs) in cascade with interstage PIN diode attenuators on a single alumina substrate. The MMICs are only 0.4 x 0.4 mm square, and each combines two silicon bipolar transistors with f_Ts of 10 GHz in a Darlington pair with on-chip bias resistors, and series and shunt feedback networks. Because of the negative feedback and extremely small size of the MMICs, the resulting amplifiers have very good thermal stability and low group delay. Three of these monolithic amplifier chips are die attached to an alumina substrate along with the interstage coupling capacitors and PIN diode chips. The associated resistive attenuator network is fabricated as part of the thin-film circuit process.

Since the gain of the AGC-553 (–1 to +45 dB) and the AGC-1053 (–13 to +22 dB) is programmed with a 0- to +5-volt DC control voltage, it is simple and practical to design it into systems controlled by standard TTL digital logic making it ideal for computer-controlled receiving systems.

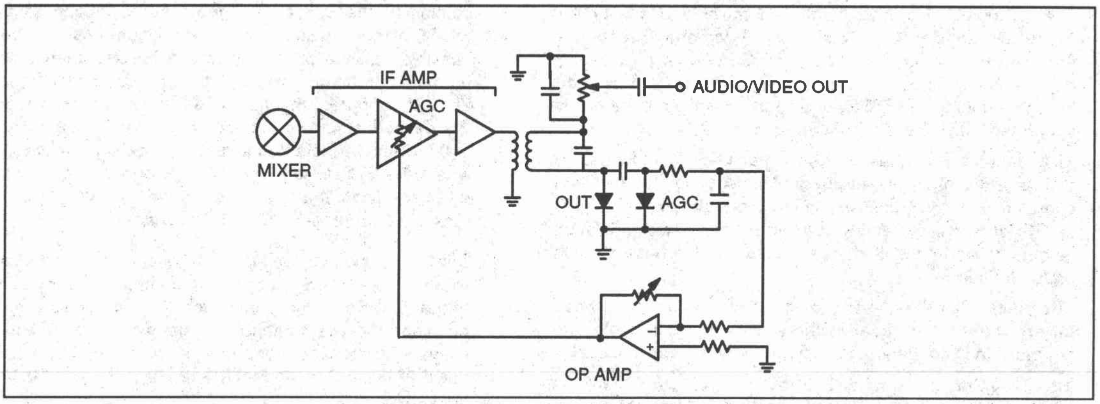
AGC SERIES

Guaranteed Specifications at 25°C Case Temperature

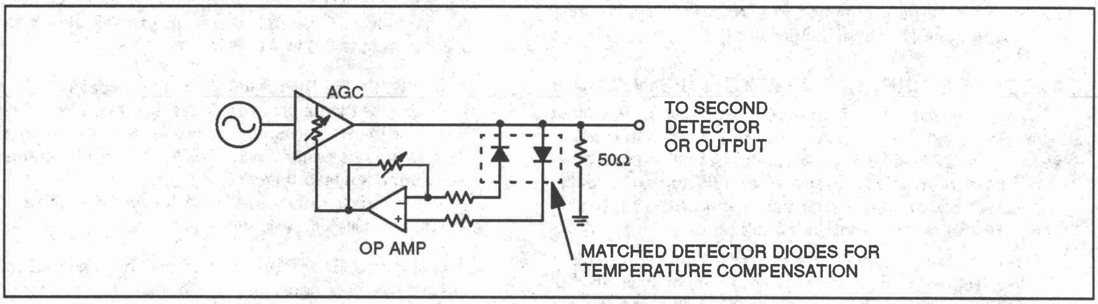
Model	Frequency Response (MHz)	Gain (dB) Typ./Min.	AGC Range (dB) Typ.	AGC Voltage Range (Volts)	AGC Current Range (mA)	Maximum[2] Noise Figure (dB) Typ./Max.	Power Output at 1 dB Gain Compression (dBm) Minimum	Typical Response Time (μsec)	Bias Voltage (VDC)	Bias Current (mA)	Typical VSWR	Transistor Package
AGC-330	5-300	22/20	36	0 to 5	0 to 30	4.0/5.0	0	1.5	+15	25	<2.0	TO-3
AGC-553	10-500	44/40	45	0 to 5	0 to 12	6.0/8.0	–4	25	+15	50	<2.0	TO-8[1]
AGC-1053	10-1000	22/18	35	0 to 5	0 to 12	11.0/12.0	+5	25	+15	90	<2.0	TO-8[1]

Notes: 1. 5 Pin Case.
2. At 0 AGC.

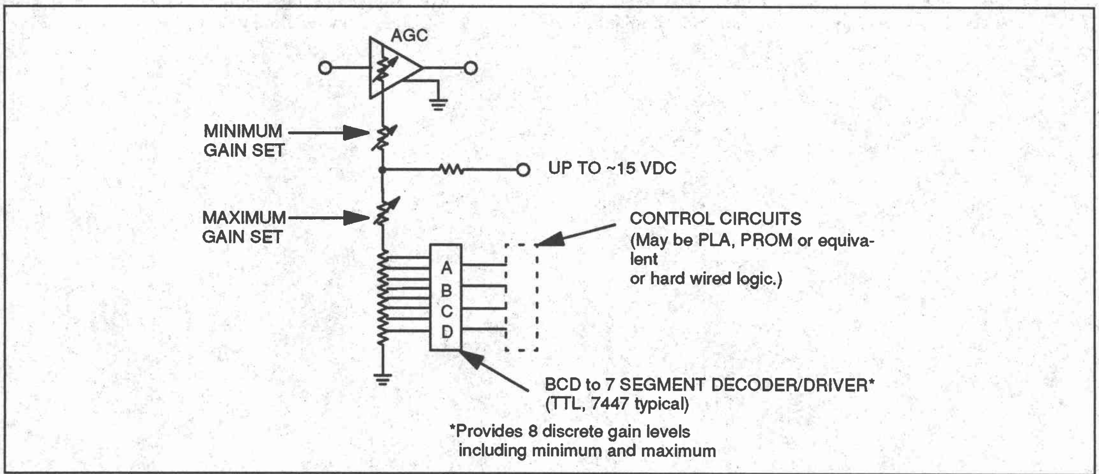
TYPICAL APPLICATIONS FOR THE AGC SERIES



LOW FREQUENCY IF WITH AGC–553 AS GAIN CONTROL



HIGH FREQUENCY IF OR GAIN LEVELED SIGNAL SOURCE



DIGITALLY CONTROLLED AMPLIFIER

DESCRIPTION

The Avanpak™ microwave thin-film mixer line covers the frequency range 0.75 to 26.0 GHz with various IF response frequencies ranging from DC to 10.0 GHz. All mixers feature high isolation, relatively low conversion loss and a good 50-ohm match (low VSWR) at all ports so they can be easily integrated with other RF components.

TFX Series mixers use precisely matched Schottky-barrier diodes and a totally planar physical construction for excellent overall symmetry. Construction techniques result in high LO to RF isolation, extremely low single-tone intermodulation distortion and excellent amplitude and phase match characteristics.

The multi-octave frequency coverage of Avantek microwave mixers make them ideal in threat warning, self protection jammer, and wideband heterodyned receiver applications.

The TFX Series of microwave mixers work equally well in narrowband low IF frequency applications. With a conversion loss less than 6.0 dB, L to R isolation of 35 dB and an R Port VSWR of less than 2.5:1, the TFX-72 is truly universal, (i.e. it provides premium performance in narrowband applications while covering multi-octave bandwidths).

UNIQUE FEATURES OF THE TFX SERIES INCLUDE:

1. *Operation with only +7 dBm LO drive level.* Unlike most multi-octave mixers, the Avanpak mixers, with the exception of the 824 Series, utilize a single Schottky diode-quad rather than two diode quads. Mixers having an "L" suffix require only +7 dBm rather than the +10 dBm LO drive level that most multi-octave mixers require.
2. *High isolation over multi-octave bands.* With 22 to 35 dB of L to R isolation, these mixers provide very high isolation of the LO signal and minimize the LO leakage to the antenna.
3. *Superior single-tone intermodulation suppression.* The mixers are fabricated in a very symmetrical configuration combining the suspended substrate technique with a totally planar layout. This combination ensures best possible balance of the mixer and best suppression of harmonic related intermodulation products. Typical $2f_{LO} \pm 2f_{RF}$ suppression of the TFX Series mixers relative to the desired output is >55 dB with an RF input level of −10.0 dBm. In instantaneous band folding applications where the IF band is 2.0 to 6.0 GHz and intermodulation products limit the dynamic range of the receiver, maximum suppression is very important.
4. *Low conversion loss at high IF frequency.* In applications where preamplifiers cannot be used because of dynamic range limitations, the conversion loss of the first mixer becomes a heavy contributor to the system noise figure. Under a "worst case" frequency condition of 18.0 GHz RF and 5.0 GHz IF, the model TFX-185 has less than 10.0 dB conversion loss.
5. *Flat IF response.* The Avantek model TFX-185 has an IF flatness of less than ±0.5 dB across 2.0 to 5.0 GHz. The Avantek model TFX-184 has an IF flatness of less than ±.25 dB across 2.0 to 4.0 GHz.
6. *Low VSWR.* The R-Port VSWR of the model TFX-185 is typically less than 2.0:1 at 18.0 GHz and the L-Port is typically less than 2.5:1 across the 5.0 to 18.0 GHz band. For the systems designer the low VSWR of the TFX series of mixers means less buffering with amplifiers, isolators or resistive pads to reduce interaction between the mixer and the local oscillator, switch or filter.
7. *Smallest size.* Each mixer is packaged in the hermetically-sealed Avanpak package with field replaceable connectors. The TFX package measures 0.96 x 0.66 x 0.22 or 0.14 cubic inches. Mounting holes through the frame of the package allow the user to ground the mixer directly to the ground plane without use of a hold-down plate.

TFX MIXER SELECTION CHART

Model TFX	Operating Frequencies RF & FLO (GHz)	Operating Frequencies IF (GHz)	Typical 1.0 dB Input Comp Pt. w/Min. LO Drive Level (dBm)	Minimum LO Drive Level (dBm)	Typical Input Intercept Point (dBm)	Assoc. LO Power (dBm)	Page	Recommended Application
72L	2.0–7.0	DC–1.2	+2	+7	+9	+10	7–6	In 2.0 to 7.0 GHz applications with low IF. Ideal for 2.0 to 6.0 GHz, and 3.7 to 4.2 GHz down-conversion.
72M	2.0–7.0	DC–1.2	+6	+10	+12	+17	7–6	
72H	2.0–7.0	DC–1.2	+12	+17	+20	+20	7–6	
158L	8.0–15.0	DC–1.0	+2	+7	+9	+10	7–8	In 8.0 to 15.0 GHz applications. Will work well as low-cost 11.7 to 12.2 GHz downconverter.
158M	8.0–15.0	DC–1.0	+6	+10	+12	+17	7–8	
167L	7.0–16.0	DC–4.0	+2	+7	+9	+10	7–10	In 7.0 to 16.0 GHz "band folding" applications. Ideal in narrow band applications where cost is more important than bandwidth.
167M	7.0–16.0	DC–4.0	+6	+10	+12	+17	7–10	
184L	4.0–18.0	DC–4.0	+2	+7	+9	+10	7–12	In 4.0 to 18.0 GHz band folding applications where the IF band is greater than 1.5 GHz.
185L	5.0–18.0	DC–5.0	+2	+7	+9	+10	7–14	In 5.0 to 18.0 GHz band applications that require a 2.0 to 5.0 GHz IF response.
186L	6.0–18.0	DC–5.5	+2	+7	+9	+10	7–16	In 6.0 to 18.0 GHz band folding applications that require a 2.0 to 5.5 GHz IF response.
18075L	.75-18	DC-0.5	+2	+7	+9	+10	7–24	Ideal for extremely wideband RF and LO applications requiring relatively narrow IF response.
18075M	.75-18	DC-0.5	+5	+10	+11	+17	7–24	
18075H	.75-18	DC-0.5	+9	+17	+20	+20	7–24	
824M	2.0–8.0	.005–4.0	+6	+10	+15	+10	7–18	In upconversion applications where wide low frequency bands of 0.1 to 2.0 GHz need to be converted into a common IF band such as 2.0 to 4.0 GHz or 2.0 to 6.0 GHz.
824H	2.0–8.0	.005–4.0	+9	+13	+18	+13	7–18	

REQUIRED MIXER LO LEVEL CHART

Type of Mixer	Mixer Models	LO Operating Power Level	Typical 1.0 dB Input Compression Point	Typical Input Intercept Point
Low Level	All "L" suffix mixers	+7 to +13 dBm	+2 dBm w/+7 dBm LO power	+9 dBm w/+10 dBm LO power
Moderate Level	All "M" suffix mixers	+10 to +17 dBm	+6 dBm w/+10 dBm LO power	+12 dBm w/+17 dBm LO power
High Level	All "H" suffix mixers	+17 to +24 dBm	+12 dBm w/+17 dBm LO power	+20 dBm w/+20 dBm LO power
Moderate Level	824M	+10 to +17 dBm	+6 dBm w/+10 dBm LO power	+15 dBm w/+10 dBm LO power
High Level	824H	+13 to +20 dBm	+9 dBm w/+13 dBm LO power	+18 dBm w/+13 dBm LO power

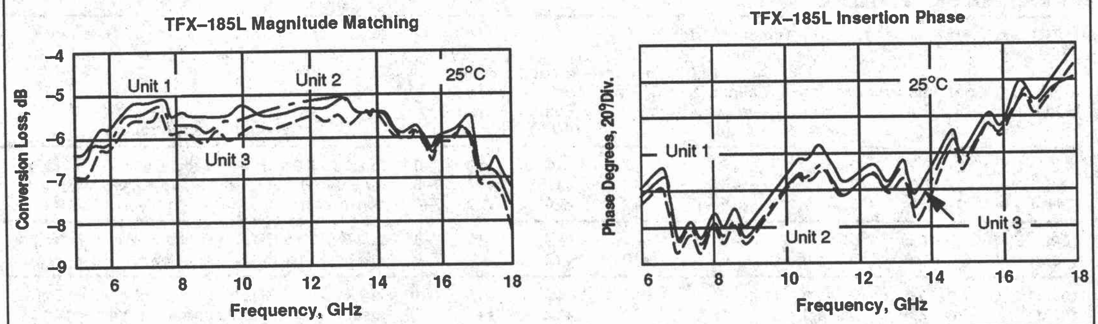


Figure 1

Excellent Amplitude and Phase Match

The totally planar circuit used in the TFX Series thin-film microwave mixers assures that all mixers' will have similar performance characteristics. The two plots in Figure 1 demonstrate Avantek mixer phase and amplitude matching and tracking capability. The plots show the performance of three TFX-185L production units. Amplitude matching and tracking can be maintained to within tenths of a dB, phase matching and tracking to within a few degrees.

Best Intermodulation Suppression

In applications where the internally-generated harmonics of a mixer limits dynamic range, a low-level mixer (L suffix) is recommended. The best suppression is generally obtained with +7 dBm LO drive level, although there will be an optimum LO drive for each harmonic product. At times, an improvement in suppression of a particular harmonic product may be obtained by reversing the LO and RF signal inputs (i.e., by feeding the high-level LO drive signal into the RF port) to the mixer.

Figure 2 shows typical single-tone intermodulation suppression for TFX Series mixers with single diode quad design. LO input levels are +7 dBm for "L"-suffix versions and +10 dBm for "M"-suffix versions, RF input level is –10 dBm. The suppression numbers represent dB below the desired output of $f_{LO} \pm f_{RF}$.

Typical Single Tone Intermodulation Suppression @25°C (dBc)

RF HARMONICS						
5	77	79	81	88	90	84
4	84	79	85	86	74	86
3	80	73	75	51	78	80
2	68	65	57	63	72	68
1	29	0	42	42	55	48
0	—	10	37	32	42	—
LO HARMONICS	0	1	2	3	4	5

Typical Harmonic Intermodulation Suppression for mixer generated harmonics of the input signals. Suppression numbers are for a f_{RF} signal level at –10 dBm and f_{LO} signal level of +7 dBm for "L" suffix and +10 dBm for "M" suffix mixers.

Figure 2. TFX-184

BEST TWO-TONE SUPPRESSION

For best two-tone $(2\ f_{R2} - f_{R1}) + f_{LO}$ suppression, a high level mixer is recommended. However to obtain best performance, a high LO drive level must be available for the mixer as indicated in the recommended LO drive level chart.

A high LO drive level raises the RF compression point and the third-order intercept point, but also results in higher LO leakage for a given isolation value and reduces harmonic intermodulation suppression.

Figure 3 shows conversion loss vs. LO drive level for the "L" and "M" suffix mixers. The minimum recommended LO drive level of + 7 dBm and +10 dBm, respectively, is approximately 6 dB above the level where the conversion loss is degraded by insufficient drive.

Figure 4 shows conversion loss and input compression as a function of LO power. Generally the input intercept point of a mixer is 9 to 11 dB higher than the 1 dB input compression point for a given LO drive level. Note that by increasing the LO drive level from +7 dBm to +10 dBm the 1 dB compression point can be raised approximately 1.5 dB.

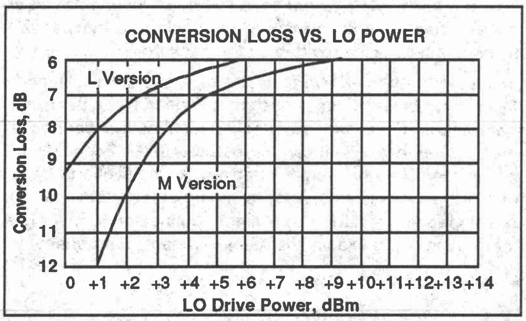


Figure 3

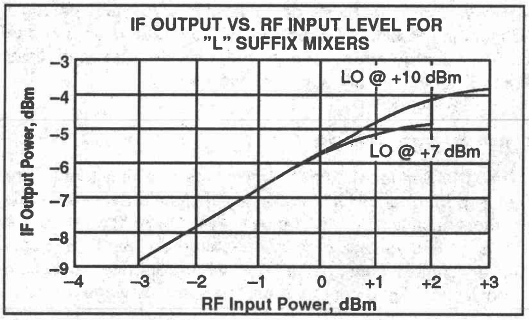


Figure 4

DESIGN AND CONSTRUCTION ASSURE CONSISTENT PERFORMANCE

Most of the Avantek TFX Series double-balanced mixers incorporate four carefully matched and qualified (low or medium turn-on depending on the model) diodes in a conventional ring configuration, with DC-coupled IF port. The high level mixers incorporate eight diodes in a well-matched diode quad to obtain high level performance. Triple-balanced mixers (e.g. 824) incorporate a dual-quad configuration.

The transmission lines for each mixer are fabricated in thin-film alumina substrate material and built in a symmetrical configuration combining the suspended substrate technique with a totally planar layout. It is this combination of well-matched diodes and properly designed four-port hybrid junctions with a highly symmetrical structure that gives these double-balanced and triple-balanced mixers their unconventionally good performance.

ENVIRONMENTAL PERFORMANCE

The TFX Series microwave mixers have been designed and built to meet their guaranteed performance specifications over the −54 to +100°C operating temperature range and after exposure to any or all of the following tests performed in accordance with MIL-STD-202:

Exposure	Method	Test Condition
Temperature Cycle	102A	C
Thermal Shock	107D	B
Altitude	105C	G
H.F. Vibration	204C	D
Mechanical Shock	213B	C
Random Vibration (15 min. per axis)	214	IIF
Solderability	208	C
Terminal Strength	211A	C
Resistance to Soldering Heat	210A	
Seal Test	112	2 x 10^{-7} cc/sec

These mixers are uniquely suited for application in satellite or other systems calling for high-MTBF microwave components.

DESCRIPTION

The Avantek MXA Series of mixer-preamplifiers integrates Avantek's proven thin-film mixer and amplifier lines. These devices cover the frequency range from 0.05 to 18 GHz on the R and L ports with IFs up to 2 GHz. Virtually any combination of one standard Avantek TFX mixer with one, two or three UTO thin-film amplifiers may be cascaded to meet customer needs. All combinations are packaged in Avanpak™-style cases to give the customer the advantages of small size, light weight and either coax, stripline or microstrip application.

MXA Series mixer-preamplifiers are standard devices; however, configurations can be tailored to meet particular customer needs. All products will operate over standard military temperature ranges and can be screened using MIL-STD-883 methods and procedures.

DESIGN FEATURES

The MXA Series of integrated mixer-preamplifiers feature premium performance for high density applications. For example, without sacrificing performance the MXA-18202 requires only 50% of the volume of a connectored Avanpak packaged mixer-amplifier combination. And, when compared to conventionally packaged components, the space savings are much greater.

In addition to the reduced size, performance improvements result from the elimination of cabling between units. The MXA Series offers excellent broadband conversion gain flatness—typically less than ±1.5 dB over the 2 to 18 GHz frequency band. Units may be matched for conversion gain and phase to within very tight tolerances.

RELIABILITY

Avantek MXA mixer-preamplifiers are supplied in a unique Avanpak miniature package—the ultimate product of Avantek's understanding of the needs of the microwave community. As with all packages used in the Avantek thin-film hybrid product (MIC) line, the Avanpak package is truly hermetic. The package lids are welded in place, all RF and DC connections are made through matched metal-glass feedthroughs, the package is filled with a dry, inert atmosphere and the complete assembly is both gross- and fine-leak tested to assure long-term protection of the internal circuitry from moisture and corrosive gases.

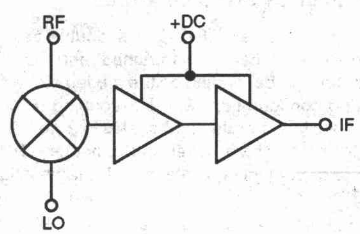
The Avanpak package may be installed directly in a 50-ohm microstrip or stripline environment by soldering to the pins. It is equipped with numerous, conveniently located through-holes so it can be quickly and easily screwed to a supporting structure to prevent any strain on the microstripline PC board and assure good RF grounding.

In addition, special type SMA (male or female) connectors may be installed directly on the Avanpak case, simply by fitting their "internal" collets over the pins of the package and bolting the connectors to the threaded mounting holes (a simple bottom spacer plate is provided to assure connector clearance). These connectors are very simple and inexpensive, since hermeticity is provided by the case itself.

This unique Avantek Avanpak package offers the ultimate in flexibility to the microwave system engineer. It can be used in coaxial-interconnected systems—note that the connectors are *field replaceable*! It can be tested with the connectors in place, then the connectors removed for installation into the microstripline system. And, a complete system can be developed and tested in coaxial-interconnected form for later integration using exactly the same Avanpak components.

TYPICAL BLOCK DIAGRAM OF AN MXA SERIES MIXER-PREAMPLIFIER

MXA–18202



RF = 2.0–18.0 GHz
LO = 2.0–18.0 GHz
IF = 10–250 MHz

RF to IF GAIN = 22 dB Min.
NOISE FIGURE = 11 dB Max.
POWER OUTPUT = +9 dBm Min.

DESCRIPTION

The UMX Series double-balanced mixers feature exceptionally high isolation and good harmonically-related intermodulation product suppression. They are packaged in compact, easy-to-use, hermetically-sealed TO-8 transistor packages.

The UMX-520 and UMX-2020 mixers cover 1 to 500 MHz and 10 to 2000 MHz respectively. Both are low-level class 1 type mixers with four closely-matched Schottky-barrier diodes in a ring configuration. The LO to RF isolation of the UMX-2020 is typically greater than 60 dB from 10 to 150 MHz, greater than 50 dB from 150 to 500 MHz, and greater than 40 dB from 500 to 2000 MHz.

The UMX-570 is a high-level, class II type 1 mixer that utilizes eight closely-matched Schottky-barrier diodes in a ring configuration. Since the diodes are a new, highly dissipative type, the UMX-570 can accept +27 dBm local oscillator power (rather than the typical +13 to +17 dBm) without the added complexity of series resistors (Type 2) or resistor-capacitor combinations (Class III). The input third-order intercept point is greater than +34 dBm below 100 MHz and +32 dBm from 100 to 500 MHz. Along with very small size for a high level mixer, the UMX-570 is unique in that its conversion loss is only 5.0 to 6.0 dB. This conversion loss is 1.0 to 2.0 dB less than comparable high level mixers.

The Model UMX-4220 is a microwave mixer designed to meet the need for a low-cost, high performance 3.7-4.2 GHz down-converter mixer in TVRO applications. Typical conversion loss is 4.5 dB with a low-side LO frequency and 5.0 dB for a high-side LO frequency for either an 880 or 1125 MHz IF frequency. LO to RF isolation exceeds 30 dB.

To assure reliability in severe applications, the circuits are packaged in hermetically welded, inert-gas-filled metal-glass packages and leak tested.

As an additional assurance of reliability in critical applications, Avantek UMX Series mixers may be qualified under the "R" Series high reliability program. In addition to the normal careful design and in-process quality control, "R" Series qualified components include conditioning and testing in accordance with MIL-STD-883.

DESCRIPTION

The UTL-1001 and -1002 offer optimum performance in a wide range of instrumentation, RF and IF amplifier applications. Their limiting characteristics and low limited output power allow them to be combined with modular amplifiers with high gain and extremely wide limiting range. Up to six* stages of amplification and limiting may be combined to produce the required limited output power level, gain and dynamic range.

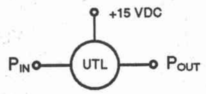
In electronic counters, a cascade of UTL-1000 Series limiters and UTO Series thin-film amplifier modules will produce a signal-processing input amplifier that will provide a very constant output level to drive ECL counter circuits. Very wide ranges of input signals (e.g., GHz signals from –18 to +26 dBm) will cause a typical variation in drive to the counter of approximately ±0.5 dB.

In the IF system of FM or PM receivers, UTL-1000 Series limiters combined with Avantek amplifier modules will provide any required gain level with very high rejection of AM components on the signal for noise-free detector operation. In AM receiving systems, UTL-1000 Series limiters in the IF can prevent high-Q tuned stages from ringing by preventing excessive impulse noise on the signal.

*Depending on specific modular amplifiers selected

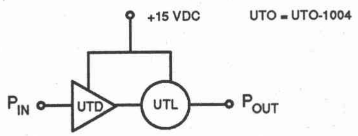
All performance indicated is typical at 25°C ambient temperature. Input voltage to limiter = +15 VDC.

A. Limiter alone @ 1 GHz



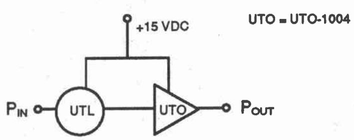
P_{IN} = 0 dBm to + 20 dBm.
P_{OUT} = 0 dBm ±0.5 dB.
NF ≈ 3 dB.

B. Limiter with Preamplifier @ 1 GHz



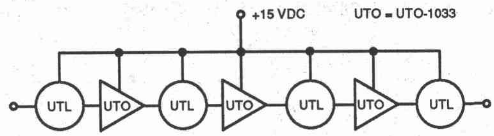
P_{IN} = +6 dBm to + 15 dBm.
P_{OUT} = 0 dBm ±0.5 dB.
NF ≈ 12.5 dB.

C. Limiter with Post Amplifier @ 1 GHz



P_{IN} = 0 dBm to + 20 dBm.
P_{OUT} = +10 dBm ±1.5 dB.
NF ≈ 15 dB.

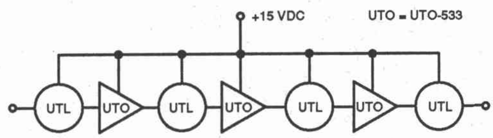
D. 1 GHz Cascade.



P_{IN} = –18 dBm to + 25 dBm.
P_{OUT} = 0 dBm ±0.5 dB.
NF ≈ 12 dB.

[Using the UTO-1033, approximately six amplifiers and limiters may be cascaded before the dynamic range is seriously limited.]

E. 500 MHz Cascade.



P_{IN} = –36 dBm to + 25 dBm.
P_{OUT} = 0 dBm ±0.5 dB.
NF ≈ 9 dB.

DESCRIPTION

A voltage-controlled attenuator provides a method of rapidly changing the gain of a cascade over a wide dynamic range. An ideal voltage-controlled attenuator would have low loss in the zero attenuation state, be non-reflective, and have linear attenuation versus control voltage.

LOW LOSS

The attenuation in the zero attenuation state is typically set by the insertion loss caused by series resistance in the PIN diodes, but is also very dependent on the circuit configuration. An attenuator with a single series diode will probably have lower loss than a multi-diode attenuator, but will also have a lower maximum attenuation value. UTF-015 and-025 use a single series diode to achieve low insertion loss in the zero attenuation state.

WIDE ATTENUATION RANGE

The maximum attenuation is set by the number of series and shunt PIN diodes used in the circuit, with the shunt diodes forward biased and the series diodes off or almost off. The more series and shunt diodes used, the higher the attenuation. The parasitic capacitance of the diodes also needs to be taken into account if the goal is high attenuation, since it is in parallel with the diode in the off (high impedance) state. Parasitic capacitance is the reason the attenuation is usually 10 to 20 dB higher at the lower frequencies. The UTF-040 uses several series and shunt diodes to provide a high maximum attenuation and wide attenuation range.

FAST SWITCHING

Switching time between attenuation states is set by both the diode capacitance and the capacitors used in the circuit for coupling and bypassing. Usually, the diode is not the limiting factor. Most of the UTF circuits have a low frequency limit of 10 MHz, requiring the use of large bypass and coupling capacitors that increase the switching time. The UTF-030 is specified down to 100 MHz, which allows the use of lower value capacitors and results in much faster switching. In general it is possible to tradeoff low-frequency cutoff for switching speed.

NON-REFLECTIVE

Ideally an attenuator has a good VSWR over the full attenuation range. This is achieved by using series and shunt diodes in a "pi" or "t" configuration much like a fixed attenuator. The challenge is to vary the series and shunt diode resistances in the right proportions to maintain a 50-ohm input and output impedance over the entire attenuation range. The UTF attenuators are designed to have a VSWR less than 2.0:1 over the full attenuation range.

LINEAR ATTENUATION

The attenuation that is observed after optimizing for good VSWR is generally not linear versus the control voltage. For example, on a UTF-030 the attenuation per volt ranges from around 0.1 dB/V to 10 dB/V depending on the control voltage. This problem can be corrected by creating a non-linearity in the control voltage that cancels the non-linearity already present in the circuit to yield linear attenuation vs. voltage. The UTF-035 combines this "linearizer" with an attenuator similar to a UTF-030 to provide a linearized attenuator in one TO-8 package.

DESCRIPTION

The UTD Series level detectors can be used to detect either the peak or average amplitude of a signal as a system test point for threshold or alarm detector, in conjunction with Avantek® UTF Series PIN diode attenuators, for AGC, ALC, linear modulation, or linearity extension.

Two detectors are available: the UTD-1000 detector has an input impedance of 50 ohms, the UTD-1001 has an input impedance of greater than 300 ohms. Both have a frequency response of 10 to 1000 MHz. Typical detected voltage sensitivity is –120 mV for –10 dBm power input. Output variation over the temperature range –55 to +85°C is less than ±1.0 dB. Tangential sensitivity with a 1.0 MHz window is typically –45 dB.

The level detector consists of an active high-to-low-impedance converter driving a Schottky-barrier detector diode. These diodes are matched "back-to-back" and closely thermally coupled to provide a DC tracking reference.

The bias current for the detector diode can be adjusted with a dropping resistor from the DC supply voltage. The amount of current can be selected to optimize the dynamic video source impedance so it properly matches the load impedance and bandwidth requirement.

OPERATING INSTRUCTIONS

Recommended External Circuitry for Amplitude Detection Application.

The detector is a Schottky-barrier diode which will display an offset voltage of approximately +200 mV with no signal input. To provide a negative output voltage, an external operational amplifier circuit is recommended to offset the +200 mV to zero. (See Figure 1.) The current through the reference diodes should be set to the same value as the bias current through the detector diode to provide best temperature tracking.

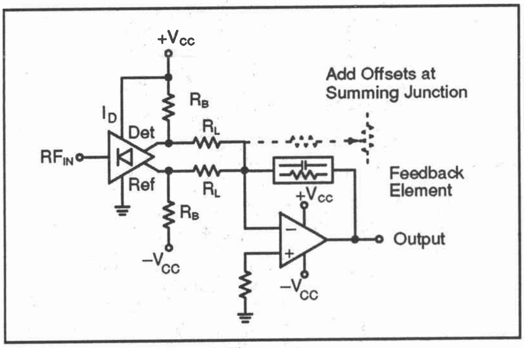


Figure 1

Average envelope detection will result when operating the detector in its square-law region with adequate video filtering (Ref: *Hewlett Packard* application note 956-5).

V± Volts	I_D µA	R_B Ω	R_L Ω	T_r(Approx.) µs
15	40	360K	10K	.720
15	100	108K	1K	.270

*Risetime based on 100 pf of internal capacitance. The risetime will be longer if external capacitance is added.

Figure 2

Video Load Selection Chart

The video load equals $R_B||R_L$ with R_A being the dropping resistor for supply voltages greater than +15 volts. (See Figure 2.)

RF Considerations

In broadband level detection applications, the UTD-1000 (50-ohm input impedance) detector should be used with a high-directivity coupler to prevent frequency dependent output ripple. (See Figure 3.) In narrowband applications (bandwidth <15%), the line may be directly sampled by the UTD-1001 detector. (See Figure 4) In both applications, the line length between the sampled point and the input to the UTD detector should be <15° at the highest sampled frequency to avoid VSWR degradation of the sampled line.

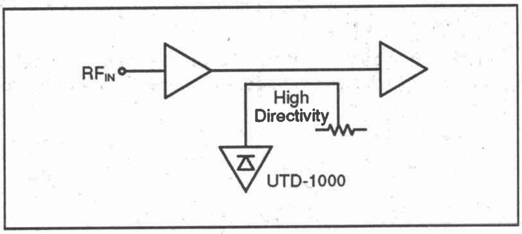


Figure 3

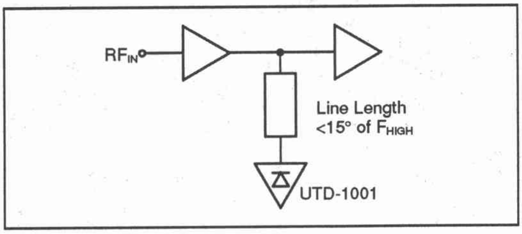


Figure 4

Biasing the Level Detector

The current through the detection diode is normally set in the 10 to 100 μA range. Its value will affect the dynamic video source impedance and the threshold level and should be selected to properly match the load impedance, bandwidth and threshold requirements. If only one (positive polarity) power supply line is available, the current through the reference diode may be positive, with the offset voltage compensation being provided by subtraction in a differentially-connected operational amplifier (See Figure 5). For better stability, it is recommended that a second (negative) power supply line be provided and that the current through the reference diode be negative with respect to ground. The offset voltage compensation may then be provided by an operational amplifier connected in a summing circuit (See . Figure 6).

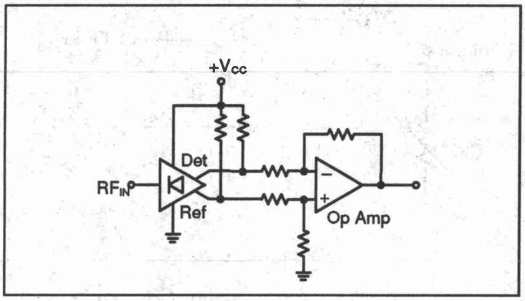


Figure 5. +Supply Voltage

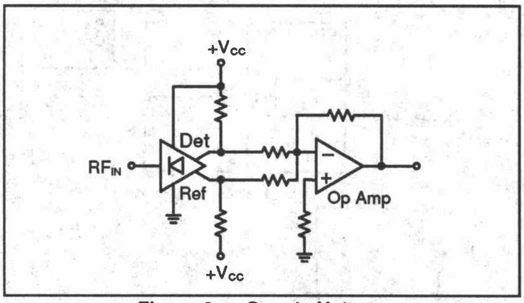


Figure 6. ±Supply Voltage

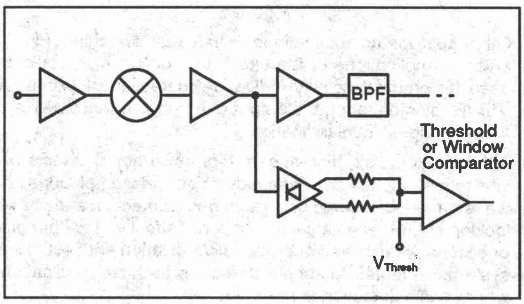


Figure 7. System Test Point

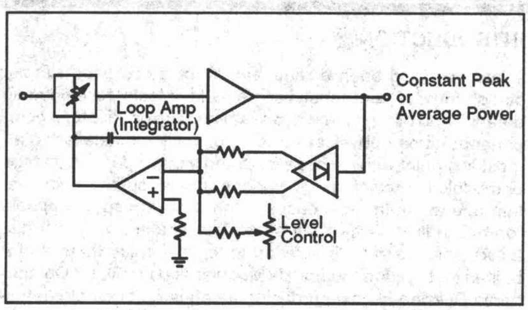


Figure 8. Automatic Level Control

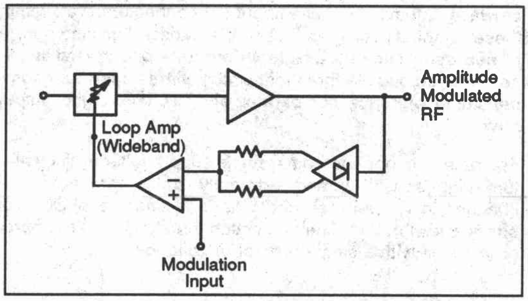


Figure 9. Linear Modulator

The linear operating region of an amplifier can be extended by using two level detectors as shown in Figure 10. This configuration forces the amplifier to follow normally compressed peaks in modulated RF signals.

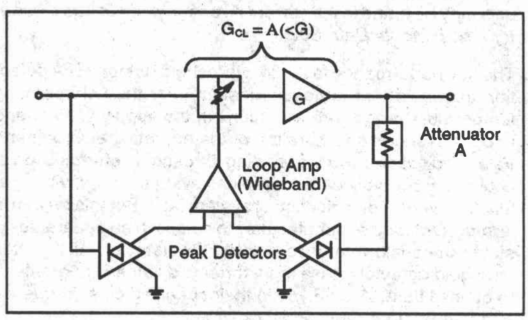


Figure 10. Linearity Extension or Control

INTRODUCTION

There has long been a requirement for a compact, simple, straightforward, and sensitive threshold detector for electronic defense and other microwave systems. The need is for a component that can physically and electrically be installed at almost any point within a system, to verify that a particular stage or module is providing a power output level sufficient for system operation. In most cases, all that is needed is a simple "on-off" indication that the stage is operating or that it has failed, which can be interfaced to logic circuitry as part of a built-in test system. Avantek's Modular and Oscillator Components Division is now producing a series of threshold detectors that are ideally suited for built-in test and related applications in microwave systems operating through 18 GHz.

These threshold detectors are extremely compact: versions are packaged in the *PlanarPak*™ 0.25 x 0.25 inch surface-mount package; TO-8 cans; and the *Avanpak*™ miniature microwave flatpack, with or without RF connectors. Yet, within these compact packages, Avantek level detectors incorporate all necessary circuitry: a high-performance operational amplifier, user-adjustable threshold circuit with temperature compensating reference, comparator, and TTL-level digital output driver.

The detectors operate from a single supply voltage. They feature high sensitivity and extremely stable threshold with changes in temperature and bias, and under conditions of shock and vibration. Their detection thresholds are user-programmable with a single resistor or voltage level.

What is a threshold detector?

Threshold detectors produce a discrete change in output level (from a low to a high state, or *vice versa*) when the signal power into the detector's input exceeds a defined level. In the case of the Avantek threshold detectors discussed in this application note, the output is specifically a TTL level.

Note the difference between these threshold detectors and *level* detectors. Level (or analog) detectors provide a DC output voltage that is *proportional* to the RF input signal level, while the output voltage of a threshold detector is either *on* or *off*. Information on the Avantek family of level detector products may be found in the current *Avantek Modular and Oscillator Components Data Book*[1].

The key performance factor in a threshold detector is a detection threshold that remains constant over the full operating temperature range, with variations in the supply voltage and under the shock and vibration of the operating environment. False indications from a shifting threshold reference point could very possibly cause needless system shut-down or, at least, an improper indication of system fault. For this reason, it is important for the manufacturer to establish and guarantee a stable threshold reference point in the detector. All Avantek threshold detectors have input threshold flatness guaranteed to be less than ±1.5 dB within their specified bias, frequency and temperature range.

APPLICATIONS

Avantek's threshold detectors will most commonly be used in electronic defense systems as continuous operational monitors during system operation, or as a part of stimulus-response test arrangements (Fig. 1). In the first case, the detector would continuously monitor the output of an oscillator or amplifier stage to assure that the power level is within system operating specifications. In the second, the detector would be used as part of a BIT system to periodically test a field-replaceable module within the system environment, but in a non-operating mode.

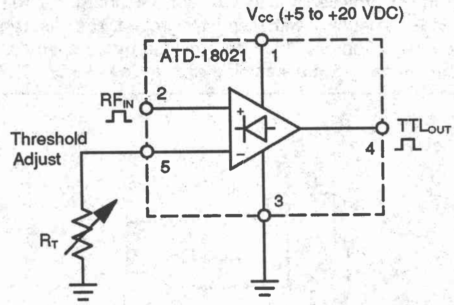


Figure 1.

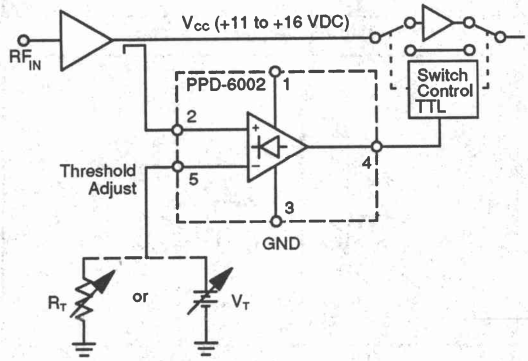


Figure 2.

Other appropriate applications include gain switching (Fig. 2), and the applications of the circuit in Fig. 3, which could be used for channel activity indication, detection of excessive VSWR (by monitoring the output of a bridge or network), and "yes-no" signal level indication.

Although complex, high-speed, high-accuracy detectors are vital for providing a detailed analysis of signal amplitudes and waveforms—for example, in radar pulse detection and phase-locking in IFM receivers—they are not effective in either size or cost for widespread operational verification and test use in systems. Avantek threshold detectors fit those applications where basic detection is required.

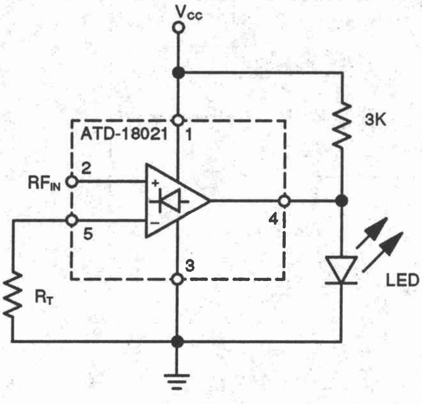


Figure 3.

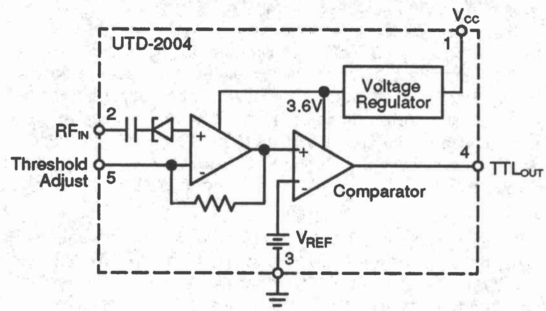


Figure 4.

CONSTRUCTION

In the Avantek threshold detector, sensitive detector diodes convert the RF input level to a proportional video level, which is then amplified through an operational amplifier. This amplified video signal is compared to a stable reference voltage by a precision comparator circuit, which provides a high- or low-state output.

In some applications a detector with the highest-possible sensitivity is desirable so that the sampled power requirement is small, and can be coupled out of a signal path without appreciably affecting the through power level. Other applications call for a more-rugged detector that can sample a higher power level, and which will be more-tolerant of excessive input power levels. Both of these cases are covered in this series of Avantek detectors, since there are versions using both tunnel diodes and Schottky-barrier diodes. The performance differences will be discussed under *Product Description.*

All Avantek detectors are of hybrid construction, using low-parasitic, unpackaged chip components bonded to thin-film gold-and-refractory-metal circuitry on a ceramic substrate. Hermetically-sealed packages help to assure repeatable and reliable performance over a wide range of environmental conditions.

PRODUCT DESCRIPTIONS

UTD-2004/ATD-18021

The UTD-2004 and ATD-18021 threshold detectors (Fig. 4) use sensitive tunnel diodes to provide stable performance over temperature with input power levels of less than -20 dBm. This low detection level is possible because of the excellent 1/f noise characteristics and the low dynamic video impedance of tunnel diodes.

Threshold adjustment over a greater than 15 dB (from -25 to -10 dBm) range is accomplished very simply by connecting a user-selected external resistor (R_T) to the designated package pin.

Both detectors provide standard TTL outputs, capable of driving up to three TTL loads, and remain stable over all operating conditions.

The UTD-2004 is packaged in a hermetic TO-8 can for easy mounting in a printed circuit environment, while the ATD-18021 is packaged in the *Avanpak*™ miniature flatpack which may be used with or without SMA coaxial connectors.

UTD-2002/PPD-6002

The UTD-2002 and PPD-6002 threshold detectors (Fig. 5) use biased Schottky detector diodes which are designed to operate at higher input power levels than tunnel diodes. Maximum continuous RF input power rating for the UTD-2002/PPD-6002 is +20 dBm, compared to +13 dBm for tunnel diodes detectors, making them good choices for circuits in which RF levels exceed +10 dBm. Schottky diodes can also withstand higher temperatures than tunnel diodes, and are specified at 150°C storage temperature (whereas tunnel diodes are typically specified at 115°C). The response times of the Schottky-diode-based detectors are also faster than the tunnel diode units.

Threshold adjustment over the available 20 dB range (from -10 to +10 dBm) may be accomplished either through the use of a user-selected external resistor (R_T), or with a voltage.

The UTD-2002 comes in a standard 5-Pin TO-8 package, while the PPD-6002 offers a high-performance threshold detector in Avantek's unique 1/4" x 1/4" *PlanarPak*™ surface-mount package.

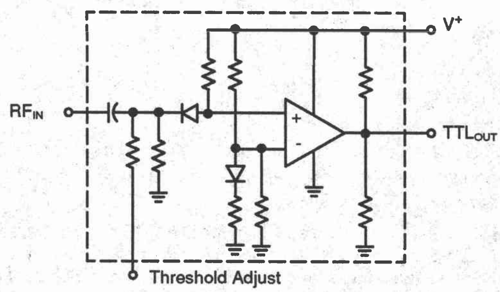


Figure 5.

USING AVANTEK THRESHOLD DETECTORS

The most common way of incorporating a threshold detector in a system is to tap into a 50-ohm signal line using a directional coupler. The biggest problem with adding such a test point to an *existing* system is that there may be test points in which there is almost no excess power available under worst-case operating conditions. For example, the output of a receiver local oscillator (LO) is seldom much in excess of what is needed to drive a diode mixer.

Assuming an LO now provides +10 dBm to a mixer L port, the addition of a 30 dB directional coupler with 0.5 dB insertion loss will provide +9.5 dBm power to the L port of the mixer, while supplying -20 dBm power to the threshold detector to indicate that the LO is functioning. It would be necessary to determine if the performance of the mixer would be adversely affected by the 0.5 dB reduction in LO level and, if so, to provide some means for increasing the LO signal level (e.g. replacement of the oscillator, or the addition of a LO booster amplifier).

Note that the greatest loss between the LO and mixer in this example is the inherent coupler loss, which is relatively independent of the amount of signal coupled out. The actual power coupled out (- 30 dB) of the through line is only 1/50th of the inherent coupler loss (or 0.01 dB). In a new or upgraded system, the LO would be designed with enough excess power capability to assure that the mixer would still receive sufficient LO drive under worst-case conditions.

Couplers

Coupling into the 50-ohm environment can be done using commercial couplers[2,3] or by designing custom couplers. Operation at lower frequencies may demand a ferrite coupler design due to physical size limitations; higher frequencies, a printed coupler (references[2]). When sufficient excess power is available, a resistive 3 dB splitter may be appropriate (Fig. 6).

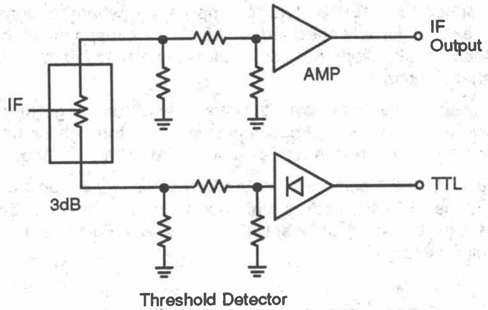


Figure 6.

Biasing

UTD-2004/ATD-18021

Each of these detectors include internal voltage regulators which permit operation from +5 to +20 VDC.

UTD-2002/PPD-6002

Both of these units are specified for +15 VDC bias, but will operate from +11 to +15 VDC. Internal bias circuitry, optimizing dynamic video impedance and bandwidth of the Schottky diodes, is incorporated in the detectors.

Output characteristics

UTD-2004/ATD-18021 (Fig. 7)

TTL or video outputs will sink 3 TTL unit loads of 1.6 mA in the low state ($I_{OL} \leq 5$ mA), and provide a pull-up of 3.6 V through a 20 kilohm internal pull-up resistor—$V_{OH} > 2.7$ VDC and $V_{OL} <$ 0.8 VDC. In most applications buffering of the output will not be required, and the level detector can drive the logic circuits directly.

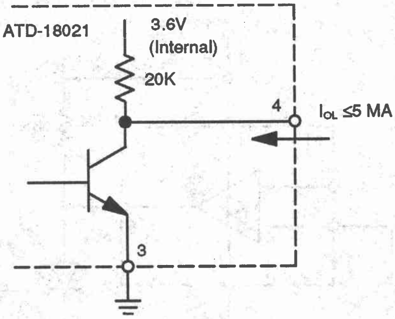


Figure 7.

UTD-2002/PPD-6002 (Fig. 8)

The voltage divider output stage on these units also allows 3 TTL unit loads, but with 1.8 kilohm pull-up resistor to the supply voltage, and 600 ohms to ground—$V_{OH} > 3.75$ V (for TTL high) and $V_{OL} < 0.7$ V (for TTL low). Applications requiring a non-standard $V_{OH} \leq +6$ VDC can be satisfied through internal modification at the factory, or by a user-supplied external pull-up resistor between the bias supply and video output pin. An external pull-up resistor of 3.6 kilohm would produce a V_{OH} of approximately +5 V (see diagram).

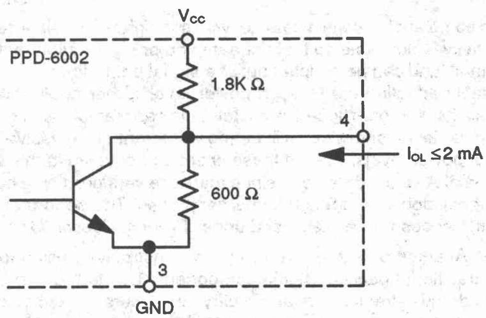


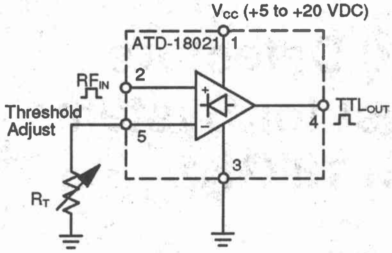
Figure 8.

Setting thresholds (Fig. 9)

UTD-2004/ATD-18021

The threshold may be set to any point between -25 and -10 dBm by adjusting the value of one external resister between 25 and 2000 ohms. Attempting to increase the threshold sensitivity by using resistors of less than 25 ohms may result in spurious operation including TTL lock-up. Too low a resistance bypasses the built-in temperature compensation and hysteresis, permitting a shift of the threshold point over temperature, and varying the detector gain.

The type and tolerance of the external threshold-setting resistor will affect the threshold-point stability of the detector. The best choice would be a resistor type similar to those internal to the detector (viz. tantalum nitride metal-film with a temperature coefficient of 100 to 250 PPM/°C). A metal-film chip resistor would also be a good choice. In either case, the threshold resistor should be mounted as close to the detector threshold-adjust pin as possible.



THRESHOLD ADJUST

R_T, Ω	SENSITIVITY dBm (typ)
20	–25
200	–20
2000	–10

Figure 9.

UTD-2002/PPD-6002 (Fig. 10)

Either a resistor or a stable voltage source may be used to set the threshold over its 20 dB adjustment range.

These two detectors provide a few different performance characteristics than the UTD-2004 and ATD-18021, especially where the users supply voltage is not expected to vary appreciably. A wider threshold window (input level) is attainable than with the UTD- 2004/ATD- 18021, and the output voltage level can be adjusted up to +6 VDC for interfacing to CMOS logic.

Threshold resistors should be of the same types suggested for the UTD-2004 and ATD-18021, and also mounted in close proximity to the threshold adjust pin.

Response Time

Response times vary widely between the UTD-2004/ ATD-18021 and the UTD-2002/PPD-6002. Minimum response times for these detectors are > 1 µs.

ELECTROSTATIC DISCHARGE (ESD) PROTECTION

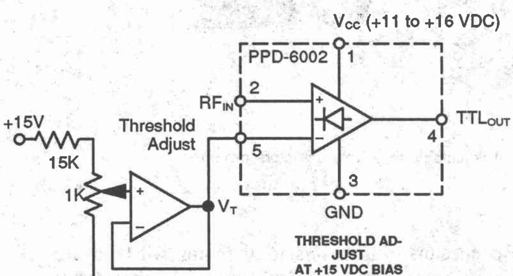
All Avantek threshold detectors are subject to damage from electrostatic discharge from mishandling and improper grounding of operators, test equipment and soldering irons. The UTD-2004 and ATD- 18021, in particular, should be handled carefully since they use the more sensitive tunnel detector diodes

PERFORMANCE TESTING

Precise testing for proper operation and performance may be accomplished using one of the dedicated test fixtures mentioned in this article, and the current Avantek *Modular and Oscillator Components* catalog. The UTD-2002/UTD-2004 may be tested using appropriate test fixtures available from Inter-Continental Microwave, Santa Clara, California. The PPD-6002 may be tested using an Avantek test fixture, the PPTF-25. The ATD-18021 is connectorized and requires no test fixture.

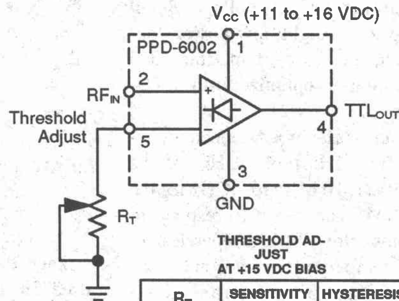
REFERENCES

1. *Avantek Modular and Oscillator Components Data Book*, Avantek, Inc., 1989
2. *Practical Microwaves*, Thomas S. Laverghetta, Howard W. Sams & Co., 1984
3. *Microwave Semiconductor Circuit Design*, W. Alan Davis, Van Nostrand Reinhold Co., 1984
4. *Microwave Solid State Circuit Design*, Inder Bahl & Prakash Bhartia, John Wiley & Co., 1988



THRESHOLD ADJUST AT +15 VDC BIAS

V_T	SENSITIVITY (Typ)	HYSTERESIS (Typ)
75 mV	-10 dBm	0.1 dB
250 mV	0 dBm	0.1 dB
900 mV	+10 dBm	0.1 dB



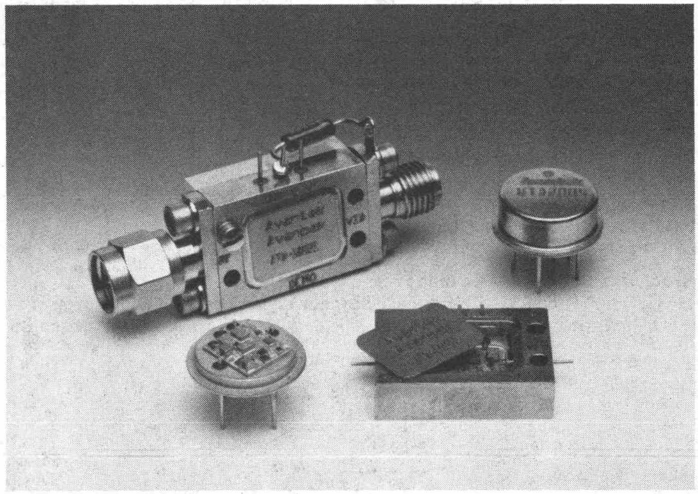
THRESHOLD ADJUST AT +15 VDC BIAS

R_T	SENSITIVITY (Typ)	HYSTERESIS (Typ)
220 Ω	-10 dBm	0.5 dB
800 Ω	0 dBm	0.5 dB
3100 Ω	+10 dBm	0.5 dB

Figure 10.

Broadband Threshold Detectors Optimized for Built-in Test for Systems Operating Through 18 GHz

By
Oren Milgrome, Engineer,
Modular Components & Subassemblies Div.
Avantek, Inc.



The ATD-18021 and UTD-2004 adjustable threshold detectors are shown.

The new UTD-2004 and ATD-18021 adjustable threshold detectors from Avantek are sensitive microwave sensors specifically designed for built-in test (BIT) in broadband equipment and systems. For BIT, the sensor should work with as small a signal sample as possible, to permit coupling into points in a system where little excess signal is available. The most important operational performance factor is a detection threshold that remains constant over temperature, under vibration and with variations in the supply voltage. Small size and low weight, low power consumption, and ease of interface and programming are optimized in the UTD-2004 and ATD-18021.

The units offer broad frequency coverage (100 MHz to 18 GHz for the ATD-18021, 10 MHz to 2 GHz for the UTD-2004), can be set to respond to thresholds below -30 dBm, operate over a wide temperature range, and consume less than 2.5 mA from a single +5 to +20 VDC supply voltage. These units offer exceptionally wide frequency coverage compared to the typical octave bandwidth available from currently-available linear tunnel diode assemblies.

The high-frequency ATD-18021 is packaged in a new five-pin *Avanpak*™ miniature microwave flatpack. Its dimensions are .750" x .530" x .190" and weight 7.1 grams (size and weight less connectors). With the Avanpak package, the type SMA RF connectors (used for RF input and logic output) are removable and field-replaceable. This means that the unit may be tested or interfaced using coaxial cable interconnections, or installed on a microstrip board by soldering directly to the package pins. The UTD-2004 is packaged in a five-pin TO can, and weighs 2.1 grams. Both packages are hermetic.

Both detectors provide standard sourcing or sinking TTL outputs, capable of driving up to three TTL loads. In the *on* state, the output will be greater than 2.7 V, the *off* state less than 0.8 V, and the output levels remain stable over all operating conditions. As with any standard TTL device, the output may be interfaced to a variety of level translator ICs or discrete-component level translation circuits.

The detection threshold may be set for levels from -30 dBm to -10 dBm by selecting the value of a single external resistor connected between the control terminal and ground. Threshold drift from -55°C to +85°C is guaranteed to be less than 3 dB, and is typically less than 1 dB. To maintain this characteristic in an operating system, the external programming resistor must be a low temperature-coefficient type— for example, 1% metal film resistors can have ± 100 PPM/°C temperature coefficients, carbon film resistors are more typically rated at 0 to -500 PPM/°C (or higher, depending on the resistor's value). Fully calibrated or matched detectors (equipped with factory-installed programming resistors) are available.

The detectors may be operated from any supply voltage from +5 to +20 VDC, with negligible change in threshold power over this voltage range. In the design of the detectors, low power consumption, rather than response time, was optimized. The response time is always less than 300 µs, measured from 50% RF to TTL "one" or "zero", with a 3 dB above CW threshold overdrive. Low slew-rate signals will not cause spurious outputs, as 0.7 dB of hysteresis (factory adjustable, and may be eliminated, if required) is built in for noise immunity. The hysteresis vs. threshold level is constant, and hysteresis is factory adjustable.

It is very difficult to obtain a good impedance match when diode detectors are optimized for sensitivity. When a large signal is applied VSWR is usually much worse than when the detector is operating in its "square law" response. The VSWR of the UTD-2004 is guaranteed less than 2.0:1 for input signals of less than -20 dBm, and 2.2:1 for signals of up to -10 dBm, over the full operating temperature range. The VSWR of the ATD-18021 is guaranteed to be less than 3.0:1 VSWR over its full bandwidth, power and temperature range. Typical VSWR for both units is much better than the maximum specification.

The circuits of both threshold detectors incorporate a planar tunnel diode, a precision integrated circuit operational amplifier, a comparator, and a temperature-compensated voltage reference.

Construction is hybrid, using chip components bonded to thin-film gold-and-refractory-metal circuitry on a ceramic substrate. This MIC construction assures highly-repeatable and predictable performance, as well as resistance to shock, vibration and thermal cycling. In the case of the stainless-steel Avanpak package, all RF and DC connections are made through matched-expansion-coefficient metal-glass feedthroughs, and the cover is welded to provide hermeticity.

Low current consumption and flexible supply voltage—which means that the detector can be powered in parallel with virtually any active device; high sensitivity, small size, and easy programming should allow the installation of self-diagnosis capabilities with minimal changes to a system. The result will be a system that is far easier to test or repair, and one that can be quickly verified as ready for operation.

Simple threshold detectors meet an ongoing need in EW systems.

Bob Dale,
Microwave Engineering Manager
Countermeasures Division
Sanders Associates, Inc.
Nashua, NH

The size and cost of previously-available threshold detector units have limited their use for BIT in current EW system designs. In most cases, more elaborate detector arrangements are used to provide the system with a far more detailed analysis of signal amplitudes and waveform, but such detector circuits are too costly and too large for widespread use in BIT. However there are appropriate applications for a very basic threshold detector, and the availability of relatively sensitive, easy-to-interface detectors makes their use very appealing—if they don't cost too much.

Essentially, the application is extremely simple: to show that a particular stage is functioning and providing a power output level that exceeds a selected minimum value.

The good sensitivity of the threshold detector means that an extremely small amount of power must be coupled out of the system signal path. A typical example would be the output of a receiver local oscillator. Assuming the LO provides +10 dBm output, a 30 dB directional coupler with 0.5 dB insertion loss will still provide +9.5 dBm power to the LO port of the mixer while supplying sufficient (-20 dBm) power to the threshold detector to indicate that the LO is functioning. The greatest loss between the LO and mixer in this example is the inherent coupler loss, which is relatively independent of the amount of signal coupled out. In most cases, the LO would be designed with enough excess power capability to assure that the mixer would receive sufficient LO drive under worst-case conditions, and providing the additional power to compensate for the coupler is a trivial problem.

Using the ATD-18021, the threshold of the detector will vary less than 1 dB, worst case over temperature and supply voltage variations, at any spot frequency, and less than 2.3 dB, worst case, from 100 MHz to 18 GHz.

Although the size, power consumption and stability of these detectors are all very important, it is particularly significant that they offer a variable threshold range and wide frequency coverage. This will minimize the number of different detectors that need to be used in a system, simplifying the stocking of spares. It should also permit the manufacturer to produce enough of these parts—which can go into a variety of systems—to reduce manufacturing costs and, therefore, (one would hope) the customer's acquisition cost.

This article "Broadband threshold detectors" is reprinted by permission from MSN & CT April, 1988. The material in "Simple threshold detectors meet an ongoing need in EW systems," was submitted with the article but not used. Our thanks to Bob Dale of Sanders Associates for his comments.

DESCRIPTION

All TO-8 thin-film oscillators are designed to operate with unconditional stability and performance equal to or better than their guaranteed specifications when installed in a properly designed 50-ohm microstripline PC board. Problems encountered with systems using TO-8 oscillators can be directly traced to improper layout of the PC board, improper grounding of the devices to the board or the board to the case or chassis in which it is installed, or the lack of RF bypassing on DC leads when required.

In this section basic information on microstrip circuit design will be presented to allow a designer to properly plan his custom microstrip board.

MICROSTRIPLINE CHARACTERISTICS

A microstrip transmission line is fabricated with a single narrow conductor on one side of a relatively thin sheet of dielectric medium with a large area of ground plane on the other side. Generally the dielectric sheet is in the form of either a ceramic substrate for thin- and thick-film hybrid integrated circuits or PC board material for assemblies.

Electrically, a microstripline behaves like a two-wire transmission line with the second conductor formed by the image of the physical conductor appearing on the ground plane.

The characteristic impedance of a microstripline is determined by the width of the conductors and the dielectric constant and thickness of the substrate material on which it is fabricated. For the 0.062 in. thick, G-10 glass epoxy PC board material (1 oz. clad, both sides), a 50-ohm stripline is always 0.10 in. wide.

In a practical application, other conductors also appear on the microstrip board for DC bias and control voltages. The widths of these conductors are relatively unimportant so long as they are narrow compared to the large grounded areas which make up the bulk of the conductor side of the board to provide as much shielding and isolation as possible.

The figure below shows the standard mounting kit for TO-8 oscillators. Also shown is the correct installation for PC board mounting.

All connections to the pins on the modular devices are made via conductors on the bottom, or circuit, side of the board. The top, or ground plane, is left completely clad except for clearances milled around the holes drilled to pass device pins to prevent unintentional short circuits.

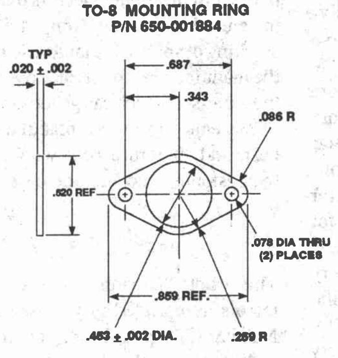
Since the ground plane side of the board is left completely clad, it assures both a good ground and effective heat sink when modules are clamped to it. Modules may also be secured with conductive epoxy or other means, so long as the cases are in intimate thermal and electrical contact with the ground plane.

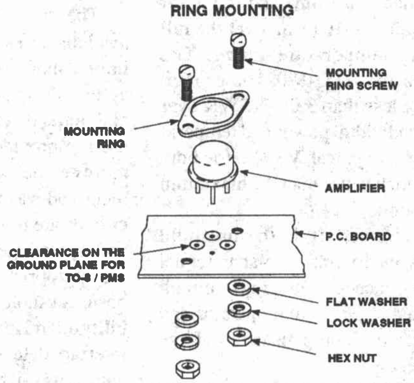
On the conductor side of the board, all of the unused conductor areas are effectively interconnected to the ground plane, and the entire board is grounded to the case or chassis via mounting hardware.

ASSEMBLY INSTRUCTIONS FOR CUSTOMER-DESIGNED CIRCUIT BOARDS

The steps below apply to the assembly of Avantek modules into microstrips or stripline circuits. CAUTION: The Avantek modules are designed for use in a 50-ohm microstrip system and the package must be adequately grounded!

1. Cut all four pins to a length of approximately 3/16 inch.
2. After cutting the pins per Step 1, install the module directly on the circuit board ground plane with the Tune Voltage, RF Output and DC Voltage pins (see Figure 1) passing through the board to the circuit on the other side. Be careful that these pins do not short out to the ground plane.
3. Using the clamp provided, secure the module firmly to the ground plane. Figure 1 shows the proper positioning and installation of the mounting clamp. This step ensures positive contact between the module package and the ground plane so that no problems with VSWR in a multistage system will be encountered.
4. Bend the Tune Voltage, RF Output, DC Voltage and GND pins flat against the proper portions of the printed circuit, then solder in place.





Mounting Kit for Standard TO-8 Packaged Oscillators

DESCRIPTION

From the viewpoint of the systems engineer, a package must be as compact as possible, easy to install in a system (with good RF grounding and heat transfer), resistant to severe shock and vibration and, because of the sensitivity of the unprotected MIC circuit, hermetically sealed for protection against moisture and corrosive atmospheric gases. It must be compatible with microstrip and stripline transmission lines, and provide adequate RFI shielding so several packages can be integrated into a subassembly. The package should be modular with the possibility of conversion to a connector-type package for testing and prototyping. The RF connectors also need to be field-replaceable to meet requirements being written into many military specifications. Both top-to-bottom and side-to-side mounting should be available.

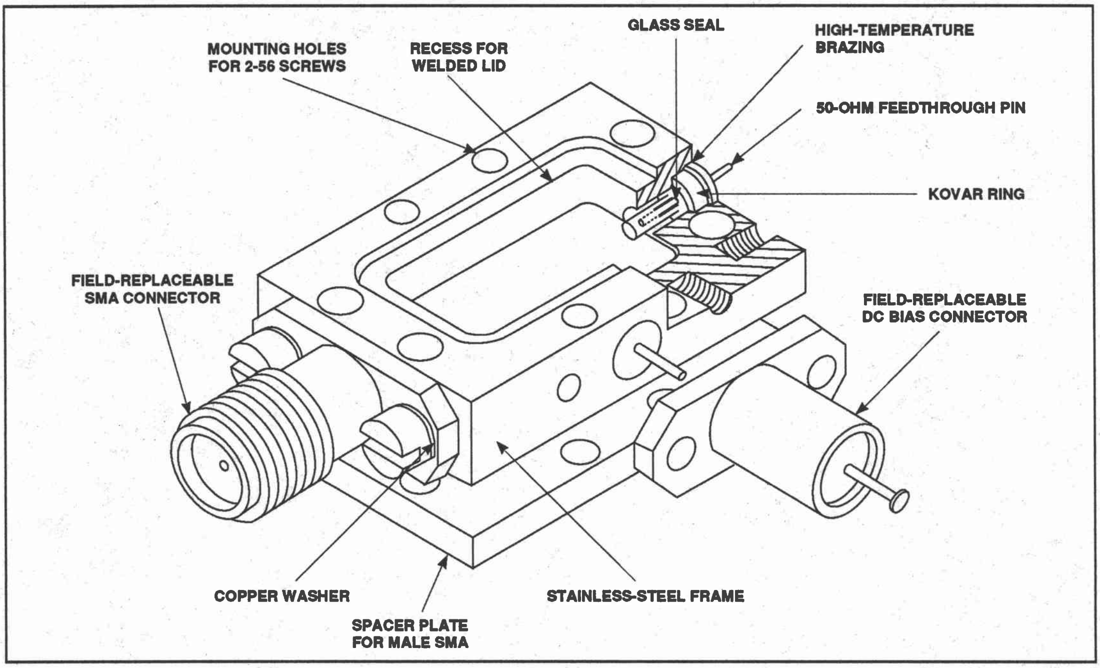
The *Avanpak* oscillator packaging system satisfies these needs without compromising electrical performance. For a pin package operating up to 18 GHz, the most critical design aspect is the RF transition through the wall of the package. *Avanpak* feedthroughs combine gold-plated pins with Kovar holding rings and glass-seals with matched expansion coefficients. The glass is a special low-loss compound to maintain RF performance, and is clear for easier inspection. To assure hermeticity, all feedthrough assemblies are brazed to the package's nickel-plated, stainless-steel frame, using a high-temperature process.

Installation of the field-replaceable SMA connector is straightforward. Since the center conductor collet is self-centering and provides a stress-free interface, the connector is simply slipped over the RF pin, pushed home, and the connector flange is bolted to the case. No special alignment is required, and the only necessary tool is a screwdriver or Allen wrench. A soft, nickel-plated copper washer is used to prevent the connector from rotating against the case. If needed in prototype testing, connectors can be installed on the RF and tune port of an oscillator and the DC bias port can remain a pin for direct attachment to a PC board.

Electrically, the *Avanpak* 50-ohm transition, *including the SMA connector,* proves to be quite good. Over the 2 to 18 GHz frequency range, worst-case insertion loss is less than 0.3 dB, and worst-case VSWR is under 1.3:1.

With connectors attached, or in pin form, the package is the smallest and lightest of its type commercially available. Pin placement is symmetrical to the package (0.11 in. from top to bottom) for use in stripline applications.

The *Avanpak* packaging concept allows the system designer to take a "building block" approach to design. He can purchase fully characterized individual MIC components, test them for his specific application, screen them to MIL-STD-833B (if need be), then remove the connectors and integrate the package directly into a subassembly. Good RF grounding is assured through mounting holes in close proximity to the package's RF transitions. Hermeticity is guaranteed by glass-to-metal seals and a welded lid. Size and weight reductions are significant. Electrical performance is not degraded.



Avanpak Style Package

INTRODUCTION

PlanarPak components are unique because they allow surface mounted devices to perform up to 18 GHz. In critical applications where small size and low weight are mandatory, these devices will provide reliable performance over this full frequency range. This application note covers methods of assembly and printed circuit board (PCB) material selection to maximize performance from these devices.

The most important aspects to consider before using any PlanarPak device is how and where it will be mounted. Reliable electrical performance above 200 to 300 MHz can only be expected when the entire bottom surface of the PlanarPak device (i.e. the lead frame) is attached to the mounting surface. The mounting surface could be the ground plane of a PCB, or grounded heat sink, but in all cases careful attention must be taken to assure an excellent RF ground.

Preferably, attachment methods of the electrical connections should be one of the solder reflow methods mentioned in this application note. Alternatively, conductive epoxy may be used to ground the lead frame when solder reflow methods are not employed. With any of the attachment methods mentioned, optimum electrical and thermal performance will only be possible if care is taken to assure the entire bottom surface is attached.

Performance verification is best proved through use of the Avantek dedicated test fixture: the PPTF-25, PPTF-38, or PPTF-48. Device performance on the test fixture closely follows actual performance proven through tests mentioned in the guidelines of this note. Electrical performance of various suggested board materials are shown in the Electrical Performance section of this note. Many charts and tables are included to assist the designer in choosing the best PCB material to suit performance and system requirements.

MATERIAL OUTLINE

ELECTRICAL PERFORMANCE

The PlanarPak package is designed for optimum performance using any of the mounting options. One major consideration, especially at higher frequencies, is adequate package grounding. Grounding in surface mount boards is achieved by using plated thru holes. The ground holes present an inductance to ground which is dependent on the dimensions of the hole: the thinner the board, the shorter is the hole length, and the lower the inductance to ground.

At frequencies above 8 GHz a short path to an effective RF ground becomes extremely important. The primary way to improve the integrity of ground connections is through the reduction of thru-hole inductance by choosing a thin substrate material. It is recommended to use a substrate thickness between 0.005 to a maximum of 0.025-inch for high frequency applications.

In the microstrip layout section, detailed board layouts and guidelines are presented.

PlanarPak components are tuned and tested in high performance test fixtures as shown in Figure 1.

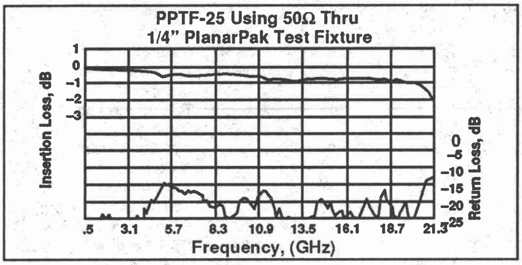


Figure 1

The performance of a PlanarPak device on a surface-mount board is very close to that in the test fixture provided the board design guidelines are followed. To demonstrate this, a PlanarPak-packaged 50-ohm thruline was mounted on different boards and the performance evaluated as shown in Figures 2 through 6.

Figure 2 shows the performance of a 1/4-inch PlanarPak 50-ohm thruline mounted on a .010-inch thick board (PTFE/glass cloth—*Taconic TLY-5*).

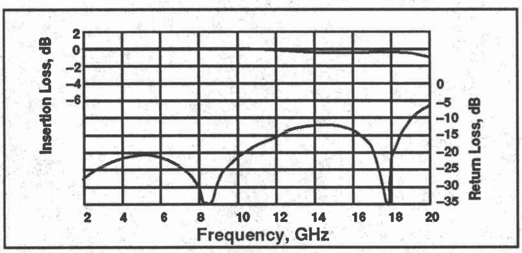


Figure 2

Figure 3 shows the performance of a 1/4-inch PlanarPak 50-ohm thruline mounted on a 0.025-inch thick board (PTFE/ceramic—*Rogers RT/6010*).

Figure 4 shows the performance of three 1/4-inch PlanarPak 50-ohm thrulines cascaded on a 0.015-inch thick board (PTFE/glass microfiber—*Rogers RT/5880*).

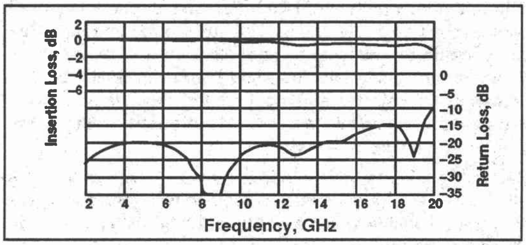


Figure 3

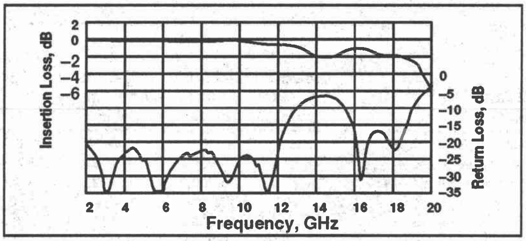


Figure 4

Figure 5 shows the performance of four 1/4-inch PlanarPak 50-ohm thrulines cascaded on a 0.010-inch board (Fluoropolymer composite—*Rogers RT/6002*). This is a more compact layout design where the package leads are trimmed, and the PlanarPak packages are cascaded closer together.

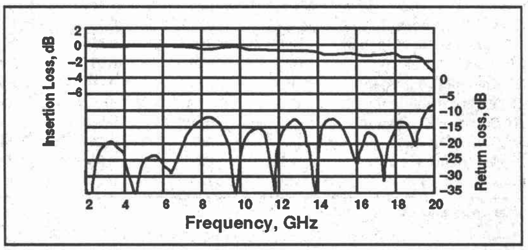


Figure 5

Figure 6 shows the performance of four 3/8-inch PlanarPak 50-ohm thrulines cascaded on a 0.010-inch thick board (*Rogers RT/6002*)

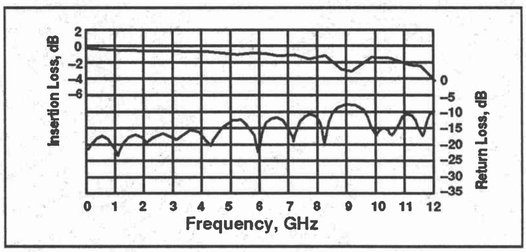


Figure 6

PlanarPak components are designed to be cascaded in the simplest possible microstrip motherboard, to facilitate circuit size reductions possible with surface-mount components. Essentially, the most compact design consists simply of pads to which the trimmed package leads can be soldered, and provisions for good grounding.

MOUNTING OPTIONS

One of the advantages of PlanarPak surface mount components is their flexibility of use. The surface mount PlanarPak components are suitable for mounting on a wide variety of "motherboard" materials, including thin- or thick-film circuits on ceramic substrates and most printed circuit laminates. In this way the PlanarPak component is attached directly to the board using solder or epoxy.

Ceramic substrate with either thin-or thick-film conductors offer good RF characteristics combined with thermal expansion characteristics which are virtually identical to those of the PlanarPak components.

The most important considerations for selecting a board material are: dielectric loss, thermal conductivity, and thermal coefficient of expansion. Ideally, a designer would like to use a board that has low dielectric loss, high thermal conductivity, and mechanical properties compatible with the PlanarPak package.

Table 1 compares the significant characteristics of the most applicable substrate materials.

Table 2 compares the significant properties of different metals available for case or carrier.

Table 1

Board Material	Dielectric Constant ER	Dielectric Loss Tangent	Thermal Conductivity* W/M°C	Thermal Coefficient of Expansion* PPM/°C X,Y	Z	Young's Modulus X10^6 PSI	Resistivity 10^6Ohm cm	Electrical Density g/cm³	Comments
Alumina Al_2O_3 99.5%	9.8	0.0001	25–30	6–7	6–7	50	10^8	3.96	Ceramic
Beryllia BeO 99.5%	6.7	0.0003	250	5.7–6.4	5.7–6.4	50	10^{11}	2.9	Ceramic
Aluminum Nitride AlN	8.8	0.0005	170–200	4.1	4.1	—	—	—	Ceramic
S-145 (Transtech)	10	00002	34	12.1	12.1	38	10^6	3.45	Ceramic
D-Mat (Transtech)	8.9-14	0.0002	8.8	7.5	7.5	30	10^6	3.45	Ceramic
D-450 (Transtech)	4.5	0.0004	4.2	2.4	2.4	18	10^6	2.45	Ceramic
Polyimide *Kevlar*	3.6	0.008	0.12	4-7	83	4	10^6	—	TCE Constrained Dielectric
Epoxy *Kevlar*	3.9	—	0.12	6-8	—	4.4	10^{10}	—	TCE Constrained Dielectric
Polyimide Quartz	3.3-3.7	0.005	—	6-8	34	7	10^3	—	TCE Constrained Dielectric
RT/6002 (Rogers)	2.9	0.0025	0.44	16	24	0.120	10^6	2.1	Fluoropolymer Composite
Cuclad 250 (Keene)	2.4—2.6	0.0018	0.11	10-15	120	0.7	10^7	2.2	PTFE/Glass Cloth
RT/Duroid 6010.5 (Rogers)	10.5	0.0028	0.41	21	20	0.135	—	2.9	PTFE/Ceramic
EPSILAM 10 (Keene)	10.2	0.002	0.37	20-25	—	0.035	—	2.98	PTFE/Ceramic
RT/Duroid 6006 (Rogers)	6	0.0027	0.48	30-34	53	0.091	—	2.9	PTFE/Ceramic
TLY-5 (Taconic)	2.2	0.0008	0.1	35	130	0.7	10^7	2.2	PTFE/Woven Glass
RT/Duroid 5870 (Rogers)	2.33	0.0012	0.26	27-31	134	0.159	10^7	2.2	PTFE/Glass Microfiber
RT/Duroid 5880 (Rogers)	2.2	0.0009	0.26	33-47	188	0.156	10^7	2.2	PTFE/Glass Microfiber
Polyimide Glass	4.5	0.01	0.35	11.7-16	60	2.8	10^6	—	
Epoxy Glass	4.8	0.022	0.16	12.7-16	189	2.5	10^6	—	

*Average value –55 to +125°C

Table 2

Carrier Material	Composition %	Density g/cm³	Thermal Coefficient of Expansion PPM/°C Average (–55 to +125°C)	Thermal Conductivity W/m°C Average (–55 to +125°C)	Young's Modulus of Elasticity X10⁶ PSI	Electrical Resistivity X10⁻⁶ Ohm-cm	Specific Heat Cal/g°C
Kovar	Fe 53.5 Ni 29 Co 17	8.35	5-6	17	20	48	0.105
Aluminum 6061	Al 98 Mg 1	2.7	23.5	171-216	10	3	0.210
Stainless Steel 303	Fe 70 Cr 18 Ni 9	8	14-18	14-20	28	78	0.120
Alloy 42	Fe 58 Ni 42	8.2	4.5-6.5	12.2	22	70	0.121
Nickel	Ni 99	8.8	15	83.5	29	6.8	0.130
Invar	Ni 36 Fe 63	8.13	1-2	14	21	81	0.123
Copper	Cu 99.9	8.9	17	390	17	1.7	0.09
Tungsten	W 99.9	19.3	4.5	177.8	50	5.6	0.032
Thermkon (Copper Tungsten)	W:75-90 Cu:25-10	14.8-17.1	8.3-5.7	190-157	34-37	5.4	0.08-0.05
Molybdenum	Mo 99.9	10.3	5	145	47	5.2	0.06
Copper-Clad Molybdenum (Cu-Mo-Cu)	Cu 13 Mo 74 Cu 13	9.9	5.6-6.4 x-y 7.7-8.2 z	172-200 x-y 147-162 z	33	3.6	0.070
Copper-Clad Invar (Cu-Invar-Cu)	Cu 12.5 Invar 75 Cu 12.5	8.3	3.5-4.6	100 x-y 19 z	20.3	6.9	0.112
	Cu 20 Invar 60 Cu 20	8.4	5.2-6	167 x-y 24 z	19.6	4.3	0.106

MICROSTRIP BOARD DESIGN GUIDELINES

It should be emphasized that the PlanarPak package is fully compatible with microstrip circuitry. By minimizing the I/O port discontinuity, the PlanarPak package is matched as closely as possible to 50-ohm impedance, therefore the board microstrip lines should be 50 ohms to realize the full performance of the component.

The following guidelines for microstrip board layout are suggested:

- The microstrip line should extend to the edge of the package for leaded PlanarPak packages and 0.030 inch underneath the package for trimmed PlanarPak packages (leads are trimmed flush with the package). (Ref. Fig. 6a and 6b.)

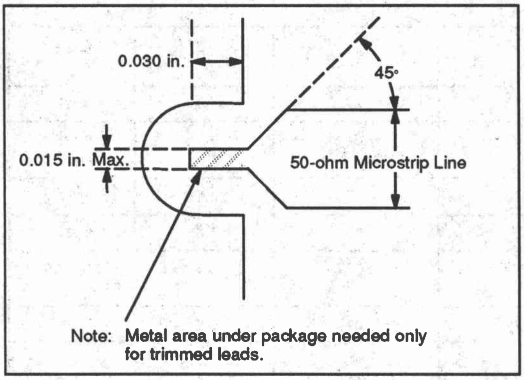


Figure 6a

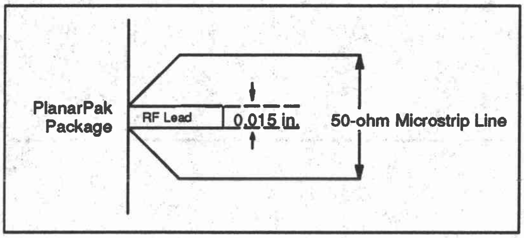


Figure 6b

- The minimum microstrip line width under the leads should be 0.015 inch, since the lead width is 0.15 inch (0.010 inch for high frequency PlanarPak components), to allow for solder fillets and good lead attachment to the board (Fig. 6b).
- The maximum microstrip line width underneath the package (for lead-trimmed PlanarPak components) should be 0.015 inch to minimize the discontinuity effects of the in/out transitions (Fig. 6a).
- The best transition from a wide trace to the edge of the package is made by tapering the microstrip trace down to the lead width. A 45-degree line taper is suggested, but other tapers can be used (Fig. 6b).
- The board material should be selected to suit the intended frequency of operation and the particular requirements of the circuit designer (thermal mechanical, high reliability, etc.) (Refer to Table 1 and 3).
- The board thickness should be between 0.005 and 0.060 inch for low frequencies (less than 8 GHz), and between 0.005 and .025 inch for higher frequencies.
- Metallized holes are used to bring the circuit ground to the bottom side effective board ground. The intent is to have sufficient PlanarPak package-to-board ground points to assure a low-impedance ground path that is a small fraction of the wavelength at the highest frequency of operation. The number and location of the holes may change as long as the previous conditions are satisfied.

Figure 7a, 7b, and 7c shows PCB layout patterns for the three different size PlanarPak packages. The metallized ground holes are spaced in such a way to assure adequate grounding coverage of the whole PlanarPak packages backside area.

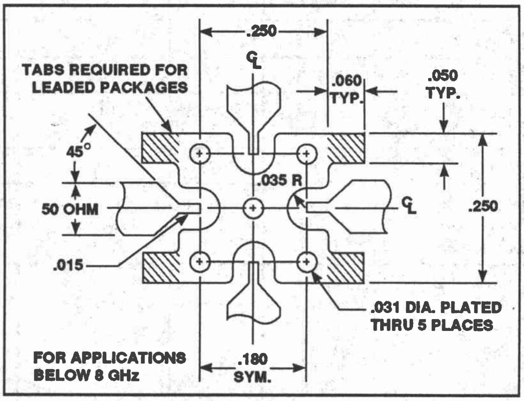


Figure 7a. 1/4-Inch PlanarPak Board Layout

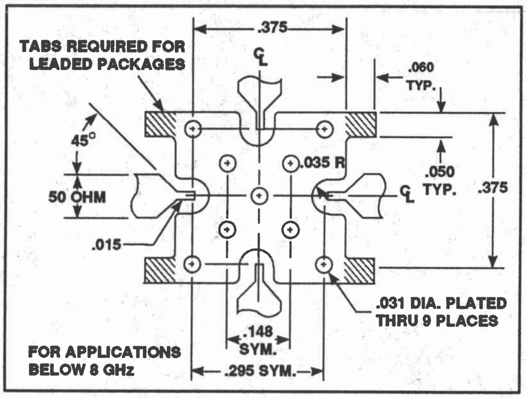


Figure 7b. 3/8-Inch PlanarPak Board Layout

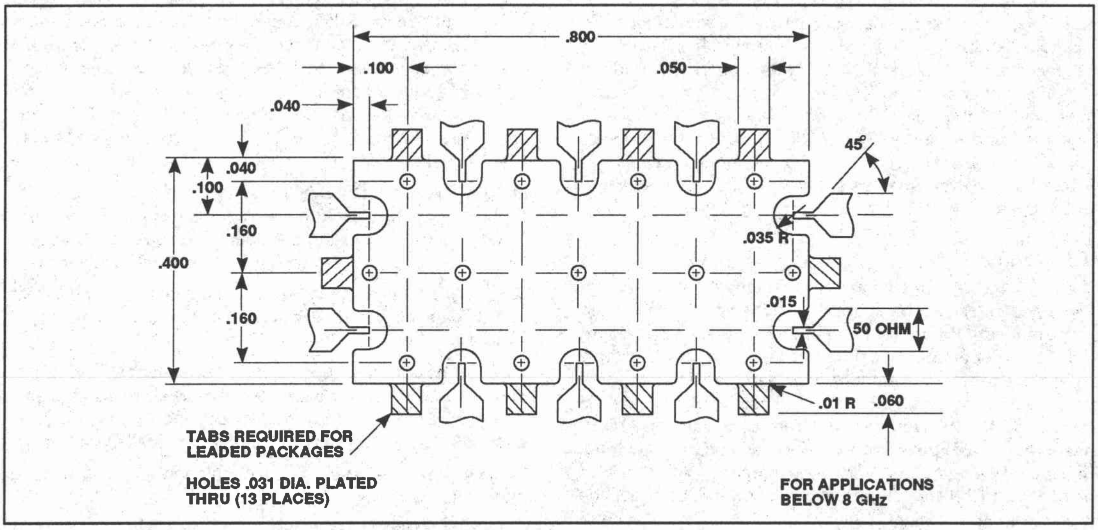


Figure 7c. .4 x .8-inch PlanarPak Board Layout

- High frequency layout: Figure 8 shows a layout pattern for the 1/4-inch PlanarPak package. It includes more metallized ground holes and unmetallized 0.070-inch diameter holes underneath the input/output RF transition. This minimizes the transition mismatch due to the effect of the board dielectric, especially for high dielectric constant and thinner boards. The transition holes can be deleted for thicker boards (0.010 to 0.025 inch) and lower dielectric constants (Er = 2 to 3).

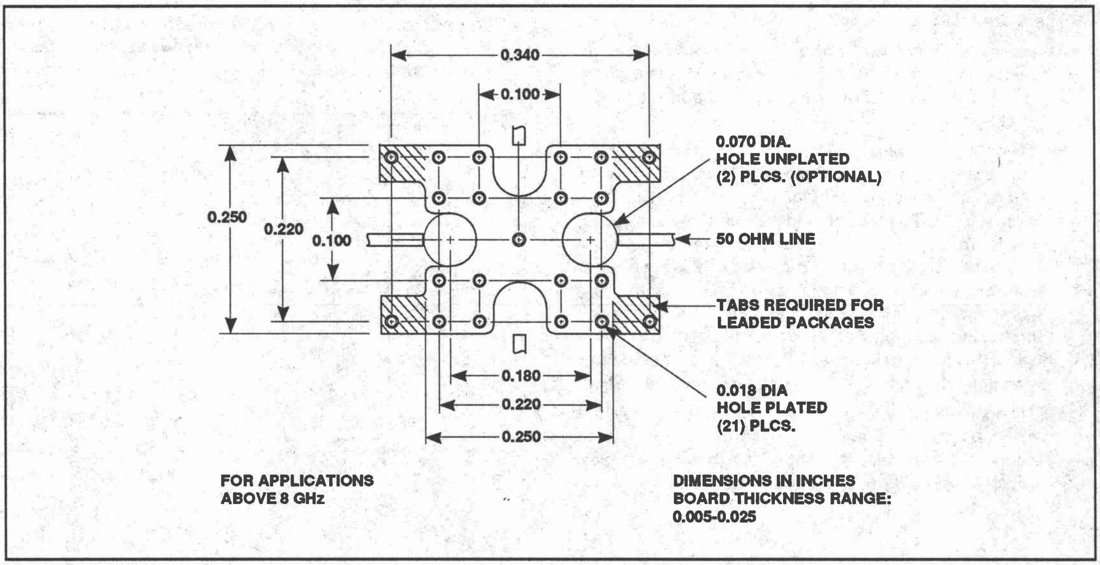


Figure 8. 1/4-inch High Frequency Board Layout

MECHANICAL PERFORMANCE

The mechanical performance of a PlanarPak component mounted on a board has certain differences from other SMT packages like the LCCC (Leadless Ceramic Chip Carrier). In the case of the LCCC and PLCC only the bottom side pads or leads are connected to a PCB footprint, while for the PlanarPak package, the complete bottom-side ground surface is connected to the board. This provides larger direct contact area with the board for PlanarPak components, and any mechanical and thermal analysis should take this advantage into account.

TCE Control

One of the major concerns when evaluating a surface-mount component is the mechanical stress at the solder joints of the package leads. When the temperature increases, the board and the surface-mount component tend to expand. If they expand by a different amount, the leads' solder joints are stressed and microcracks can occur. The rate of expansion is determined by the thermal coefficient of expansion (TCE), measured in parts per million per degree centigrade (ppm/c). For stress-free operation over a wide temperature range, both the board and the surface-mount component TCEs should be similar, but the greater the TCE mismatch is, the more mechanical stress problems occur on the solder joints.

The TCE for the PlanarPak package is 6 ppm/°C (see Table 2).

There are two approaches to solving the TCE mismatch problem:

- Providing TCE match between the board and the package.
- Providing stress relief for the package leads.

1. TCE Matching

   There are four major ways to provide TCE match:

   a. *Board Materials with similar TCE*: The easiest way is to use alumina or other ceramics as substrate in order to duplicate the characteristics of the surface-mount package.

   b. *Using a constraining dielectric*: The idea here is to incorporate a low TCE dielectric, such as Kevlar or quartz, in the board material in order to constrain its overall TCE. To produce a low expansion composite, Kevlar (a DuPont product) cloth, for example, is used as the reinforcing medium in place of glass in epoxy or polyimide resin. Kevlar also has a lower dielectric constant and dissipation factor than glass, which makes it promising for high frequency circuits. Boards made with Kevlar are lightweight and have mechanical damping power that makes them resistant to vibration.

   c. *Using a constraining metal core*: This method involves selecting a low-TCE metal core, such as copper-Invar-copper or copper-molybdenum-copper, which is bonded to the dielectric material layers. The core constrains the normal expansion of the board, and its composition allows the TCE of the board to be tailored to match that of the SMT package. For example, copper-clad Invar, with copper clad to both sides of an Invar core, can be tailored to provide a selected TCE by varying the copper-to-Invar ratio. C-I-C can provide support and TCE match to single and multilayer boards.

Major military/industry evaluation programs are in progress evaluating different TCE matching techniques. Preliminary results are very promising and each technique has its advantages depending on the user environment and applications.

Table 3 presents advantages and disadvantages of different board materials used to control the thermal coefficient of expansion.

Avantek has performed evaluation and thermal cycling of different board materials on two PlanarPak package sizes. The units were tested for mechanical and electrical failures over –55 to +125°C range of the standard military specs.

Table 4 shows the results of the Avantek evaluations of board materials.

2. Stress Relief

   Another approach to minimizing problems from incompatible thermal expansion between PlanarPak components and boards is to provide stress relief for the package leads. This is done by attaching a ribbon wire from the PlanarPak package leads to the microstrip trace to make the electrical connection instead of soldering the leads. The leads remain unattached flush over the surface of the board (Figure 9). The flexible ribbon absorbs any stresses that develop on the board-ribbon interface.

   The ribbon stress relief approach should perform well electrically when proper design considerations are taken into account.

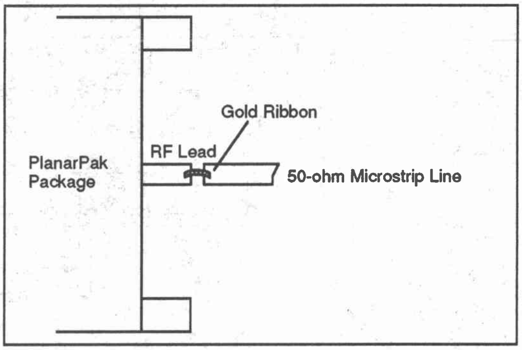


Figure 9

Table 3. TCE Match Board Materials

Board Material	Advantages	Disadvantages
Ceramic	Exact TCE Match, Good Thermal Conductivity, Excellent Electrical Performance, Thin and Thick Film Compatible	Fragility, cost, limited substrate size
Epoxy *Kevlar*	TCE Match, Weight, Reworkable, Conventional Board Processing, Substrate Size, Dielectric Properties, Vibration Damping	Thermal Conductivity, Resin Microcracking, Water Absorption
Polymide *Kevlar*	TCE Match, Weight, Reworkable, Good Dielectric Properties, Z-Axis TCE, Conventional Substrate Processing, Substrate Size	Thermal Conductivity, Resin Microcracking, Water Absorption, Cost
Polymide Quartz	TCE Match, Weight, Reworkable, Good Dielectric Properties, Z-Axis TCE, Conventional Substrate Processing, Substrate Size	Drilling, Cost, Thermal Conductivity
PCB Bonded To Copper Invar Copper (CIC) Core Or Support	Can be Tailored to Provide X-Y TCE match, Good Thermal Management, Board Size, Rigidity, Multilayer Capabilities, EMI/RFI Shielding	Weight Increase
PCB Bonded To Copper Molybdenum Copper Core Or Support	Same as CIC but Better Thermal Conductivity and Higher Young's Modulus	Weight Increase

Table 4. PlanarPak PCB Thermal Cycling Evaluation

Board Material	Dielectric Thickness	Number of Cycles	Thermal Cycling Performance
Copper-Invar-Copper/*Teflon*	0.010	240	Excellent
Polyimide Quartz	0.006	240	Good
RT/6002 (Rogers)	0.010	480	Poor
RT/6002	0.030	480	Poor
RT/6010 (Rogers)	0.025	420	Poor
Epoxy-Glass	0.032	480	Poor
Epoxy-Glass	0.062	480	Poor
RT/5870 (Rogers)	0.031	405	Poor

Thermal Management

In all system applications thermal dissipation should be considered for optimum performance. For PlanarPak packages the majority of the heat is transmitted through the alumina substrate and the Kovar lead frame (forming the package bottom). Several thermal characteristics are provided to assist designers in planning for heat dissipation, which are found in the catalog data sheets. These are as follows:

1. θ_{JC} (Thermal Resistance)
2. Active Transistor Power Dissipation
3. Junction Temperature above Case Temperature, T_{rise}
4. Maximum Operating Case Temperature

θ_{JC} represents the total junction to case thermal resistance which includes transistor, alumina substrate and Kovar lead frame.

Active power dissipation is the power dissipated across the transistor die.

The junction temperature above case temperature, T_{rise}, is given by:

$$T_{rise} = \theta_{JC} \times P_d \text{ (transistor) °C}$$

(Temperature rise data for PlanarPak packages refers to the change in temperature from the lead frame to the hottest spot on the transistor die.)

Maximum operating case temperature is specified in catalog data sheets. (Total package dissipation, P_d, may be calculated from the DC values contained in the data sheets, and will provide useful information in determining actual operating temperature.)

$$P_d = V_{bias} \times I(\text{total}) \text{ watts}$$

Based on the above measurements and calculations the maximum operating case temperature, specified in the catalog, should not be exceeded. Thermal data for different circuit board and carrier materials are given in Tables 1 and 2 to assist designers in thermal management. Best thermal dissipation is provided when the suggested mounting techniques are followed. This means that the entire lead frame should be soldered, or attached using conductive epoxy, to the board ground plane.

MOUNTING TECHNIQUES

Although this format bears the appearance of conventional surface mount packaging, it has several properties which require special consideration in application. This section covers the following:

- Mechanical Interface
- Assembly Instructions

Mechanical Interface

The PlanarPak-packaged component is an unconventional surface mount device in that its entire back plane is soldered to the substrate. Its lead interconnect is co-planar with the substrate for electrical reasons and, therefore, has no stress relief loop. This geometry induces high shear stresses in the connecting braze at the lead if thermal mismatch with the substrate exists.

It is recommended that if the system in which the PlanarPak component is to be installed requires repeated thermal excursions (of 50°C) that a thermally-matched board material be used. In any case residual stresses from soldering processes should be minimized.

Top metallization can be copper plated with nickel or clad with solder.

If the package is to be directly paste-soldered, all possible precautions against the formation of solder balls must be taken. Solder balls caught between the signal lead and the ground plane will deteriorate electrical performance even though no short circuit exists.

In cases of direct paste reflow, the humidity content of the paste must be controlled. A slow bake of the placed part in the paste can reduce the humidity to acceptable levels. Time and temperature will vary with the part size and system mass.

Assembly Instructions*

The following section details the soldering methods for R&D, prototype and production installation of PlanarPak packages. Install only PlanarPak components and compatible ceramic chip capacitors and resistors prior to reflow soldering. Additional components, such as tantalum bypass capacitors or ferrite-core coils should be installed by hand soldering. Adjust the hot plate for a temperature of 260°C maximum, and allow the temperature to stabilize before reflow soldering.

1. Chemically clean the PC board and the unit to be mounted using a vapor degreaser, or acetone followed by an isopropyl alcohol wash (check for compatibility of solvents with other components on the board. Do not use ultrasonic cleaning.
2. Mask the backside of the PC board to prevent solder from flowing through the plated through holes causing a rough ground plane surface. A suggested masking material is 2 mil thick DuPont *Kapton* film with silicon adhesive back (Avery International Permacel part number *P-222*).
3. Apply solder cream using screen printing techniques or careful hand application. A layer 4- to 6-mils thick is adequate. It is suggested that a cream combining eutectic alloy with non-foaming flux, such as Ersin Multicore *SN62PRMAB3* or equivalent, may be used.
4. Reflow solder on substrate *only*, using vapor phase, infrared, or conducted heat.
5. Chemically reclean the unit using the procedure given in step 1. Make sure that a flux remover is used which is appropriate for the type of solder cream used (Multicore *PC81* is recommended flux remover for the *SN62PRMAB3* cream). Do not use ultrasonic cleaning.
6. Brush RMA flux on surface (e.g. Alpha *100*). Place the PlanarPak package on substrate. Bake at 120°C for 10 minutes. (Excessive time will polymerize flux.)
7. Reflow on hot plate, vapor phase or conductive belt.
8. Repeat step 5 above.

Production Soldering

In production, solder cream may be applied manually with a syringe or with a pneumatic, controlled-volume dispenser system; or via screen printing. When the surface-mounted components are hand-placed over the solder cream, slight errors in centering will usually be no problem, since the surface tension while the solder is liquified will tend to pull the component into proper alignment.

Most solder creams are of relatively low viscosity, which means that automation equipment, or any handling of the board between component insertion and reflow, may call for fixturing to hold the components in place. The use of fixtures eliminates the self-centering effect.

Recommended Methods of Solder Reflow

Vapor-phase: The vapor-phase reflow system makes use of the condensation of the saturated vapor of a synthetic solvent, which is accompanied by the release of the latent heat of vaporization. This, in turn, causes the assembly to become uniformly heated to a temperature in excess of the melting point of the tin-lead eutectic alloy (186°C), normally within 10 to 30 seconds. Control over the actual soldering temperature is through the dwell time during which the assembly is permitted to remain in the vapor.

One of the most significant advantages of vapor-phase reflow soldering in the high-volume production environment is that the vapor stays clean, with any contaminents falling from the boards settling in the liquid phase of the solvent. The fact that the vapor condenses on all surfaces simultaneously means that the applied temperature is uniform. This minimizes stress on the package and helps assure good solder joints.

The disadvantage is that the vapor-producing liquid (such as 3M *Flourinet®* FC-70) is expensive, and some portion is inevitably lost. To help prevent this loss, a secondary vapor zone of material such as DuPont *Freon–TF®* is generally used.

After soldering, flux residues should be removed using a solvent appropriate to the type of flux. Typically, removal of resin-type fluxes requires the use of a fluorocarbon or chlorinated fluorocarbon solvent, often with the addition of isopropyl alcohol. Any cleaning solvents should be tested for compatibility with the PC material and components (particularly with parts containing reactive metals such as aluminum or zinc) before use.

*Hand soldering, or wire bonding, *only* the lead frame tabs severely limits the operating frequency range of PlanarPak devices (e.g. 200 to 300 MHz), and are not recommended procedures. If reflow techniques are not possible then another method must be used to conductively attach the lead frame.

Convection: Although convection is an inefficient method of transferring heat, it is, perhaps, the most widely-used technique. Dwell time (belt speed) and temperature must be carefully controlled to assure sufficient heating to prevent cold solder joints or inadequate wicking of the solder into the connections.

Infrared: The major disadvantage of infrared reflow soldering is the possibility that some areas of the package will be shielded from the heat radiation. This is frequently a problem, since the surface-mounted components are often held in place with fixturing during the reflow heating cycle. If the heating arrangement is not carefully adjusted, temperature gradients during reflow may be enough to overheat some connections and inadequately heat others. Temperature also tends to be higher for components or parts of components of darker color or higher heat absorption.

SOURCES OF MATERIALS

Substrates

- Alumina Al_2O_3, Beryllia BeO, Aluminum Nitride AIN.
  —Accumet Engineering Corp.,
  518 Main St., Hudson, MA 01748
  Tel: (617) 568-8311
- COR-LAM (Epoxy-Kevlar, Polyimide-Kevlar)
  —DuPont Company, Electronic Department,
  Barley Mill Plaza, P22-1204,
  Wilmington, DE 18898
  Tel: (800) 345-9999
- EPSILAM-10, CU-CLAD 217/233/250,
  DI-CLAD 522/527,870/880/810
  —Keene Corporation,
  1100 Goverror Lea Road, Bear DE 19701
  Tel. (800) 635-9333
- NORPLEX/OAK 601, 602, 605
  —NORPLEX/OAK, 505 King St.,
  Le Crosse, WI 54601
  Tel: (608) 784-5070
- Polyimide-Quartz, Teflon-CIC-Teflon
  —Oak Industries Inc., 54 Church Street
  Hoosick Falls, NY 12090
  Tel: (518) 686-7301
- CUFLON
  —Polyflon Company, 35 River Road,
  New Rochelle, NY 10801
  Tel: (914) 636-7222
- RT/5870, RT/5880, RT/6006, RT/6010, RO2800, ULTRALAM 2000
  —Rogers Corporation, Microwave Material Division,
  Box 3000, Chandler, AZ 85244
  Tel: (602) 961-1382
- TLY-5, TLY-3, TAC-LAM-T, TAC-LAM-X
  —TACONIC Plastics, Ltd., Microwave Dielectric Division,
  Coonbrook Rd., P.O. Box 68, Petersburg, NY 12138
  Tel: (518) 658-3202
- Copper-Invar-Copper, CERCIC.
  —Texas Instruments, Inc., Industrial Material Dept. MS 4-9,
  Attleboro, MA 02703
  Tel: (617) 699-3800, ext. 1660
- S-145, D-MAT, D-450
  —Transtech, a Subsidary of Alpha Industries,
  P.O.Box 69, 5520 Adamstown Rd.,
  Adamstown, MD 21710
  Tel: (310) 695-9400

Metals

- (CMC) Copper-Molybdenum-Copper
  —AMAX Specialty Metals Corp., 21801 Tungsten Rd.,
  Cleveland, OH 4417
  Tel: (216) 692-3990
- Thermkon
  —Contacts Metals Welding, Inc.,
  70 S. Gray St., P.O. Box 2266,
  Indianapolis IN 46206
  Tel: (317) 634-8884
- (CIC) Copper-Invar-Copper
  —Texas Instruments, Inc., Industrial Metals Dept.. MS 4-9,
  Attleboro, MA 02703
  Tel: (167) 699-1617, (800) 341-5202

Fixtures

- Inter-Continental Microwave (ICM),
  2372 Walsh Ave., Santa Clara, CA 95051
  Tel: (408) 727-1596.

Solders

- Multicore Soldering Products
  Multicore Solders
  Cantiague Rock Road
  Westbury, NY 11590
  Tel: (516) 334-7997

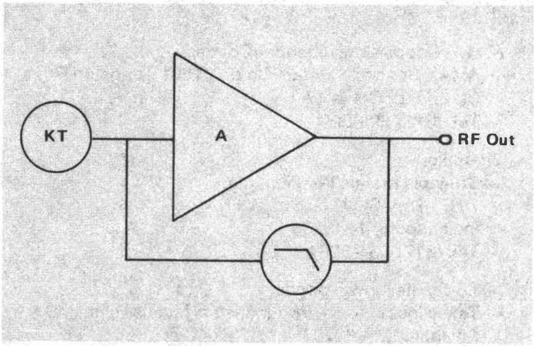
Masking Film

- Permacel Masking Film
  Avery International, Fasson Industrial Division
  250 Chester Street
  Painesville, OH 44077
  Tel: (216) 352-4444

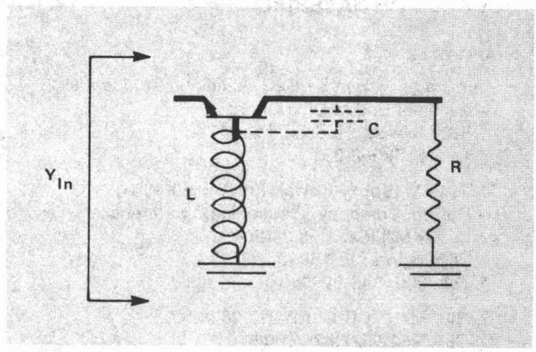
Voltage-Controlled Oscillators Evaluated for System Design

By
R.M. Leier and R.W. Patston
Avantek, Inc.

High tuning speed, small size, and low power consumption make VCOs important components in a number of microwave applications. The designer must be able to evaluate these devices accurately in order to write proper VCO specifications for critical applications.



1. Block diagram of a microwave oscillator, modeled as a combination of an amplifier with a positive-feedback loop and a frequency-determining network. KT represents the noise input that starts oscillation.



2. Example of a negative-resistance generator. Most designers model microwave oscillators as a negative-resistance generator and oscillator.

With its unique combination of very high tuning speed (typical full-band tuning in less than 30 ns.), small size, and low power consumption, the varactor-tuned, voltage-controlled oscillator (VCO) is a vital component in electronic defense systems, frequency-hopping radar, frequency synthesizers, and many other microwave applications. Unfortunately, high-performance microwave VCOs are difficult to design, build, and optimize.

Most microwave system designers find it far more practical to consider VCOs or integrated oscillator subsystems as components, and purchase them from one of the specialized manufacturers. Available production "raw" VCOs and VCO assemblies, which offer a wide selection of optimized performance features, are readily available in the 300-MHz to 18-GHz range. This article is intended primarily to help system designers evaluate available VCOs, and to assist them in writing VCO specifications for critical applications.

A Look at Oscillator Fundamentals

In its simplest form, a sinusoidal or quasi-sinusoidal oscillator (as opposed to such square-wave or pulse sources as the blocking or relaxation oscillator) can be modeled as the combination of an amplifier with a positive feedback loop and a frequency-determining network. Figure 1 illustrates this concept. The general feedback formula is

$$A_f = \frac{A}{1-\beta_f A} \tag{1}$$

where A = gain of the amplifier without feedback
A_f = gain of the amplifier with feedback
β_f = reverse transfer function of the feedback path

$$= \frac{V_f \text{ angle } \theta_1}{V_o \text{ angle } \theta_2} \tag{2}$$

(the difference between θ_1 and θ_2 represents the phase shift through the path)

When feedback is positive, β_f is a positive quantity and, according to the Barkhausen criterion, when $\beta_f A=1$, A_f becomes infinite and the feedback amplifier becomes an oscillator. Since both the amplifier and the feedback circuit

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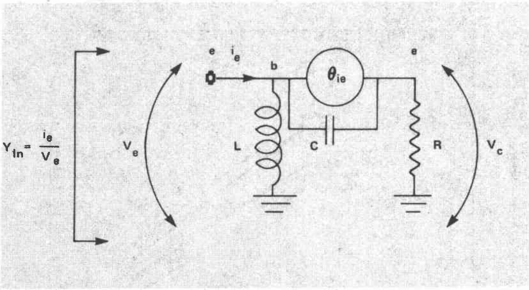
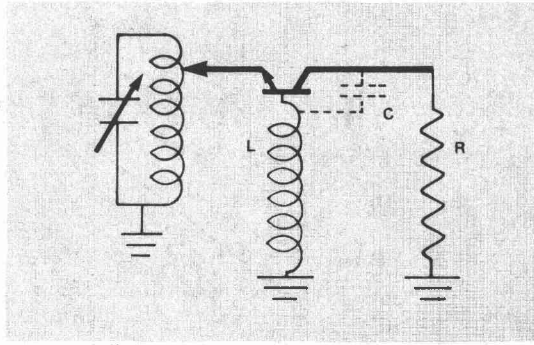


3. *The equivalent circuit of the negative-resistance generator shown in Figure 2. Through nodal analysis, the input impedance of this circuit can be shown to generate a negative resistance.*



4. *When the designer adds a parallel resonant circuit to the equivalent circuit shown in Figure 2, the result is a complete voltage-controlled oscillator.*

contain capacitive or inductive energy-storage elements (even if only due to parasitics), $\beta_f A$ is complex. To satisfy the Barkhausen criterion, the real part of $\beta_f A=1$ and the imaginary part is 0; thus the real part is unity and the phase is 0. Clearly, under these conditions, once oscillation begins due to any small amount of noise at the input of the amplifier, the signal would build up until the output of the amplifier reaches its saturated limit.

The common-emitter amplifier circuit provides a nominal 180° phase shift, with the feedback network adding the additional 180° (or 540° . . . 360n + 180°). In the common-collector amplifier circuit, where the phase shift is nominally 0°, the feedback network must provide a full 360° phase shift.

The model in Figure 1 represents essentially a surface-acoustic-wave (SAW) oscillator in which the feedback path consists of a delay line and low-pass filter. Of course, if the transistor has a sufficiently high f_{max}, there is always a possibility that a simple delay line will provide a total 360° phase shift at a fundamental frequency and at a number of harmonically related frequencies, or that other 360° feedback paths at non-harmonically related frequencies will exist since conductor lengths are a significant part of an electrical wavelength.

Actually, most microwave-oscillator designers use a different model, and analyze oscillators in terms of a negative-resistance generator and resonator. An example of a negative-resistance generator is shown in Figure 2. By first transforming it to its equivalent circuit (Fig. 3), the input impedance of this circuit can be shown to generate a negative-resistance. It can be shown through nodal analysis that the input admittance of this circuit is:

$$Y_{in} = \frac{1}{R}\left\{1 - \frac{f_c^2}{f^2}\right\} + \frac{1}{j2\pi f1} \qquad (3)$$

if $f_c > f$ Re $| \; Y_{in} \; | <$

Im $| \; Y_{in} \; |$ Inductive

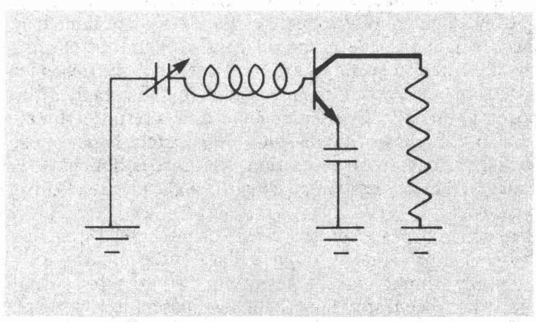
$$\text{where } f_c = \frac{1}{2\pi\sqrt{LC}} \qquad (4)$$

This equation demonstrates that a bipolar transistor with an inductor between base and ground becomes the equivalent of negative conductance in parallel with an inductive susceptance over a range of frequencies $f_c > f$. The inductor L is selected by design, whereas the value of C is provided by the collector-base capacitance of the transistor.

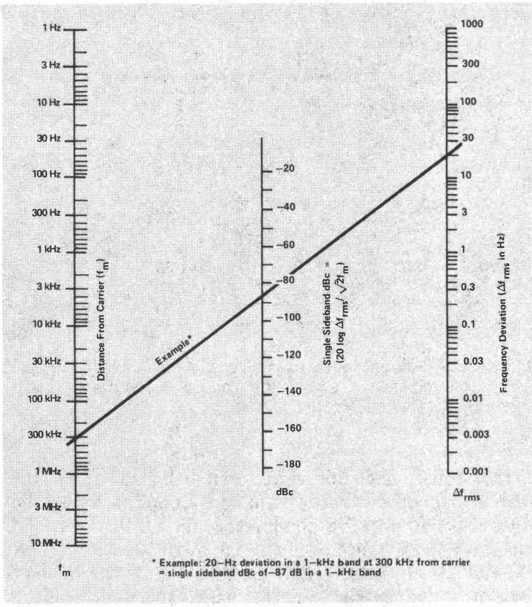
The common-base circuit is not the only topology that can be used to generate a negative resistance, and in practice a common-emitter configuration with the resonator in the base circuit is used as frequently as the former. The selection of an appropriate circuit topology is a complex task, dictated by such factors as the type of resonator being used, the characteristics of the transistor, and the frequency of the oscillator. The complete VCO is produced by adding a parallel or series resonant circuit (Figs. 4 and 5).

Phase (FM) Noise—a Significant Criterion

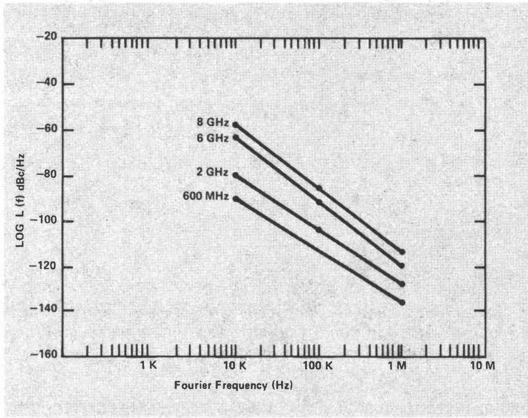
The major concern of synthesizer designers is the phase stability (or phase noise). It is also critically important in ECM systems, frequency-agile radar systems, Doppler radar systems, radar warning receivers, and various communications applications. In such applications, an oscillator's phase-noise output may set the system's limits for dynamic



5. *VCOs may also be constructed by adding a series resonant circuit to the negative-resistance generator. In this example, it is added to the base circuit in a common-emitter amplifier.*



6. FM noise-conversion nomograph. By placing a straight edge on the frequency deviation in Hz (right column) and on the distance from the carrier at which that deviation occurs (left column), the single-sideband noise-power ratio in dBc is shown in the center column.



7. Single-sideband phase-noise comparison of four production VCOs.

range and reception sensitivity. The output of an ideal sine-wave oscillator can be described as:

$$V(t) = V_0 \sin 2\pi\mu_0 t$$

where V_0 is the nominal amplitude and μ_0 the nominal frequency. For an actual sine wave, the equation becomes:

$$V(t) = \left[V_0 + E(t) \right] \sin \left[2\pi\mu_0 t + \phi(t) \right], \quad (5)$$

where E(t) is the magnitude of random variation in amplitude, and ϕ (t) that of phase.

The phase noise of an oscillator is best seen in the frequency domain, where spectral purity is determined by measuring noise power in sidebands about the output-signal center frequency (carrier). Note, though, that on a spectrum analyzer it is impossible to tell whether the power at different Fourier frequencies is a result of amplitude or of phase fluctuations. Fortunately, since most oscillators operate in saturation, AM noise is limited. It is usually 20 dB lower than phase noise and can often be disregarded.

In practice, phase spectral density is measured by passing the oscillator signal through a phase discriminator, substantially amplifying the resulting discriminator-output spectrum, then displaying it on a low-phase-noise spectrum analyzer. Single-sideband phase noise is usually specified in dBc/Hz at a given frequency from the carrier. Figure 6 is an FM noise nomograph that converts between single-sideband noise power ratio and frequency deviation at any distance from the carrier.

Total FM noise can be expressed as a sideband-to-carrier power ratio by the following relationship:

$$dB = 20 \log \sqrt{2} \left\{ \frac{f_m}{\Delta f_{RMS}} \right\} \quad (6)$$

where F_m = frequency from the carrier
Δf_{RMS} = deviation

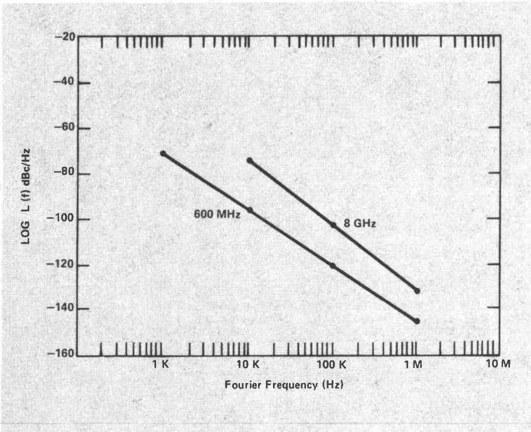
When frequency deviation is known in a given bandwidth, the following equation can be used to normalize the frequency deviation to any reference bandwidth:

$$\Delta f_{2RMS} = \Delta f_{1RMS} \frac{B_2}{B_1} \quad (7)$$

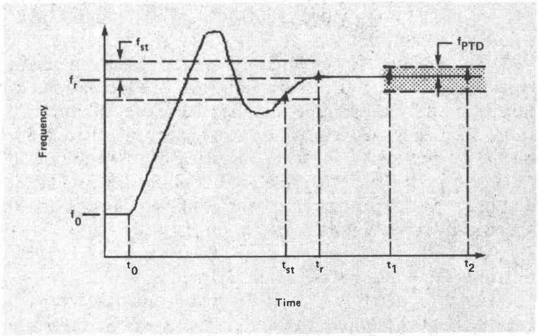
This relationship shows the importance of specifying the reference bandwidth when comparing the FM noise performance of various VCOs. The typical FM noise performance of four production VCOs is shown in Figure 7.

The phase noise generated by a VCO is determined primarily by the Q (quality factor—ratio of reactance to resistance) of the overall circuit and the Q of the varactor diode. The oscillator circuit itself is usually designed with a specific parameter in mind. In order to design a circuit with a very high Q, the tuning bandwidth must invariably suffer. Therefore, an oscillator circuit designed for optimum phase-noise performance will be ultimately a fairly narrow-band oscillator.

In most cases, choosing a varactor diode for low phase noise requires only that the highest available Q be selected for the operating frequency and tuning bandwidth required. The selection of transistors, however, is a more involved process. The transistor intended for use as a microwave oscillator must offer a high f_{max} to ensure reasonable efficiency, have a sufficiently large active area to provide



8. Low-noise VCOs typically have phase noise 10 to 15 dB lower than standard VCOs. These curves should be compared to those displayed in Figure 7.



9. Frequency response of a VCO in response to a tuning-voltage step change. The input-drive waveform reaches its final value at time t_0. The VCO frequency reaches the lower edge of its specified tolerance band Δf_{ST} at time t_{ST}. Settling time is the interval t_{ST} to t_0. The required final frequency is reached at time t_r. The frequency drift that occurs between two arbitrarily defined times t_1 (which may be defined typically as 10 μs. to 1 sec. after the tuning step has been applied to the VCO) and t_2 (which is defined as "post-tuning drift").

adequate output power, and have a low-enough thermal resistance to ensure thermal stability.

The problem is that the f_{max} is higher for devices with smaller areas and, conversely, larger-area devices yield higher output power at lower frequencies. Thus, the transistor is selected by balancing output power vs. oscillator efficiency.

The transistor with the largest device geometry or periphery that will operate at the design frequency is usually selected. For example, in designing a +10-dBm-power-

> *Once oscillation begins due to any small amount of noise at the amplifier's input, the signal will build up until the amplifier's output reaches its saturated limit.*

output 10-GHz oscillator for low noise, a bipolar transistor with an F_t of 8 GHz and saturated output power of +20 dBm would be preferable to another device with an F_t of 12 GHz and the capability of only +13-dBm output power. As a general rule, silicon bipolar transistors are used rather than FETs in oscillators through Ku band when low noise is the most important consideration, since the phase-noise performance of silicon bipolar oscillators is typically 10 to 15 percent lower than that of FET oscillators operating under the same conditions.

The design of low-noise oscillators is complicated when frequency tuning is required. If only a narrow tuning range (< 2 percent) is needed, a cavity-stabilized or dielectric resonator oscillator with a frequency-pulling circuit—essentially an AFC with user access to the error voltage loop—is often the best choice. Thin-film VCOs can also be suitable with circuit optimization, and careful varactor and semiconductor selection.

When wider tuning bandwidths (10 to 15 percent) are required, VCO circuits using high-Q tuning diodes and low-noise silicon transistors, combined with special feedback techniques that reduce FM noise while retaining other critical VCO performance characteristics, are necessary. The best noise performance is obtained by tuning the VCO directly, without the use of a linearizer. A practical linearizer circuit will contribute AM noise to the control signal, which results in VCO phase noise at the oscillator output.

The impedance of the tuning voltage source fed to a "raw" VCO should be very low and, in many cases, shielding may be required on interconnecting leads and wires to suppress stray pick-up. Noise specifications should include

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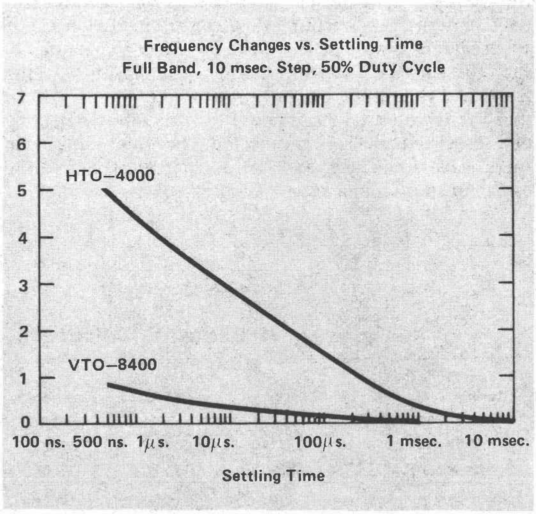


10. Comparison of the settling times of two standard VCOs at 4 GHz. Use of a silicon varactor results in substantially faster settling than does the use of a GaAs varactor.

the required tuning video bandwidth, which should be as small as possible.

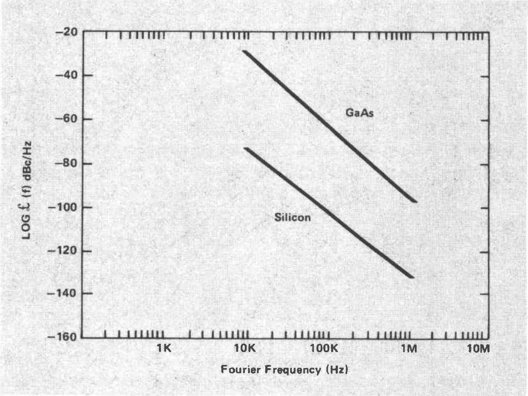
Power-supply voltage regulation is also a very important consideration when using low-noise VCOs. Fluctuations or noise on the bias voltage supplied to the oscillator will cause frequency pushing, which also appears as phase noise on the output-signal spectrum. Figure 8 shows the typical FM noise performance of a 600-MHz thin-film oscillator, and of an 8-GHz fundamental thin-film oscillator designed specifically for low-noise applications.

Settling Time and Post-Tuning Drift

For a VCO, settling time is defined as that interval between the time when the input-tuning-drive waveform reaches its final value and the time when the VCO frequency falls within a specified tolerance of a stated final value. In Figure 9, the input-drive waveform reaches its final value at time t_0. The VCO frequency reaches the lower edge of its specified tolerance band Δf_{ST} at time t_{ST}. Settling time is the interval t_{ST} to t_0. The required final frequency is reached at time t_r.

Post-tuning drift is defined as the frequency drift that occurs between two arbitrarily defined times t_1 (which may be specified typically as 10μs. to 1 sec. after the tuning step has been applied to the VCO) and t_2. For short-term PTD, time t_2 would generally be defined in the range of 10μs. to 1 sec. after t_1; for long-term PTD, t_2 could range from 1 sec. to 1 hr. Drifting of bias voltages and thermal effects (i.e., changes in both the varactor and transistor junction temperatures) are the primary contributors to short-term PTD.

Bias circuit design is critical to PTD performance. The change in frequency due to a change in input bias is approximately 0.3 to 0.7 percent per Volt. This cannot be eliminated simply by using a well-regulated bias supply, since dramatic changes in PTD will occur due to changes in the transistor load present at the device end of the oscillator's internal bias circuitry. As the operating frequency of an oscillator is varied, the currents flowing in both the varactor and the transistor change (the reason why the frequency-vs.-output power curve is not perfectly flat), thus varying the amount of power dissipated (the efficiency of the oscillator). This means the load on the bias line varies with frequency, and the bias circuitry within the oscillator must compensate.



11. Single-sideband phase-noise comparison of a silicon and a GaAs varactor used in an 8-GHz VCO. The superiority of the silicon varactor in phase noise is readily apparent.

During the interval when a VCO is being tuned, the junction temperatures of both the transistor and varactor are also changing due to the changes in RF circuit efficiency and loading. This causes impedance changes, which result in frequency shift. The time interval during which this happens is dependent upon the thermal impedance of the devices.

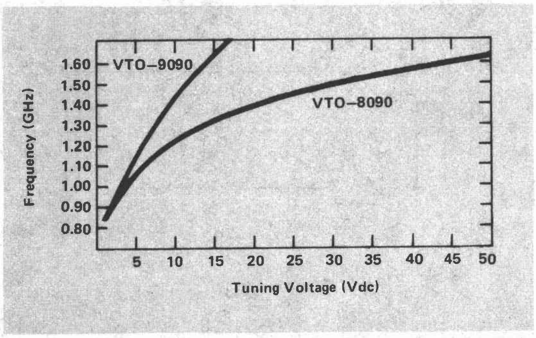
Varactors used below Ku band are made typically from silicon. Above 12 GHz, GaAs varactors are used because of their higher Q. The GaAs devices have higher thermal resistance than silicon devices; this results in significantly higher short-term PTD factors.

Changes in the junction temperature of the transistor can be minimized through a reduction in input bias power. The trade-off is that reduced bias results in lower oscillator output power so that additional amplifier stages are required to bring the power output up to the required level.

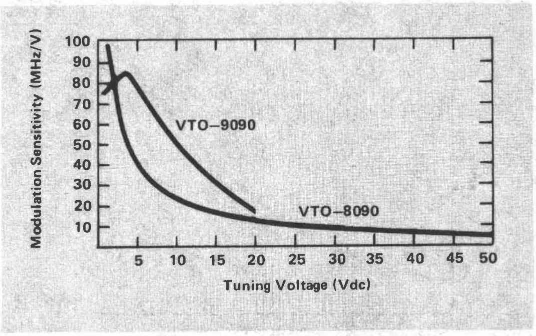
Long-term PTD is affected mainly by the varactor-charging effect over a period of time. This reversible effect is caused by impurity ion buildup around the varactor junction over a long period of time. This causes a change in the capacitance of the varactor, resulting in a frequency change in the oscillator. Passivation of silicon varactors has been very successful in reducing this effect. Long-term PTD

Table I
Relative VCO Performance vs. Type of Varactor Diode

Diode	Linearity	Tuning Voltage	Harmonics	Residual FM	Phase Noise	Temperature Stability	Settling Time	PTD
Si-Abrupt	Fair	0 to 60	Good	Very good	Very good	Very good	Excellent	Excellent
Si-Hyperabrupt	Good	0 to 20	Good	Good	Good	Good	Excellent	Excellent
GaAs-Abrupt	Fair	0 to 50	Good	Good	Good	Excellent	Good	Good
GaAs-Hyperabrupt	Good	0 to 20	Good	Fair	Fair	Fair	Fair	Fair



12. Tuning voltage vs. frequency for similar non-buffered VCO modules. One uses an abrupt-tuning varactor, the other a hyperabrupt-tuning varactor. The hyperabrupt varactor provides a significant improvement in tuning linearity with a significantly lower tuning-voltage range.



13. The superior linearity of the VTO-9090 can be seen by comparing the modulation-sensitivity curves displayed here, with the two tuning-voltage characteristics shown in Figure 12.

has been improved to yield less than 1 MHz frequency drift for one-hour periods. No such technique has yet been applied effectively to GaAs varactors, which display a significant charging effect.

Figure 10 is a comparison of fundamental transistor oscillators using a silicon varactor diode (Avantek VTO-8400) and a GaAs varactor diode (Avantek HTO-4000) at 4 GHz. Both settling time and post-tuning drift can also be affected by instability of the tuning signal.

Table I illustrates the various VCO parameters affected by the varactor. Care should be taken in selecting the correct type of VCO for a particular application, keeping in mind the trade-offs between tuning voltage limits, phase noise, settling time, and PTD. Figure 11 depicts a phase-noise comparison between a VCO using a silicon tuning diode versus one with a GaAs tuning diode, to highlight the phase-noise trade-offs.

Tuning Linearity and Linearizers

Whether silicon or GaAs, there are two basic types of varactors: abrupt and hyperabrupt. The essential difference between the two is that the concentration of N-type dopant is nearly constant across the depletion region of an abrupt diode, but is nonlinear in a hyperabrupt diode. As the reverse bias is increased, the nonlinear doping profile causes a greater capacitance change in the hyperabrupt-junction diode than in the abrupt-junction diode. This results in a more nearly linear tuning curve, and a lower maximum tuning voltage.

The equation for junction capacitance vs. applied voltage for the abrupt varactor is approximated by:

$$C\,(V) = \frac{C\,(0)}{\left(1 + \dfrac{V}{\phi}\right)^{\gamma}} \tag{8}$$

where C(0) = junction capacitance at 0 Volts,
V = applied voltage
ϕ = contact potential
γ = a constant.

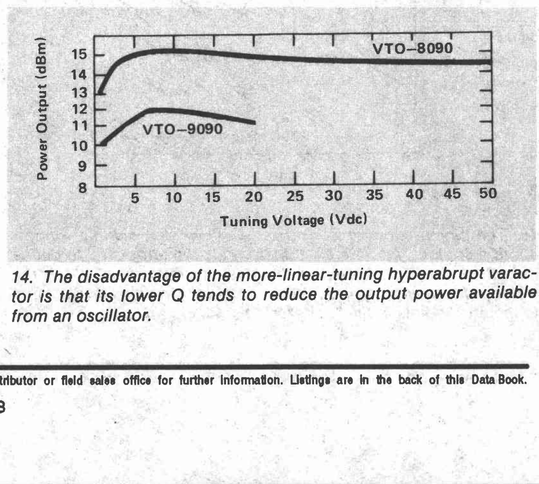
γ is dependent on the doping of the device, but is usually equal to approximately 0.5 for an abrupt-junction diode. For $\gamma = 2$, which is approximately the case for a hyperabrupt-junction varactor, the tuning curve is nearly linear.

The abrupt-tuning diode will provide a very high Q with a continuous monotonic tuning curve, and will also operate over a very large range of tuning voltages (0 to 50 V). Because of its high Q, the abrupt diode offers the best available phase-noise performance. Both silicon and GaAs abrupt diodes are available, and both are used in VCOs.

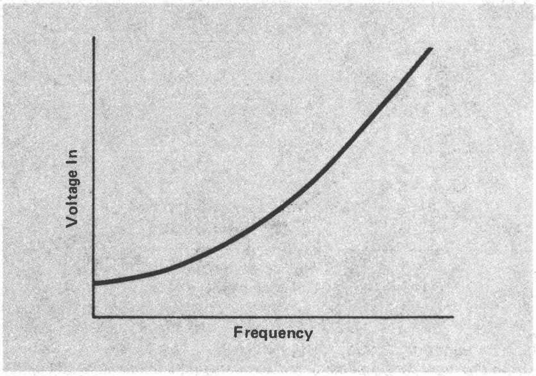
The hyperabrupt diode will provide a much more linear tuning response than the abrupt diode due to its linear voltage-vs.-capacitance characteristics. This also enables it to cover a wider frequency range in a smaller tuning voltage (0 to 20 V). Its drawback is a much lower Q than the abrupt diode. This results in a phase noise typically about 3 dB higher than for an abrupt diode.

The trade-offs become obvious by examining the performance of two fundamental-output voltage-tuned oscillators covering 900 MHz to 1600 MHz (Figs. 12 to 14). The Avantek VTO-8090 employs an abrupt-tuning varactor while the VTO-9090 uses a hyperabrupt-tuning varactor.

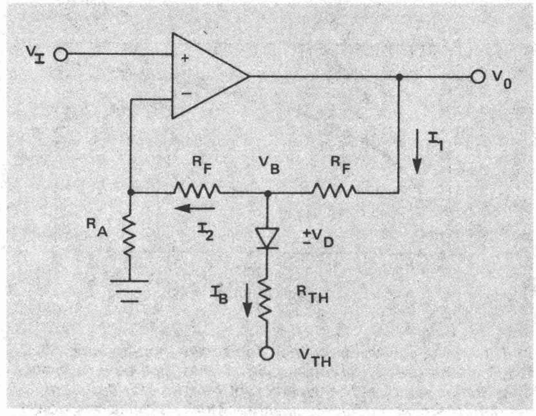
The superior linearity of the VTO-9090 can be seen by comparing the two tuning-voltage characteristics (Fig. 12) and their modulation-sensitivity curves (Fig. 13). Note the power output difference of the two types of oscillators (Fig. 14). The abrupt-tuned VCO has higher power than its hyperabrupt-tuned counterpart. This is due to the higher Q of the abrupt varactor.



14. The disadvantage of the more-linear-tuning hyperabrupt varactor is that its lower Q tends to reduce the output power available from an oscillator.



15. Typical varactor-tuned-oscillator voltage-vs.-frequency curve. Note that, although nonlinear, the curve is monotonic—an increase in tuning voltage always results in an increase in frequency. This curve can be linearized with additional circuitry at the expense of new problems.



17. In this typical analog-linearizer circuit, V_{TH} will determine where an increase in the voltage-vs.-frequency slope will occur and R_{TH} will determine the amount of the increase in the slope that takes place.

A typical VCO tuning curve is shown in Figure 15. Where a straight voltage-vs.-frequency curve is necessary (e.g., in an open-loop system), a linearizer may also be needed.

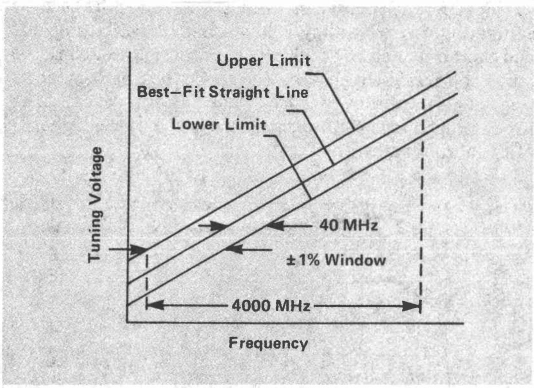
Using a VCO linearizer can provide a very accurate tuning curve but creates its own set of problems. In addition to the tuning-curve correction, a linearizer can provide

1. a low tuning-voltage range, typically 0 to 10 Volts;
2. a constant tuning-port input impedance;
3. simple interface to a digital-to-analog (D-A) converter.

On the negative side, a linearizer

1. requires additional input power;
2. may result in a higher MHz-per-Volt modulation sensitivity (which may not be desirable);
3. will almost invariably have a lower input impedance than the oscillator;
4. will reduce the modulation bandwidth.

The tuning curve of a linearized VCO will fall within a window about a straight line. Percent linearity is the term used to define the actual linearity achieved vs. the "best-fit straight line." This is graphically shown in Figure 16.



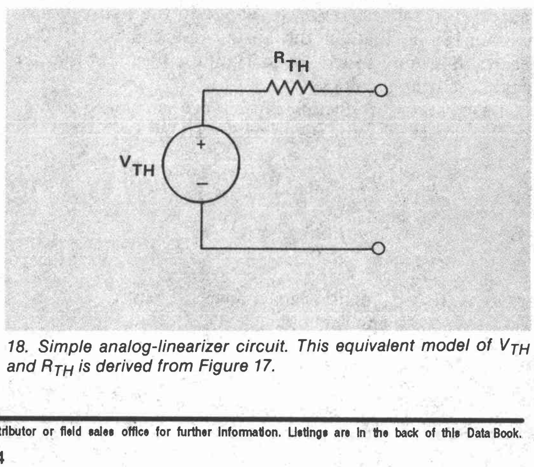
16. The tuning curve of a linearized VCO will fall within a window about a straight line. "Percent linearity" is the term used to define the actual linearity achieved vs. the "best-fit straight line." Within the window there will be typically some irregular variations in slope due to the breakpoints in the linearizer.

Calculating percent linearity is done by taking one-half the measured window, dividing this figure by the total tuning range, and expressing the result as a percentage. Using the values given in Figure 16, percent linearity is expressed as:

$$\text{Percent} = \pm \frac{80/2}{4000} \times 100 = 1\% \tag{9}$$

Within the percentage window specified there will be typically some irregular variations in slope due to the breakpoints in the linearizer. The result is that the amount of frequency change per tuning-voltage change will vary from point to point along the curve. If modulation is applied to the tuning input, varying FM deviation would result over the tuning range. A slope-ratio limit should be specified where constant FM deviation is required.

A properly designed and "tweaked" linearizer can provide virtually any degree of linearity required for a particular application. Linearizer circuits may also incorporate the



18. Simple analog-linearizer circuit. This equivalent model of V_{TH} and R_{TH} is derived from Figure 17.

additional function of shifting the tuning voltage provided by the system to one more appropriate for the oscillator itself.

Typically two types of linearization schemes are employed today: analog and digital. The use of an analog linearizer is desirable when the oscillator interfaces with an analog tuning voltage or when a linear modulation spectrum is desired at any point in the frequency range. A simple analog-linearizer circuit is shown in Figure 17. The primary use for a digital linearizer is in applications where the oscillator is to be tuned by a digital computer.

Referring to the analog-linearizer circuit shown in Figure 17:

$$V_O = V_i + (I_2R_F) + (I_1R_F)$$

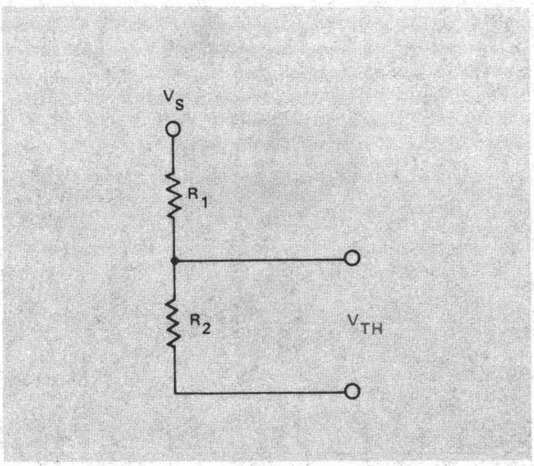
$$I_2 = \frac{V_i}{R_A}$$

$$I_B = \frac{(V_B - V_D - V_{TH})}{R_{TH}} \tag{10}$$

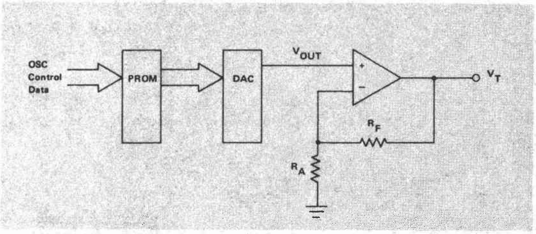
$$I_1 = I_B + I_2$$

Also $I_B = 0$ if $(V_D + V_{TH}) \leq V_B$

Therefore $$V_O = V_i \left(1 + \frac{2R_F}{R_A}\right) + I_BR_F \tag{11}$$



19. To replace R_{TH} and V_{TH} (Figs. 17 and 18) with a simple resistive divider, it is possible to calculate the required values using Thevenin's theorem. This provides the capability of introducing almost any number of changes to the slope of the tuning curve.



20. One of the most efficient linearization techniques combines an analog-to-digital converter with a PROM and an op amp. The PROM may be programmed to provide linearity better than 0.5 percent across the full frequency spectrum of the VCO and will also provide extremely fast tuning-response time, primarily limited by the settling time of the op amp.

From this it is easily seen that V_{TH} will determine where the increase in slope will occur and R_{TH} will determine the amount of the increase in the tuning slope.

To replace R_{TH} and V_{TH} with a simple resistive divider, Thevenin's theorem is used. By this method, the circuit shown in Figure 18 may be replaced by the circuit shown in Figure 19 where

$$V = \frac{V_s}{V_{TH}}$$

$$R_1 = \frac{R_{TH}}{V} \tag{12}$$

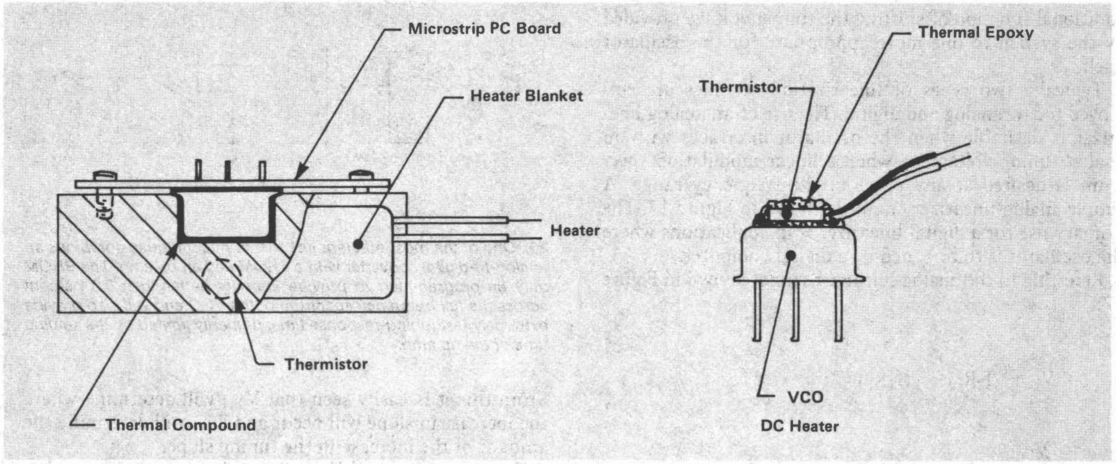
$$R_2 = \frac{R_{TH}}{(1-V)}$$

Using this type of circuit gives the designer the capability of introducing almost any number of changes to the slope of the tuning curve, which may all be implemented in parallel, depending upon the degree of linearity required. This circuit will also provide good modulation response, which will only be restricted by the frequency response of the op amp itself.

One of the most efficient linearization techniques combines an analog-to-digital converter with a PROM and an op amp (Fig. 20). Using this configuration and a small computer, the PROM may be programmed to provide linearity better than 0.5 percent across the full frequency spectrum of the VCO. The circuit will also provide extremely fast tuning-response time, primarily limited by the settling time of the op amp.

Temperature Compensation and Stabilization

A reduction of VCO frequency variations with changes in temperature may be carried out using one or more of these three basic techniques: control of the oscillator temperature, tuning-voltage temperature compensation, or the use of a phase-locked loop.



21. The temperature of a small VCO may be stabilized by mounting the oscillator on a block (which provides thermal mass) that is temperature-controlled by using a proportional heater, or with a small heater directly epoxied to the top of the TO-8 oscillator.

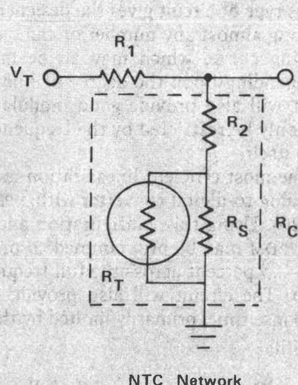
The temperature of a small component such as a TO-packaged VCO is easily controlled either by a very small, low-power heater or by placing the component in a temperature-controlled chamber (oven). DC proportionally controlled heater assemblies specifically designed for use on TO-8-type cans are available commercially. It is also relatively simple to fabricate a heater by mounting the oscillator on a block (which provides thermal mass) that is temperature-controlled using a proportional heater (Fig. 21).

A self-controlling heater that employs a material with a definitive temperature-vs.-resistance characteristic may be used. This material may be epoxied directly to the top of the TO-8 oscillator and then supplied with a bias voltage. The temperature-vs.-resistance characteristic of the material will make it act as a temperature-controlled heater that will provide very good temperature stability at a very low cost.

When any heater approach is used for temperature compensation, the temperature of the oscillator must be kept 5 to 10 degrees above the maximum expected system operating temperature. This will ensure that the oscillator will not be affected by the external temperature changes. The primary drawback to using the heater is the extra power required to keep the oscillator at a higher-than-ambient temperature.

The effect of temperature on the oscillator frequency may also be reduced indirectly by varying the tuning voltage in the proper direction to bring the oscillator back to

The second network is that using a NTC thermistor.

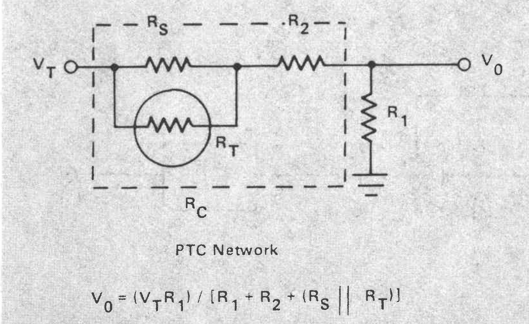


$$V_0 = V_t\,(R_2 + R_s \,||\, R_T) \,/\, [R_1 + R_2 + (R_s \,||\, R_T)]$$

$$R_T = R_{25}\,(1 + A)\,(T - 25)$$

Where:
T = Temperature in ^{o}C
A = Temperature coefficient of thermistor $\%/^{o}C$ @ $25^{o}C$
R_{25} = Thermistor resistance at $25^{o}C$

22. The effect of temperature on the frequency of a VCO may be reduced indirectly by varying the tuning voltage in the proper direction to bring the oscillator back to the correct frequency. This circuit, using a negative-temperature-coefficient (NTC) thermistor, is appropriate for use with oscillators that typically display a negative frequency-vs.-temperature drift coefficient. Note that the current through the thermistor should be held to less than approximately 1 mA (depending on the thermistor's mass) to prevent self-heating. Figure 23 shows a similar circuit using a positive-temperature-coefficient (PTC) thermistor.



23. *A VCO tuning-voltage-compensation network using a positive-temperature-coefficient (PTC) thermistor. Details of these terms are provided in Figure 22.*

Table II
Typical Digitally Tuned-Oscillator Specification
(Avantek DTO-2500)

Binary Word Input	12 bits
Frequency Range	2.5 to 6.5 GHz
Power Output	+7 dBm, minimum
Linearity	±80 MHz
Tuning Sensitivity	2.6 ± 1.0 MHz/LSB
Settling Time	2 MHz @ 2.0 μs.
Post Tuning Drift	2 MHz, maximum
Temperature Range	−54°C to +85°C

the correct frequency. Temperature compensation of the tuning network requires using a negative-temperature-coefficient (NTC) or positive-temperature-coefficient (PTC) thermistor or a network of thermistors, depending on the actual tuning circuitry used.

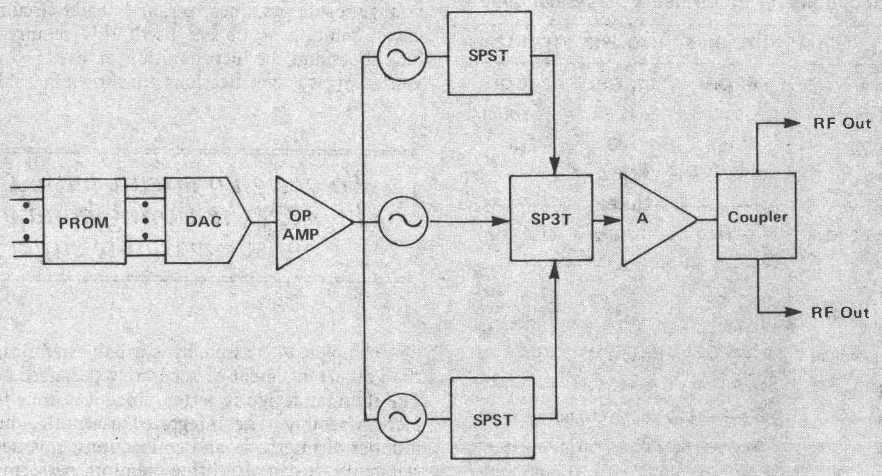
For example, Avantek VTO-8000 series oscillators will display typically a negative frequency-vs.-temperature drift coefficient. To compensate for this, a voltage-compensation network may be used. Two simple networks are shown in Figures 22 and 23.

Other types of resistance networks may be used in place of R_c. A suggestion for determining the resistor values for an effective compensation network is to hold the values of R_1 fixed, and use a curve-fitting routine to determine the values of R_2 and R_s when the desired value of R_c is known for at least three different temperatures.

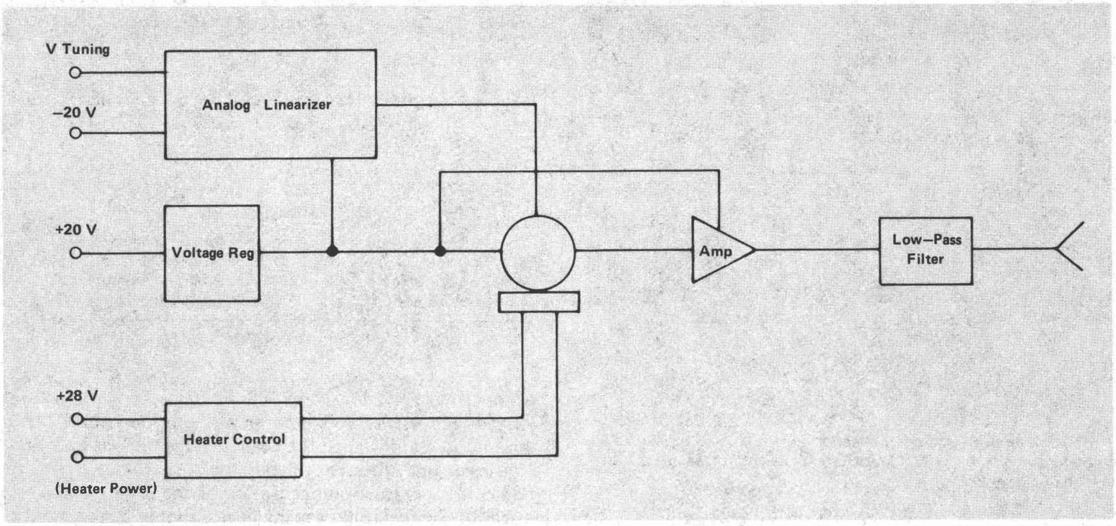
When temperature compensation of the tuning voltage is used, the temperature-sensing device should be mounted as close as possible to the oscillator itself. This will provide the shortest thermal time constant possible from the sensing device to the compensated oscillator.

Phase-locked loops using VCOs are becoming much more common due to improvements in, and the greater availability of, divider techniques and SAW or crystal multiplied sources. Some of the more important requirements for an oscillator to be suitable for a phase-locked application are:

1. phase stability (spectral purity),
2. large electrical tuning range,
3. linearity of frequency vs. control voltage, and
4. (frequently) the capability of accepting wideband modulation.



24. *A typical DTO design with the frequency of three VCOs controlled simultaneously by input data via a PROM and a single D-A converter. A typical set of specifications for a DTO appears in Table II.*



25. A typical VCO assembly integrates a voltage-controlled oscillator with amplifiers, voltage regulators, linearizer, and heater circuitry. Typical VCO assembly specifications are given in Table III.

From the information supplied so far it is clear that, if a very-low-noise oscillator is required, the best performance will be obtained when the bandwidth is kept as low as possible (<20 percent) and the tuning voltage as high as possible (>10 V).

Digitally Tuned Oscillators and VCO Assemblies

A number of today's sophisticated systems require an oscillator that can be directly programmed in frequency by digital data inputs. A typical DTO design is shown in Figure 24. The input bits control the output frequencies of three VCOs in parallel via a PROM and a single D-A converter.

Unique design characteristics in this type of oscillator yield very good linearity, excellent frequency drift-vs.-temperature performance without a heater, and good frequency-settling time and post-tuning drift. DTOs of this type are also often classified as VCO assemblies. A typical set of specifications for a DTO (Avantek model DTO-2500) is shown in Table II.

The more traditional VCO assemblies differ from the DTO mainly in the elimination of the input digital interface. Most VCO assemblies (such as the one shown in Figure 25) integrate the voltage-controlled oscillator with amplifiers, voltage regulators, linearizer, and heater circuitry. In some cases, multiple VCOs are used; this requires additional amplifiers and the incorporation of switch combiner networks. Typical specifications are shown in Table III.

Table III
Typical Specifications for Integrated VCO Assemblies

	HTO-0102	HTO-0812	HTO-1218
Frequency range	1-2 GHz	8-12 GHz	12-18 GHz
Power output, min.	+15 dBm	+14 dBm	+14 dBm
Power flatness, max.	5 dB	3 dB	3 dB
Harmonics, min.	<———— 20 dBc ————>		
Spurious, min.	<———— 60 dBc ————>		
Residual FM (@ 3 dBc)	50 kHz	100 kHz	100 kHz
Load VSWR	<———— 1.5:1 ————>		
Linearity	<———— ±2% ————>		
Mod. sense ratio	1.8:1	2.0:1	2.0:1
Operating temperature	<——— −54° to +71°C ———>		
Tuning voltage	<——— 0 to +10 Vdc ———>		
Input power	<—— +20 Vdc @ 600 mA ——>		
	<—— −20 Vdc @ 250 mA ——>		
	<— +28 Vdc @ 4.0 A (Heater) —>		

To design a circuit with a very high Q, the tuning bandwidth must invariably suffer.

A complete VCO assembly is usually significantly smaller than an arrangement of separately packaged components. The thermal design is better, since it is done for the complete assembly. The integrated assembly minimizes the number of interfaces and connections; this helps improve reliability. It can also offer premium performance due to the complete control of all critical components, and of integrating and matching functions.

Table IV
Avantek Voltage-Controlled Oscillators

Product Series	Tuning Voltage	Phase Noise	Bandwidth	Linearity BSFL	Harmonics	Case	Post-Tuning Drift
VTO-8000	0 to +60	Good	75% max.	Fair	−15 dBc	TO-8V	Good
VTO-9000	0 to +20	Good	75% max.	Excellent	−14 dBc	TO-8V	Very Good
MTO-8000	0 to +60	Good	75% max.	Fair	−10 dBc	TO-8V	Good
HTO-	0 to +20	Fair	Octave	Excellent	−12 dBc	TO-8V*	Fair
LNO-	0 to −20	Excellent	30% max.	Good	−12 dBc	TO-8V*	Excellent
VTD-	0 to +30	Good	75% max.	Fair	−20 dBc	DIP	Excellent

(*Also available in Avanpak™ miniature flatpack)

VCO assemblies tend to be custom designs for particular applications. The basic performance trade-offs for particular VCO types should also be considered when specifying VCO assemblies.

One Family of "Raw" VCOs

To examine some of the characteristics of off-the-shelf VCOs, it is useful to look at the Avantek product line. The VTO-8000 series commercial VCOs combine a silicon transistor chip with a silicon abrupt varactor diode. Maximum tuning voltages are between 40 and 50 Volts, which typically is acceptable for most commercial applications. This series of VCOs, mated with a user-supplied low-impedance driver, exhibits tuning speeds on the order of less than 1 μs. across the full band. The operating temperature range for these products is 0° to +65°C, and they are packaged in compact, lightweight TO-8 cans.

The VTO-9000 series oscillators use a silicon transistor chip and silicon hyperabrupt varactor diode. This produces more linear tuning curves than their abrupt-tuned VTO-8000 counterparts. Tuning voltages required are less than 25 Volts, making them very compatible with digital systems. Nanosecond tuning speeds are achievable with a low-impedance driver due simply to the lower tuning-voltage swing required. The operating temperature range for these products is also 0° to +65°C.

Militarized MTO-8000 products exhibit the same basic performance characteristics as the VTO-8000 series. The major difference is that they have been designed and tested to meet performance specifications over the military temperature range of −54°C to +85°C.

HTO series militarized hyperabrupt VCOs are designed specifically for octave band coverage. They use silicon transistors and silicon hyperabrupt diodes for frequencies from 900 MHz to 2 GHz and use GaAs transistors from 2 to 18 GHz. Tuning speeds are on the order of 3 μs. The VCOs have been designed and tested for specification compliance from −54°C to +85°C, and are packaged in either hermetically sealed TO-8 cans or the Avanpak™ miniature microwave flatpak with field-replaceable coaxial connectors.

VTO-series buffered VCOs are designed specifically for good phase-noise and frequency settling-time characteristics. They can be tuned full band typically in less than 3 μs. while settling to within 1 MHz. Internal buffer amplifiers provide very good isolation from variations in load impedance while also minimizing frequency pulling. A customer-supplied heater is required to maintain the oscillator temperature at 80° (±5°C) for specified performance. ■

Reprinted from the November 1985 edition of MSN & COMMUNICATIONS TECHNOLOGY

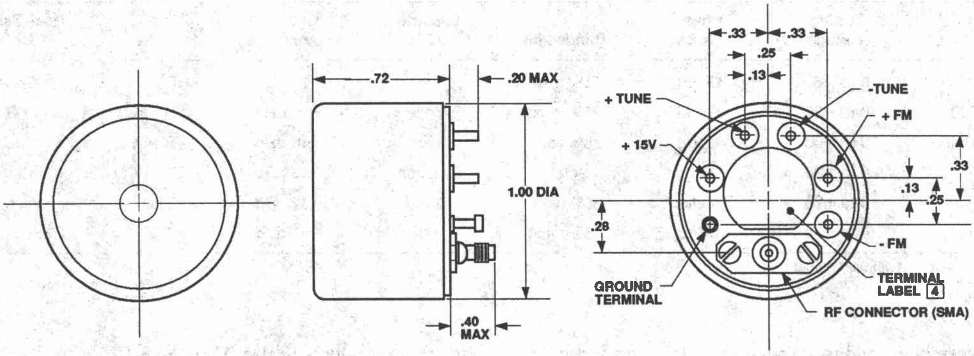


Figure 1. LUCY YTO Package

General

The LUCY YTO is packaged in a one inch diameter cylindrical housing, 0.72 inches high (see Fig. 1). The DC power, Main and FM coil tuning currents, and RF ouput ports are all positioned on the top, which is fixed to the body of the oscillator by a mechanical crimp. This roller crimping operation provides an effective moisture seal between the top and the case.

Electrical Requirements

The oscillator requires a single DC bias of +15 Volts +/– 0.5 Volt (+ 20 VDC Maximum) capable of supplying 100 mA (maximum) of current.

Tuning current for the main tuning coil is determined by dividing the output frequency desired (in MHz) by the coil sensitivity, in this case 20 MHz/mA. For example, the AV–7028 at 8 GHz requires 8000 MHz/20 MHz/mA or 400 mA. This current should be applied to the coil per the polarity indications on the label.

The FM coil is used to provide fine tuning, modulation, and phase locking capability. This coil has a much lower sensitivity (310 kHz/mA) and is rated at 300 mA maximum current. Current applied as indicated by the polarity markings on the label will increase the output frequency. Current of the reverse polarity will decrease the output frequency. An Application Note (AN-M001) is available which describes a general purpose driver for the FM coil.

Precautions

Do not exceed rated maximums: +20 VDC Bias voltage
300 mA FM coil current

Extreme caution should be observed during interconnect so as not to reverse the polarity of the +15 VDC supply or to operate the oscillator with either a poor or nonexistent ground return.

Do not disconnect the tuning leads to either coil when tuning current is flowing.

"Instantaneous" reversals of tuning current polarity are to be avoided.

Mounting Considerations

A mounting bracket is available (Avantek Part number 632-510786, see Fig. 2) which clamps the body of the unit and provides tabs with drilled holes, facilitating perpendicular placement on the mounting surface. This may be used with or without the optional mu–metal shield.

Placement should be such that adequate heat–sinking is provided so as not to exceed the rated operating temperature (0°C to +50°C). Note that the greatest portion of the power dissipated is due to the tuning current flowing through the main tuning coil.

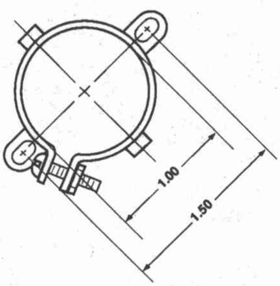


Figure 2. YTO Mounting Bracket

Optional mu–metal shield

As the frequency output of a YIG tuned device is determined by the applied magnetic field, an oscillator is susceptible to frequency deviations resulting from external magnetic field components co–axial to the internally generated field.

An optional mu–metal shield (see Fig. 3) is available for applications requiring reduced sensitivity to magnetic fields, decreasing susceptibility by a factor of two to three.

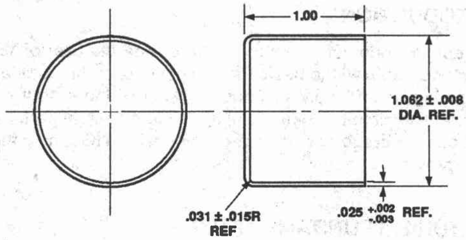


Figure 3. Mu-Metal Shield

INTRODUCTION

This applications note is intended to provide the user of YIG tuned oscillators with a basic FM coil driver circuit to facilitate fine tuning, modulation, or phase locking of the output frequency. The circuit, as well as simulated and actual performance data, is presented. A brief discussion of YIG tuning theory is provided.

YIG TUNING FUNDAMENTALS

The frequency of a YIG tuned fundamental oscillator is determined by the magnetic field applied to the ferrimagnetic resonator according to the relation F = 2.8 H where F = the frequency in MHz and H = the field in gauss. The resonator is placed in the air gap of an electromagnet with the field generated by current flowing through a coil (see Fig. 1). Typically the main tuning coil is designed to provide a sensitivity on the order of 20 MHz per mA of current applied to the coil. Thus, a 2 to 18 GHz YTO would require between 100 and 900 mA main tuning current.

To provide a fine tuning/modulation/phase–locking capability, a secondary coil is included with a much lower sensitivity, typically 300 – 500 kHz per mA. Due to design limitations, these coils are typically limited to 200 mA of tuning current. (Applications requiring higher current levels can be accommodated. Please consult the factory) With a bipolar current source, the maximum deviation at ± 200 mA is between ± 60 and ± 100 MHz. With an input impedance of approximately 0.3 to 1 ohms in series with 1 to 2 µH, typical 3dB bandwidths of the FM ports range from 50 kHz to 1 MHz and can go even higher with the removal of the RF filter capacitors from the FM port. The 3 dB bandwidth is defined as that frequency at which the current delivered by the driver circuit decreases by 3 dB (0.707) with a corresponding decrease in deviation by 0.707 (or 3 dB) from the value measured under static conditions. It is important to note that the 3 dB bandwidth realizable is a function of not only the oscillator, but the driver as well.

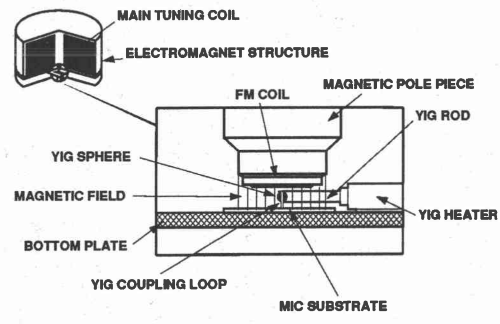


Figure 1. Basic YTO Structure

Circuit Design Considerations

The circuit described is intended to be a general purpose FM coil driver providing the basic voltage to current conversion function. Readily available components and standard PCB layout techniques are utilized. Performance can be enhanced by design optimization and component upgrades. Some of these improvements will be discussed later.

Circuit Description

The circuit as designed will provide ± 200 mA to the FM coil with an input of ± 10 V and supply voltages of + and – 15 V. U_1 is configured for a gain of –20 dB, (R_2/R_1), which results in a output voltage across R_6 of 1 volt. .

R_3 and R_9 (and R_4 and R_{10} by symmetry) control rise time and quiescent current. Increasing the value of R_3 (R_4) will decrease the rise time, however the quiescent current will increase. With the present configuration, rise time for a maximum current swing (–200 mA to + 200 mA) is 3.4 µs with a quiescent current of 5 mA per side (+ and – 15 volt supplies).

Q_1 and Q_2 should be adequately heat sunk due to the current levels present.

R_7 and R_8 are biasing resistors for Q_1 and Q_2.

R_5 and R_6 are present for circuit simulation only and are not physically realized in the actual circuit.

Circuit Simulation

The circuit was developed and modeled using MICRO–CAP II* with the circuit topology shown in Fig. 2. The circuit was then analyzed to determine both the AC and the transient response, results of which appear in Fig. 3 and 4 respectively.

* Product of Spectrum Software

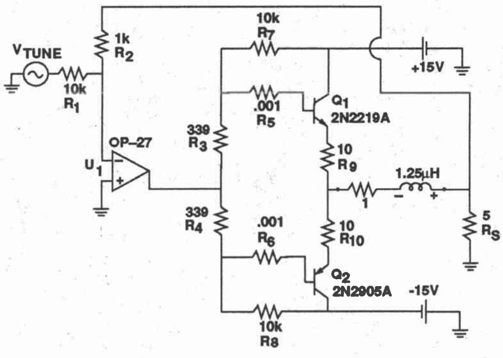


Figure 2. FM Coil Driver

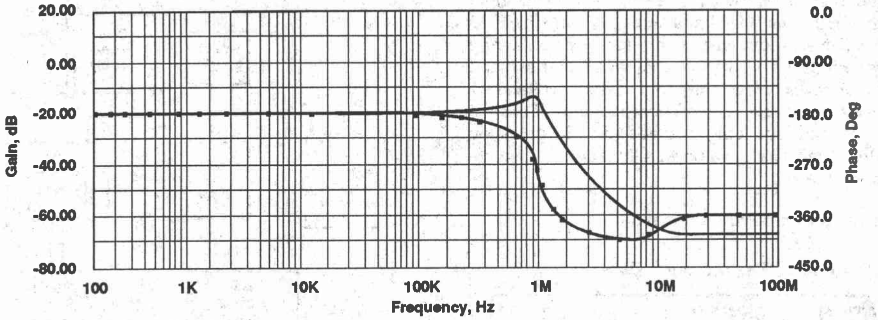


Figure 3. AC Analysis

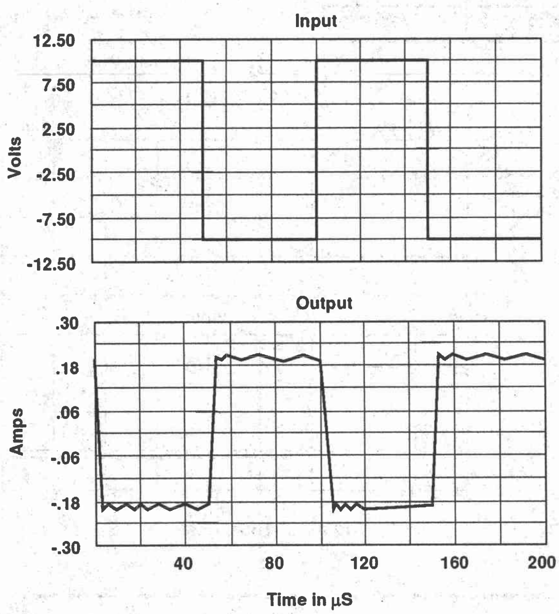


Figure 4. Transient Analysis

Circuit Performance

The circuit as described was constructed on a proto board using discrete components. The test equipment configuration of Fig. 5 was used to evaluate the circuit by monitoring the input signal to the driver, the output voltage across R_s, and the YTO output. The 3 dB bandwidth was determined by monitoring the input waveform as the input frequency was increased and noting that frequency at which the input current (voltage as measured across the sense resistor) decreased to .707 of its initial value. The corresponding decrease in FM deviation from the DC (less than 10 Hz) value was then determined using the spectrum analyzer.

Table 1 summarizes the performance data.

Table 1. Performance Data

DEVIATION AT DC (MHz)	DEVIATION AT 3dB FREQ (MHz)	3dB FREQ (kHz)
±50	±35	190
±20	±14	385
±10	±7	500
±5	±3.5	525

Rise time was measured by observing the voltage waveform across the sense resistor R_s (see Figure 6) using the digital oscilloscope.

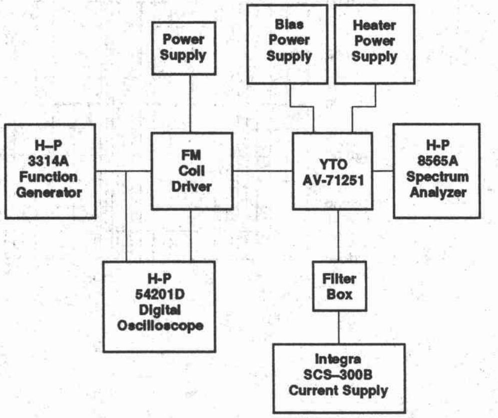


Figure 5. Test Equipment Configuration

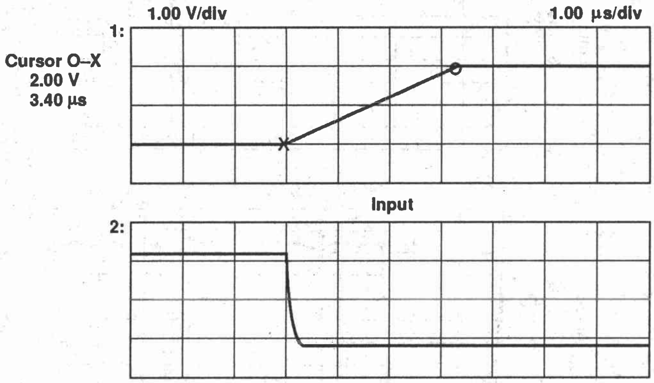


Figure 6. Rise Time

Further Considerations

The circuit as described is suitable for general purpose use in many YIG tuned oscillator applications. In certain situations, enhancements can be made to the design which will improve performance. For instance, in phase-lock-loop applications, limiting the circuit bandwidth and slew rate of the op amps will result in less phase noise degradation due to the driver. On the other hand, for applications requiring high rates of modulation, the designer would want to utilize op amps with faster slew rates and wider bandwidths. Also worth considering is the aforementioned trade–off between rise time and quiescent current.

In conclusion, the design as presented will meet many FM coil driver requirements and will provide a suitable framework for modification for those applications with more stringent requirements.

INTRODUCTION

This applications note describes a method of designing oscillators using small signal s parameters. The background theory is first developed to produce the design equations. These equations are then applied to develop three different oscillators: a 4 GHz bipolar lumped resonator oscillator, a 4 GHz bipolar dielectric resonator oscillator, and a 12 GHz GaAs FET dielectric resonator oscillator.

THEORY

Microwave transistors can be used for both amplifier and oscillator applications. From the small signal s parameters of the transistor, the *stability factor* k can be calculated from:

$$k = \frac{1 + |D|^2 - |s_{11}|^2 - |s_{22}|^2}{2\,|s_{21}|\,|s_{12}|}\,, \qquad (1)$$

where

$$D = s_{11}s_{22} - s_{21}s_{12}. \qquad (2)$$

Note that since the transistor s parameters change with frequency, k also varies with frequency.

A transistor is unconditionally stable at any frequency where k>1. This condition guarantees that at the specified frequency the transistor will not oscillate into any termination at either port that has a positive resistance (i.e. into any impedance that is inside the Smith chart). To be mathematically rigorous, we should add that the condition |D|<1 must also be met to insure stability; since in practice with real circuits this seems always to be the case we ignore this requirement in this design procedure.

For amplifiers it is desirable to have k>1. At any frequency where this condition holds, a simultaneous match can be achieved at both ports, resulting in

$$s_{11}' = s_{11} + \frac{s_{12}\;s_{21}\;\Gamma_L}{1 - s_{22}\;\Gamma_L} = 0 \qquad (3)$$

$$s_{22}' = s_{22} + \frac{s_{12}\;s_{21}\;\Gamma_G}{1 - s_{11}\;\Gamma_G} = 0 \qquad (4)$$

In these equations Γ_G is the reflection coefficient seen looking into the generator, Γ_L is the reflection coefficient seen looking into the load, the unprimed s parameters refer to the transistor as measured with 50 Ω terminations, and the primed s parameters show the effects of loading the transistor with Γ_G and Γ_L. When equations (3) and (4) are satisfied, there is no reflected power at either the input port or at the output port. The power gain of the transistor under these conditions is called the maximum available gain (G_{ma}), and is given by:

$$G_{ma} = |s_{21}'|^2 = \frac{|s_{21}|}{|s_{12}|}\left(k - \sqrt{k^2 - 1}\right) \qquad (5)$$

The s parameters are a function of the common (ground) lead. Usually amplifiers are built in the common emitter or common source configuration since k is often greater than one with this grounding. If k<1 it is still possible to design an amplifier for finite gain. To do so the condition that both Γ_G and Γ_L are in the stable region must be satisfied. With k<1 a simultaneous match is not possible, as selecting $\Gamma_G = s_{11}'^* = 0$ and $\Gamma_L = s_{22}'^* = 0$ would result in terminations in the unstable region. With k<1 the amplifier must be less than perfectly matched; many practical amplifiers are built in this manner.

This discussion of amplifier design gives us some insight into how to design an oscillator from small signal s parameters. If we can design an "amplifier" for which k<1 and either Γ_G or Γ_L is in the unstable region, we will in reality have designed an oscillator (see Figure 1).

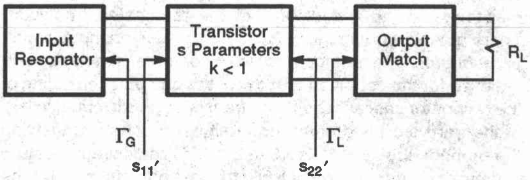


Figure 1. Oscillator Design

The necessary conditions for oscillation can be restated as:

$$k < 1 \qquad (6)$$

$$s_{11}'\,\Gamma_G = 1 \quad \text{and} \quad s_{22}'\,\Gamma_L = 1 \qquad (7)$$

If the active device selected has a stability factor greater than one at the desired frequency of oscillation, condition (6) can be achieved either by changing the two-port configuration (changing from common emitter to common base or common collector, for example) or by adding feedback.

Condition (7) simply confirms that the oscillator produces power at both ports. If either condition in (7) is satisfied, the other condition is automatically satisfied. Once we have achieved k<1, condition (7) gives the necessary relationship to complete the oscillator design. We will adopt the technique of resonating the input port and designing a match that satisfies condition (7) at the output.

The upper frequency for oscillation is limited to f_{max}, which is the frequency where unilateral gain equals unity. The unilateral gain is generated by reducing the s parameters to a single gain parameter given by:

$$s_{11}' = 0$$
$$s_{22}' = 0$$
$$s_{12}' = 0$$

$$U = |s_{21}'|^2 = \frac{1/2\,|s_{21}/s_{12} - 1|}{k\,|s_{21}/s_{12}| - \mathrm{Re}\{s_{21}/s_{12}\}} \qquad (8)$$

This parameter U is the highest gain the transistor can ever achieve and it is invariant to the common lead. In practice, it is difficult to build a useful oscillator at frequencies above $f_{max}/2$.

Design Procedure

Oscillator design from s parameters therefore proceeds as follows. First an active device is selected, and its stability factor k is calculated at the desired frequency of oscillation. If k<1 the design can proceed. If k>1, a configuration change must be made or feedback must be added until k<1 is achieved.

With k<1 we know that an input matching circuit having Γ_G which produces $|s_{22}'| > 1$ can be found. The design condition is therefore

$$|s_{22}'| > 1 \quad (9)$$

This condition can be viewed as stating that there is a negative resistance at the output port of the terminated transistor. There are many techniques for realizing such an input circuit, or *resonator*. One method is to use a computer simulation and optimize for the condition that s_{11} of the one port consisting of the resonator cascaded with the transistor (this is equal to s_{22}' of the transistor) is greater than unity. A resonator satisfying the property that $|\Gamma_G| = 1$ is lossless; this is a desirable feature in most oscillator designs. Oscillators are often named by the type of resonator they employ, as shown in Table 1.

Table 1

Resonator	Oscillator Name
Cavity	High Q or Stable
YIG	YTO (YIG Tuned Oscillator)
Varactor	VTO (Voltage Tuned Oscillator)
Lossless Transmission Lines	Distributed or Microstrip Oscillator
Lossless Lumped Element	Lumped Oscillator
Dielectric Resonator	DRO (Dielectric Resonator Oscillator)

With the input circuit established, the load circuit is designed to satisfy

$$\Gamma_L = 1/s_{22}' \quad (10)$$

which follows directly from condition (7). Note that since $|s_{22}'| > 1$, this equation guarantees $|\Gamma_L| < 1$, i.e. the load resistor will be positive.

For the special case where the oscillator is intended to oscillate directly into a 50 Ω load, no load circuit needs to be designed, and the condition for oscillation can be re–expressed. If the load is 50 Ω, $\Gamma_L = 0$. Therefore, since $|s_{22}'|\ \Gamma_L = 1$, we have $|s_{22}'| = 1$. In practice it has proven sufficient to design for

$$|s_{22}'| > 100. \quad (11)$$

Satisfying condition (9) requires $|\Gamma_L| < .01$, which corresponds to a load that is essentially 50 Ω.

The above method will only predict the frequency of oscillation. It provides no information about output power, harmonics, phase noise, or other parameters of possible interest. In general the output power of the oscillator will approach the 1 dB compression power ($P_{1\,dB}$) of the transistor used as an amplifier if the dc bias is designed for maximum $P_{1\,dB}$. Other performance parameters would typically have to be measured from the finished oscillator.

Design Examples

Example 1: A 4 GHz Lumped Resonator Oscillator

The first example is a computer study of a 4 GHz lumped resonator oscillator based on the Avantek AT–41400 bipolar transistor chip. The program used in this design is TOUCHSTONE™ from EEsof; any other linear analysis and optimization could equally well be used. To achieve an "active device" with k<1, the transistor chip is used in the common base configuration. The catalog common emitter s parameters are use to describe the transistor chip. The s parameters for a bias of 8V and 25 mA are selected to give the best output power. Since this data includes .5 nH of base bonding inductance and .2 nH of emitter bonding inductance (see reference 1), these parasistics have to be removed (by cascading negative valued inductors) to get to the chip level s parameters. The .21 nH base bond wire used in the oscillator is included as part of the "active device" description. Note that the nodal connections establish the emitter as the input and the collector as the output. Analysis shows that this two port has a stability factor k = –.423 at 4 GHz. Since this value is less than one, we know that an oscillator design is possible.

A topology of series inductor (emitter bond wire) – shunt capacitor is chosen for the resonator. Note that other resonator topologies are possible; this choice represents one possible solution that is easily realized physically. Initial values are guessed (4 pF for the capacitor, .2 nH for the inductor) and the circuit is optimized for s_{11} of the oscillator greater than 100. Optimization finds a solution of C=3.9891 pF; LE=.16044 nH, and LB=.21362 nH. The circuit file is shown in Figure 2, along with the output file. Note MAG[S11] of OSC = 140.756 > 100, i.e. the circuit will oscillate into an essentially 50 Ω load. A schematic for the finished design is shown in Figure 3.

```
! <OSCEX1_T.CKT>
! A 4 GHZ LUMPED RESONATOR OSCILLATOR USING THE AT-41400 CHIP

CKT

         IND_LBX  1        2                  L=-.5
         S2PA     2        3         4        A:\S_DATA\AT41400G.S2P
         IND_LEX  4        5                  L=-.2
         DEF3P    5        3         1        CHIP
! CHIP IS THE AT-41400 CHIP WITH BOND WIRES REMOVED AND CONFIGURED COMMON BASE

         CHIP     1        2         3
         IND_LB   3        0                  L#.15 0.21362 1
         DEF2P    1        2                  XR
! XR IS THE ACTIVE DEVICE FOR THE OSCILLATOR

         CAP_CR   1        0                  C# .01 3.98910 25
         IND_LE   1        2                  L# .15 0.16044 1
         XR       2        3
         DEF1P    3                           OSC
!OCS IS THE RESONATED OSCILLATOR


FREQ

         STEP     4

OUT

         XR       K
         OSC      S11

OPT

         XR       K<1
         OSC      MAG[S11]>100
```

Figure 2a. Circuit File for 4 GHz Lumped Resonator Oscillator

```
FREQ-GHZ          K MAG[S11] ANG[S11]
                 XR       OSC       OSC

4.00000      -0.423  140.756   52.435
```

Figure 2b. Output File for OSCEX1_T.

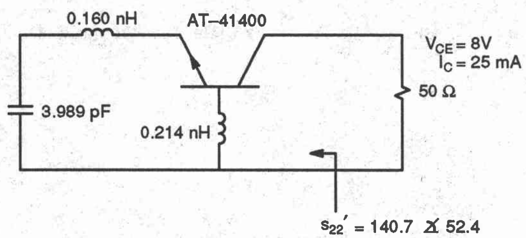


Figure 3. Lumped Resonator Oscillator at 4 GHz

Example 2: A 4 GHz Dielectric Resonator Oscillator

A more interesting circuit to build is an equivalent 4 GHz oscillator that uses a dielectric resonator (DR) in series configuration to create the input resonator. In this application the DR is tightly coupled in the $TE_{01}\delta$ mode (reference 2) to an input 50 Ω microstripline. This effectively creates a very large resistance (i.e. open circuit) at the correct electrical distance from the transistor, causing oscillation. One advantage to using a DR as the input resonator is that the very high unloaded Qs of these devices (often on the order of 10000) yields an oscillator with little tendency to drift in frequency. The fact that the resonator consists effectively of an open circuit that is only coupled to the line at the frequency of oscillation indicates that at other frequencies the transistor can be terminated in 50 Ω, greatly reducing the possibility of secondary oscillations at undesired frequencies.

Once again the circuit can be simulated and optimized for s_{11} OSC > 100. The dielectric resonator is modeled by a large valued series resistor. The initial estimate of 1000 Ω comes from an estimate of 10 for the coupling coefficient β of the DR to the microstripline (typical for this kind of application), and the relationship that $\beta = R/(2\ Zo)$. This value and the distance from the transistor at which the DR is coupled are the variables for optimization. A printout of the circuit file and the resultant output are given in Figure 4; the schematic for the resulting oscillator is shown in Figure 5. Measurements on this oscillator (reference 3) show that as predicted the frequency of oscillation is 4 GHz. The observed output power of +14 dBm is in fair agreement with the +19 dBm level that would be predicted from the $P_{1\,dB}$ of the transistor. This oscillator also exhibited excellent phase noise performance, –117 dBc/Hz at 10 KHz from the carrier.

```
! <OSCEX2_T.CKT>
! A 4 GHZ DIELECTRIC RESONATOR OSCILLATOR USING THE AT-41400 CHIP

CKT

         IND_LBX  1        2                   L=-.5
         S2PA     2        3         4         A:\S_DATA\AT41400G.S2P
         IND_LEX  4        5                   L=-.2
         DEF3P    5        3         1         CHIP
! CHIP IS THE AT-41400 CHIP WITH BOND WIRES REMOVED AND CONFIGURED COMMON BASE

         CHIP     1        2         3
         IND_LB   3        0                   L=.33
         DEF2P    1        2                   XR
! XR IS THE ACTIVE DEVICE FOR THE OSCILLATOR

         RES_DR   1        0                   R/1.421e+03
         TLINP    1        2                   Z=50 L/218.81238 K=6.6 A=0 F=1
         IND_LE   2        3                   L=0.5
         XR       3        4
         DEF1P    4                            OSC
!OCS IS THE RESONATED OSCILLATOR


FREQ

         STEP     4

OUT

         XR       K
         OSC      S11

OPT

         XR       K<1
         OSC      MAG[S11]>100
```

Figure 4a. Circuit File for 4 GHz Dielectric Resonator Oscillator

```
FREQ-GHZ          K MAG[S11] ANG[S11]
                 XR       OSC       OSC

4.00000      -0.675  195.417   -38.919
```

Figure 4b. Output File for OSCEX2_T.

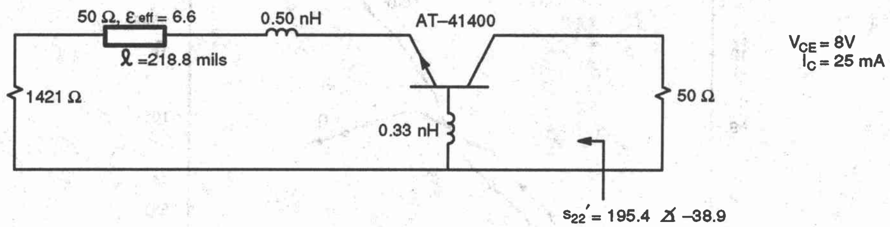


Figure 5. Dielectric Resonator Oscillator(DRO) at 4 GHz

(Phase noise is a way of measuring the "noise skirts" of the oscillator. This noise level is expressed as being a certain level below the oscillation signal, at a certain distance out from the center frequency of oscillation. High levels of suppression at a narrow spacing indicates a very quiet oscillator.)

Example 3: A 12 GHz Dielectric Resonator Oscillator

Most high performance microwave bipolar transistors have an f_{max} on the order of 20 GHz. Thus it is difficult to build oscillators with these devices at 12 GHz (above $f_{max}/2$). Gallium arsenide field effect transistors, with typical f_{max} values approaching 100 GHz, provide a reasonable solution to this problem. Where possible silicon bipolar transistors are used for oscillator design because of their superior phase noise performance.

The third example uses a dielectric series resonator to input tune a common–source GaAs FET, the packaged AT–10635. The s–parameter data is taken from the model (reference 4) of the AT–10635 at a bias condition of 5V, 30 mA. As before a circuit simulation is done, with the variable for optimization being the position of the DR relative to the transistor. The resulting circuit is given in Figure 6; this circuit uses a dielectric substrate of $\varepsilon = 2.2$ and h = 20 mils.

This oscillator has been built and tested over temperature. These measurements show another significant advantage of DROs: by choosing a DR with the appropriate temperature coefficient, an oscillator that is very stable in output frequency over temperature can be built. Using a dielectric puck with a temperature coefficient of 3ppm/°C the frequency remains constant to +3MHz over a –40° to 60°C temperature range.The typical output power is 11 dBm and the efficiency is about 10 %. Typical test data for this oscillator is plotted in Figure 7. The oscillator phase noise at 100 KHz from the carrier is about –110 dBc/Hz.

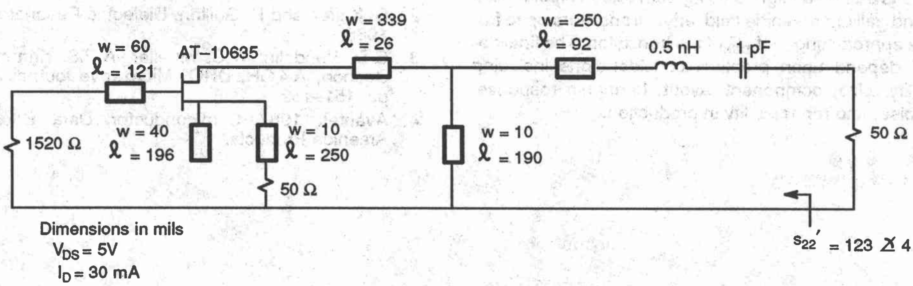


Figure 6. Dielectric Resonator Oscillator (DRO) at 11.5 GHz

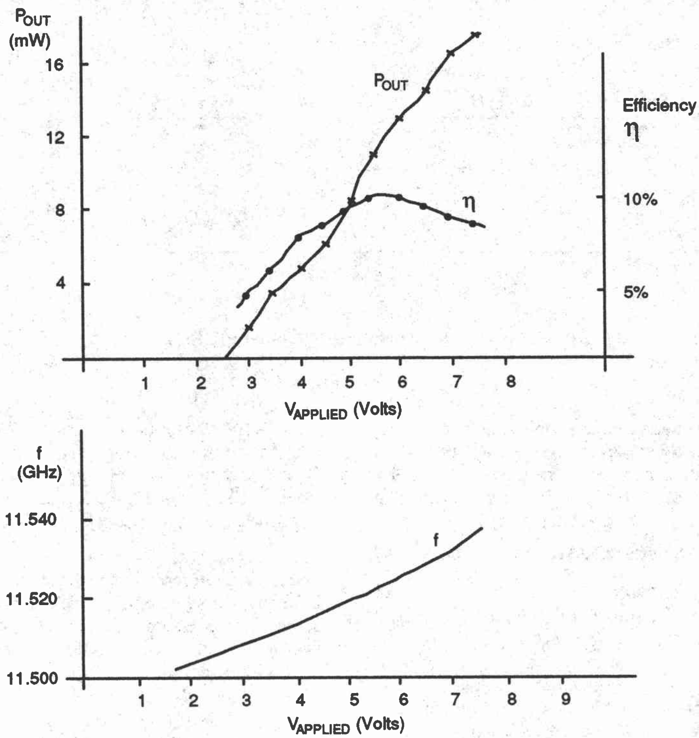


Figure 7. Test Data for 11.5 GHz DRO

CONCLUSION

Applying the design procedure given in this note, many oscillator circuits can be designed using both silicon bipolar transistors and gallium arsenide field effect transistors up to frequencies approaching $f_{max}/2$ of the transistor. The final design will depend upon practical considerations including realizability, size, component layout, harmonic response, phase noise, and repeatability in production.

REFERENCES

1. Avantek 1987 Semiconductor Data Book – Silicon Products, p. 161.
2. D. Kajfez and P. Guillon, Dielectric Resonators, Artech, 1986.
3. G.D. Vendelin, W.C. Mueller, A.P.S. Khanna, and R. Soohoo, "A 4 GHz DRO", Microwave Journal, June 1986, pp. 151–152.
4. Avantek 1987 Semiconductor Data Book–Gallium Arsenide Products.

With the advent of high-Q temperature-stable dielectric material, the transistor dielectric resonator oscillator (DRO) is fast becoming the most desirable choice in a vast number of fixed-frequency microwave signal source applications. A DRO clearly fills the gap between a free-running oscillator and a synthesized source, and represents a good compromise of cost, size and performance compared to alternative signal sources such as high-Q cavity oscillators, microstrip oscillators or multiplied crystal oscillators. Dielectric resonators, due to their excellent integrability in MIC circuits, can directly be used as the frequency-determining element for realizing a stable microwave frequency source. The primary characteristics of the ceramic material to be used for dielectric resonators are:

- The quality factor, Q, which is approximately equal to the inverse of the loss tangent.
- The temperature coefficient of the resonant frequency, τ_f which includes the combined effects of the temperature coefficient of the dielectric constant and the thermal expansion of the dielectric resonator and the shielding package.
- The dielectric constant, ε_r.

The Q, τ_f and ε_r values required for various applications differ and, in general, satisfactory oscillator operation under most conditions can be achieved by choosing an appropriate material composition. Until several years ago, the lack of suitable materials (i.e., materials possessing acceptable combinations of Q, τ_f and ε_r) severely limited dielectric resonator applications. Materials such as rutile-phase TiO_2, which has an unloaded Q of about 10000 at 4 GHz and ε_r of 100, were most often used. However, TiO_2 has a τ_f value of 400 ppm/°C which makes it impractical for most applications.

The development of temperature-stable dielectric resonators dates back about a decade. A number of material compositions have been explored in attempts to develop suitable dielectric materials, including ceramic mixtures containing TiO_2, various Titanates and Zirconates, glass, ceramic systems and alumina-based ceramics.

At present, several ceramic compositions have been developed offering excellent dielectric properties. Complex perouskite compounds with the general formula $A(B'_{1/3}B''_{2/3})O_3$ (where A = Ba, Sr; B′ = Zn, Mg, Co, Ni; B″ = Ta, Nb) have proved to possess acceptable properties for dielectric resonators. These compounds have dielectric constants between 20 and 40, a high quality factor, some greater than 10000 at 10 GHz, and a temperature coefficient which is variable through modification of the composition. Table 1 compares the important properties of different materials developed commercially.

It is impossible to say that any of the dielectric compositions shown in Table 1 is "better" than any other, since other factors, such as the ease of ceramic processing and the ability of a manufacturer to hold tolerances on the dielectric properties must also be considered. Performance limitations, if any, of the lower dielectric constant materials remain to be determined, since most component work reported thus far has used dielectric resonators with ε_r in the range of 37-100. The lower dielectric constant material is likely to be more sensitive to shielding, due to the increase in fields outside the resonator.

RESONANT FREQUENCY

A dielectric resonator, made of low-loss, high-permittivity ceramic material, resonates in various modes at frequencies determined both by its dimensions and its surroundings. Although the geometrical form of a dielectric resonator is extremely simple, an exact solution of the Maxwell equations is considerably more difficult than for the hollow metallic cavity. For this reason, the exact resonant frequency of a particular resonant mode, such as the most commonly used $TE_{01\delta}$, can only be computed by rigorous numerical procedures.

A number of mathematical techniques which can predict resonant frequency to an accuracy of ±1% for specific configurations appear in the literature. Unfortunately, these methods call for the use of high-powered computers. Kajfez has presented an approximate solution of the equations for both the case of an isolated dielectric resonator and for a resonator

Table 1. Dielectric Resonator Materials

Composition	*Dielectric constant*	*Q*	*Temperature coefficient of frequency (ppm)*	*Frequency range (GHz)*	*Manufacturer*
$Ba_2Ti_9O_{20}$	40	10 000 at 4 GHz	+2	1–100	Bell Labs
$(Zr\text{-}Sn)TiO_4$	38	10 000 at 4 GHz	–4 to +10[1]	1–100	Trans Tech Thomson-CSF Murata
$Ba(0.33Zn0.67Ta)O_2$	30	10 000 at 10 GHz	0–10[1]	4–100	Murata
$Ba(0.33Mg0.67Ta)O_2$	25	25 000 at 10 GHz	4	4–100	Sumimoto
$BaO\text{–}PbO\text{–}Nd_2O_3\text{–}TiO_2$	88	5000 at 1 GHz	0–6[1]	<4	Murata-Trans Tech
Al_2O_3	11	50 000 at 10 GHz	0–6[1]	>18	NTK-Trans Tech

[1] Adjustable with composition.

coupled into a MIC microstrip circuit. This method is typically accurate to ±2%.

Practical dielectric resonators available today cover the frequency range of 2 to 100 GHz. However, with the recent development of conveniently-sized coaxial tubular dielectric resonators, the usable frequency range has been extended to 500 MHz. The lower frequency limit is imposed by the large resulting dimensions of the resonator, while the upper frequency is limited by the reduced Q of small resonators, as well as by resonator dimensions that become too small to effectively couple to a transmission line.

To a first approximation, a dielectric resonator is the dual of a metallic cavity. The radiation losses of the dielectric resonators with commonly-available permittivities, however, are generally much greater than the energy losses in the metallic cavities, which makes proper shielding of the dielectric resonator a necessity.

Dimensions of a dielectric resonator are also considerably smaller than those of an empty metallic cavity resonant at the same frequency – by a factor of approximately $\sqrt{\varepsilon_r}$. If ε_r is high, the electric and magnetic fields are confined in the region near the resonator, which results in small radiation losses. The unloaded quality factor Q_u is thus limited by the losses in the dielectric resonator. The shape of a dielectric resonator is usually a solid cylinder, but tubular, spherical and parallelopiped shapes are also used.

The $TE_{01\delta}$ resonant mode is the most commonly used in cylindrical resonators. In the $TE_{01\delta}$ mode, magnetic field lines are contained in the meridian plane while the electric field lines are concentric circles around z-axis as shown in Fig. 1. For a distant observer, this mode appears as a magnetic dipole, and for this reason it is sometimes referred-to as the "magnetic dipole mode." When the relative dielectric constant is around 40, more than 95% of the stored electric energy, and more than 60% of the stored magnetic energy is located within the cylinder. The remaining energy is distributed in the air around the resonator, decaying rapidly with distance away from the resonator surface.

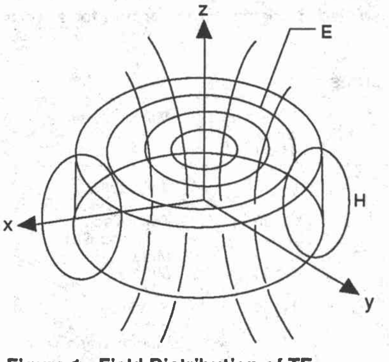


Figure 1. Field Distribution of $TE_{01\delta}$ Mode in a Dielectric Resonator

COUPLING TO THE RESONATOR IS CRITICAL

To effectively use dielectric resonators in microwave circuits, it is necessary to accurately understand the coupling between the resonator and transmission lines. The $TE_{01\delta}$ mode of the cylindrical resonator can be easily coupled to a microstrip line, fin line, magnetic loop, or to a metallic or dielectric waveguide. Figure 2 shows the magnetic coupling between a dielectric resonator and microstrip line. The resonator is placed on top of the microstrip substrate, with the lateral distance between the resonator and the microstrip conductor primarily determining the amount of coupling between the resonator and transmission line. The degree of coupling has a direct effect upon output power, frequency stability, and harmonic content, as well as resonant frequency of a dielectric resonator oscillator.

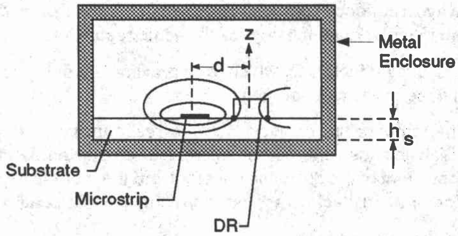


Figure 2. Dielectric Resonator Coupled to a Microstrip Line

Proper metallic shielding, required to minimize the radiation losses (hence to increase Q), also affects the resonant frequency of the $TE_{01\delta}$ mode. Figure 3 shows the equivalent circuit of the dielectric resonator coupled to a microstrip line.

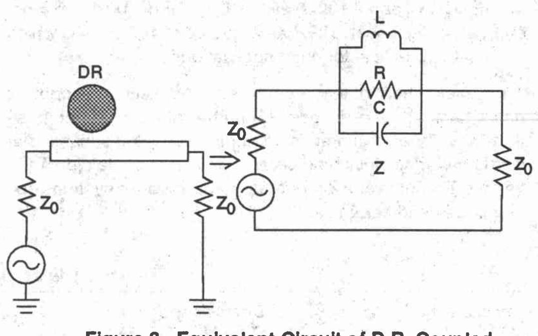


Figure 3. Equivalent Circuit of D.R. Coupled to a Microstrip Line

At the resonant frequency of the dielectric resonator, the S-Parameters of the configuration shown in Fig. 3 are given by:

$$S_{11} = S_{22} = \frac{\beta}{(1+\beta)} \quad \text{and} \quad S_{12} = S_{21} = \frac{1}{(1+\beta)}$$

where β, the coupling coefficient is defined by:

$$\beta = \frac{R}{2Z_0}$$

Figure 4 shows a model of a dielectric resonator coupled to two lines. In the model, the ideal transformers simulate the magnetic coupling of the resonator to the lines, and the RLC tank circuit models the resonance. The turns ratio of the transformers are a function of the distance from the lines to the resonator (they do not have to be equal, i.e., the DR need not be symmetrically placed between the lines). The values of the elements of the tank circuit depend on the frequency of resonance and the Q of the DR in the enclosure. The S-parameters of the configuration shown in Fig. 4 are given by:

$$S_{11} = \frac{\beta_1 - 1 - \beta_2}{1 + \beta_1 + \beta_2}$$

$$S_{12} = S_{21} = \frac{2\sqrt{(\beta_1 \cdot \beta_2)}}{1 + \beta_1 + \beta_2}$$

$$S_{22} = \frac{\beta_2 - 1 - \beta_1}{1 + \beta_1 + \beta_2}$$

where $\beta_1 = \dfrac{R}{n_1^2 \cdot Z_0}$ and $\beta_2 = \dfrac{R}{n_2^2 \cdot Z_0}$

represent the coupling coefficients and n_1 and n_2 represent the equivalent turn ratios of the transformers.

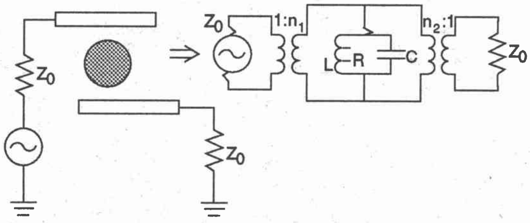


Figure 4. Model for a Dielectric Resonator Coupled to Two Lines

ACTIVE DEVICES FOR DROS

Transistors are most commonly used to build today's DROs up to 40 GHz. Transistor DROs can be realized using either silicon bipolar or GaAs FET devices. The maximum oscillation frequency for silicon bipolar transistor oscillators is lower than that of the GaAs FET oscillators. Reasonable power outputs have been obtained up to 40 GHz and 20 GHz using GaAs FET and silicon bipolar devices respectively. Figure 5 shows the present power and frequency coverage capabilities of the dielectric resonator oscillators. The silicon bipolar transistor, however, offers lower phase noise close to the carrier and faster frequency settling characteristics compared to a GaAs FET oscillator.

Other devices usable in DROs are Gunn and Impatt diodes. Gunn oscillators offer lower AM and FM noise characteristics at the cost of poor DC to RF efficiency (<1%) and reliability problems over the wide range of temperature operation. Impatts have poor noise performance, but offer medium powers at reasonable efficiencies (>30%). Transistors, on the other hand, offer medium noise with medium efficiencies (>20%). Both Gunn and Impatt diode sources are commonly used at millimeter frequencies (30-100 GHz).

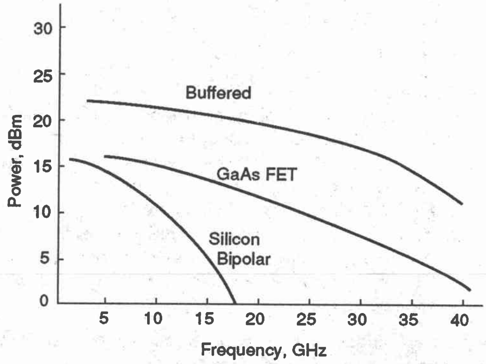


Figure 5. Power vs. Frequency for Transistor DROs

DRO CIRCUITS

There are two means of incorporating a dielectric resonator in a MIC oscillator: as a passive stabilization element *(stabilized DRO)* or as a circuit element in a frequency-determining network *(stable DRO).*

A stabilized DRO is an oscillator which uses a dielectric resonator in the output plane of the circuit to stabilize an otherwise free-running oscillator (Fig. 6). This approach has several disadvantages, including a tendency toward mode jumping, frequency hysteresis problems, higher insertion loss due to the resonator being coupled to the output circuitry and increased output power variation.

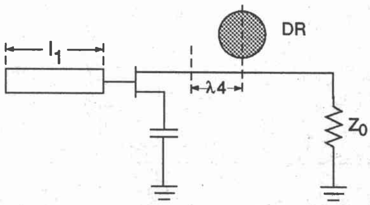


Figure 6. Stabilized GaAs FET DRO

The stable DRO configuration, which uses the dielectric resonator as a feedback/frequency determining element, is the most commonly used. It provides greater efficiency, simpler construction and more resistance to mode jumping and hysteresis effects than the stabilized DRO.

To realize a stable DRO, the resonator may be used as either a series or parallel feedback element in the frequency determining circuit. Figure 7 shows two common configurations of each type.

Series feedback configurations are based on the ability of the active device to produce a negative resistance (*reflection* coefficient greater than 1) at at least one of the three terminals, in the frequency range of interest. The small signal oscillation conditions in this case are reduced to:

$|S_{11}'| \cdot |\Gamma_1| > 1$ and

$\angle S_{11}' + \angle \Gamma_1 = 2\pi n \qquad n = 0, 1, 2, \ldots$

where S_{11}' and Γ_1 are the reflection coefficients of the transistor and the resonator at any plane between the device and the resonator (Fig. 7a). Since Γ_1 is always less than 1, this condition implies that $|S_{11}'|$ looking into the device should be greater than 1. A distributed capacitance in the source for the configuration of Fig. 7a and inductance in the gate for the configuration shown in Fig. 7b is commonly required to generate a high value of $|S_{11}'|$ (>1). Position of the dielectric resonator with respect to the device is now determined to satisfy the oscillation condition completely.

The parallel feedback configuration is based on the use of the forward gain of a device (*transmission* coefficient greater than 1). In such a design, a dielectric resonator is used as a bandpass filter, and connected across the two terminals of an active device possessing transmission gain greater than the insertion loss of the dielectric resonator. To oscillate, the electrical line length between the device input and output must provide a phase shift around the feedback loop equal to an integer multiple of 2π radians at the oscillation frequency.

An advantage of the series feedback design is the relative ease of coupling to a single line, compared to the parallel circuit's requirement for coupling to two lines. In addition, the two coupling coefficients in the parallel case are not independent, increasing the difficulty of alignment. With the parallel feedback circuit, however, the use of a high-gain amplifier can allow significant decoupling of the resonator from the microstrip lines, resulting in a higher loaded Q factor with associated reduction in phase noise.

ELECTRICAL PERFORMANCE

The transistor DROs are available spanning the frequency range of 3 GHz to 40 GHz with power outputs ranging to greater than +23 dBm at X-band (Fig. 5). As noted earlier, the oscillator can use either a silicon bipolar or GaAs FET device, each device having associated tradeoffs in performance, and the oscillator can be followed by one or more buffer amplifier

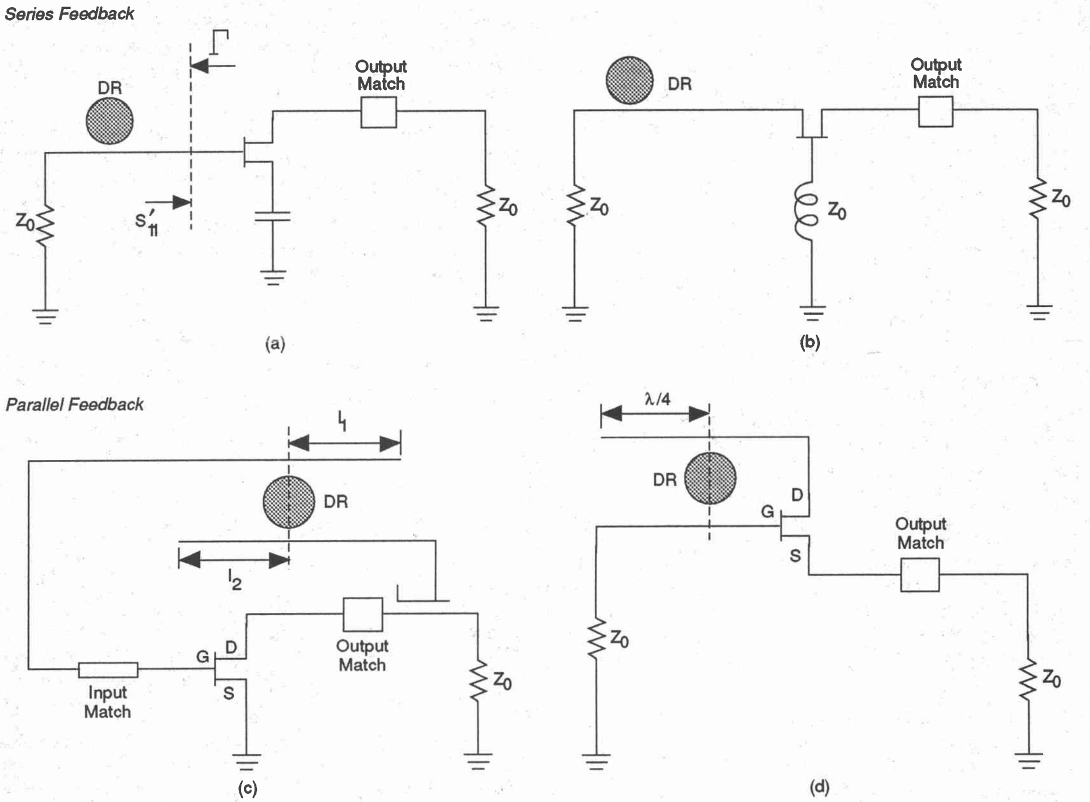


Figure 7. Stable DRO Configurations

stages as required to meet power output specifications. The center frequency is usually specified in MHz with an associated frequency accuracy (temperature, pulling and pushing dependant) specification. The DRO frequency can be fixed, mechanically or electrically tunable over a narrow band. The characterization of a DRO is discussed in greater detail in Avantek Application Note *AN-M004, Specifying a DRO.* Important aspects of the salient characteristics of a DRO are discussed next.

Temperature Stability

The principal cause of DRO frequency drift with temperature is the phase deviation between the resonant circuit and the active circuit including device, feedback and output circuitry. Using the oscillation condition in the reflection coefficient form,[4] it can be easily proved that the temperature coefficient of DRO frequency is a function of the following parameters:

- The temperature coefficient, τ_f of the dielectric resonator placed in a shielded MIC configuration.
- The unloaded Q of the dielectric resonator.
- The coupling coefficient of the dielectric resonator with the microstrip line.
- The temperature coefficient (τ_{pn}) of the device (transistor) input reflection coefficient phase that is known to decrease linearly with temperature.

In order to achieve a temperature-compensated DRO, a resonator with a temperature coefficient of +1 to +4 ppm/°C is generally required to offset the negative temperature coefficient of the device phase temperature coefficient. Figure 8 shows some of the typical frequency drift curves over temperature for free-running DROs.

With present technology it is now possible to repeatably produce free-running DROs with frequency drift of less than ±100 ppm over the -55 to +85°C military temperature range, at frequencies up to 18 GHz. However, as shown in Fig. 8, results reported in the R & D environment are significantly better (±10 ppm over temperature).

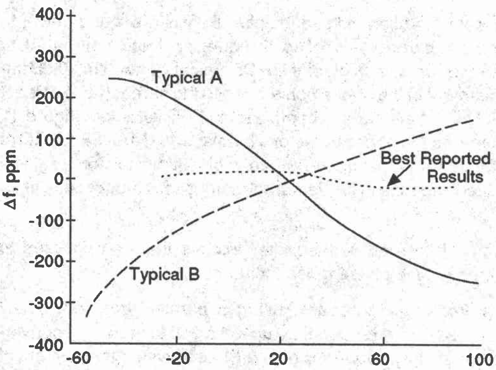


Figure 8. Frequency Drift vs. Temperature for a Free Running 12 GHz GaAs FET DRO

Frequency Temperature Compensation

Certain system applications require greater temperature stabilities than are achievable using free running DROs, even with temperature compensation. A number of techniques are used to improve the temperature stability of a DRO.

The Digitally Compensated DRO (DC-DRO) uses a sensor mounted in the oscillator to detect temperature changes. The output of the sensor goes through an A/D converter to produce a digital word corresponding to the particular temperature. EPROMs, programmed with the temperature characteristics of the DRO and a correction look-up table, drive a D/A converter to provide the correction signal, which is applied to the varactor of an electronically-tuned DRO. Using this technique frequency stability of ±15 ppm can be obtained over temperature.

The Analog-Compensated DRO (AC-DRO) uses an analog compensator circuit in conjunction with a temperature sensor to achieve up to ±20 ppm frequency stability. In analog compensation the individual oscillator is tested to produce a custom tuning voltage-vs.-temperature curve required to maintain a constant frequency. The compensation circuit is then aligned to fit the curve of the specific oscillator.

Ovenization may also be used to enhance the temperature stability of a DRO. To achieve temperature stability, the oscillator package is inserted in a temperature-stabilized oven. Using a heater element, a quick-response thermistor and associated control circuitry, the package temperature can be maintained within ±5°C at 5 to 10 degrees above the maximum ambient temperature. A total frequency stability of better than ±10 ppm can be obtained using this approach.

Ovenized DROs offer lower phase noise than analog- or digitally-compensated DROs because the oscillator does not need to incorporate electrical tuning circuitry. Analog- and digitally-compensated DROs, however, are smaller in size and do not need the substantial amount of heater power required by the ovenized DRO.

Locked DROs

Phase Locked DROs (PL-DRO) and *Injection Locked DROs* (IL-DRO) are used when the requisite frequency stability and phase noise cannot be achieved using stabilization techniques. A PL-DRO or IL-DRO approach also becomes necessary when multiple oscillators are required to be phase- or frequency-coherent or both. For locked systems, a highly stable crystal-controlled signal source operating at HF or VHF is used as a reference oscillator.

In injection (frequency) locking, a VHF power amplifier driving a step-recovery diode is used to generate a wideband harmonic comb, which includes the required locking frequency. A bandpass filter is used to select the desired harmonic, and a free-running DRO is locked to the harmonic through the circuit shown in Fig. 9a. The main requirement in this case is to make sure that the DRO frequency drift under all operating conditions is less than the injection locking bandwidth, Δf. This bandwidth is a function of the injection power, oscillator output power, and external Q.

Injection locking is simpler and less expensive than phase locking, but the RF output is more likely to contain spurious signals at the harmonics of the reference oscillator frequency.

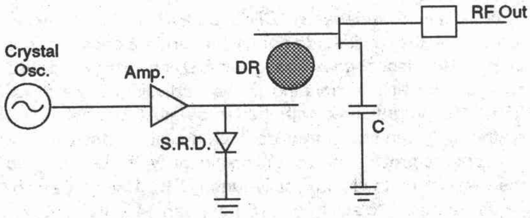


Figure 9a. Injection Locked DRO

Figure 9b shows a typical phase-locked DRO circuit. A DC-coupled sampler/phase detector is used to mix the desired harmonic of the amplified crystal oscillator with the incoming frequency from the DRO. If the difference frequency is small enough, the loop will be driven towards a point where the difference frequency out of the sampler becomes zero. The loop then drives the DRO towards a zero phase error condition.

A search mechanism is generally included in the system so that the loop will be forced to tune through a stable lock point if the initial difference frequency is too large for capture to occur. An AC-coupled phase-locked DRO circuit is used when the output frequency of the DRO is not harmonically related to the reference oscillator frequency.

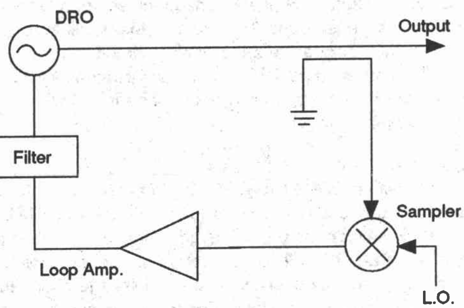


Figure 9b. Phase Locked DRO

Phase Noise

Phase noise, related to short-term frequency stability, is characterized by variations in the output frequency which appear, in the frequency domain, as FM energy around the carrier frequency. This is shown graphically in Fig. 10. Phase noise is specified in dBc/Hz measured at specified offsets from the carrier frequency: typical offsets are 10 and 100 kHz. In a DRO, phase noise is primarily dependent on the following factors:

1. The low-frequency noise sources inherent in the active device designated by Sen(f), the noise spectral density at a frequency f.
2. F_c, defined as the upconversion factor, a measure of the efficiency in the conversion of the low frequency noise to the phase noise of the microwave oscillator.
3. The loaded Q factor of the dielectric resonator.
4. The output power, P_o and external Q of the oscillator.

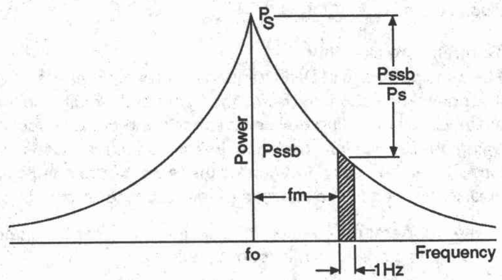


Figure 10. Oscillator Phase Noise

The relation between the phase noise and these parameters is given by:

$$\Delta f_{eff} = F_c \, Sen(f) \, \frac{fm}{Q_{ext} \sqrt{P_o}}$$

In this relation, Δf_{eff} represents the phase noise and fm is the offset frequency.

Optimization of phase noise performance calls for the use of a high-Q dielectric resonator and a low-noise device combined with specific design considerations in the oscillator circuit.

It has been proven that the low-frequency noise in a GaAs FET is inversely proportional to the gate length and width of the device. Both biasing conditions and the processing of the GaAs FET also play vital roles in achieving low noise oscillators. Figure 11 compares the phase noise performance of a number of different oscillators.

As noted earlier, silicon bipolar transistors are known to produce lower levels of low-frequency noise compared to GaAs FETs. Silicon bipolar DROs typically offer 6 to 10 dB improvement in the phase noise close to the carrier (up to at least 100 kHz off the carrier) compared to FET versions. Figure 11 compares the phase noise of a bipolar and GaAs FET DRO at different frequencies. Fortunately, bipolar transistors are now available for use in fundamental-output oscillator circuits at up to Ku band.

Some of the newer design techniques that can be used to further reduce phase noise include:

Low frequency feedback, using a parallel feedback circuit designed at low frequencies (up to 1 MHz) to reduce upconversion of the low frequency noise. Phase noise improvement of up to 20 dB has been reported using this technique. This method is sometimes referred to as bias feedback.

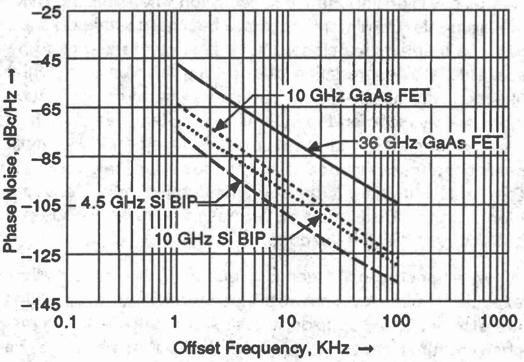


Figure 11. DRO Phase Noise: GaAs FET & Bipolar

Noise degeneration, using the same dielectric resonator both as the frequency-determining element of the oscillator and the dispersive element of a frequency discriminator. The DC output of the discriminator is applied to the frequency control port of the DRO. This technique has been reported to achieve phase noise as low as -120 dBc at 10 kHz from the carrier at 10 GHz.

Mechanical Tuning

The frequency of oscillation of the dielectric resonator is dependant on a number of factors, not the least of which is its proximity to the ground plane. To take advantage of this, a tuning screw can be installed in the top cover directly above the resonator which, by reducing the distance between the resonator and the apparent ground plane, will provide for a certain amount of change in the resonant frequency (Fig. 12).

The reason for such behavior can be found in the cavity perturbation theory. Namely, when a metal wall of a resonant cavity is moved inward, the resonant frequency will decrease if the stored energy is predominantly in the electric field. Otherwise, when the stored energy close to the walls is mostly magnetic, as is the case for the shielded $TE_{01\delta}$ dielectric resonator, the resonant frequency will increase when the wall moves inward.

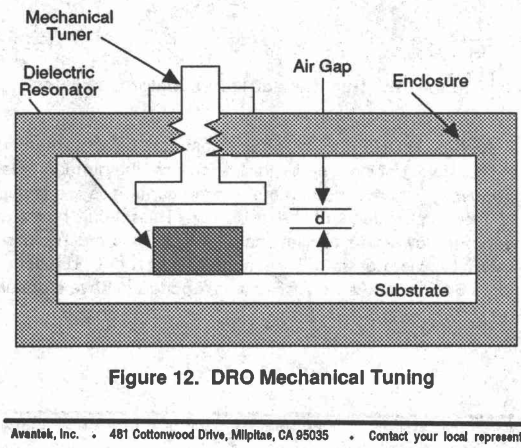


Figure 12. DRO Mechanical Tuning

Current designs allow for up to 0.2% tuning range without significant degradation of other performance parameters. A properly-designed mechanical tuning option will provide a maximum of tuning range while still maintaining hermeticity and reliability, and will not appreciably affect the resonator Q factor (apparent as a degradation in noise and power performance) or temperature stability.

Electronic Tuning

Some applications, such as FMCW radar sources, narrow-band-modulated communication systems or PLL systems, need electronic tuning bandwidths on the order of 0.1% to 1%. These applications require sources with low phase noise, high tuning speed and low tuning power. Electronically tunable DROs (ET-DRO) can now meet the requirements for many such applications.

ET-DROs are also commonly used for analog or digital temperature compensation of the oscillator. This application requires that the frequency tuning range of the DRO exceeds the frequency drift of the oscillator under any combination of operating conditions (temperature, load and bias variations). Various means are used to electrically tune the DRO, including ferrite tuning, optical tuning, and the more popular varactor and bias tuning.

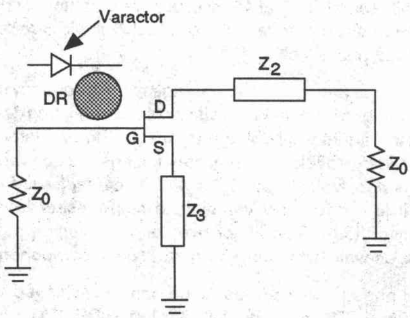


Figure 13. Varactor Tuned DRO

Varactor tuning (a typical scheme is shown in Fig. 13) can provide up to 1% frequency adjustment. To permit varactor tuning, the dielectric resonator is coupled to another microstrip line connected to a varactor, resulting in mutually-coupled resonant circuits. The bias-voltage-dependant capacitance of the varactor varies the resonant frequency of the low-Q resonant circuit with the tuning voltage.

The amount of frequency tuning range can be controlled by varying the coupling between the low-Q microstripline/varactor circuit and the dielectric resonator circuit. Tighter coupling permits greater tuning range, however the attendant degradation in the Q factor manifests itself primarily as an increase in phase noise. Varactor tuning is by far the most common means of incorporating electronic tuning.

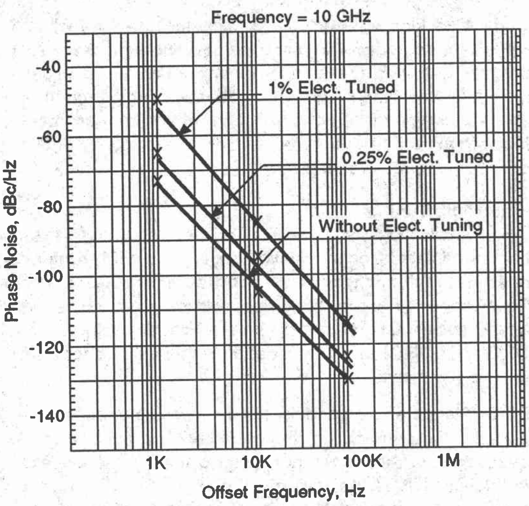


Figure 14. Phase Noise Deterioration with Electronic Tuning

Figure 14 shows the phase noise characteristics for an electronically-tuned DRO at 10 GHz using a varactor. It should be noted that any increase in the elctrical tuning range results in increased phase noise.

Bias voltage tuning takes advantage of the frequency sensitivity to changes in the supply voltage of the oscillating device. By not using an internal voltage regulator, the oscillator can be designed to provide the necessary tuning range by varying the bias voltage, typically within 0.1% of the center frequency. This is sufficient frequency variation to compensate for the frequency drift of the oscillator over load and temperature variations, as well as the long-term drift due to component aging.

Better phase noise performance can be achieved with the bias-tuned DRO than the varactor tuned DRO. The latter requires the dielectric resonator to be simultaneously coupled to two microstrip lines, thus lowering the loaded quality factor of the resonator. However, as the output power is often a function of the supply voltage, care must be exercised to maintain suitable output power variation characteristics for the bias-tuned DRO.

MECHANICAL CONSIDERATIONS

The minimum size of a practical DRO is primarily limited by the cavity required by the particular resonator. Normal design procedure calls for a separation of more than one resonator diameter between the resonator and its surrounding walls in order to properly excite the $TE_{01\delta}$ resonant mode. Also, the separation between the resonator and the housing lid should be more than one resonator thickness to minimize the effects of the lid on the resonator performance. Too-small a cavity can prevent oscillation in the preferred mode, as well as causing Q-factor degradation.

Hermeticity is an important consideration when defining DRO requirements. Oscillators which are backfilled with a dry inert gas and then welded closed, have less of a tendency to be susceptible to degradation due to long-term environmental effects. Hermetically-sealed oscillators are, of course, much more readily incorporated in a military system with the attendant performance and qualification requirements. Hermetic sealing is normally characterized by the helium leak rate of the DRO enclosure after it has seen a saturated helium environment. Typical leak rates of hermetically-sealed DROs are better than 10^{-7}cc(He)/second.

When a mechanical tuner is required, tuner construction, expected lifetime, over-travel protection and ease of operation are also important considerations. A properly-designed mechanical tuner should provide the desired tuning range, be simple to adjust, have an acceptable number of operations, incorporate stops to limit travel and still maintain case integrity and hermeticity.

SPECIAL DRO CIRCUITS

Excellent integrability and high performance of the dielectric resonators has generated a large number of interesting DRO configurations for various system applications. Some of those special circuits will be described in this section:

A *dual-resonator oscillator*, shown in Fig. 15, presents a highly stable DRO circuit using identical resonators in a series feedback configuration in both the source and gate circuit of a FET. This oscillator has three output ports, and its microstrip circuitry is wideband due to the simple, minimally-tuned 50-ohm lines on all three ports of the transistor. This oscillator is not particularly susceptible to spurious oscillations, and can provide good temperature stability by selecting appropriate dielectric mixes for the resonators.

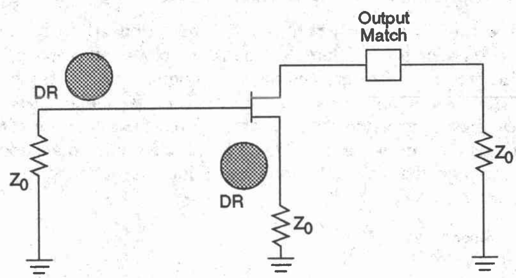


Figure 15. Dual Dielectric Resonator Oscillator

A *push-push DRO* (Fig. 16) uses a common dielectric resonator for two transistors. In this approach the fundamental frequency is cancelled and the second harmonics are added at the output plane of the oscillator. This circuit helps to generate low-noise oscillations at frequencies much higher than otherwise possible. For example, using a 17 GHz resonator, a 34 GHz GaAs FET DRO was reported to have a phase

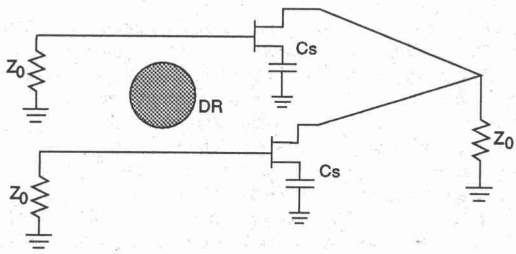


Figure 16. Push Push Transistor DRO

noise of -100 dBc at 100 kHz. Figure 17 shows a comparison of phase noise between an Avantek 18 GHz push-push bipolar DRO and fundamental GaAs FET oscillator.

A *selectable multi-frequency oscillator* development appears in Fig. 18. The diagram shows a fast-settling tri-frequency-selectable DRO. A single GaAs FET is used in conjunction with a simple single-pole three-throw (SP3T) switch to select the dielectric resonator corresponding to the desired output RF frequency. Compared to the traditional approach of using

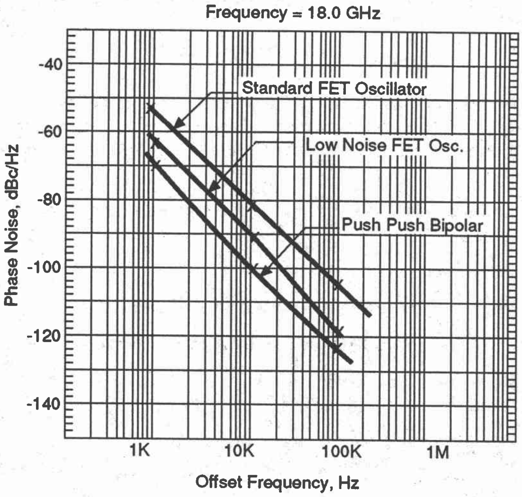


Figure 17. Phase Noise Comparison between Push-Push Bipolar DRO & Fundamental GaAs FET DROs

several continuously-operating DROs and a high-isolation, matched SP3T switch, this approach is free of the spurious signals at the unselected frequencies. This approach is also less expensive, uses fewer components and is more reliable compared to the old approach. Fast switching between the output frequencies is obtained by keeping the active device always biased "on" and using the switchable high-Q resonators to control the frequencies. Using this approach the output frequency settles within ±100 ppm in less than 2μs. Special precautions need to be taken to keep the RF output power and DC/RF efficiencies as close to the same as possible at each frequency to minimize the settling time. The number and range of frequencies, selectable using single device and multiple switchable resonators is limited due to the PIN switch parasitics and the negative resistance bandwidth capability of the active device.

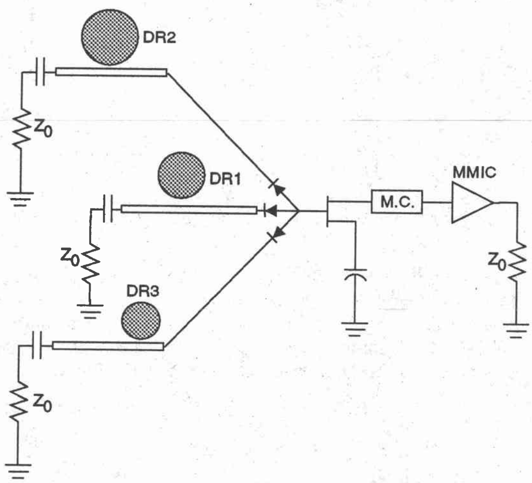


Figure 18. Selectable Multi-Frequency DRO

Microwave Quenchable DROs: Microwave quenchable oscillators represent a new class of fast-switching oscillators in which the oscillations are turned on and off without affecting the device bias conditions. This is accomplished by quenching the negative resistance with a PIN diode. Fig. 19 represents the basic configuration of the quenchable DRO. The quenching circuit includes a PIN diode and an RF bypass capacitor, and is coupled to the transistor at the same port as the reactive feedback and the means for applying the bias voltage to the diode. The quenching circuit selectively diverts a small fraction of the current flowing through the oscillator transistor to control the PIN diode resistance. For the PIN diode resistance value of 50 ohms or less, the oscillations are switched off completely. Using this quenching technique, the DRO settles within 10 ppm in less than 2 μs.

Quenchable DROs can be effectively used in the selectable frequency oscillator assemblies by combining them with ring combiners. Unlike the selectable multi-frequency oscillator using a single device described below, there is no limit to the number or range of the output frequencies. Additionally, each oscillator can be optimally biased for fast switching at its frequency.

The quenching current through the PIN diode can also be controlled to vary the degree of nonlinearity and, hence, the operating point of the oscillating device. The partial quenching thus achieved can be used to control the power output, harmonics and amplitude modulation.

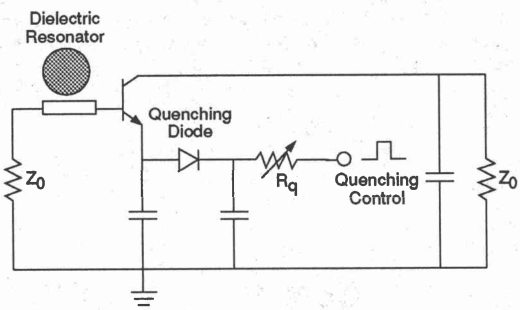


Figure 19. Microwave Quenchable DRO Circuit

A *silicon monolithic self-oscillating mixer* is shown in Fig. 20. The dielectric resonator is used in parallel feedback between the input and output of the device, a silicon bipolar Darlington-pair MMIC. RF input is mixed with the LO in the first transistor Q1 and the second transistor offers gain at the IF frequency.

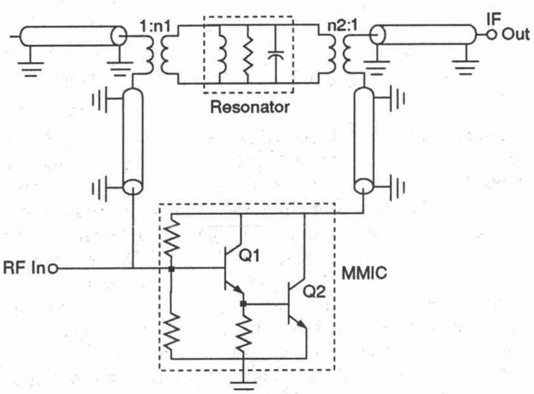


Figure 20. Silicon MMIC Self Oscillating Mixer

The Avantek MMIC used has an f_T=10 GHz and f_{MAX}=20 GHz and is packaged in a standard 70 mil microstrip ceramic package. The MMIC features interdigitated 0.75 µm-wide arsenic-doped emitters, 4 µm emitter-to-emitter pitch, ion implantation, thin film polysilicon resistors and gold metalization. The prototype was fabricated using a 31-mil-thick epoxy-glass (FR4) board. The dielectric resonator had a resonant frequency of 5.15 GHz, dielectric constant of 37 and an unloaded Q of 7000. Using the configuration shown in fig. 20, an RF signal at 3.7 to 4.2 GHz was downconverted to L band with 9±1 dB conversion gain. The output compression point of the SOM was measured to be +7 dBm.

LIMITATIONS OF TRANSISTOR DROS

Free-running DROs presently do not have the low phase noise and temperature stabilities required for certain high-performance applications. This limitation necessitates the use of phase locking, injection locking, ovenizing or analog or digital compensation circuits when necessary. Another important limitation of the DRO is the phase noise degradation under vibration due to the variation of the distance between the resonator and the outer shield. Significant deterioration of the phase noise at offsets up to the highest frequency of vibration can be expected under vibration. Ruggedization of the oscillator, injection locking or phase locking are typically used to minimize these effects.

FUTURE TRENDS

The dielectric resonator oscillator technology is developing exceedingly rapidly. Emphasis will continue to develop higher performing DROs. The following aspects are likely to be dealt with in the near future:

- Lower phase noise and higher temperature stability oscillators.
- Reduction in cost and size
- Wider mechanical and electrical tuning bandwidths
- Improvement in DRO performance under vibration
- Development of new materials for dielectric resonators for linear temperature coefficient and higher quality factor.
- Use of higher-order modes in resonators.

INTRODUCTION

This applications note lists and explains the electrical parameters used to define the performance of the dielectric resonator oscillator (DRO). By filling out the *Quick Specs* table on page 4, the engineer planning to use a DRO in a system design should have all the information necessary to order a standard unit or to request a quote on a customized unit.

For a detailed explanation of DRO theory and practice, please request a copy of Avantek's *Introduction to DROs* (ATP-1097).

FREQUENCY ACCURACY

The frequency of a DRO is typically defined in MHz, bounded by an accuracy window in percent or parts per million (ppm). This window includes the "setability" and the change in frequency due to temperature, load (pulling), supply voltage (pushing), and time (aging).

Stability can be expressed in MHz, parts per million or as a percentage of the carrier frequency. Chart 1 on page 3 of this application note presents an easy method of conversion between delta frequency in ppm, and percent frequency change. As an example of how it is used, using $\Delta f = 0.2$ MHz and $f_0 = 2$ GHz, at the intersection of f_0 and Δf move vertically up to read 10^2 ppm or down to read .01%.

Setability

Frequency setability of the oscillator represents the closeness to which one can set the center frequency. Typically, the DRO frequency can be set within ±100 ppm of the ideal frequency.

Temperature Stability

Temperature stability is the measure of the change in oscillator frequency over the specified temperature range. Traditionally, this has been expressed in ppm/°C (parts per million per degree C) or ±ppm/°C. In general, the DRO frequency change is not a linear function of the temperature change, therefore, the frequency stability should be specified as the maximum frequency change in percent (or ppm) with respect to the ideal frequency for a specified temperature range. As an example, a typical 10 GHz DRO could be specified to have a frequency stability of ±500 ppm over -55 to +85°C. This specification implies that the DRO frequency will not drift more than 5 MHz on either side of 10 GHz over the specified temperature range.

Frequency Pulling

Frequency pulling represents the change of the DRO frequency when the phase of a specified load VSWR is rotated through 360 degrees. Typically, this is measured into a load impedance with a VSWR of 1.67:1, which can be conveniently achieved by using a 6 dB pad (12 dB return loss) at the oscillator output. Frequency pulling for a load VSWR, S, other than 1.67:1 can be measured directly or approximated from the pulling measured with a VSWR of 1.67:1 by using the following relationship:

$$\text{Pulling for S} = \text{Pulling at 1.67:1} \times 0.93 \left(S - \frac{1}{S}\right) \qquad (1)$$

This linear relation, however, should be used with caution for VSWRs greater than 2.0:1. For high values of load VSWRs or for oscillators with little buffering, the pulling figure should be practically measured in order to verify that the oscillator does not stop oscillating at some phase of the desired VSWR. A single stage GaAs FET buffer amplifier commonly follows the oscillating device to improve the pulling performance.

The frequency pulling of a typical X or Ku-band DRO into 1.67:1 is less than ±100 ppm.

Frequency Pushing

Frequency pushing is the incremental output frequency change produced by an incremental change in supply voltage. It is generally specified in kHz/V. Measurements are taken at a DC rate unless frequency range and amplitude of the supply voltage ripple are specified. Special ripple filters are sometimes used to reduce the spurious generated through the supply. Typically, the DC supply pushing in a standard DRO, which incorporates a voltage regulator, is less than 10 ppm/V.

Aging

Aging represents the long term change in the DRO frequency. This frequency change is caused by the slow change in the properties of the components and package used. The frequency change of an X-band DRO due to aging is typically less than ±100 ppm/yr. The oscillators are generally thermally cycled and burned in for several days in order to minimize the aging.

The overall frequency accuracy including setability, aging, temperature (-55 to +85°C) stability, pulling into 1.67:1, supply pushing and aging over a year of a typical free-running X-band DRO is thus less than ±1000 ppm or ±0.1%.

TUNING RANGE

A DRO can be tuned mechanically and electrically. The mechanical and electrical tuning can be specified in MHz, percentage or ppm above and below the center frequency. The parameters these tuning ranges will affect are power output, phase noise and power pulling.

Typically, mechanical tuning up to ±0.1% does not affect these parameters noticeably. Wider tuning range, however, can be achieved with some degradation in phase noise and power output variation over the tuning range. The setability of the mechanical tuner is generally better than ±.01% (100 ppm).

Electronic tuning is used for phase locking the oscillator to a more stable reference frequency or for narrowband modulation applications. Electronic tuning ranges of ±0.1% of the carrier frequency can be obtained for tuning voltages between 1 and 20 volts. It should be noted that though the specified tuning range is assumed to be divided symmetrically around the desired center frequency, the tuning voltage required is generally not symmetrical. For phase locking applications, it is also important that the electronic tuning range should be greater than the overall frequency accuracy of the DRO. The output power variation over the electronic tuning range should be specified if critical to the application. Typically, about 1 dB variation in the output power can be expected. Phase noise deterioration due to electronic tuning depends on the desired tuning range. A 6-10 dB degradation can be expected for an electronically tuned DRO with a ±0.1% tuning bandwidth.

OUTPUT VSWR

DROs typically have a VSWR of less than 2:1 at X or Ku-band. The VSWR is determined from the measurement of the power pulling of the oscillator into a 1.67:1 VSWR load by using the following relations:

$$\text{output VSWR} = \frac{1 + |\rho_o|}{1 - |\rho_o|} \qquad (2)$$

$$\text{where } \rho_o = \frac{4(10^{\Delta P/20} - 1)}{(10^{\Delta P/20} + 1)} \qquad (3)$$

is the oscillator output reflection coefficient, and ΔP represents the peak-to-peak power variation into 1.67:1.

POWER OUTPUT

Power output should be specified in "dBm, min.", with a variation window in dB over a specified temperature looking into a typical 50 ohms. Power outputs of +13 dBm can be achieved up to 40 GHz. Higher powers are available at lower frequencies. Power variation of less than 3 dB are typically obtainable over the military temperatures of -55 to +85°C.

Power variation under all phases of a specified load VSWR can also be included in the overall power variation specification. Using 1.67:1 load VSWR, power pulling of less than 1 dB can be achieved at X-band. In view of measurement inaccuracies involved at high values of load VSWR, the power pulling is measured at the load VSWR of 1.67:1 and the expected power variation for higher load VSWR of S_1 can be approximated by:

Power Variation for VSWR,

$$S_1 = 20 \log \frac{1 + |\rho_o \rho_l|}{1 - |\rho_o \rho_l|} \qquad (4)$$

$$\text{where } \rho_l = \frac{S_1 - 1}{S_1 + 1} \qquad (5)$$

and ρ_o is the oscillator output reflection coefficient given in equation 3.

It is, however, practical to verify that the oscillator does not stop oscillating under any phase of the specified load VSWR S_1.

PHASE NOISE

Phase noise is an important parameter for a DRO. It is an indication of the circuit Q as well as the low frequency noise properties of the oscillating device. Single sideband phase noise of DROs is usually specified in dBc/Hz at 10 and 100 kHz offset from the carrier frequency. This helps in comparing different types of oscillators. A typical fixed frequency silicon bipolar DRO at 10 GHz will have phase noise of about -100 and -130 dBc/Hz at 10 and 100 kHz offset from the carrier, respectively.

Phase noise is also affected by mechanical perturbations imposed on the DRO case. For this reason, it is important to make a distinction between phase noise under quiescent conditions and phase noise when the DRO is exposed to vibration energy. The extent of phase noise degradation under vibration depends on the magnitude and frequency of the applied mechanical energy.

There are a number of other ways to specify the oscillator phase noise, e.g., Allan variance, phase jitter, spectral density of phase fluctuations, etc. It is possible to convert one form of specifications to another through known approximate relationships in the literature. It is, however, preferred that the phase noise should be specified in dBc/Hz at offsets of 10 kHz, 100 kHz, and any other offset of particular interest.

AM NOISE

Certain applications of the DRO require very low AM noise. Typically, the AM noise for an X or Ku-band GaAs FET DRO is better than -120, -140, and -150 dBc/Hz at 1, 10 or 100 kHz respectively from the carrier.

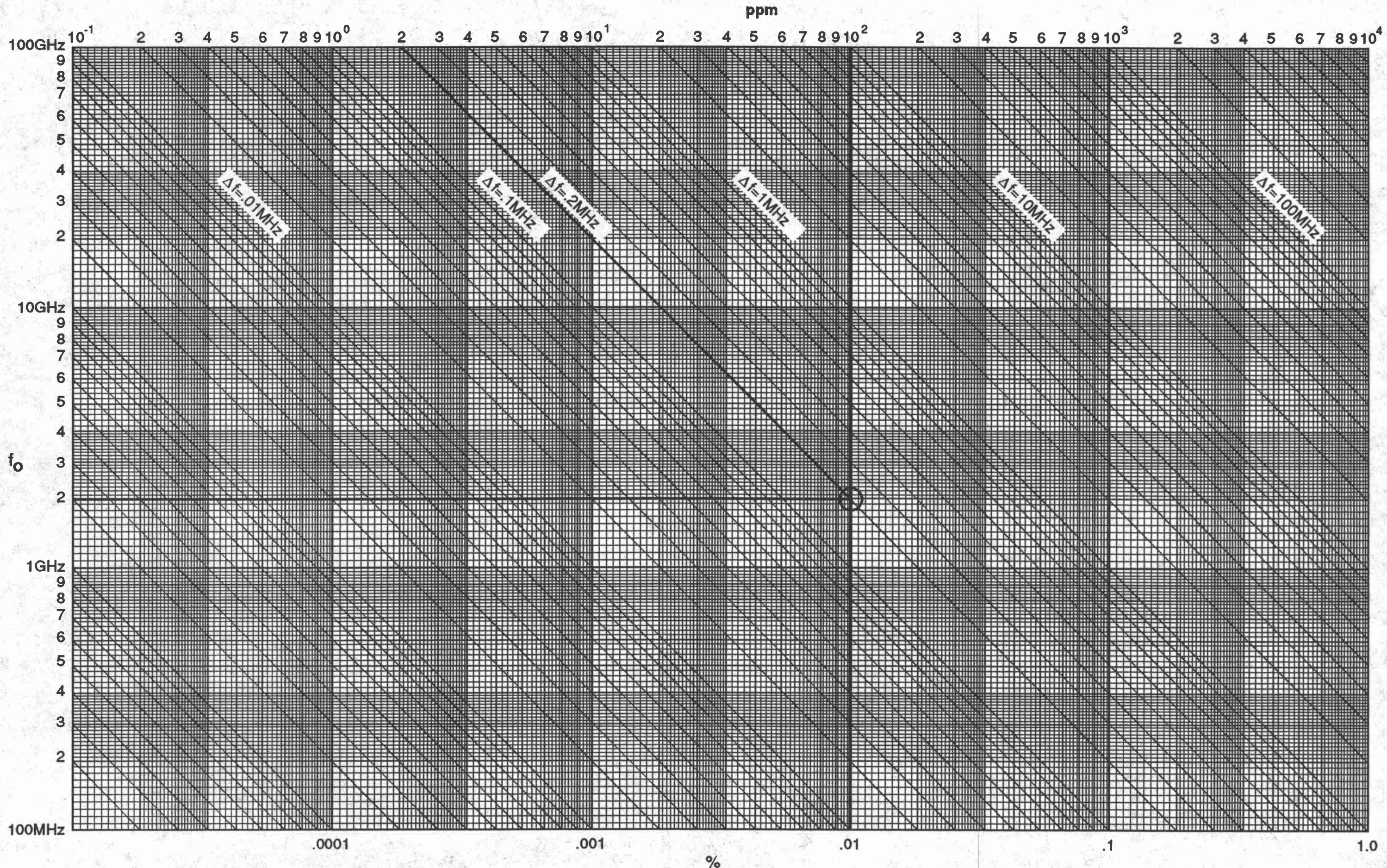
HARMONICS

Harmonic signals are coherently related to the output frequency. In general, these signals tend to be integer multiples of the output frequency. Harmonics are specified in dB below the fundamental or carrier output level (dBc). Typically, the DROs in all frequency ranges will have maximum harmonic levels of -20 dBc. Low-pass filters can be used to reduce harmonics even further.

SPURIOUS

Non-harmonic spurious signals should not be present in the output of a well-designed and -constructed DRO. Typically specified at -60 dBc or better, measurements are time consuming and performance is generally guaranteed but not tested at levels below -60 dBc.

Chart 1. This nomogram converts Δf at any given frequency f_o, into $\frac{\Delta f}{f_o}$ in ppm or %

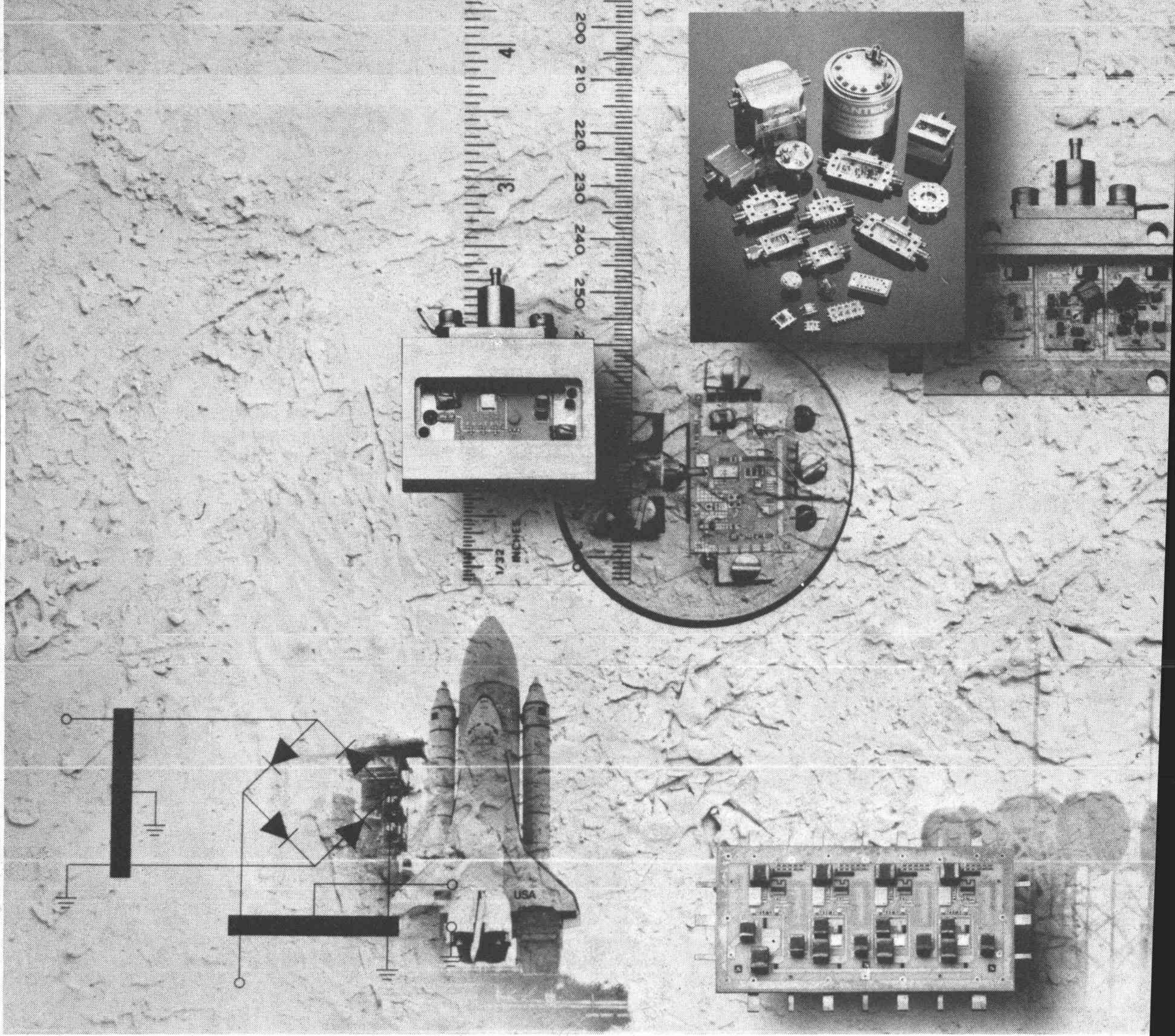


Example. f_o=2GHz, Δf=.2MHz.
At intersection of f_o and Δf, move vertically and read 10^2 ppm or down to .01%.

QUICK SPECS FOR A DRO

Center frequency (Note 1)	________________	MHz
Power output into 50 ohm load	________________	dBm (min)
Power variation	________________	dB
Temperature range	________________	°C
Frequency accuracy (Note 2)	± ________________	%/PPM/MHz
Tuning range: Electrical	± ________________	%/PPM/MHz
Tuning voltage min	________________	Volts
Tuning voltage max	________________	Volts
Mechanical	± ________________	%/PPM/MHz
Frequency pushing	± ________________	kHz/volt
Frequency pulling: ___dB return loss	± ________________	%/PPM/MHz
Output VSWR	________________	
Harmonics, max	________________	dBc
Spurious, max	________________	dBc
Phase noise, SSB:10 KHz offset	________________	dBc/Hz
KHz offset	________________	dBc/Hz
AM noise ________KHz offset	________________	dBc/Hz
Input power: Voltage	________________	Volts
Current, max	________________	mA
Case style	________________	
Weight, max	________________	
Other	________________	

Notes:
1. Center frequency is the user-specified ideal operating frequency.
2. The oscillator will stay within the frequency accuracy of the user-specified frequency under all conditions, including the full temperature range, load pulling, frequency pushing, and aging.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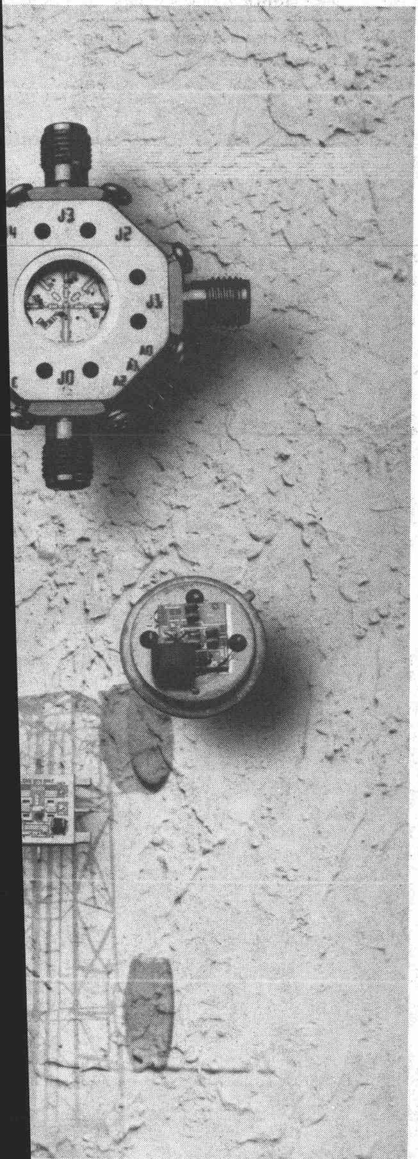
HARDWARE AND TEST FIXTURES



HARDWARE

TEST FIXTURES

INTRODUCTION

To aid the user in achieving optimum performance and to provide flexibility in the use of modular components, Avantek offers a wide range of hardware accessories. The following pages provide dimensional and ordering information for all hardware and accessories available from Avantek. Note: All of the hardware described below is available from Avantek only as indicated; the individual kit components, such as screws, washers, or mounting rings will not be available separately from Avantek. All of the following hardware is stocked by Avantek authorized distributors. The user should contact the nearest Avantek authorized distributor for these items.

Table 1. Products Supplied With Mounting Hardware (listed in alphabetical order)

Product	Voltage Controlled Oscillator	Case Style
AGC	Amplifier	TO-8
GPD	Amplifier	TO-12
GPL	Limiter	TO-12
GPM	Amplifier	TO-12
UDL	Limiting Amplifier	DIP
UMX	Mixers	TO-8
UTD	Detector	TO-8
UTF	Attenuators	TO-8
UTL	Limiting Amplifier/Limiter	TO-8
UTM	MOD Amplifier	TO-8
UTO	Amplifier	TO-8
VTO	Voltage Controlled Oscillator	TO-8
HTO	Voltage Controlled Oscillator	TO-8
VTD	Buffered VCO	DIP

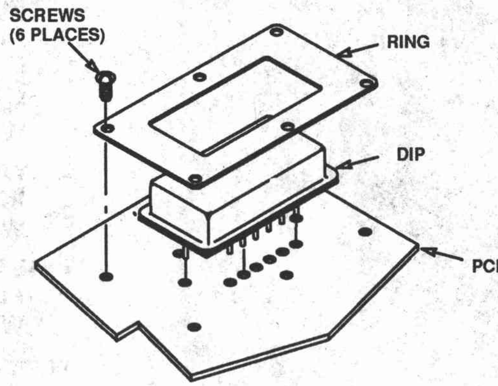
Note: Mounting Hardware for the above case styles are found on the following pages.

MOUNTING HARDWARE

Dual-Inline Package

(VTD Oscillators, UDL Limiting Amplifiers)

Component	Description	Qty
—	0-80 X 1/4 Pan Head Screw	6 ea
380-003414-001	DIP Mounting Bracket	1 ea
330-006757-001	UDP Accessory Pack	1 ea.



MOUNTING HARDWARE

TO-12 Accessory Pak

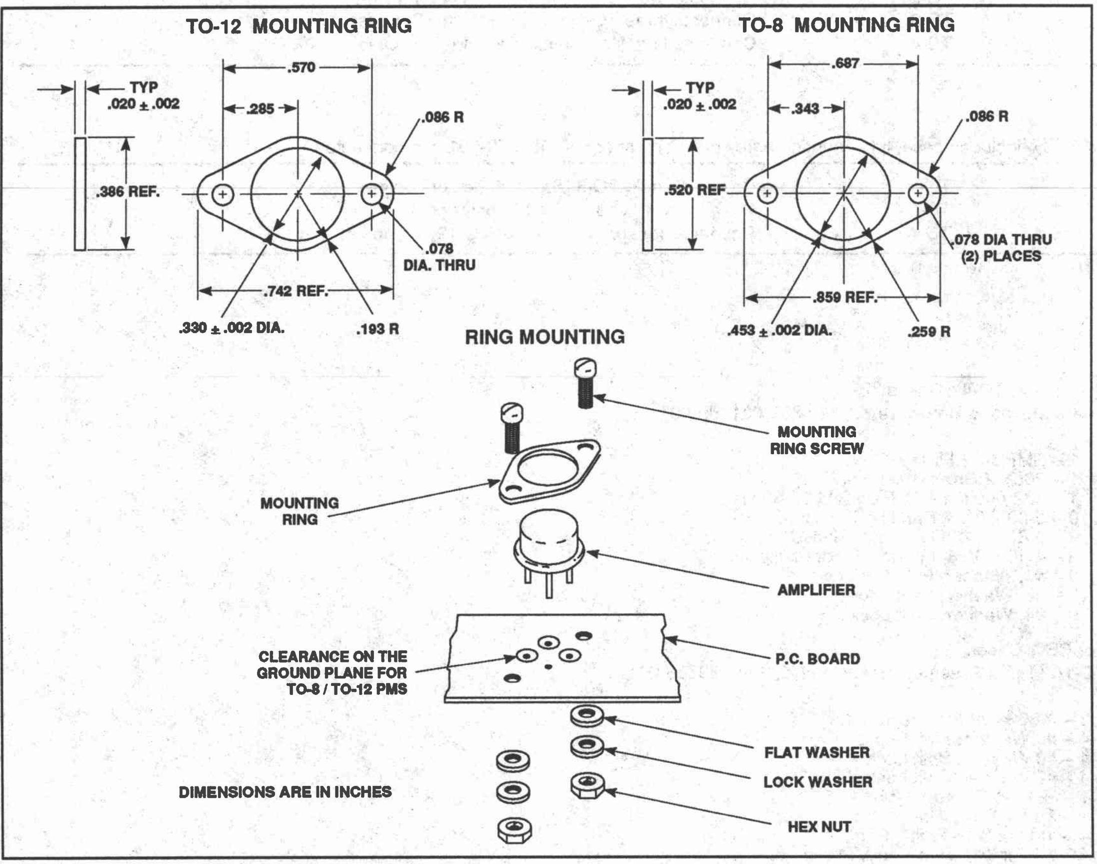
Order Kit No. 330-006756-001

Consisting of:
- 2 ea 0-80 x 1/4 Pan Head Slotted
- 2 ea #0 Washer, Flat Reduced OD
- 2 ea #0 Washer, Split Lock
- 2 ea #0 Nut, S. P.
- 1 ea GPD Mounting Ring

TO-8 Accessory Pak

Order Kit No. 330-001951-001

Consisting of:
- 2 ea 0-80 x 1/4 Pan Head Slotted
- 2 ea #0 Washer, Flat Reduced OD
- 2 ea #0 Washer, Split Lock
- 2 ea #0 Nut, S. P.
- 1 ea UTO Mounting Ring



TC-1, TC-2, TC-4 STYLE CASCADE HARDWARE (with individual part listings)

CIRCUIT BOARDS (Hardware not included with circuit boards)

Part Number	Description
GP-2	Connects two GPD (TO-12) components in TC-2 case.
GP-4	Connects three or four GPD (TO-12) components in TC-4 case.
TB-1A	Connects one TO-8 component in TC-1 case.
TB-1	Connects one TO-8 components in TC-2 case.
TB-2	Connects two TO-8 components in TC-2 case.
TB-3	Connects three TO-8 components in TC-4 case.
TB-4	Connects four TO-8 components in TC-4 case.

CASES (Includes case, lid, mounting hardware kit number 330-001859-001 and connectors)

TC-1	Case for single TO-8 (SMA connectors only).
TC-2X	Case for two TO-8 or TO-12 components.
TC-4X	Case for three or four TO-8 or TO-12 components.

NOTES: X = Connector options
N = Type
M = SMA (OSM)
T = TNC
B = BNC

For TC-2X, TC-4X Cases
Spare Mounting Hardware Kit. No. 330-001859-001

1 – SMFB-A2 Filter DC
1 – 2051-2 Ground Terminal
1 – 622-000401-001 Plug Bolt 12-32 Hex
10 – 0-80 x 3/16, Pan Head, Slotted
6 – 0-80 x 1/4, Flat Head, Slotted
8 – 4-40 x 3/16, Fillister Head, Phillip
10 – #0, Washer, Flat, Reduced
10 – #0, Washer, Split Lock
9 – #4, Washer, Split Lock

For CS-1 Cases
TC-1A (4-pin) Assembly Pak, Part No. 330-550556-001

5 – 0-80 x 1/8 Flat Head
4 – #0 Washer, Flat
4 – #0 Washer, Split Lock
4 – #2 Washer, Split Lock
1 – Hi Freq Filter (FD thru)
1 – Turret Term. Brass
4 – 0-80 x 3/16 Phillip Pan
4 – 2-56 x 3/16 Pan Head, Phillip

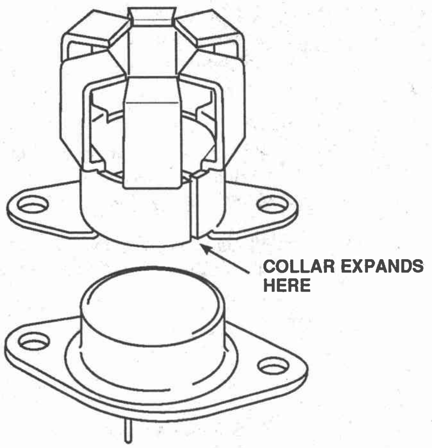
AVANPAK™ PACKAGE HARDWARE

Model Number	Description	Use With
SK-001	Avanpak SMA Female Connector Kit contains: 1 ea SMA Female Avanpak Connector 1 ea RFI Gasket 2 ea Mounting Screws 2 ea Washers	ACT Series cascades DBX Series mixers TFX Series mixers
SK-002	Avanpak SMA Male Connector Kit contains: 1 ea SMA Male Avanpak Connector 1 ea RFI Gasket 2 ea Mounting Screws 2 ea Washers	ACT Series cascades DBX Series mixers TFX Series mixers
SK-003	Avanpak Slip-on Sleeve Kit contains: 3 ea Microstrip Slip-on Sleeves	All Avanpak components when mounting without connectors to provide soldering strain relief.
SK-004	Avanpak DC Connector Kit contains: 1 ea Avanpak DC Slip-on Connector 1 ea RFI Gasket 2 ea Mounting Screws 2 ea Mounting Washers 1 ea Solder Lug	All Avanpak components where slip-on DC Connection is desired.
SK-005	Avanpak (Small Pattern) SMA Female Connector Kit contains: 1 ea SMA Female Avanpak Connector 2 ea Mounting Screws 2 ea Washers	AHS Series switches AHD Series switches AHL Series limiters DBY Series mixers
SK-006	Avanpak (Small Pattern) SMA Male Connector Kit contains: 1 ea SMA Male Avanpak Connector 2 ea Mounting Screws 2 ea Washers	AHS Series switches AHD Series switches AHL Series limiters DBY Series mixers
SK-009	Avanpak (Small Pattern) SMA Female Connector Kit contains: 1 ea SMA Female Avanpak Connector 2 ea Mounting Screws 2 ea Washers	AHT Series switches AHQ Series switches AHF Series limiters
SK-010	Avanpak (Small Pattern) SMA Male Connector Kit contains: 1 ea SMA Male Avanpak Connector 2 ea Mounting Screws 2 ea Washers	AHT Series switches AHQ Series switches AHF Series limiters

HEAT SINK (For TO-8/TO-3 Packages)

For customers concerned about dissipation patterns and heat sinking, Avantek offers the following suggestion. A heat sink, manufactured by Aavid Engineering, Inc., (P.O. Box 400, Laconia, NH 03247, (603) 528-3400), will fit over the standard mounting hardware, and will not require additional board space. Designer will need to allow for vertical clearance only. The heat sink collar provides a snug fit over the TO-8 device cover. TO-8 mounting hardware tightens both the heat sink and TO-8 device securely to the printed circuit board (Figure 1).

Figure 2 provides necessary data for thermal dissipation management. For closed modules the TO-8 device may require direct connection to the module or case using these, or other, heat dissipation connections.



HEAT SINK SLIPS OVER TO-8 COVER AND RING CLAMP

Figure 1. Mounting

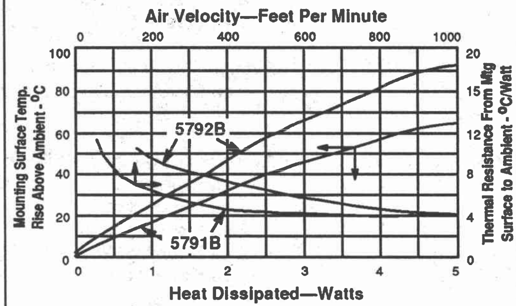
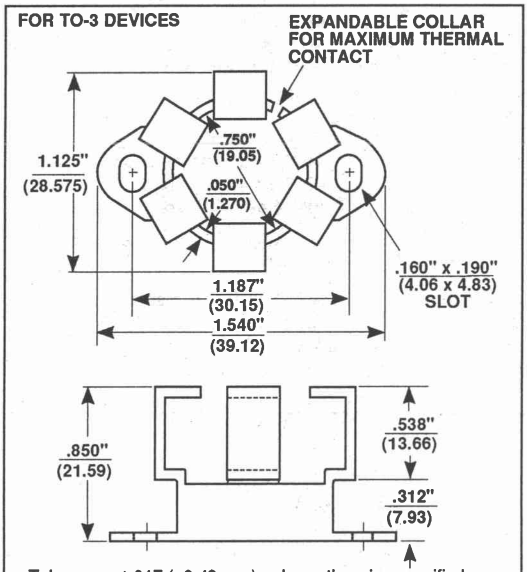
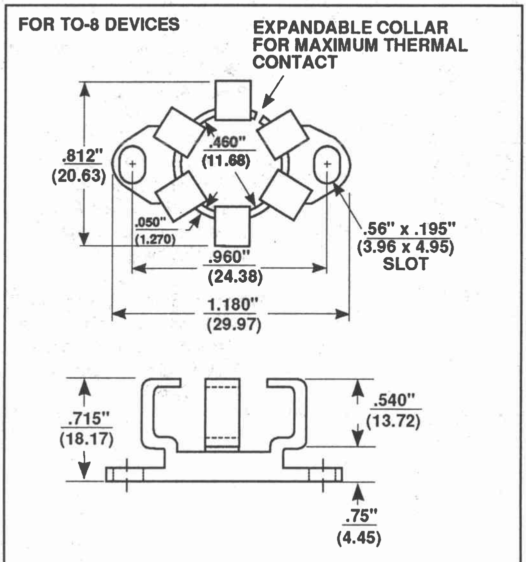


Figure 2. Thermal Dissipation



Tolerances ±.017 (+0.43 mm) unless otherwise specified.
Dimensions in parenthesis are millimeters.

Avantek P/N 681-554629-001 (Aavid P/N 5791B)



Tolerances ±.017 (+0.43 mm) unless otherwise specified.
Dimensions in parenthesis are millimeters.

Avantek P/N 681-554629-002 (Aavid P/N 5792B)

INTRODUCTION

Avantek stocks standard test fixtures which are useful in demonstrating performance of certain modular products. These test fixtures will help assure customers of device performance for failure analysis, prior to installation in systems and allow special testing for non-standard characteristics.

1. PlanarPak Devices:
   PPTF-25 for 1/4-in. packages
   PPTF-38 for 3/8-in. packages
   PPTF-48 for .4-in. x .8-in. packages
2. Voltage Controlled Oscillators—TO–8 Package:
   TF-800/801/802
3. Buffered Voltage Controlled Oscillators—DIP Packages:
   TF-900/901
4. All other products in TO-8 and TO-12 style packages. Excellent products are produced by:

   Inter-Continental Microwave
   2370-B Walsh Avenue
   Santa Clara, CA 95051
   Telephone: 408/727-1596

FEATURES

- DC to 18 GHz Frequency Range
- Connectorized Inputs/Outputs
- Easy to Test Surface Mount Package
- Includes Calibration Device
- Repeatable Performance

APPLICATIONS

- Engineering Characterization
- Incoming Inspection
- System Prototype
- Demonstration of Device Performance

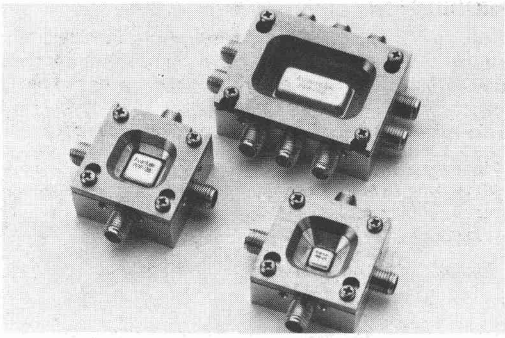


Figure 1

DESCRIPTION

To facilitate testing and prototyping of products offered in the PlanarPak package a series of test fixtures is available (Figure 1). Designated the Avantek PPTF Series test fixtures, they feature rugged construction for precise, repeatable measurements. Each PPTF test fixture comes supplied with calibration references consisting of an appropriate 50-ohm thru-line, 50-ohm termination and short. All three references, the PPR-25/38/48, are contained in each PlanarPak reference (see Figure 2) for ease of use.

The PPTF-25, for 0.25-inch square PlanarPak packages, and PPTF-38, for 0.38-inch square packages, are equipped with four full-specification microwave ports, each consisting of an isolated 50-ohm microstrip line on 0.015-inch-thickness alumina. Connection between the SMA connector and the microstrip is made using welded gold ribbon. The PPTF-48, for the 0.4 by 0.8-inch PlanarPak packages is similar in design, but provides 10 RF connections, each with SMA connectors.

In use the PlanarPak package is physically aligned and held into the test fixture by an aluminum compression window equipped with silicon rubber pressure pads over the leads (Figure 3).

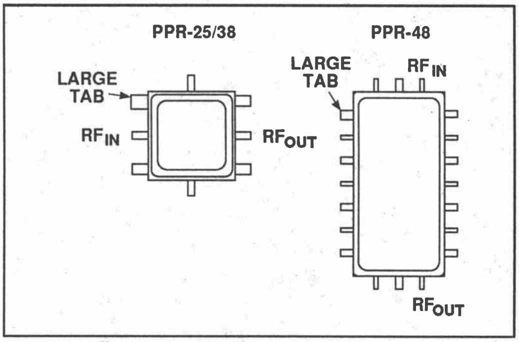
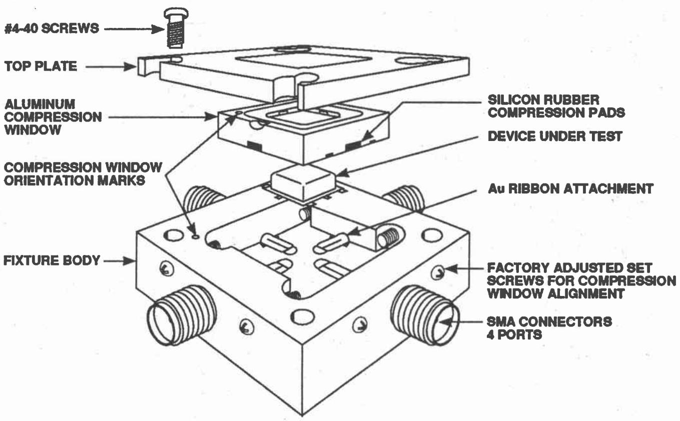


Figure 2. Micro Stripline Reference



To use the PPTF test fixture, the PlanarPak package is aligned and pressed into the fixture by an aluminum compression window (rexolite on the PPTF-48), equipped with silicon rubber pressure pads over the leads. The bottom of the fixture body is furnished with four tapped holes to facilitate mounting to a master plate.

Figure 3. PlanarPak Package

The compression window is factory-aligned to the fixture body with the set screws, and its orientation is referenced by the dimple on one corner of the window (Figure 3), with an associated mark on the fixture body. The bottom of the fixture body is furnished with four tapped holes to facilitate mounting to a master plate.

The electrical characteristics of the PPTF Series fixtures are shown in Table 1, thru insertion and return loss curves in Figure 4.

Table 1. Test Fixture with Thru Reference Installed

Model No.	Frequency GHz Min.	Thru Loss dB Max.	Thru VSWR :1 Max.	Operating Temperature Range °C Max.
PPTF-25	DC-18	2.5	2.2	–55 to +125
PPTF-38	DC-12	1.5	2.2	–55 to +125
PPTF-48	DC-8	1.5	2.2	0 to +50
Calibration Reference — Typical Performance at +25°C				
PPTF-25	DC-18	1.5	1.5	–55 to +125
PPTF-38	DC-12	1.0	1.5	–55 to +125
PPTF-48	DC-8	1.0	1.5	–55 to +125

PlanarPak Test Fixture User's Note

1. Insert the PlanarPak package into the fixture cavity.
2. Insert window in the fixture so that the drilled corner on the window is aligned with the drilled corner marker on the housing. (These should be located in the upper left hand corner.)
3. Install the compression frame using No. 2-56 screws. While pushing window and PlanarPak package toward corner marker, tighten screws uniformly. Do not tighten screws past the point where they are making moderate pressure on window since this will deform the window and shorten it's life.
4. Check that the frame is tightened uniformly over the window. (There is a constant gap over the window.)
5. The fixture is now ready for electrical testing.
6. PlanarPak case drawings showing lead designations appear elsewhere in this *Data Book.*

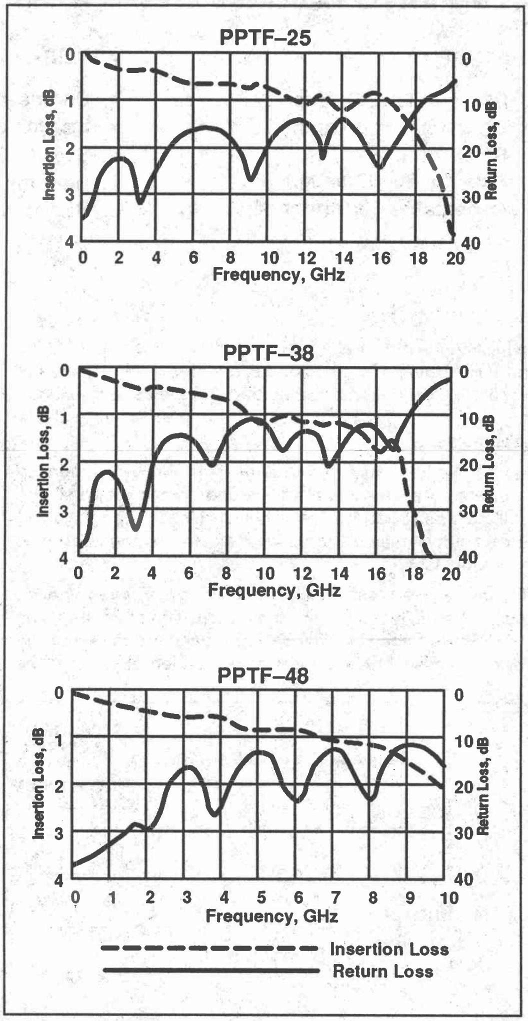


Figure 4

FEATURES

- DC to 11 GHz Frequency Range
- Connectorized Tuning Port and RF Output
- Easy to Test Package
- Repeatable Performance

APPLICATIONS

- Engineering Characterization
- Incoming Inspection
- System Prototype
- Demonstration of Device Performance

DESCRIPTION

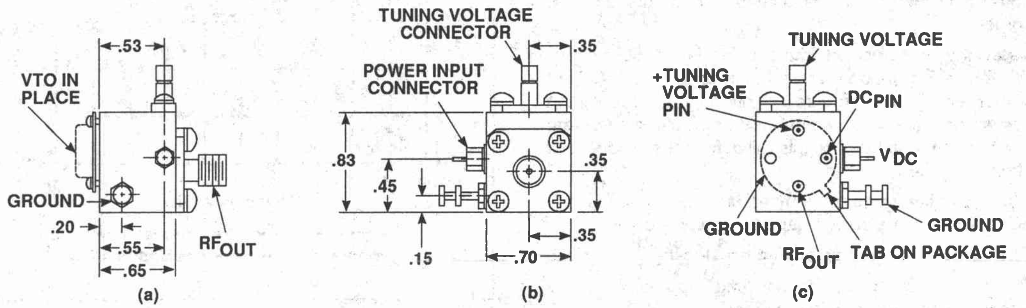
To facilitate testing and prototyping of products in the TO-8V and VTD (dual in-line) packages, a series of test fixtures is available. Designated the Avantek® TF Series test fixtures, they feature rugged construction for precise, repeatable measurements.

The TF Series test fixtures come supplied with mounting hardware to ensure excellent ground contact between the oscillator package and test fixture. This assures excellent contact between package pins and test fixture connector pins for reliable testing.

The device under test is aligned according to Figures 1 and 2, and pushed fully down onto the fixture. The steel mounting ring clamp is placed over the device under test and secured by machine screws prior to testing. Orientation of pins can be verified by comparison with part (c) of Figures 1 and 2. For the TO-8 devices compare pin locations with Figure 1(c), and for VTD packages compare pin locations with Figure 2(c). For the TF-800 series it is recommended that both machine screws be used to fasten the ring clamp. For the TF-900 Series it is recommended that all six screws be used to fasten the rectangular ring clamp. Screws should be tightened down snugly with a jewelers type screwdriver.

For different connector options check the tables in Figures 1 and 2 to identify the correct part numbers.

It should be noted that some output power variation may be seen, from unit data, at frequencies above 8 GHz. This is due to small differences in lengths of test fixture RF output connector pins.



CONNECTOR OPTION	MODEL		
CONNECTOR	TF-800	TF-801	TF-802
TUNING VOLTAGE	SMB	SMA	SMA
RF OUT	SMA	SMA	N

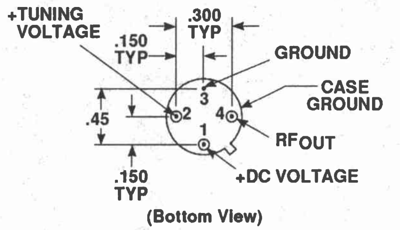
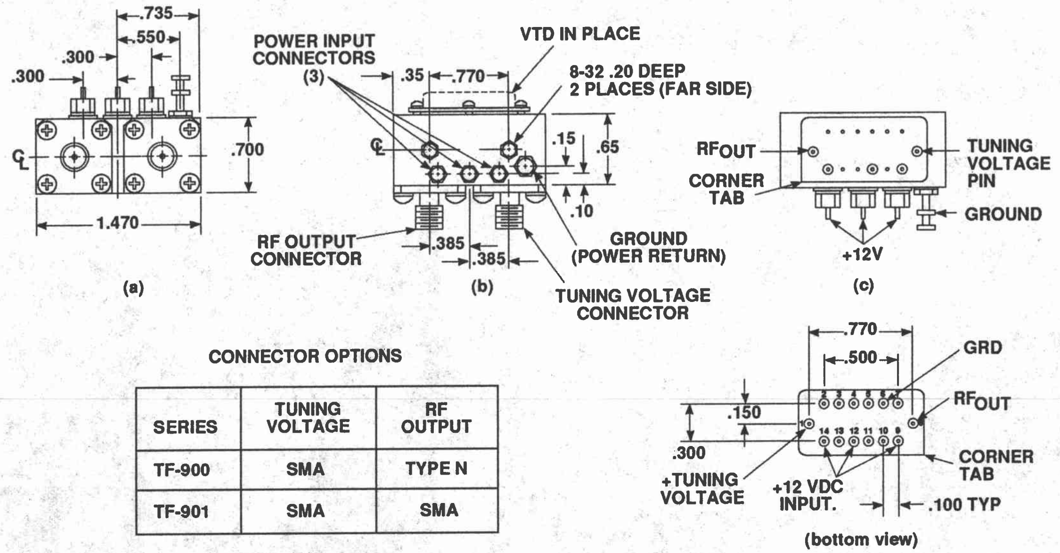


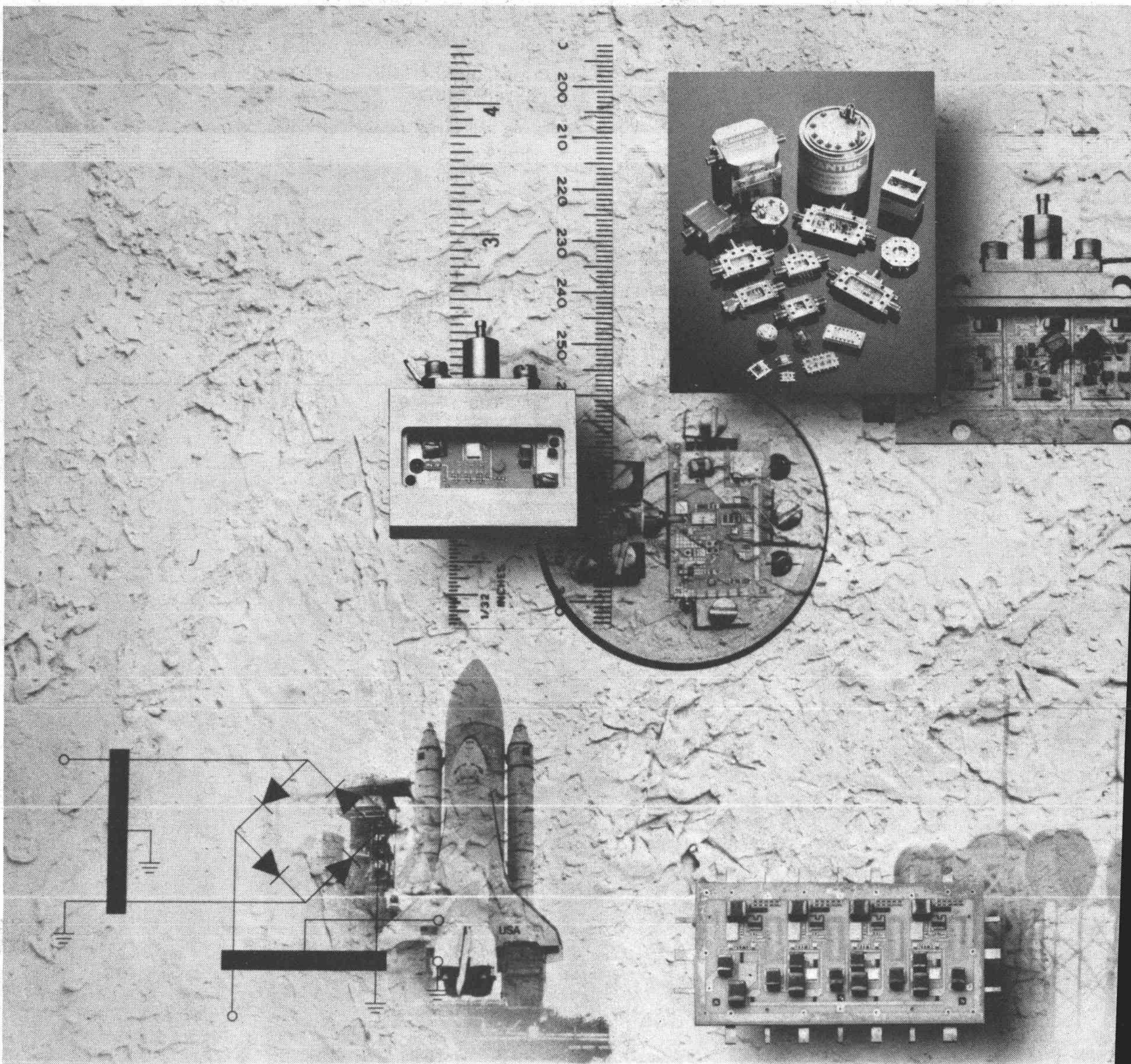
Figure 1. TO-8V Test Fixture



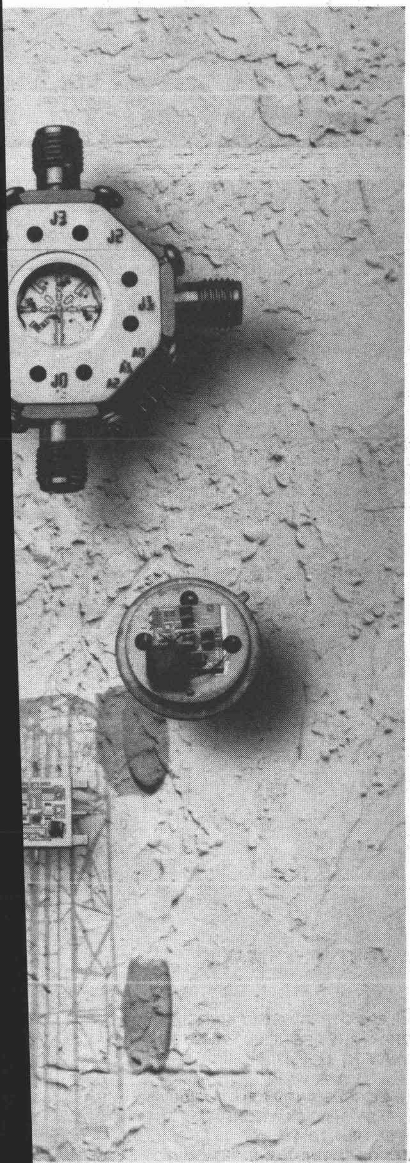
CONNECTOR OPTIONS

SERIES	TUNING VOLTAGE	RF OUTPUT
TF-900	SMA	TYPE N
TF-901	SMA	SMA

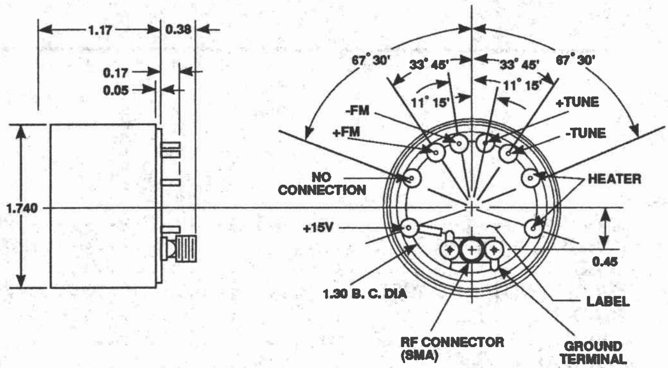
Figure 2. VTD Test Fixture


200 210 220 230 240 250
USA

CASE DRAWINGS

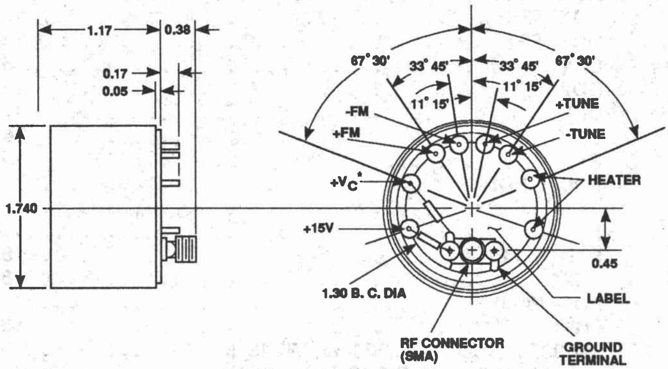


A



WEIGHT 10 oz. (MAX)

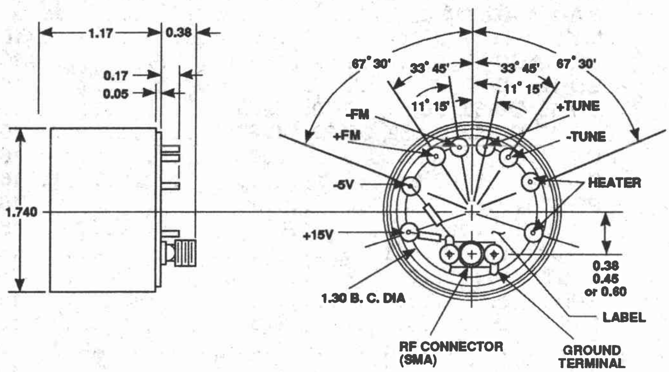
B



* FOR AV-7204, TERMINAL $+V_c$ REQUIRES A LINEAR VOLTAGE RAMP PROPORTIONAL TO FREQUENCY. THE VOLTAGE AT 2 GHz IS FACTORY SELECTED WITHIN THE RANGE +7 TO +13 VOLTS AND THE VOLTAGE AT 4 GHz IS +15.0 VOLTS.

WEIGHT 10 oz. (MAX)

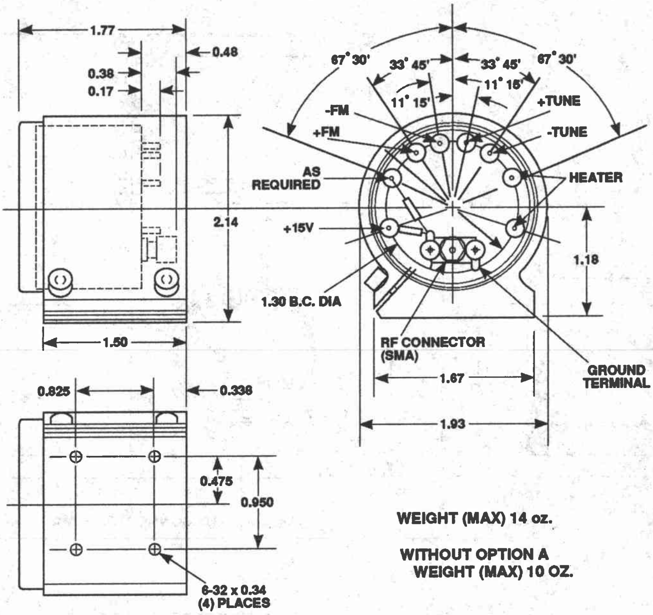
C



WEIGHT 10 oz. (MAX.)

NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010
3. DC CONNECTIONS ARE 0.030 DIA. PINS AND ARE AS REQUIRED BY SPECIFICATIONS
4. LABEL PER MIL-STD -130
5. POLARITY OF FM AND TUNE IS SHOWN ON LABEL

OPTION A (MU-METAL SHIELD) SHOWN WITH YIG A INSTALLED

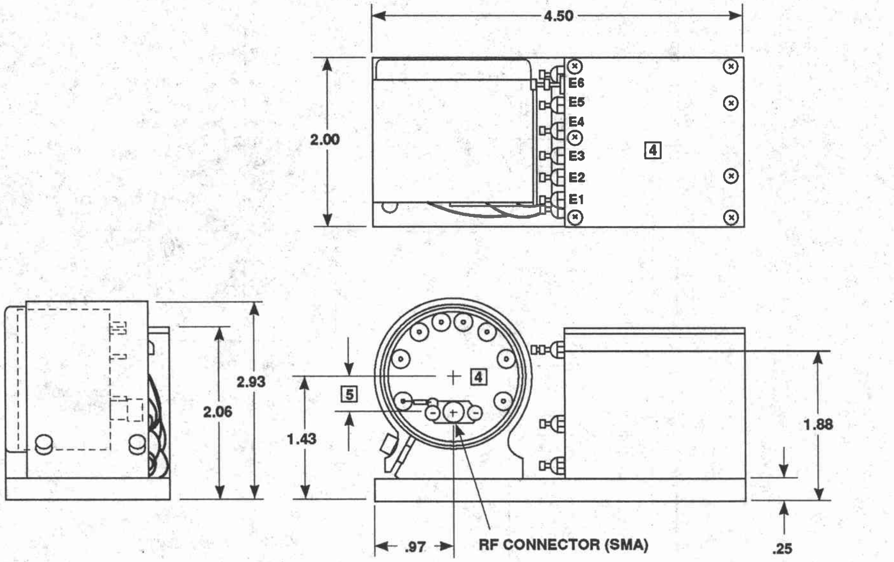


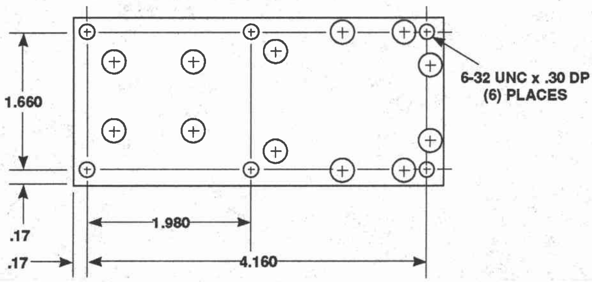
WEIGHT (MAX) 14 oz.

WITHOUT OPTION A
WEIGHT (MAX) 10 OZ.

NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010
3. DC CONNECTIONS ARE 0.030 DIA. PINS AND ARE AS REQUIRED BY SPECIFICATIONS
4. LABEL PER MIL-STD -130
5. POLARITY OF FM AND TUNE IS SHOWN ON LABEL

ANALOG DRIVER WITH YIG OSCILLATOR WITH OPTION A





ANALOG YIG DRIVER ELECTRICAL CONNECTIONS

PIN INDEX	
E1	+15V INPUT
E2	–15V INPUT
E3	±15V RETURN
E4	+TUNE INPUT
E5	–TUNE INPUT
E6	GROUND
HTR*	20-28V HEATER INPUT
–FM*	–FM TUNING INPUT
+FM*	+FM TUNING INPUT

*On YIG Body

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES xx ± .02
   xxx ± .010
3. RF CONNECTOR SMA JACK INTERFACE DIMENSIONS PER MIL-C-3901

4 PRODUCT LABEL PER MIL-STD-130.

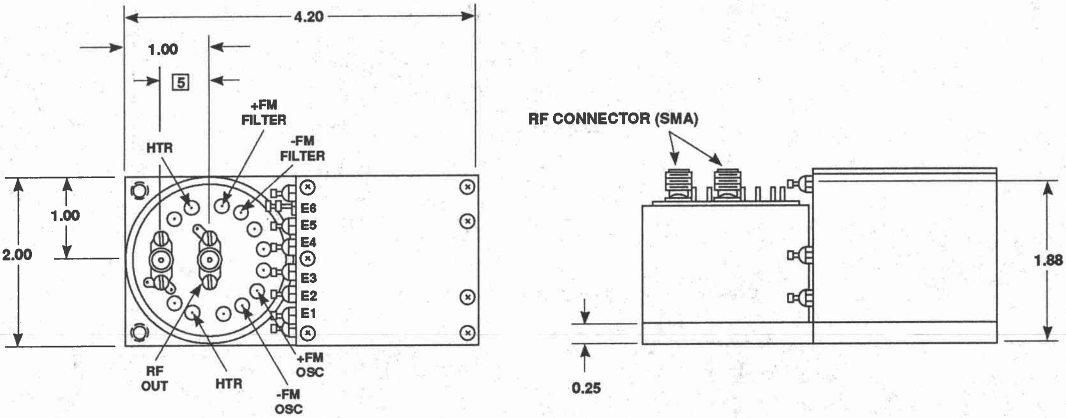
5 SEE INDIVIDUAL OSC. DRAWING FOR DIMENSION.

Operating Precautions

1. Do not exceed the supply voltage at +15V or –15V by more than 5%.
2. Caution should be observed not to operate the unit without a ±15V return.
3. Do not exceed the maximum FM tuning coil current of ±200 mA RMS except 7248 Filter which is ±300 mA RMS.

Note: (Applicable to units with mounting clamp) Silicon grease has been used in the mechanical assembly for improved thermal characteristics. Some silicon grease may "bleed" out around the clamp. This is normal.

ANALOG DRIVER WITH F1 YIG OSCILLATOR



NOTES: (UNLESS OTHERWISE SPECIFIED)

1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES xx ± .02
   xxx ± .010
3. RF CONNECTOR SMA JACK INTERFACE DIMENSIONS PER MIL-C-3901

4 PRODUCT LABEL PER MIL-STD-130.

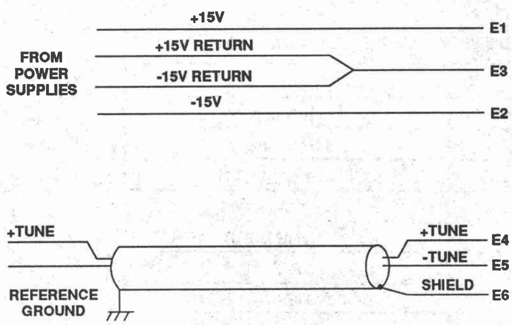
5 SEE INDIVIDUAL OSC. DRAWING FOR DIMENSION.

ANALOG YIG DRIVER ELECTRICAL CONNECTIONS

PIN INDEX	
E1	+15V INPUT
E2	–15V INPUT
E3	±15V RETURN
E4	+TUNE INPUT
E5	–TUNE INPUT
E6	GROUND
HTR*	20-28V HEATER INPUT
–FM*	–FM TUNING INPUT
+FM*	+FM TUNING INPUT

*On YIG Body

Recommended Hook-up System

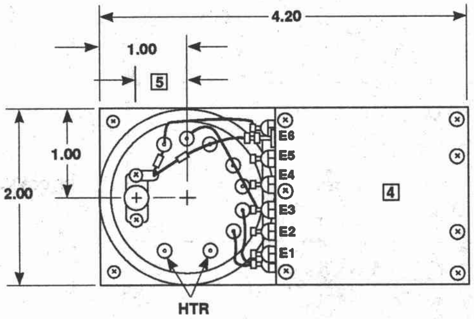


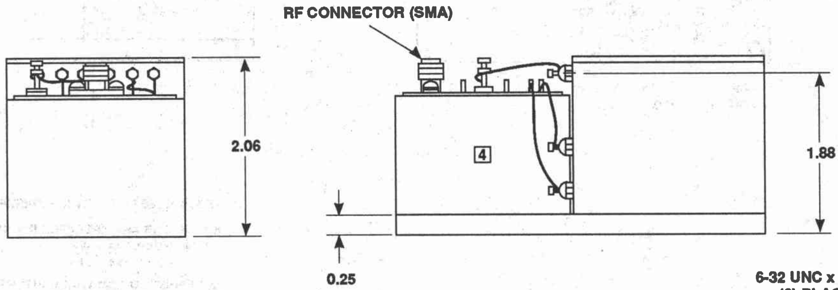
Operating Precautions

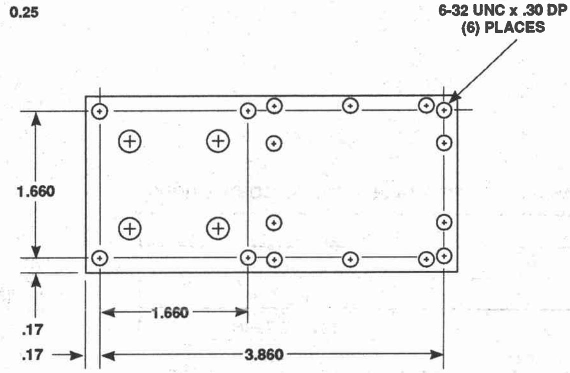
1. Do not exceed the supply voltage at +15V or –15V by more than 5%.
2. Caution should be observed not to operate the unit without a ±15V return.
3. Do not exceed the maximum FM tuning coil current of ±200 mA RMS except 7248 Filter which is ±300 mA RMS.

Note: (Applicable to units with mounting clamp) Silicon grease has been used in the mechanical assembly for improved thermal characteristics. Some silicon grease may "bleed" out around the clamp. This is normal.

ANALOG DRIVER WITH YIG OSCILLATOR







ANALOG YIG DRIVER ELECTRICAL CONNECTIONS

PIN INDEX	
E1	+15V INPUT
E2	–15V INPUT
E3	±15V RETURN
E4	+TUNE INPUT
E5	–TUNE INPUT
E6	GROUND
HTR*	20-28V HEATER INPUT
–FM*	–FM TUNING INPUT
+FM*	+FM TUNING INPUT

*On YIG Body

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES xx ± .02
   xxx ± .010
3. RF CONNECTOR SMA JACK INTERFACE DIMENSIONS PER MIL-C-3901

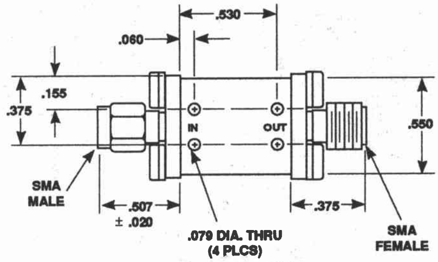
[4] PRODUCT LABEL PER MIL-STD-130.

[5] SEE INDIVIDUAL OSC. DRAWING FOR DIMENSION.

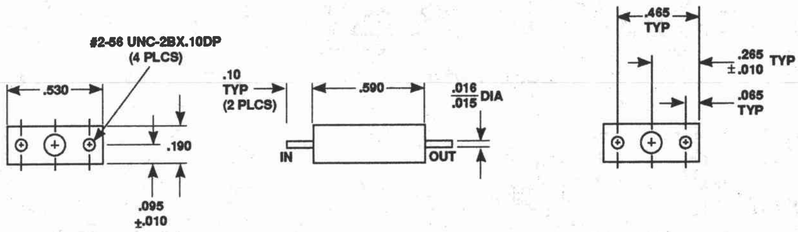
Operating Precautions

1. Do not exceed the supply voltage at +15V or –15V by more than 5%.
2. Caution should be observed not to operate the unit without a ±15V return.
3. Do not exceed the maximum FM tuning coil current of ±200 mA RMS except 7248 Filter which is ±300 mA RMS.

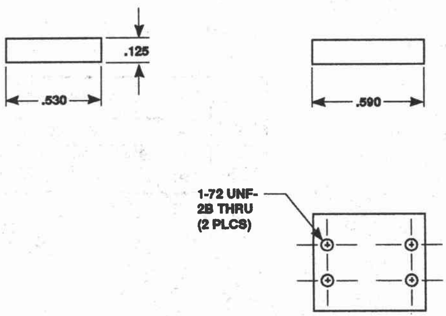
SMA PACKAGE



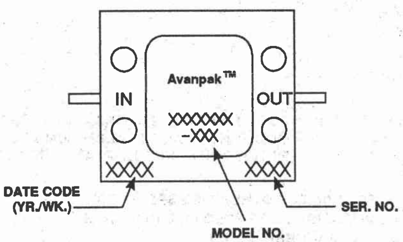
PIN PACKAGE



OPTIONAL SPACER FOR CONNECTOR GROUND CLEARANCE



LABELING

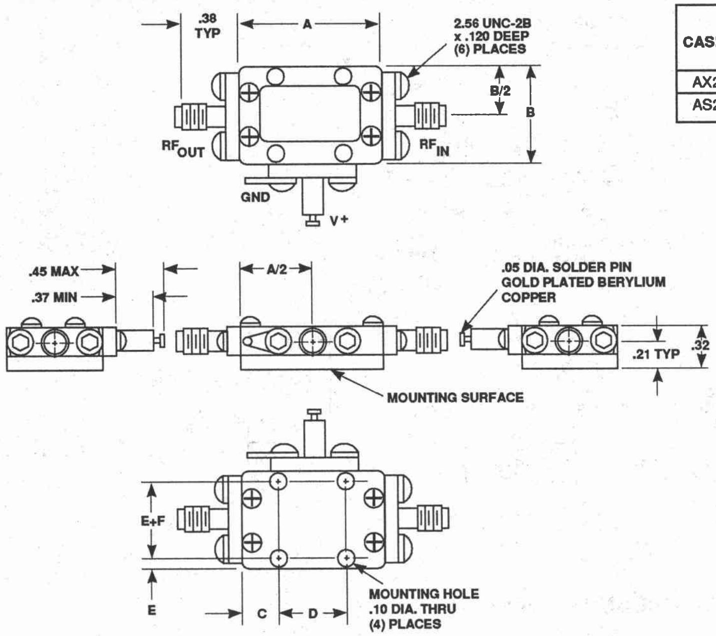


(SHOWN WITHOUT CONNECTORS)

WEIGHT WITH CONNECTORS AND SPACER = 10.5 GRAMS
WEIGHT WITHOUT CONNECTORS AND SPACER = 5.0 GRAMS

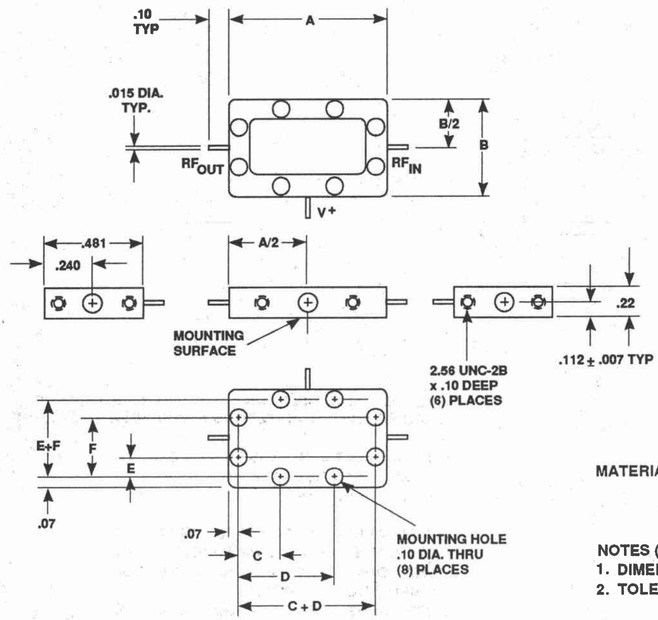
NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010
3. CLEARANCE HOLE FOR #1-72 UNF-2A x 5/16" FOR MOUNTING OPTIONAL SPACER PLATE.
4. SMA CONNECTORS OPTIONAL SHOWN FOR DIMENSIONAL PURPOSES.
5. USE CONNECTOR KITS SK-005 AND SK-006

SMA PACKAGE WITH OPTIONAL SPACER FOR CONNECTOR GROUND CLEARANCE



CASE	DIMENSIONS						WEIGHT TYP. gms.
	A	B	C	D	E	F	
AX2	1.364	.664	.31	.750	.07	.524	35
AS2	1.500	.862	.34	.826	.07	.722	40

PIN PACKAGE

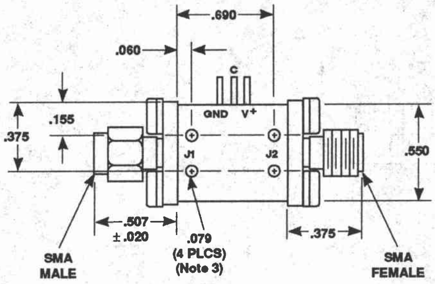


CASE	DIMENSIONS						WEIGHT TYP. gms.
	A	B	C	D	E	F	
AX2	1.364	.664	.237	.987	.137	.387	26
AS2	1.500	.862	.267	1.093	.236	.486	31

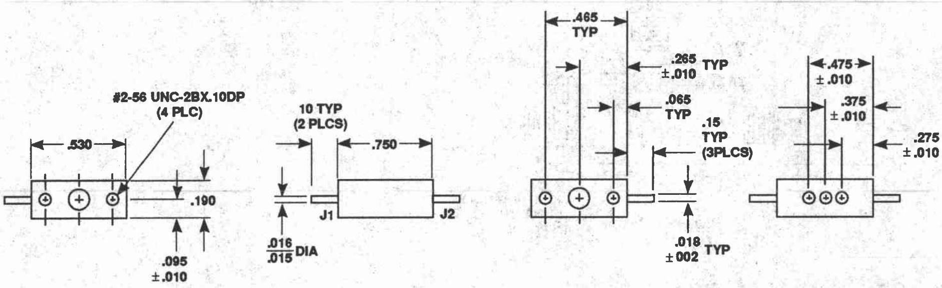
MATERIAL: BODY & RF CONNECTORS - 30 STAINLESS STEEL
MOUNTING SPACER - ALUMINUM ALLOY
FILTER BODY - NICKEL PLATED BRASS

NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
xxx ± .010

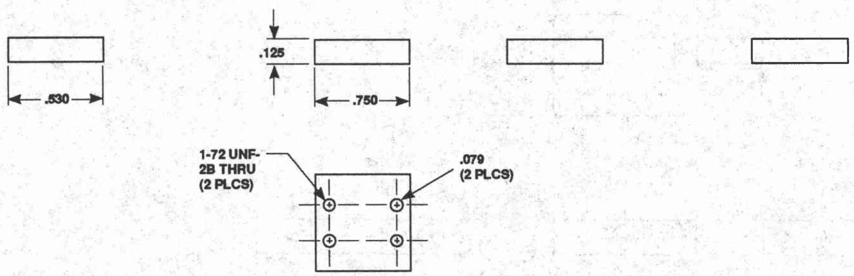
SMA PACKAGE



PIN PACKAGE



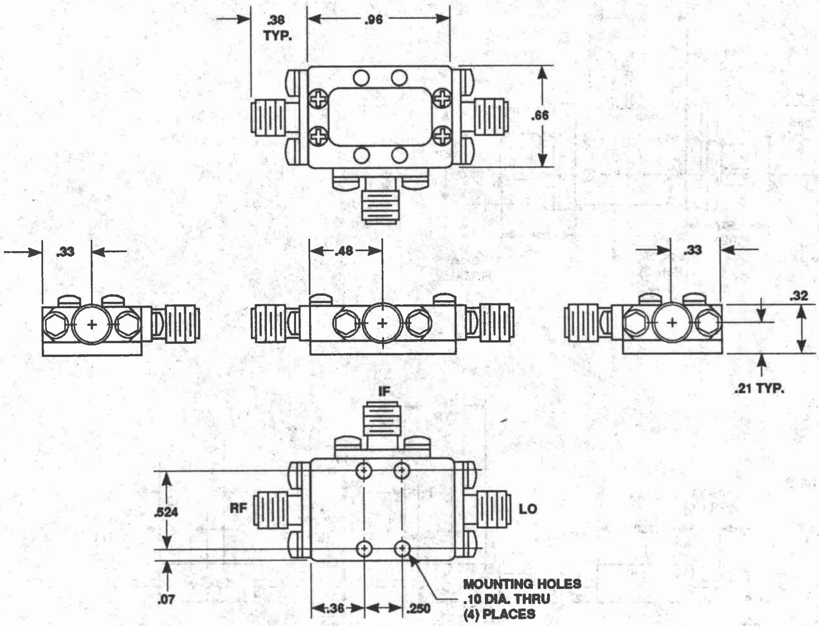
OPTIONAL SPACER FOR CONNECTOR GROUND CLEARANCE



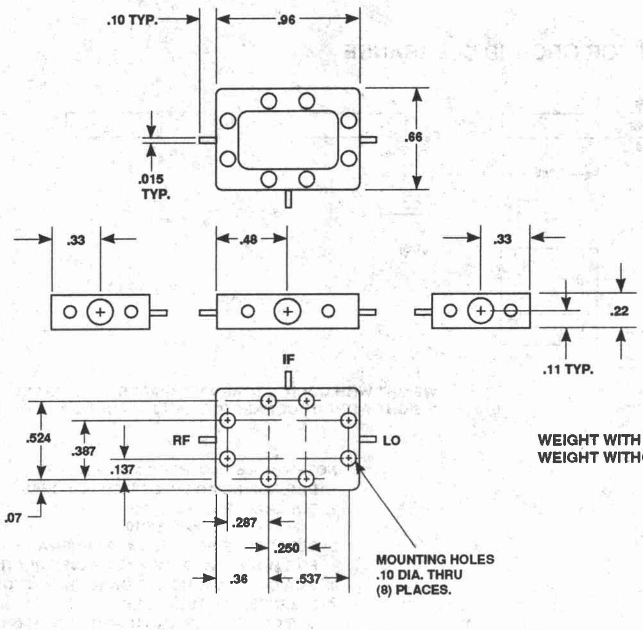
WEIGHT WITH CONNECTORS AND SPACER = 14.5 GRAMS
WEIGHT WITHOUT CONNECTORS AND SPACER = 7.1 GRAMS

NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010
3. CLEARANCE HOLE FOR #1-72 UNF-2A x 5/16" FOR MOUNTING OPTIONAL SPACER PLATE.
4. SMA CONNECTORS OPTIONAL SHOWN FOR DIMENSIONAL PURPOSES.
5. USE CONNECTOR KITS SK-005 AND SK-006

SMA PACKAGE WITH OPTIONAL SPACER FOR CONNECTOR GROUND CLEARANCE



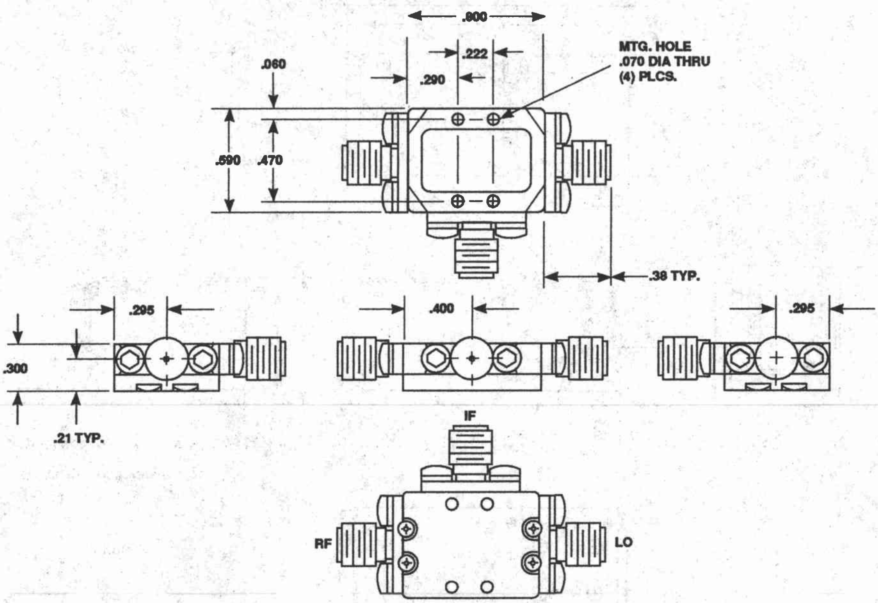
PIN PACKAGE



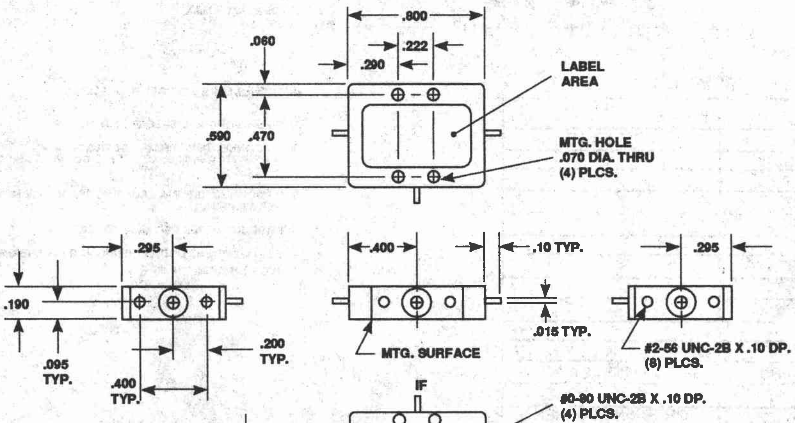
WEIGHT WITH CONNECTORS AND SPACER = 22 GRAMS
WEIGHT WITHOUT CONNECTORS AND SPACER = 13 GRAMS

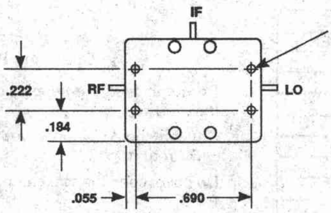
NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010
3. CONNECTORS, TYPE SMA FEMALE
   (SMA MALE OR SEMI RIGID OPTIONAL)

SMA PACKAGE WITH OPTIONAL SPACER FOR CONNECTOR GROUND CLEARANCE



PIN PACKAGE

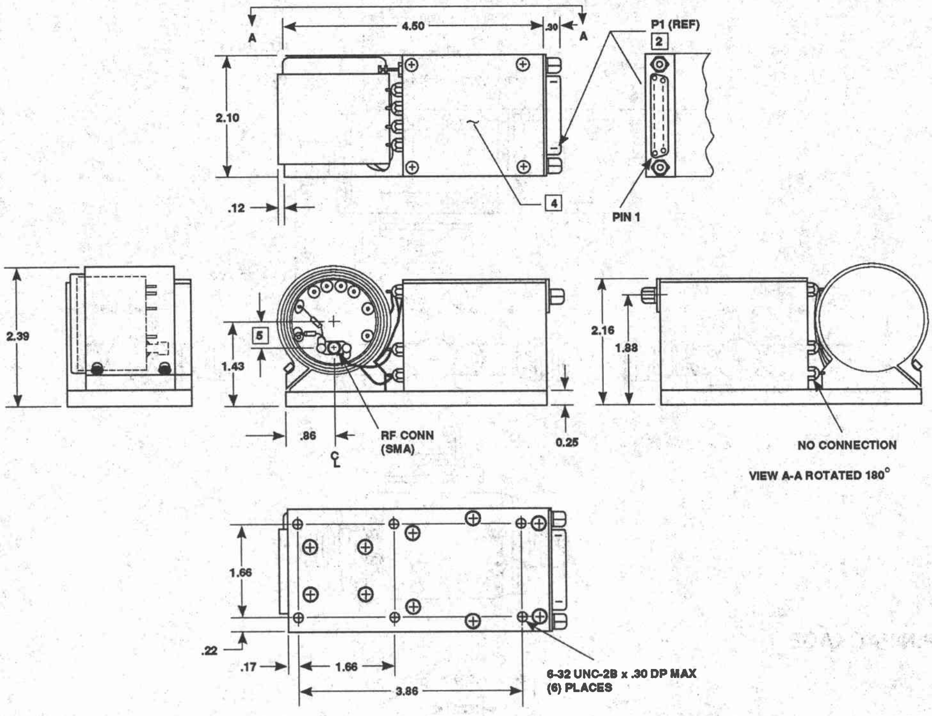




WEIGHT WITH CONNECTORS AND SPACER = 16 GRAMS
WEIGHT WITHOUT CONNECTORS AND SPACER = 7 GRAMS

NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010
3. CONNECTORS, TYPE SMA FEMALE
4. USE CONNECTOR KITS SK-005 AND SK-006

DIGITAL DRIVER WITH YIG OSCILLATOR



DIGITAL YIG DRIVER ELECTRICAL CONNECTIONS

CONNECTOR P1 PIN INDEX		
PIN #	FUNCTION	COMMENTS
1	BIT #1 INPUT (LSB)	
2	BIT #3 INPUT	
3	BIT #5 INPUT	
4	BIT #7 INPUT	
5	BIT #9 INPUT	
6	BIT #11 INPUT	
7	N/C	
8	N/C	
9	–FM	
10	+FM	
11	+15V GND RETURN	FOR PINS 12 & 13
12	+15V	
13	+15V to +30V	FOR TUNING CURRENT
14	BIT #2 INPUT	
15	BIT #4 INPUT	
16	BIT #6 INPUT	
17	BIT #8 INPUT	
18	BIT #10 INPUT	
19	BIT #12 INPUT	
20	N/C	
21	FM SHIELD GND	
22	HEATER	20–28V
23	HEATER	POLARITY NOT CRITICAL
24	–15V GND RETURN	
25	–15V	

NOTES: (UNLESS OTHERWISE SPECIFIED)

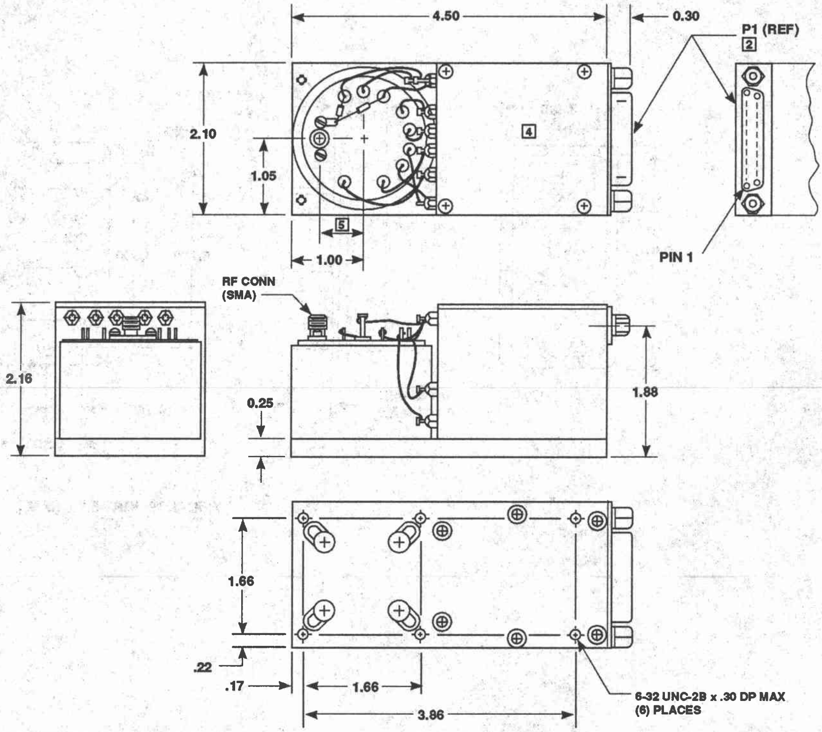
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. DC CONNECTOR PER MIL-C-24308/3-3. FOR CONNECTOR PIN FUNCTION SEE CONNECTOR P1 INDEX.
3. RF CONNECTOR SMA JACK INTERFACE DIMENSIONS PER MIL-C-3901
4. PRODUCT LABEL PER MIL-STD-130.
5. SEE INDIVIDUAL OSC. DRAWING FOR DIMENSION.
6. TOLERANCES: xx ± .02
   xxx ± .010

Operating Precautions

1. Do not exceed the supply voltage at +15V or –15V by more than 5%.
2. Caution should be observed not to operate the unit without a ±15V return.
3. Do not exceed the maximum FM tuning coil current of ±200 mA RMS.

NOTE: (Applicable to units with mounting clamp) Silicon grease has been used in the mechanical assembly for improved thermal characteristics. Some silicon grease may "bleed" out around the clamp. This is normal.

DIGITAL DRIVER WITH YIG OSCILLATOR



DIGITAL YIG DRIVER ELECTRICAL CONNECTIONS

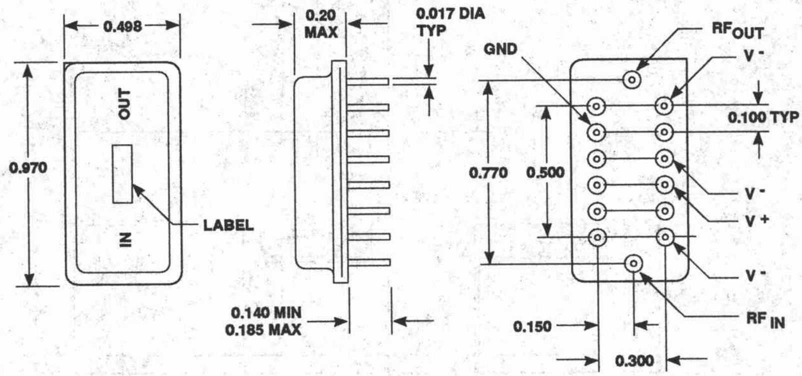
CONNECTOR P1 PIN INDEX		
PIN #	FUNCTION	COMMENTS
1	BIT #1 INPUT (LSB)	
2	BIT #3 INPUT	
3	BIT #5 INPUT	
4	BIT #7 INPUT	
5	BIT #9 INPUT	
6	BIT #11 INPUT	
7	N/C	
8	N/C	
9	–FM	
10	+FM	
11	+15V GND RETURN	FOR PINS 12 & 13
12	+15V	
13	+15V to +30V	FOR TUNING CURRENT
14	BIT #2 INPUT	
15	BIT #4 INPUT	
16	BIT #6 INPUT	
17	BIT #8 INPUT	
18	BIT #10 INPUT	
19	BIT #12 INPUT	
20	N/C	
21	FM SHIELD GND	
22	HEATER	20–28V
23	HEATER	POLARITY NOT CRITICAL
24	–15V GND RETURN	
25	–15V	

NOTES (UNLESS OTHERWISE SPECIFIED):

1. DIMENSIONS ARE SPECIFIED IN INCHES
2. DC CONNECTOR PER MIL-C-24308/3-3. FOR CONNECTOR PIN FUNCTION SEE CONNECTOR P1 INDEX.
3. RF CONNECTOR SMA JACK INTERFACE DIMENSIONS PER MIL-C-3901
4. PRODUCT LABEL PER MIL-STD-130.
5. SEE INDIVIDUAL OSC. DRAWING FOR DIMENSION.
6. TOLERANCES: xx ± .02
   xxx ± .010

Operating Precautions

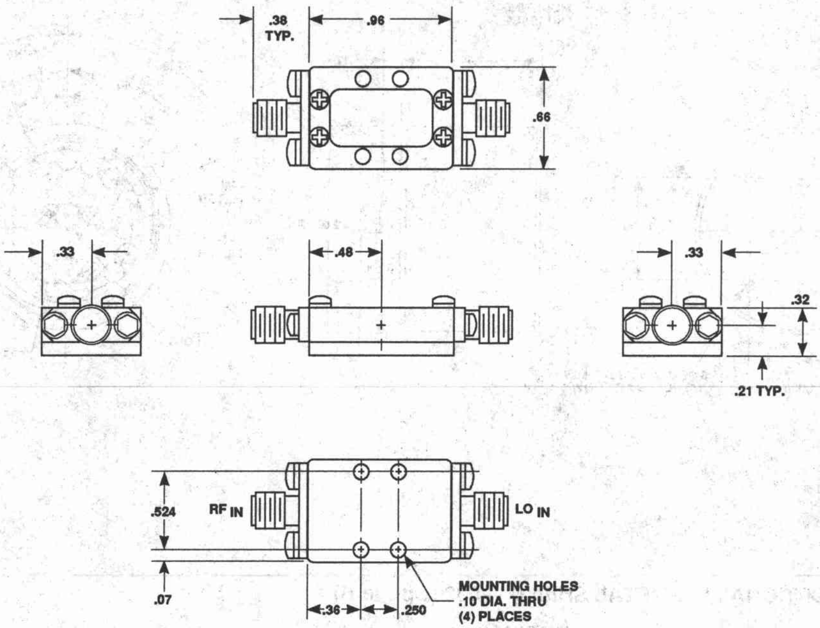
1. Do not exceed the supply voltage at +15V or –15V by more than 5%.
2. Caution should be observed not to operate the unit without a ±15V return.
3. Do not exceed the maximum FM tuning coil current of ±200 mA RMS.



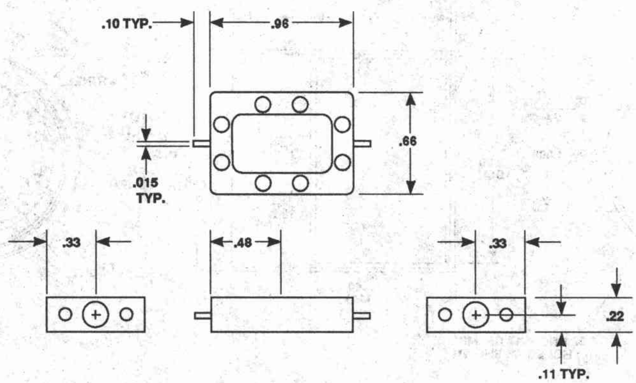
TYPICAL WEIGHT 5.7 GRAMS

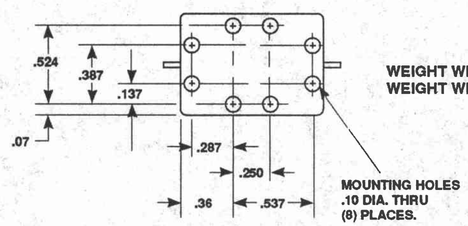
NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
xxx ± .010

SMA PACKAGE WITH OPTIONAL SPACER FOR CONNECTOR GROUND CLEARANCE



PIN PACKAGE

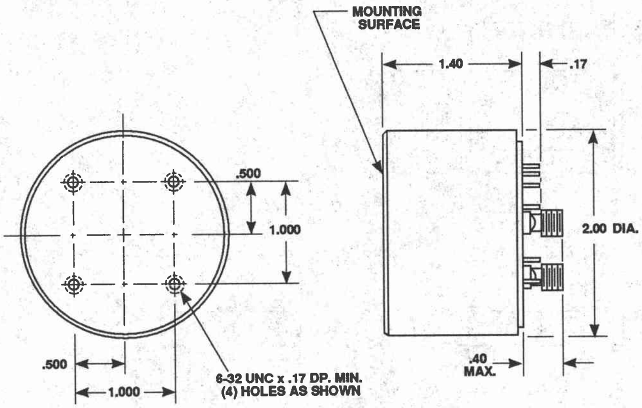


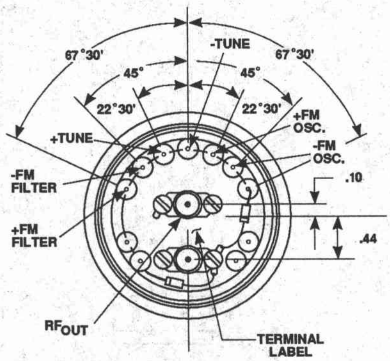


WEIGHT WITH CONNECTORS AND SPACER = 20 GRAMS
WEIGHT WITHOUT CONNECTORS AND SPACER = 13 GRAMS

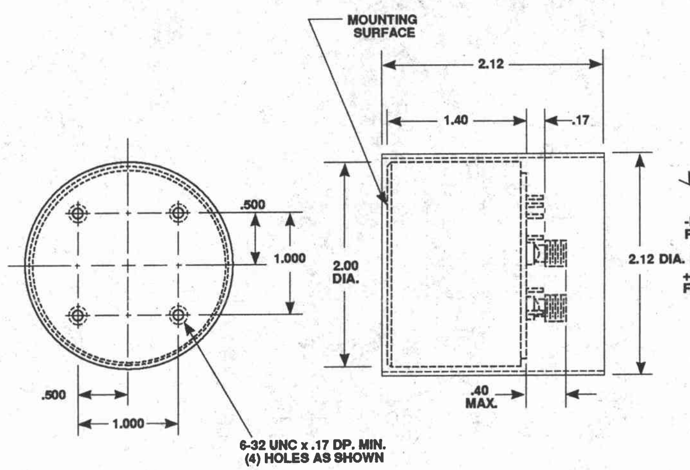
NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010
3. CONNECTORS, TYPE SMA FEMALE
   (SMA MALE OR SEMI RIGID OPTIONAL)

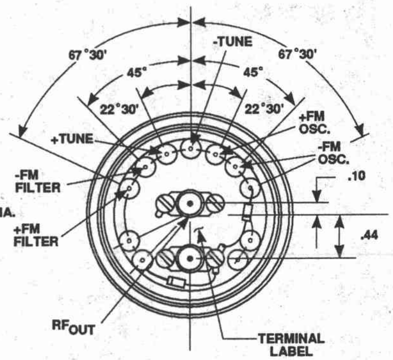
F-1 STANDARD VERSION — 001





F-1 WITH OPTIONAL MU-METAL SHIELD — 002 (Option B)

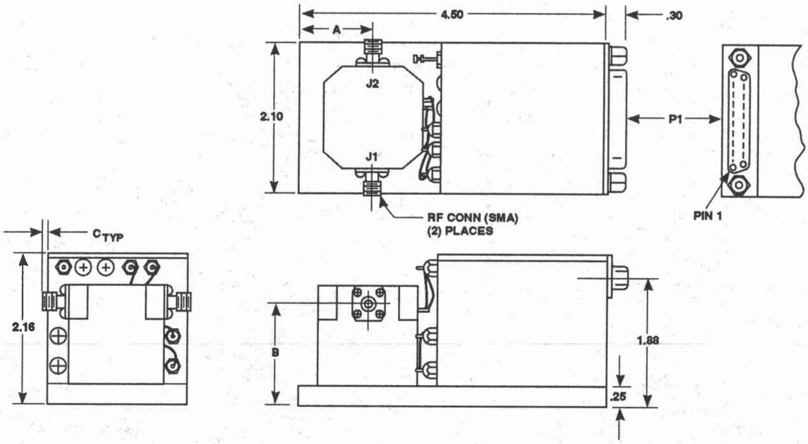


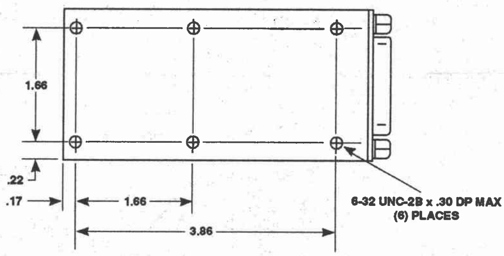


NOTES (UNLESS OTHERWISE SPECIFIED):

1. DIMENSIONS ARE SPECIFIED IN INCHES
   TOLERANCES xx ± .02
   xxx ± .010
2. DC CONNECTORS ARE .030 DIA. PIN ON A 1.30 B.C. DIA.
3. LABEL PER MIL-STD-130.
4. POLARITY OF FM & TUNE IS SHOWN ON LABEL

DIGITAL DRIVER WITH YIG FILTER





DIGITAL YIG DRIVER ELECTRICAL CONNECTIONS

CONNECTOR P1 PIN INDEX		
PIN #	FUNCTION	COMMENTS
1	BIT #1 INPUT (LSB)	
2	BIT #3 INPUT	
3	BIT #5 INPUT	
4	BIT #7 INPUT	
5	BIT #9 INPUT	
6	BIT #11 INPUT	
7	N/C	
8	N/C	
9	N/C	
10	N/C	
11	+15V GND RETURN	FOR PINS 12 & 13
12	+15V	
13	+15V to +30V	FOR TUNING CURRENT
14	BIT #2 INPUT	
15	BIT #4 INPUT	
16	BIT #6 INPUT	
17	BIT #8 INPUT	
18	BIT #10 INPUT	
19	BIT #12 INPUT	
20	N/C	
21	N/C	
22	HEATER	20–28V
23	HEATER	POLARITY NOT CRITICAL
24	–15V GND RETURN	
25	–15V	

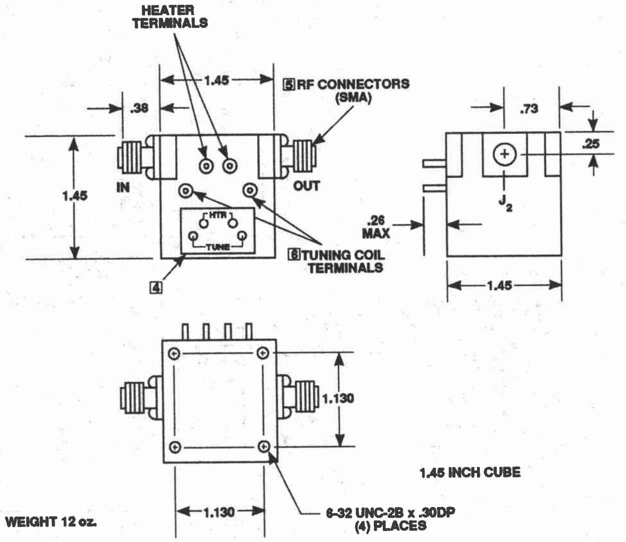
NOTES (UNLESS OTHERWISE SPECIFIED):

1. DIMENSIONS ARE SPECIFIED IN INCHES.
2. DC CONNECTIONS ARE .030 DIAMETER PINS.
3. LABEL PER MIL-STD-130.
4. INTERFACE DIMENSIONS PER MIL-C-39012.
5. DC CONNECTOR PER MIL-C-24308/3-3. FOR CONNECTOR PIN FUNCTION SEE CONNECTOR P1 INDEX.
6. TOLERANCES: xx ± .02
   xxx ± .010

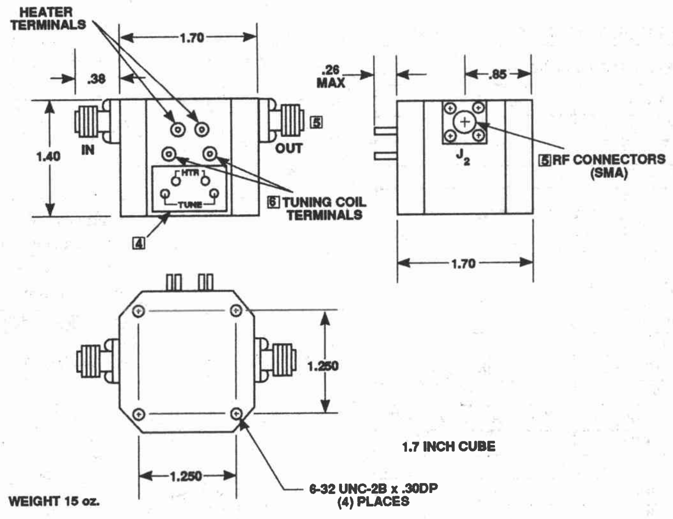
FILTER CASE	DIMENSION		
	A	B	C
FIL 1	1.00	1.45	.05
FIL 2	1.00	1.40	.17

J1	RF IN
J2	RF OUT

FIL 1



FIL 2



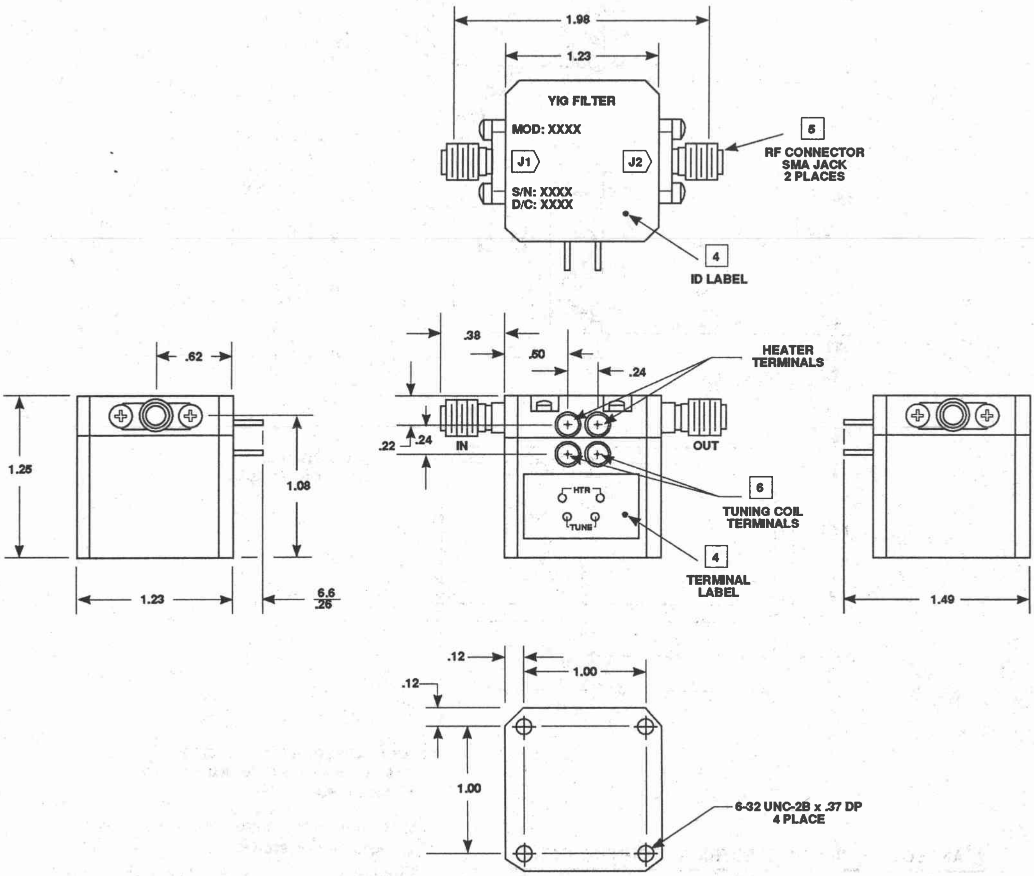
NOTES: (UNLESS OTHERWISE SPECIFIED)

1. DIMENSIONS IN INCHES:
2. TOLERANCES xx ± .02
   xxx ± .010
3. DC CONNECTIONS ARE .030 DIAMETER PINS.

4 LABEL PER MIL-STD-130.

5 INTERFACE DIMENSIONS PER MIL-C-39012.

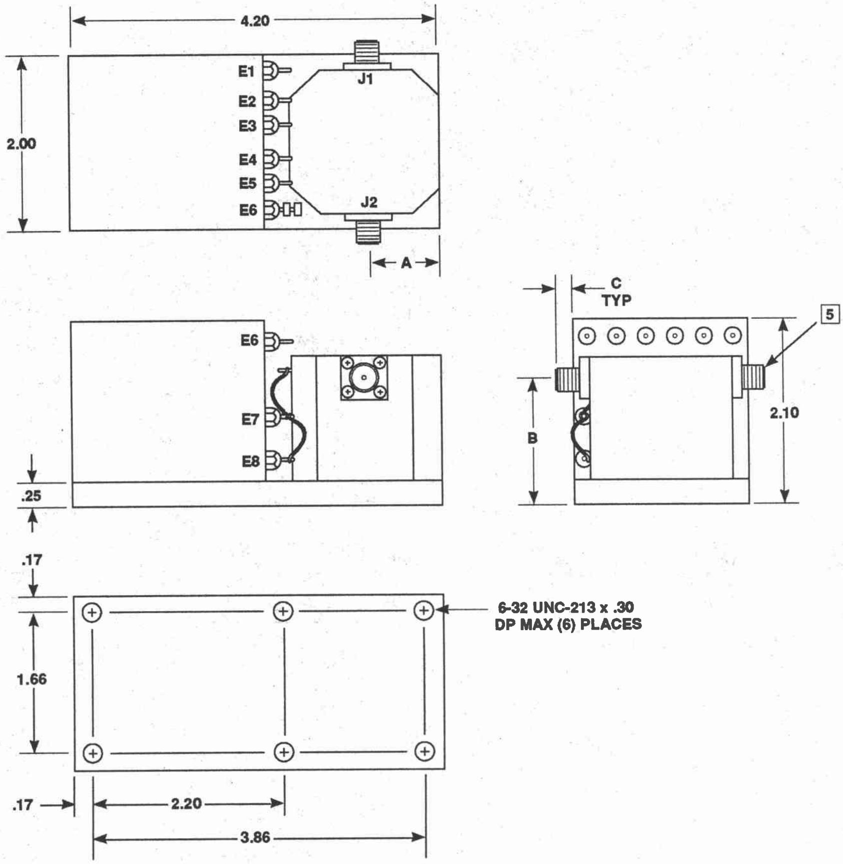
6 TUNING COIL TERMINALS POLARITY MAY BE REVERSED. POLARITY ON LABEL INDICATES BEST PERFORMANCE.



NOTES (UNLESS OTHERWISE SPECIFIED):

1. DIMENSIONS ARE SPECIFIED IN INCHES.
2. TOLERANCES: xx ± .02
   xxx ± .010
3. DC CONNECTIONS ARE 0.76/.030 DIAMETER PINS.
4. LABEL PER MIL-STD-130.
5. INTERFACE DIMENSIONS PER MIL-C-39012.
6. TUNING COIL TERMINALS POLARITY MAY BE REVERSED. POLARITY ON LABEL INDICATES BEST PERFORMANCE.

ANALOG DRIVER WITH YIG FILTER



NOTES: (UNLESS OTHERWISE SPECIFIED)

1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ±.02
   xxx ±.010
3. DC CONNECTIONS ARE 0.76/.030 DIAMETER PINS.
4. LABEL PER MIL-STD-130.

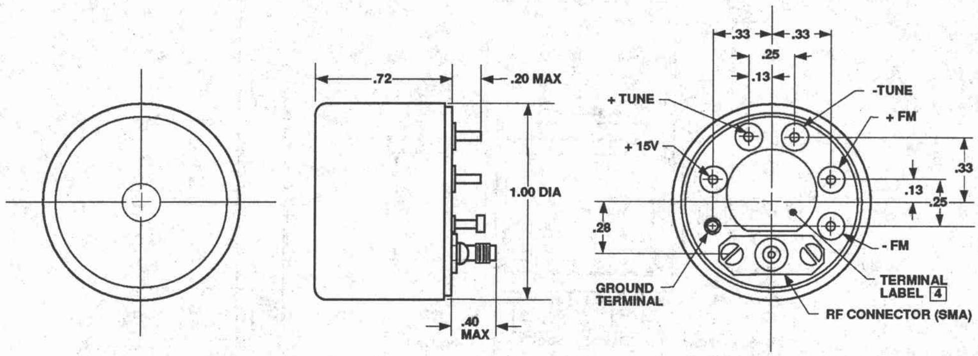
5 INTERFACE DIMENSIONS PER MIL-C-39012.

6 DC CONNECTOR PER MIL-C-24308/3-3. FOR CONNECTOR PIN FUNCTION SEE CONNECTOR P1 INDEX.

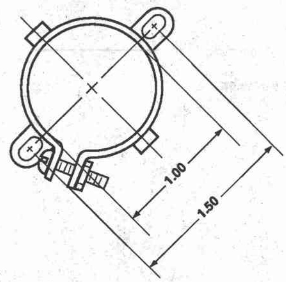
ANALOG YIG DRIVER ELECTRICAL CONNECTIONS

PIN INDEX	
E1	+15V INPUT
E2	−15V INPUT
E3	±15V RETURN
E4	+TUNE INPUT
E5	−TUNE INPUT
E6	GROUND
E7	HEATER
E8	HEATER
J1	RF INPUT
J2	RF OUTPUT

FILTER CASE	DIMENSION A	DIMENSION B	DIMENSION C
FIL 1	1.00	1.45	.10
FIL 2	1.00	1.40	.23

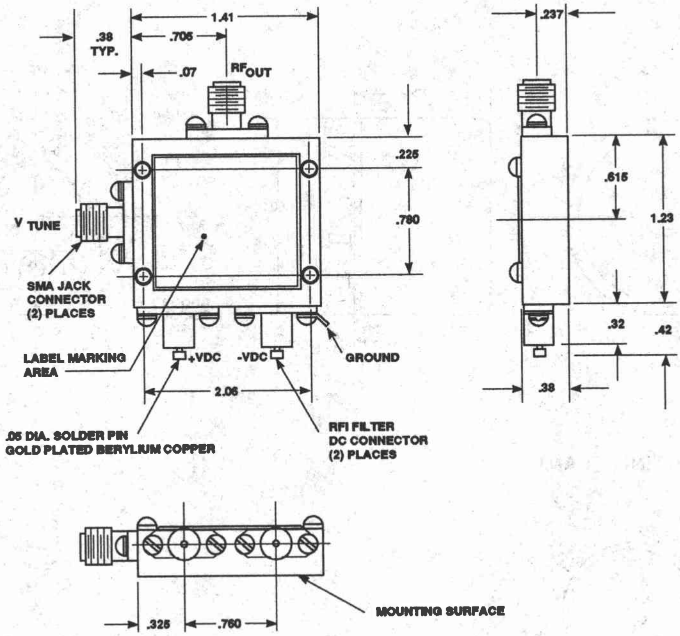


OPTIONAL MOUNTING CLAMP



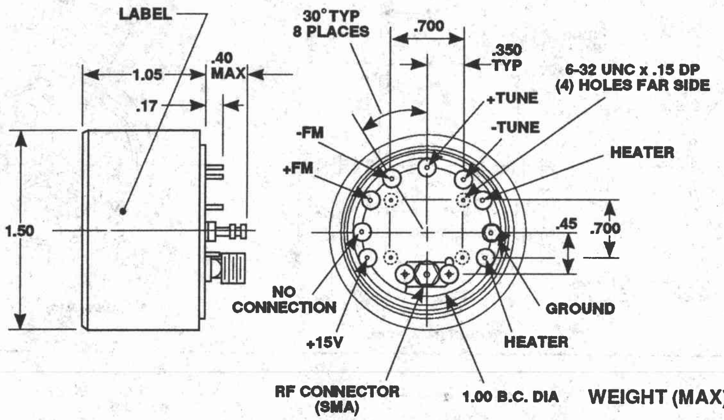
NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010
3. DC CONNECTIONS ARE .030 DIA., PINS ON A 1.30 DIA. B.C.
4. LABEL PER MIL–STD–130
5. OPTIONAL MOUNTING CLAMP AVANTEK OPTION E

SMA PACKAGE



NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
xxx ± .010

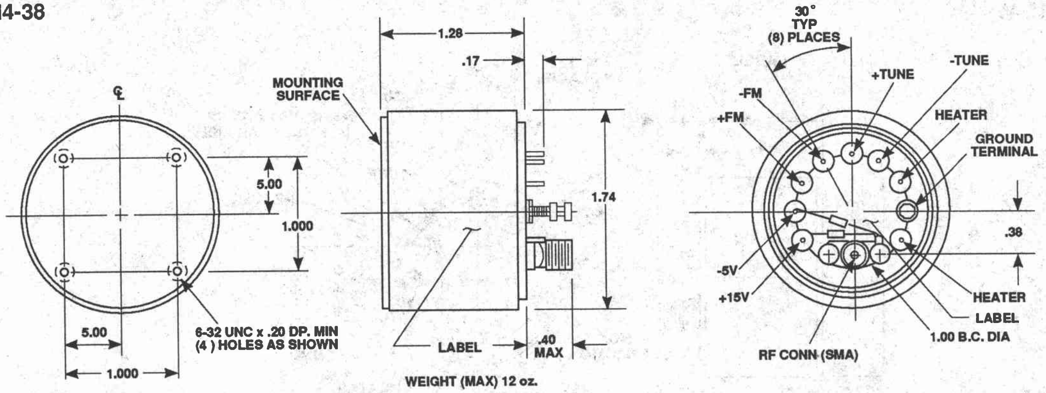
M1-45



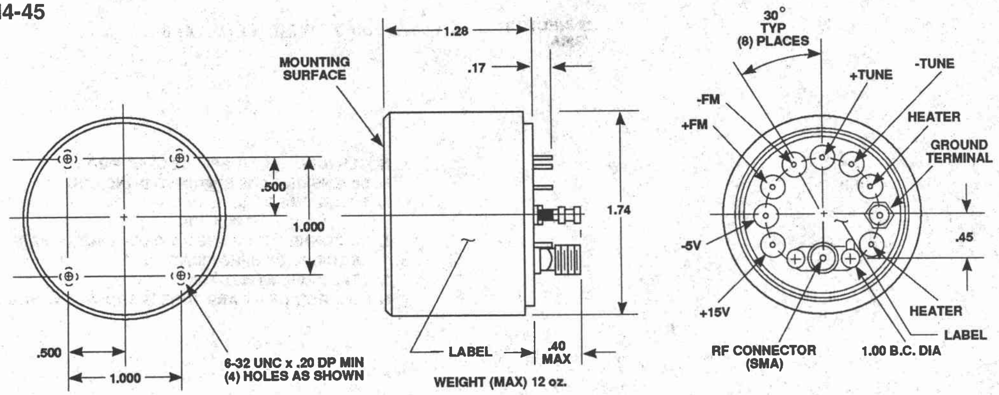
WEIGHT (MAX) 8 oz.

NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010
3. DC CONNECTIONS ARE 0.030 DIA. PINS AND ARE AS REQUIRED BY SPECIFICATIONS
4. LABEL PER MIL-STD -130
5. POLARITY OF FM AND TUNE IS SHOWN ON LABEL

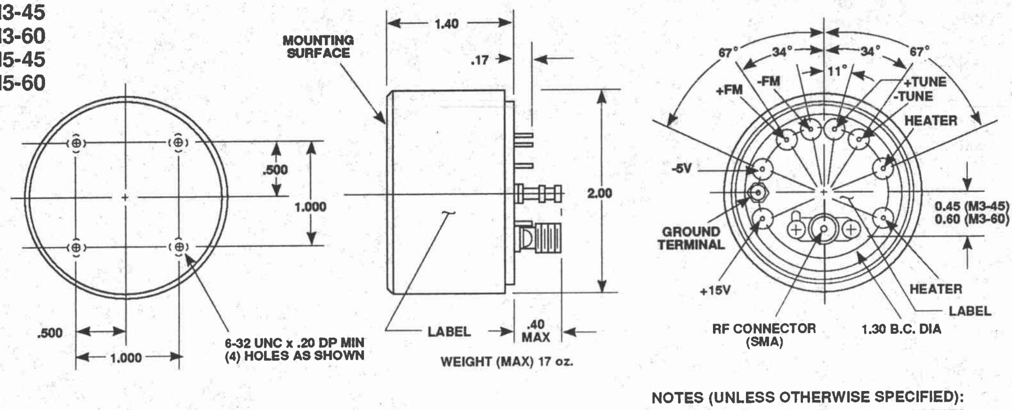
M4-38



M4-45

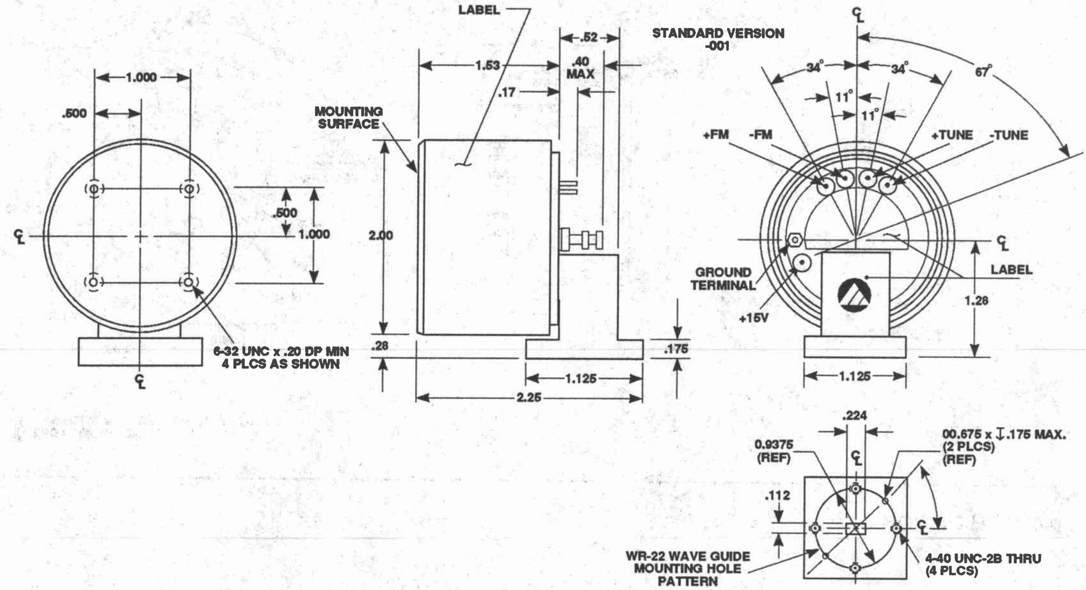


M3-45
M3-60
M5-45
M5-60

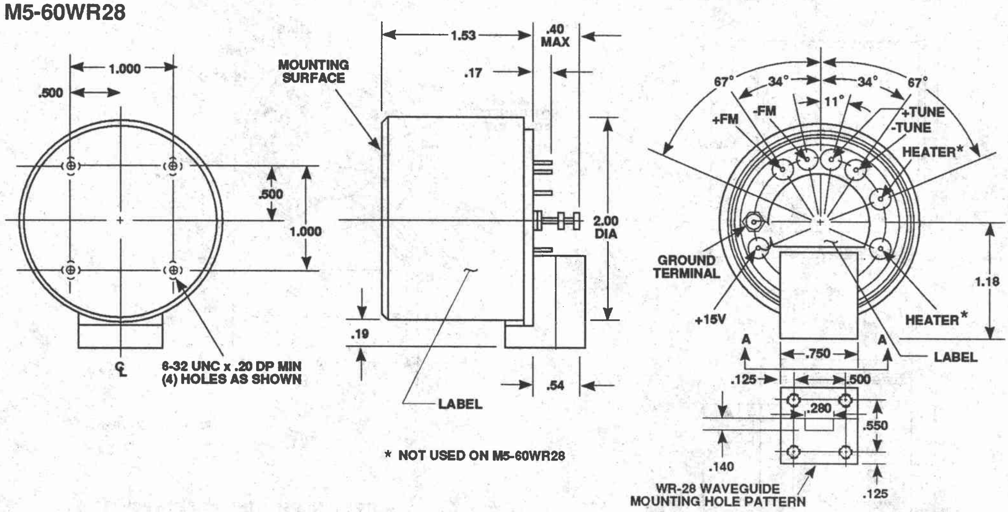


NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010
3. DC CONNECTIONS ARE 0.030 DIA. PINS AND ARE AS REQUIRED BY SPECIFICATIONS
4. LABEL PER MIL-STD - 130
5. POLARITY OF FM AND TUNE IS SHOWN ON LABEL

M5-45WR22



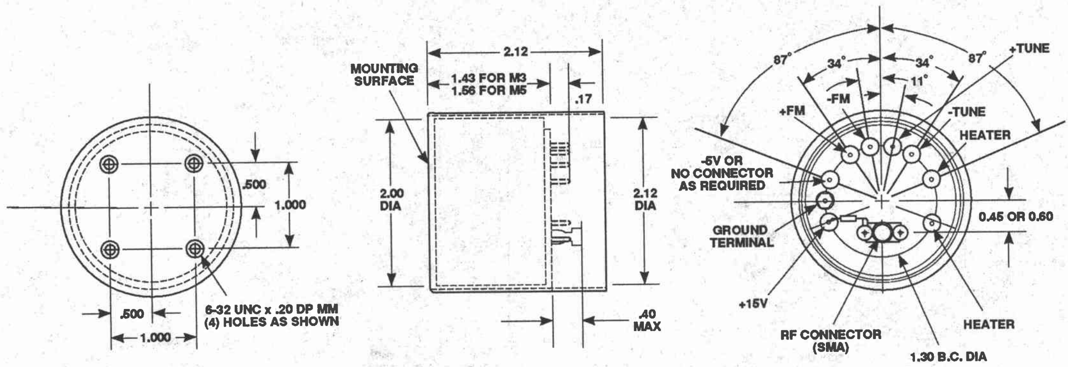
M5-45WR28
M5-60WR28



* NOT USED ON M5-60WR28

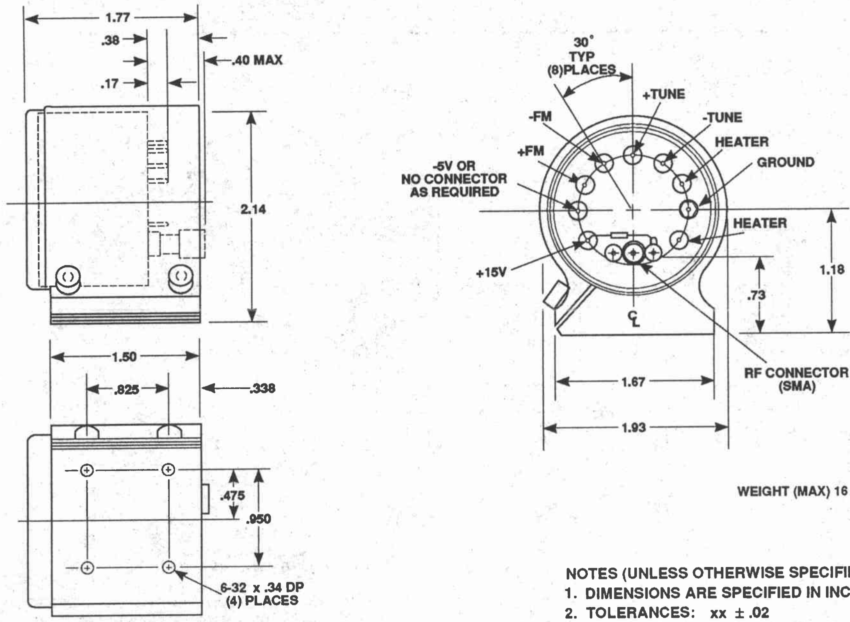
NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010
3. DC CONNECTIONS ARE 0.030 DIA. PINS AND ARE AS REQUIRED BY SPECIFICATIONS
4. LABEL PER MIL-STD - 130
5. POLARITY OF FM AND TUNE IS SHOWN ON LABEL

M3 AND M5 WITH OPTION B
MU-METAL SHIELD — 002



WEIGHT (MAX) 19 OZ. (M3 WITH OPT B)
21 OZ. (M5 WITH OPT B)

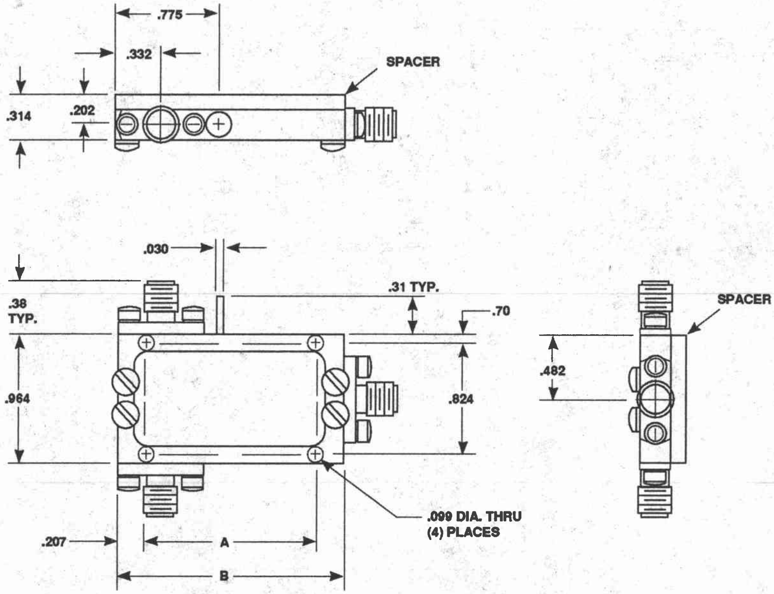
M4 WITH OPTION A



WEIGHT (MAX) 16 oz.

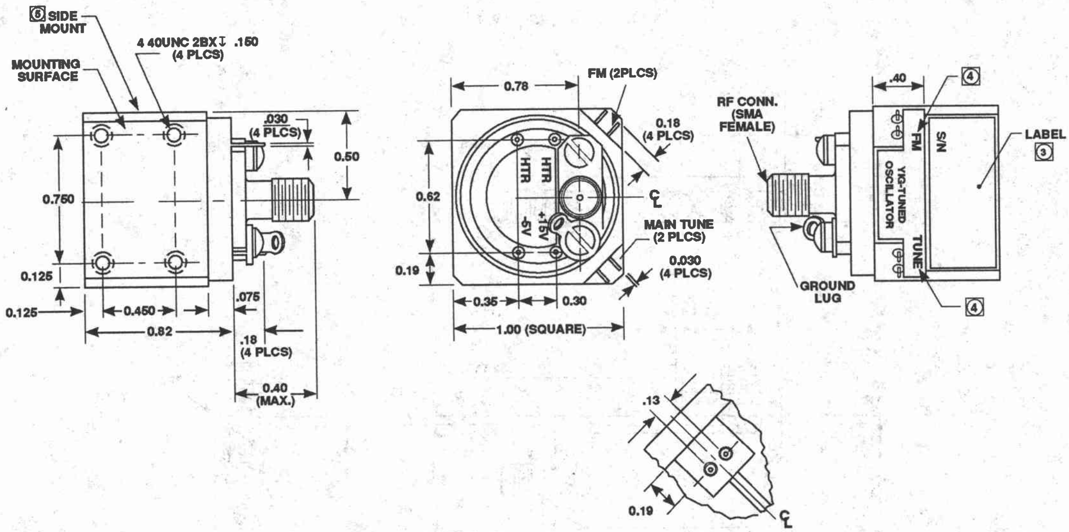
NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010
3. DC CONNECTIONS ARE 0.030 DIA. PINS AND ARE AS REQUIRED BY SPECIFICATIONS
4. LABEL PER MIL-STD -130
5. POLARITY OF FM AND TUNE IS SHOWN ON LABEL

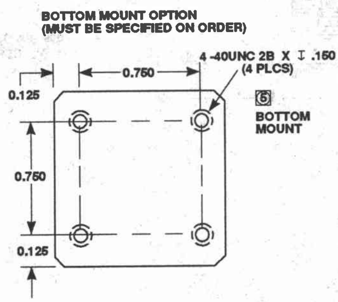
SMA PACKAGE WITH OPTIONAL SPACER FOR CONNECTOR GROUND CLEARANCE



CASE TYPE	DIM. A	DIM. B	TYPICAL WEIGHT
MA-1	.763	1.040	40 grams
MA-2	.956	1.370	50 grams
MA-3	1.286	1.700	60 grams

NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: XX ±.02
XXX ±.010
3. USE CONNECTOR KITS SK-001 AND SK-002





NOTES: (UNLESS OTHERWISE SPECIFIED)

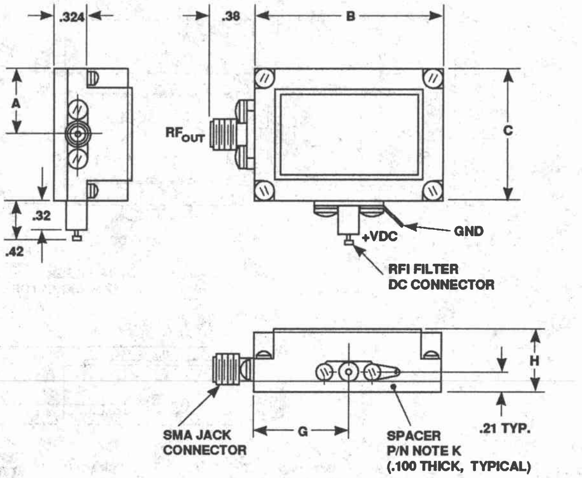
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. DC CONNECTORS ARE .030 DIA. PINS AND ARE REQUIRED BY SPECIFICATIONS

3 LABEL PER MIL-STD-130

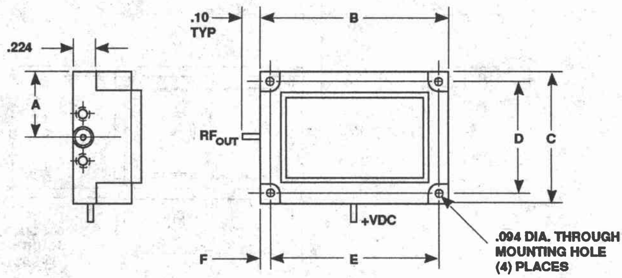
4 POLARITY OF FM AND TUNE IS SHOWN ON LABEL

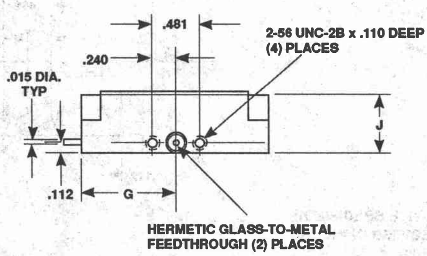
5 S OR B AFTER MODEL NUMBER TO INDICATE MOUNTING SURFACE
SIDE MOUNT AV-XXXXS
BOTTOM MOUNT AV-XXXXB

SMA PACKAGE



PIN PACKAGE

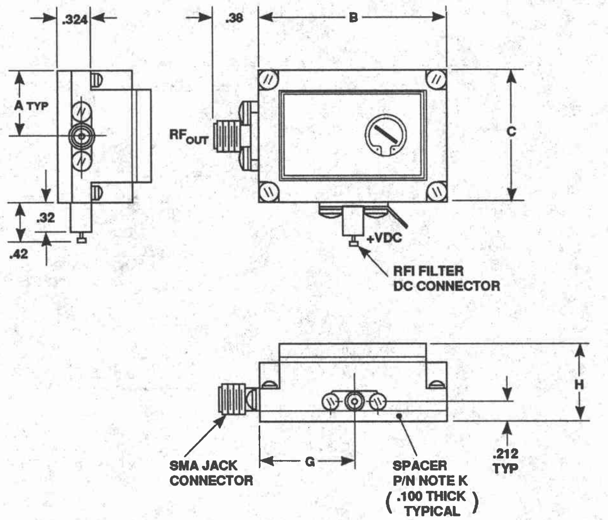




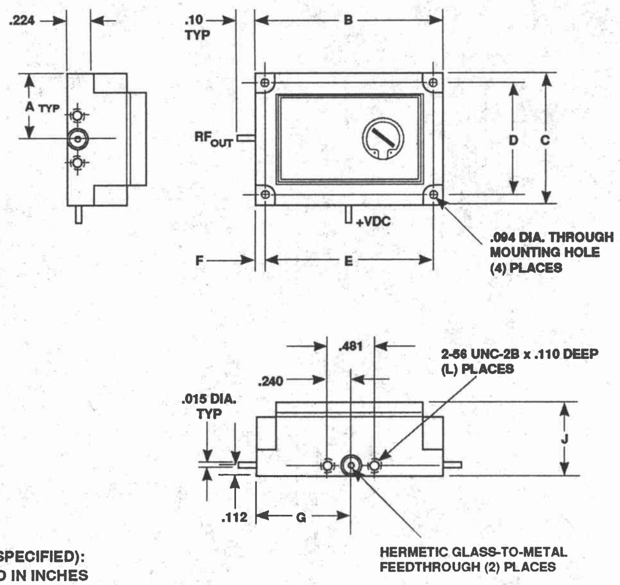
NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010

CASE TYPE	DIMENSION									SPACER	WEIGHT MAXIMUM
	A	B	C	D	E	F	G	H	J	K	
OD-10	.530	1.63	1.06	.872	1.442	.094	.82	.59	.49	380-029135	2.0 oz.
OD-20	.675	1.98	1.35	1.17	1.795	.094	.99	.69	.59	380-028928	2.6 oz.

SMA PACKAGE



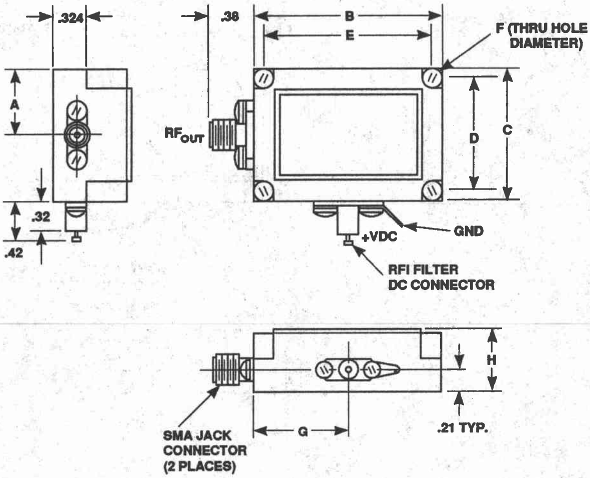
PIN PACKAGE



NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
xxx ± .010

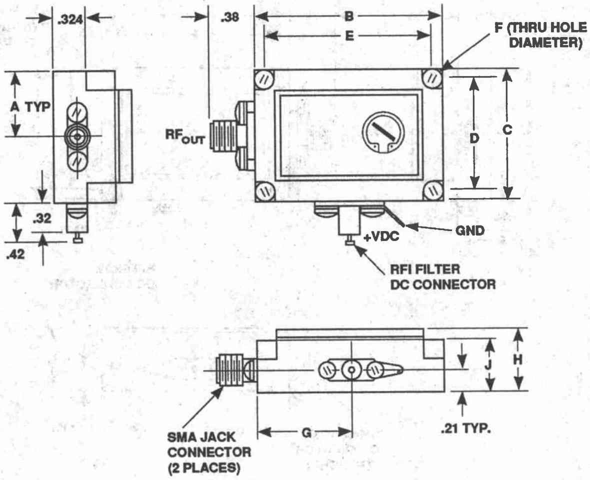
CASE TYPE	DIMENSION									SPACER	WEIGHT MAXIMUM
	A	B	D	C	E	F	G	H	J	K	
OD-12	.530	1.63	.872	1.06	1.442	.094	.82	.72	.60	380-029135	2.1 oz.
OD-22	.675	1.98	1.17	1.35	1.795	.094	.99	.875	.70	380-028928	3.1 oz.

SMA PACKAGE



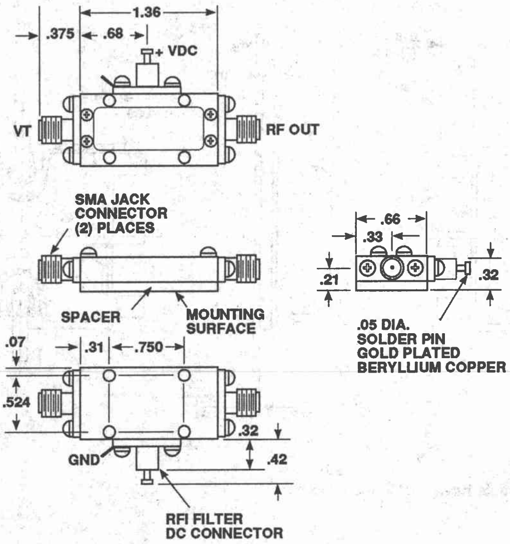
CASE TYPE	DIMENSION								WEIGHT MAXIMUM
	A	B	C	D	E	F	G	H	
OD-40	Obsolete – See OD-60								
OD-50	Obsolete – See OD-70								
OD-60	1.00	2.85	2.00	1.78	2.63	.120	1.43	.90	6.3 oz.
OD-70	.80	2.75	1.60	1.38	2.53	.120	1.38	.81	4.7 oz.
OD-80	.675	1.98	1.35	1.17	1.795	.094	.99	.69	2.6 oz.

SMA PACKAGE

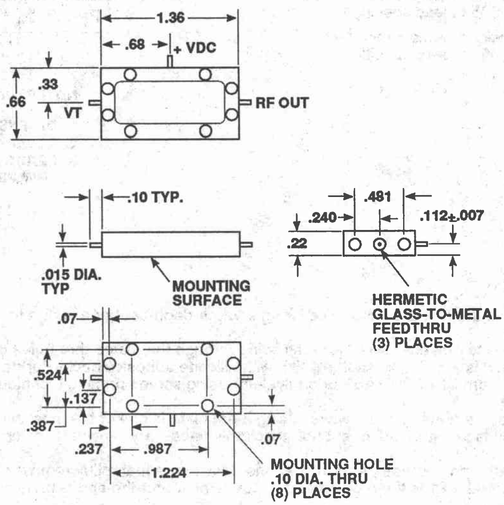


CASE TYPE	DIMENSION									WEIGHT MAXIMUM
	A	B	C	D	E	F	G	H	J	
OD-42	Obsolete – See OD-62									
OD-52	Obsolete – See OD-72									
OD-62	1.00	2.85	2.00	1.78	2.63	.120	1.43	1.08	.87	7.5 oz.
OD-72	.80	2.75	1.60	1.38	2.53	.120	1.38	.98	.79	5.5 oz.
OD-82	.675	1.98	1.35	1.17	1.795	.094	.99	.875	.70	3.1 oz.

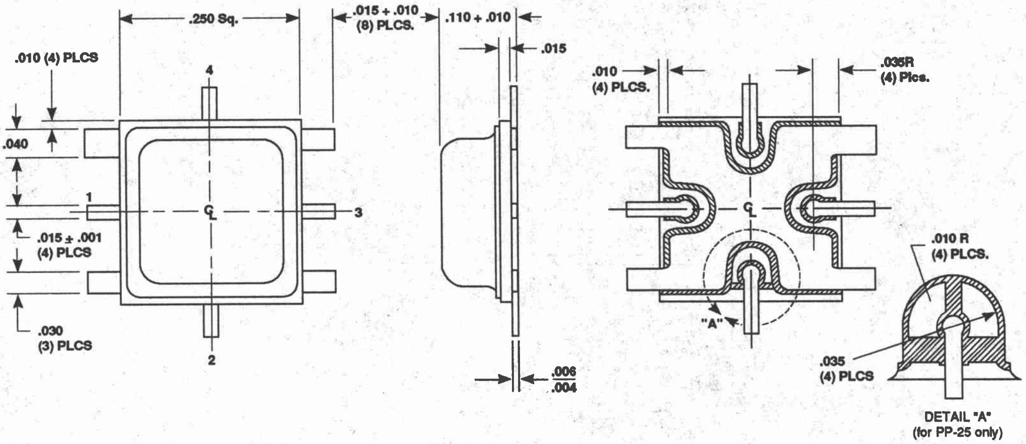
SMA PACKAGE



PIN PACKAGE



.25 x .25 PLANARPAK™ SURFACE MOUNTED COMPONENTS



NOTE: Certain high frequency models have 0.010" lead widths

TYPICAL WEIGHT .21 GRAMS

PLATING OPTIONS

-001	Gold Lid and Gold Leadframe
-002	Gold Lid and Nickel Leadframe
-003	Not Used
-004	Not Used
-005	Gold Lid and Pretinned Leadframe
-006	Not Used

NOTES: 1. For all products with performance under 6 GHz, plating option will be -005 unless specified.

2. For all products with performance over 6 GHz, plating option will be -001 unless specified.

CASE NUMBER	PIN DESIGNATION 1	2	3	4
PP-25	RF_{IN}	Ground	RF_{OUT}	V^+
PP-25F	RF_{IN}	$V_{CONTROL}$	RF_{OUT}	V^+
PP-25S	J_1	$V_{CONTROL}$	J_2	J_0
PP-25DA	RF_{IN}	V^-	V_{OUT}	V^+
PP-25DD	RF_{IN}	$V_{CONTROL}$	V_{OUT}	V^+

NOTES (UNLESS OTHERWISE SPECIFIED):

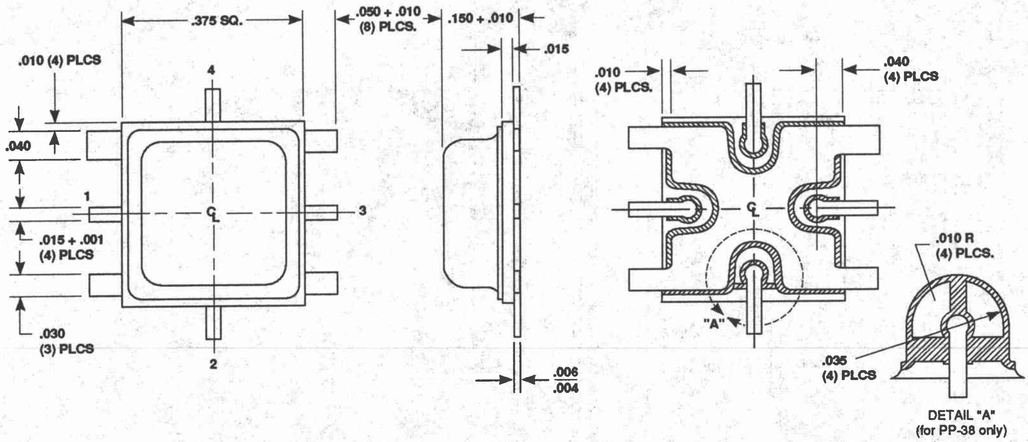
1. **DIMENSIONS ARE SPECIFIED IN INCHES**
2. **TOLERANCES: xxx ± .005**
3. **LEADS ARE FOR TESTING ONLY AND MAY BE TRIMMED FLUSH AT TIME OF INSTALLATION.**

Recommended Assembly Procedure

1. Chemically clean the PC board and the unit to be mounted using a vapor degreaser or acetone followed by an isopropol alcohol wash. Do not use ultrasonic cleaning.
2. Mask the backside of the PC board to prevent solder from reflowing through the plated thru-holes causing a rough ground plane surface. A suggested masking material is 2 mil thick Kapton® film with silicone adhesive back (Permacel part #P-222).
3. Apply solder cream (suggest Multicore SN62PRMAB3 or equivalent) using screen printing techniques or careful hand application. A layer 4 to 6 mils thick is adequate.
4. Reflow of the unit to the board may be done in many ways. Using a hot plate is one of the most simple. During reflow, pressure (with a clamping arrangement) on the unit is recommended, but not absolutely necessary. Absolute maximum reflow temperature is 260°C for not more than 10 seconds.
5. Chemically reclean the unit using the procedures given in step one. Make sure that a flux remover is used which is appropriate for the type of solder cream used (Multicore PC81 is the recommended flux remover for the above mentioned cream).

It should be noted that there are many alternatives for component attachment. This procedure has been found to be simple and effective. For more detailed instructions on how to use PlanarPak Products, please see the application note "Using PlanarPak Components" on page 14–39 of this Data Book.

.375 x .375 PLANARPAK™ SURFACE MOUNTED COMPONENTS



TYPICAL WEIGHT 0.5 GRAMS

PLATING OPTIONS

-001	Gold Lid and Gold Leadframe
-002	Gold Lid and Nickel Leadframe
-003	Not Used
-004	Not Used
-005	Gold Lid and Pretinned Leadframe
-006	Not Used

NOTES: 1. For all products with performance under 6 GHz, plating option will be -005 unless specified.

2. For all products with performance over 6 GHz, plating option will be -001 unless specified.

CASE NUMBER	PIN DESIGNATION 1	2	3	4
PP-38	RF_{IN}	GROUND	RF_{OUT}	V^+
PP-38M	RF	LO	IF	N/C

NOTES (UNLESS OTHERWISE SPECIFIED):

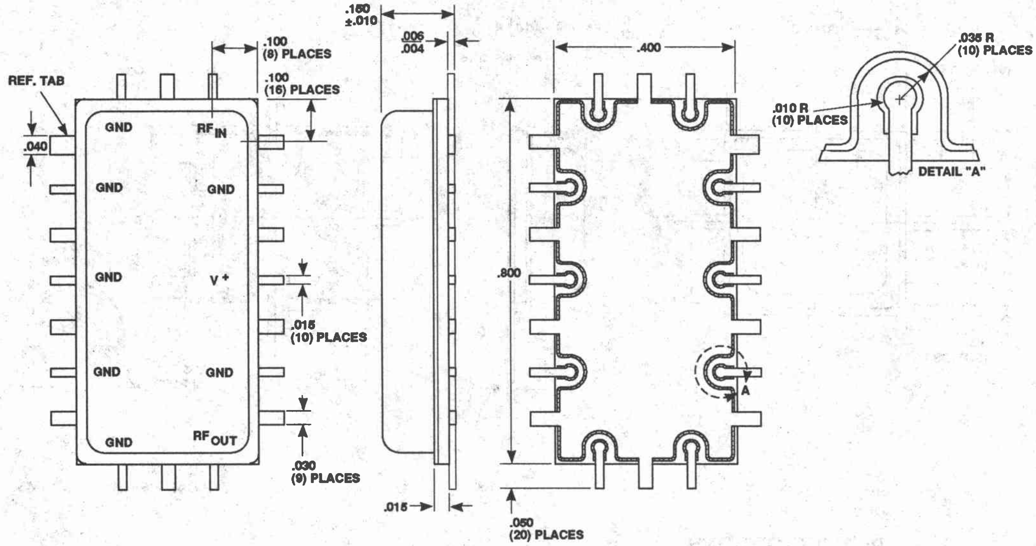
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xxx ± .005
3. LEADS ARE FOR TESTING ONLY AND MAY BE TRIMMED FLUSH AT TIME OF INSTALLATION.
4. N/C = NOT CONNECTED

Recommended Assembly Procedure

1. Chemically clean the PC board and the unit to be mounted using a vapor degreaser or acetone followed by an isopropol alcohol wash. **Do not use ultrasonic cleaning.**
2. Mask the backside of the PC board to prevent solder from reflowing through the plated thru-holes causing a rough ground plane surface. A suggested masking material is 2 mil thick Kapton® film with silicone adhesive back (Permacel part #P-222).
3. Apply solder cream (suggest Multicore SN62PRMAB3 or equivalent) using screen printing techniques or careful hand application. A layer 4 to 6 mils thick is adequate.
4. Reflow of the unit to the board may be done in many ways. Using a hot plate is one of the most simple. During reflow, pressure (with a clamping arrangement) on the unit is recommended, but not absolutely necessary. Absolute maximum reflow temperature is 260°C for not more than 10 seconds.
5. Chemically reclean the unit using the procedures given in step one. Make sure that a flux remover is used which is appropriate for the type of solder cream used (Multicore PC81 is the recommended flux remover for the above mentioned cream).

It should be noted that there are many alternatives for component attachment. This procedure has been found to be simple and effective. For more detailed instructions on how to use PlanarPak Products, please see the application note "Using PlanarPak Components" on page 14–39 of this Data Book.

.4 x .8 PLANARPAK™ SURFACE MOUNTED COMPONENTS



TYPICAL WEIGHT 1.1 GRAMS

PLATING OPTIONS

-001	Gold Lid and Gold Leadframe
-002	Gold Lid and Nickel Leadframe
-003	Not Used
-004	Not Used
-005	Gold Lid and Pretinned Leadframe
-006	Not Used

NOTES: 1. For all products with performance under 6 GHz, plating option will be -005 unless specified.

2. For all products with performance over 6 GHz, plating option will be -001 unless specified.

NOTES (UNLESS OTHERWISE SPECIFIED):

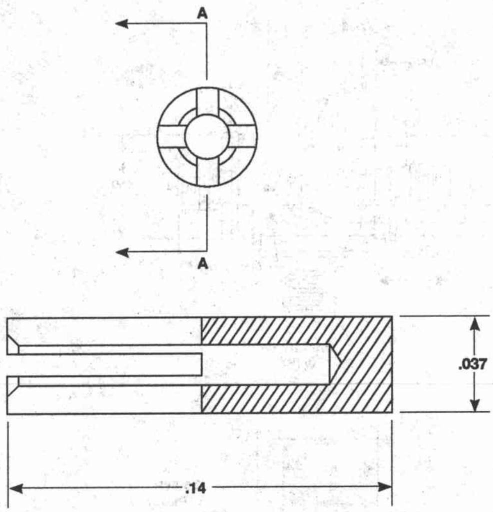
1. **DIMENSIONS ARE SPECIFIED IN INCHES**
2. **TOLERANCES: xxx ± .005**

Recommended Assembly Procedure

1. Chemically clean the PC board and the unit to be mounted using a vapor degreaser or acetone followed by an isopropol alcohol wash. **Do not use ultrasonic cleaning.**
2. Mask the backside of the PC board to prevent solder from reflowing through the plated thru-holes causing a rough ground plane surface. A suggested masking material is 2 mil thick Kapton® film with silicone adhesive back (Permacel part #P-222).
3. Apply solder cream (suggest Multicore SN62PRMAB3 or equivalent) using screen printing techniques or careful hand application. A layer 4 to 6 mils thick is adequate.
4. Reflow of the unit to the board may be done in many ways. Using a hot plate is one of the most simple. During reflow, pressure (with a clamping arrangement) on the unit is recommended, but not absolutely necessary. Absolute maximum reflow temperature is 260°C for not more than 10 seconds.
5. Chemically reclean the unit using the procedures given in step one. Make sure that a flux remover is used which is appropriate for the type of solder cream used (Multicore PC81 is the recommended flux remover for the above mentioned cream).

It should be noted that there are many alternatives for component attachment. This procedure has been found to be simple and effective. For more detailed instructions on how to use PlanarPak Products, please see the application note "Using PlanarPak Components" on page 14–39 of this Data Book.

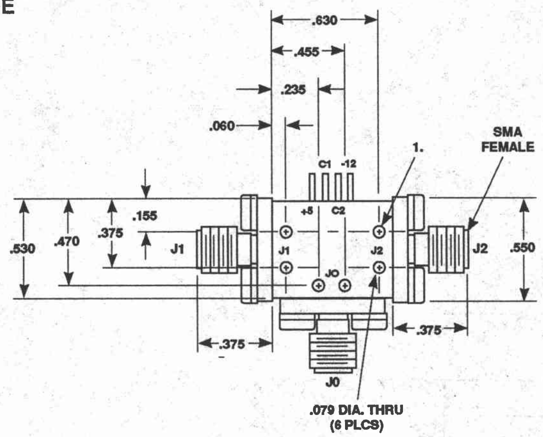
SK-003 SLIP-ON SLEEVES



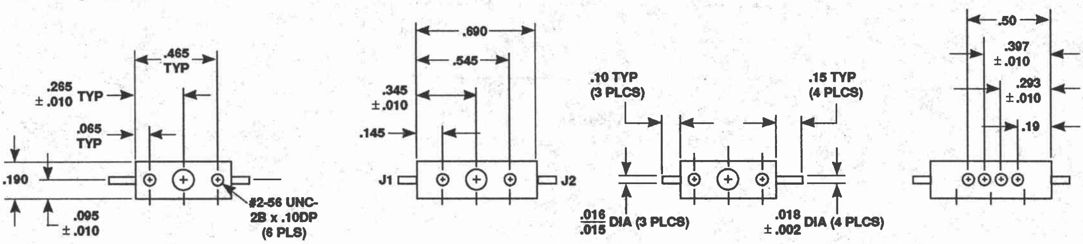
VIEW AA

NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
xxx ± .010

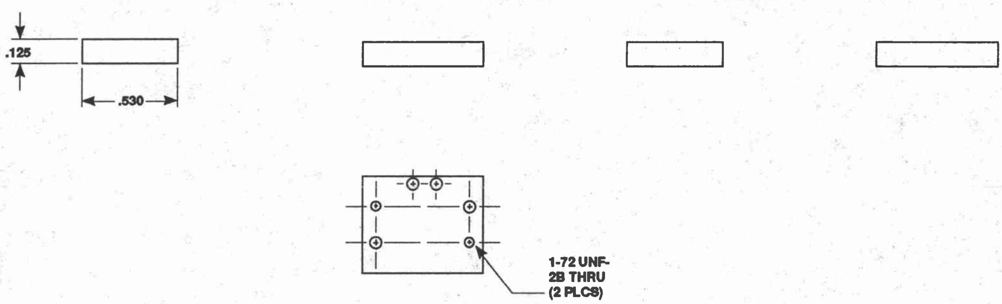
SMA PACKAGE



PIN PACKAGE



OPTIONAL SPACER FOR CONNECTOR GROUND CLEARANCE

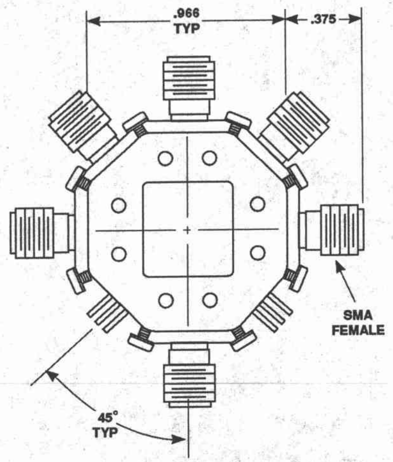


WEIGHT WITH CONNECTORS AND SPACER = 14.5 GRAMS
WEIGHT WITHOUT CONNECTORS AND SPACER = 6.5 GRAMS

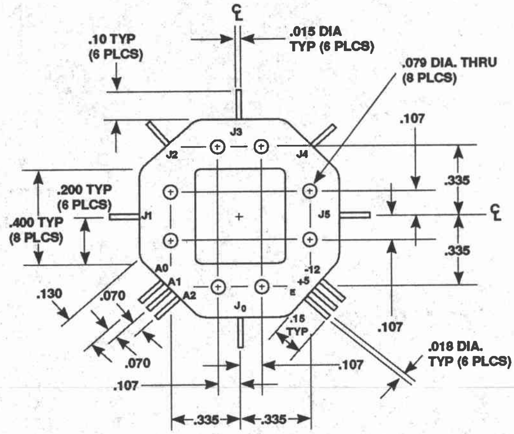
NOTES (UNLESS OTHERWISE SPECIFIED):

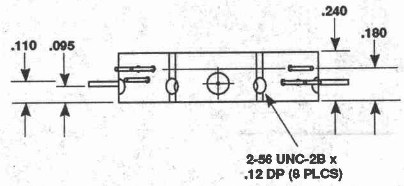
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010
3. CLEARANCE HOLE FOR #1-72 UNF-2A x 5/16" FOR MOUNTING OPTIONAL SPACER PLATE.
4. SMA CONNECTORS OPTIONAL SHOWN FOR DIMENSIONAL PURPOSES.
5. USE CONNECTOR KITS SK-005 AND SK-006

SMA PACKAGE

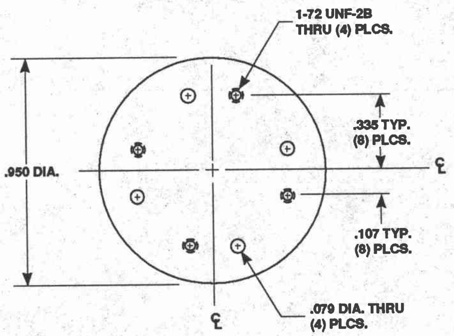


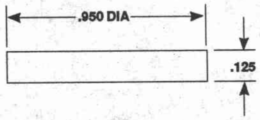
PIN PACKAGE





OPTIONAL SPACER FOR CONNECTOR GROUND CLEARANCE

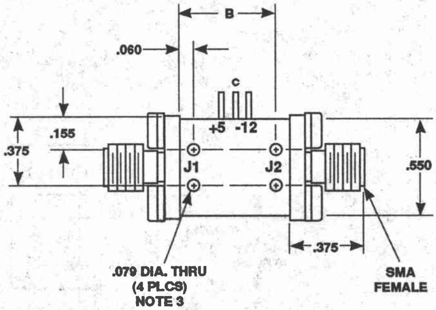




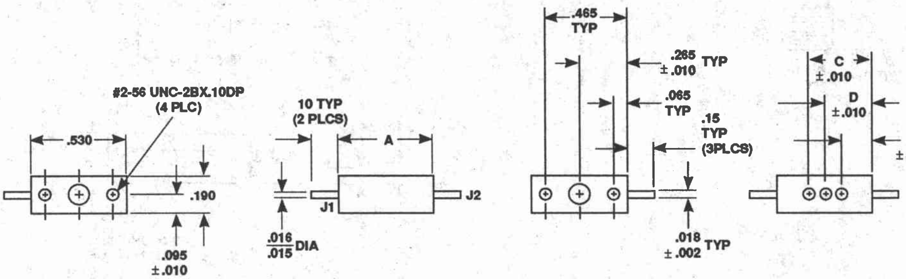
WEIGHT WITH CONNECTORS AND SPACER = 32 GRAMS
WEIGHT WITHOUT CONNECTORS AND SPACER = 17.5 GRAMS

NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010
3. CLEARANCE HOLE FOR #1-72 UNF-2A x 5/16" FOR MOUNTING OPTIONAL SPACER PLATE.
4. SMA CONNECTORS OPTIONAL SHOWN FOR DIMENSIONAL PURPOSES.
5. USE CONNECTOR KITS SK-009 AND SK-010

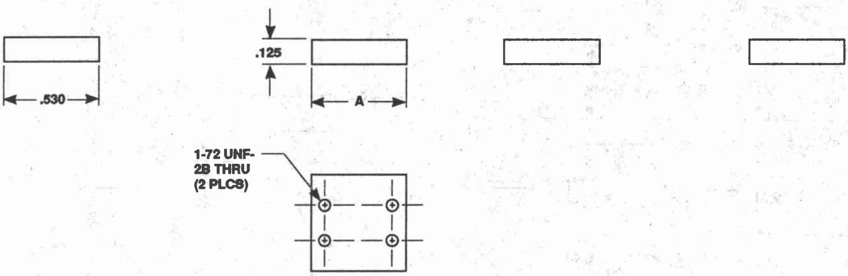
SMA PACKAGE



PIN PACKAGE



OPTIONAL SPACER FOR CONNECTOR GROUND CLEARANCE

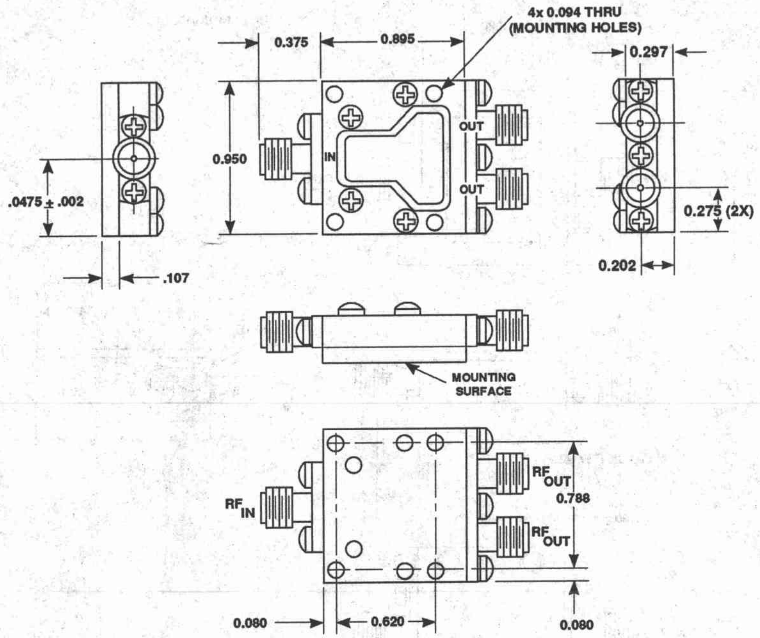


WEIGHT WITH CONNECTORS AND SPACER = 11.5 GRAMS
WEIGHT WITHOUT CONNECTORS AND SPACER = 5.5 GRAMS

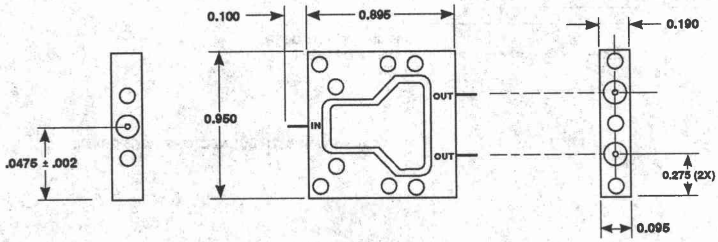
DIM.	−0XX LOW LOSS	−1XX HIGH ISOL.
A	.590	.690
B	.530	.630
C	.400	.450
D	.295	.345
E	.190	.240

NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ±.02
   xxx ±.010
3. CLEARANCE HOLE FOR #1-72 UNF-2A x 5/16" FOR MOUNTING OPTIONAL SPACER PLATE.
4. SMA CONNECTORS OPTIONAL SHOWN FOR DIMENSIONAL PURPOSES.
5. USE CONNECTOR KITS SK-005 AND SK-006

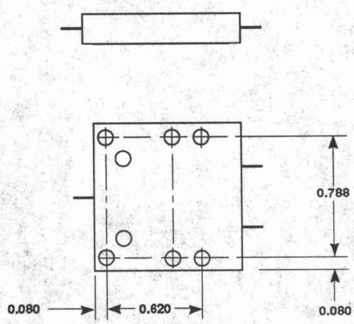
SMA PACKAGE WITH OPTIONAL SPACER FOR CONNECTOR GROUND CLEARANCE



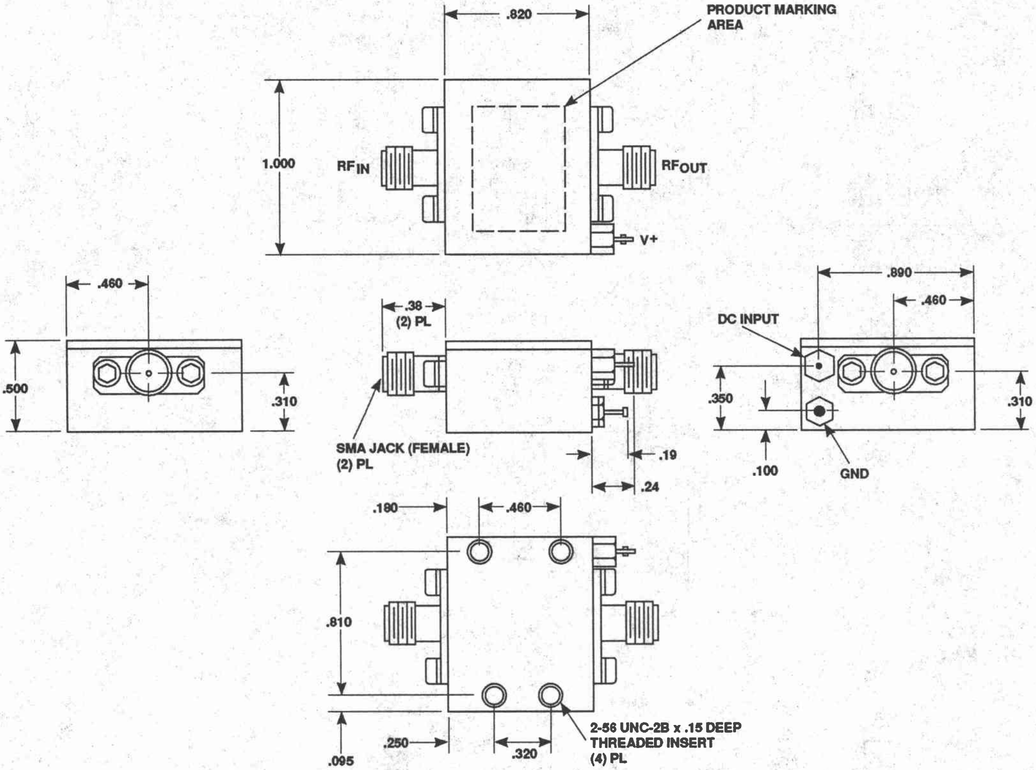
PIN PACKAGE



WEIGHT WITH CONNECTORS AND SPACER = 32 GRAMS
WEIGHT WITHOUT CONNECTORS AND SPACER = 22 GRAMS

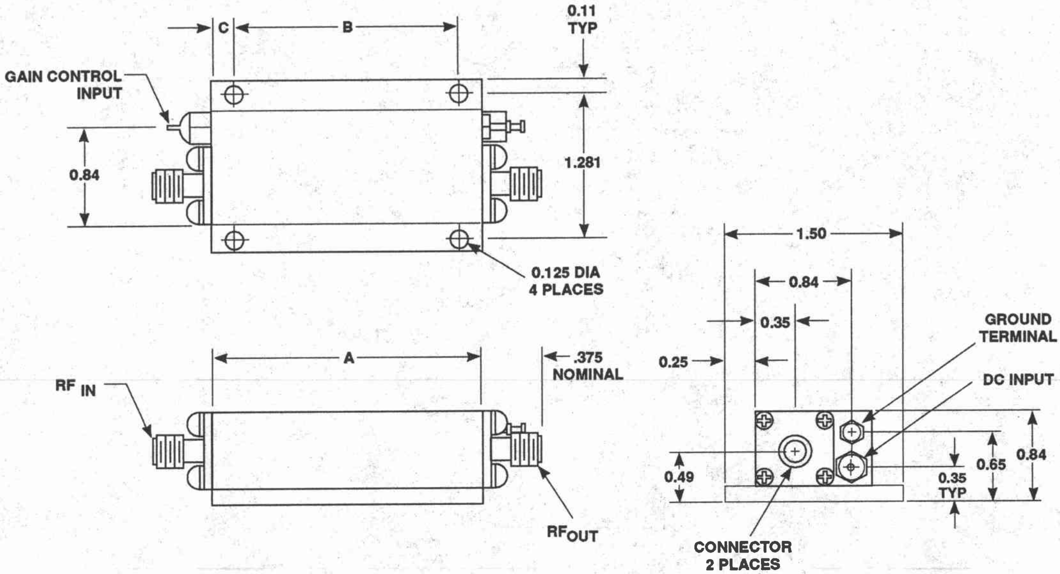


NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
xxx ± .010



TYPICAL WEIGHT WITH CONNECTORS = 21.5 GRAMS

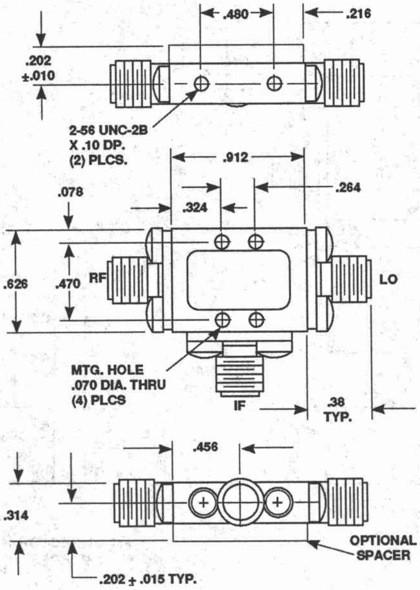
NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
xxx ± .010



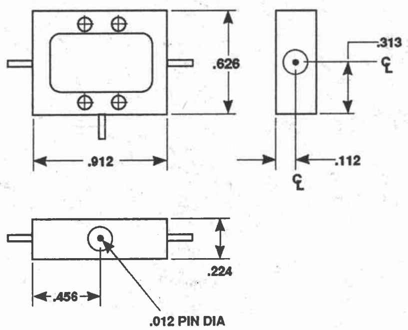
CASE	DIMENSION A	DIMENSION B	DIMENSION C	APPROX. WEIGHT
TC-2	1.37	1.00	0.187	2 oz.
TC-4	2.40	2.00	0.202	4 oz.
CONNECTOR OPTIONS: SMA, N, TNC, BNC				

NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010

SMA PACKAGE WITH OPTIONAL SPACER FOR CONNECTOR GROUND CLEARANCE



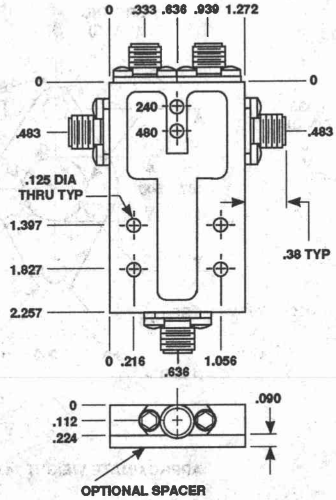
PIN PACKAGE



WEIGHT WITH CONNECTORS AND SPACER = 22 GRAMS
WEIGHT WITHOUT CONNECTORS AND SPACER = 12 GRAMS

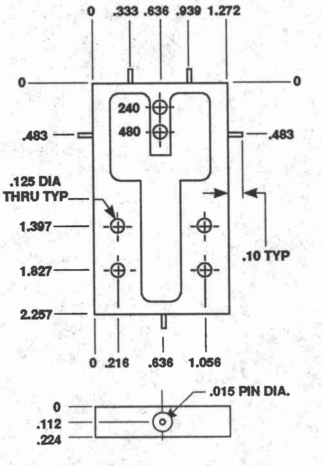
NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
xxx ± .010

SMA PACKAGE WITH OPTIONAL SPACER FOR CONNECTOR GROUND CLEARANCE

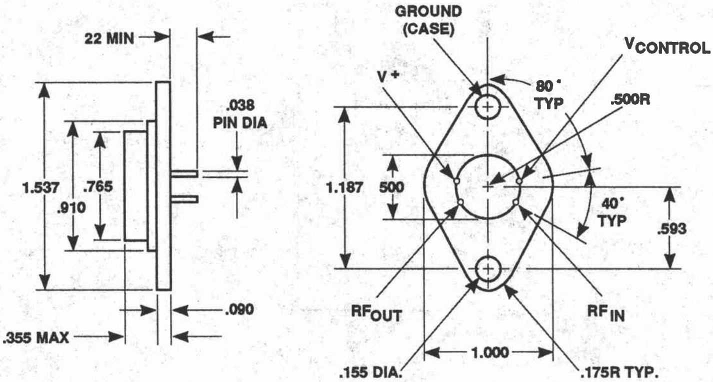


WEIGHT WITH CONNECTORS AND SPACER PLATE = 71 GRAMS
WEIGHT WITHOUT CONNECTORS AND SPACER PLATE = 64 GRAMS

PIN PACKAGE



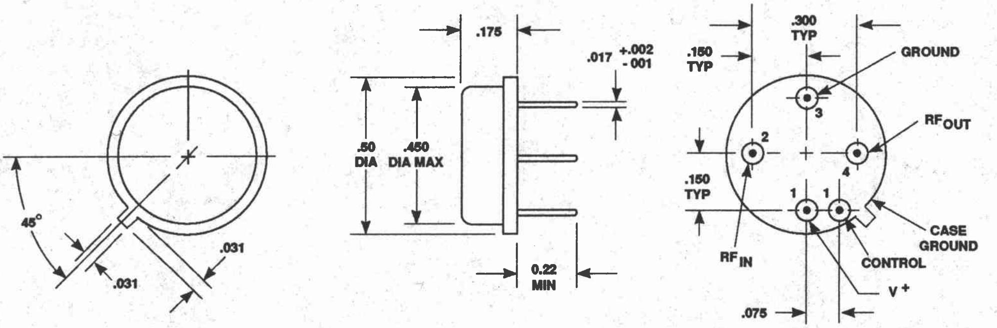
NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
xxx ± .010



APPROXIMATE WEIGHT 14.5 GRAMS

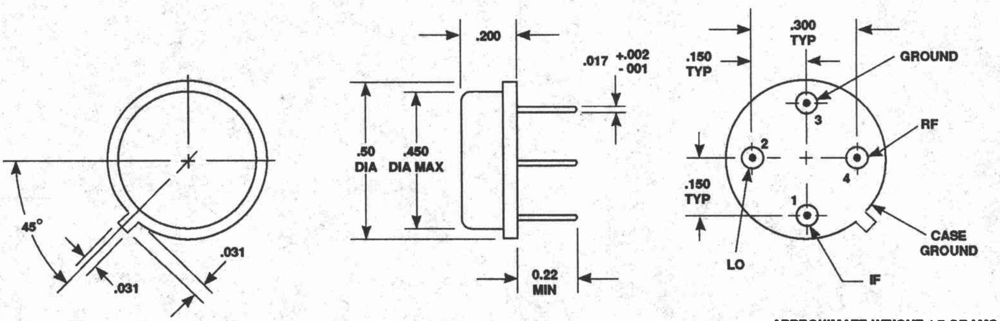
NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ±.02
xxx ±.010

TO-8F



APPROXIMATE WEIGHT 1.7 GRAMS

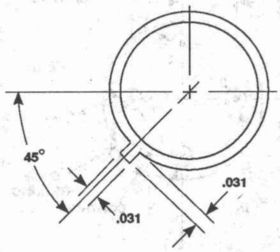
TO-8M

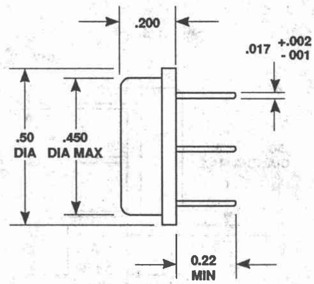


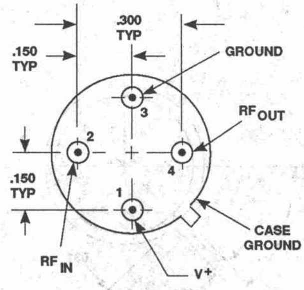
APPROXIMATE WEIGHT 1.7 GRAMS

NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010

TO-8T



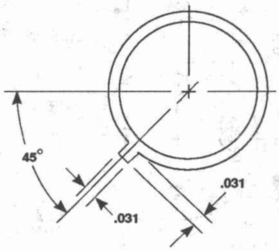


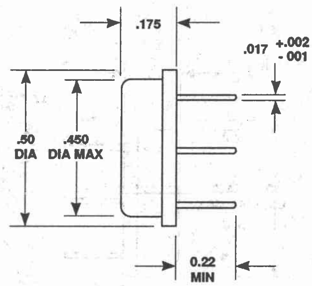


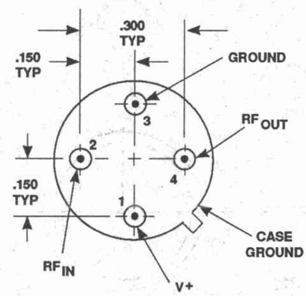
APPROXIMATE WEIGHT 1.7 GRAMS

NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ±.02
xxx ±.010

TO-8U

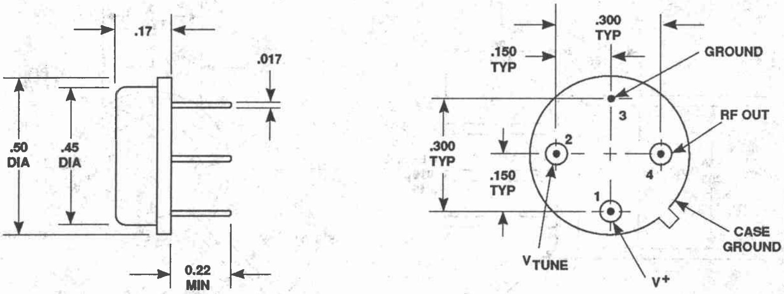






APPROXIMATE WEIGHT 1.7 GRAMS

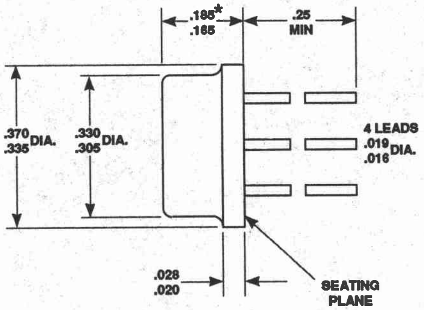
NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ±.02
xxx ±.010

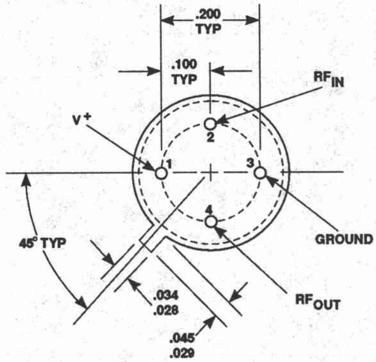


APPROXIMATE WEIGHT 1.7 GRAMS

NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010

TO-12

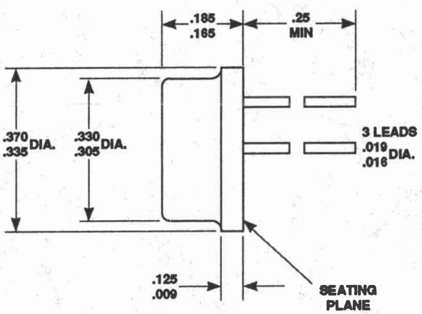


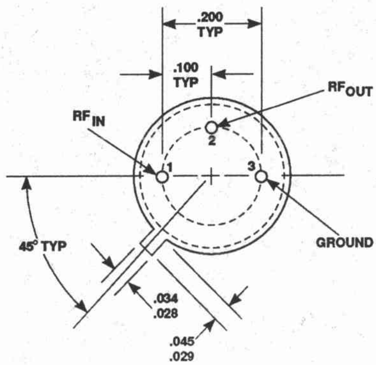


APPROXIMATE WEIGHT 1.7 GRAMS

*NOTES (UNLESS OTHERWISE SPECIFIED):
1. FOR GPD-405 (TO-12T CASE) THESE DIMENSIONS ARE: $\frac{.230}{.260}$
2. DIMENSIONS ARE SPECIFIED IN INCHES

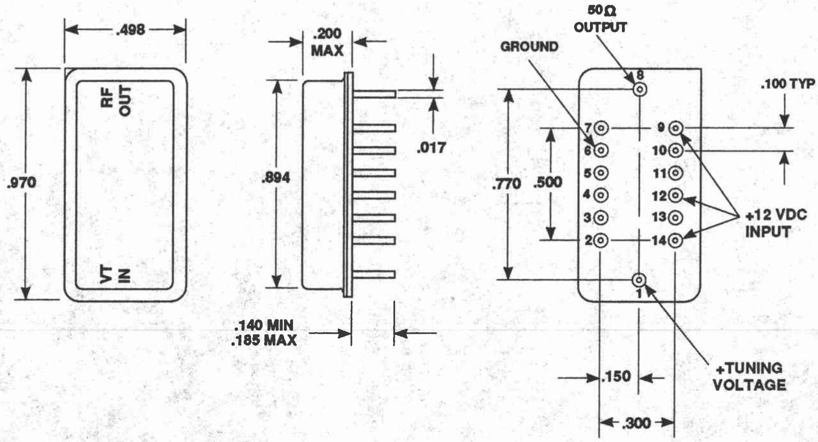
TO-39





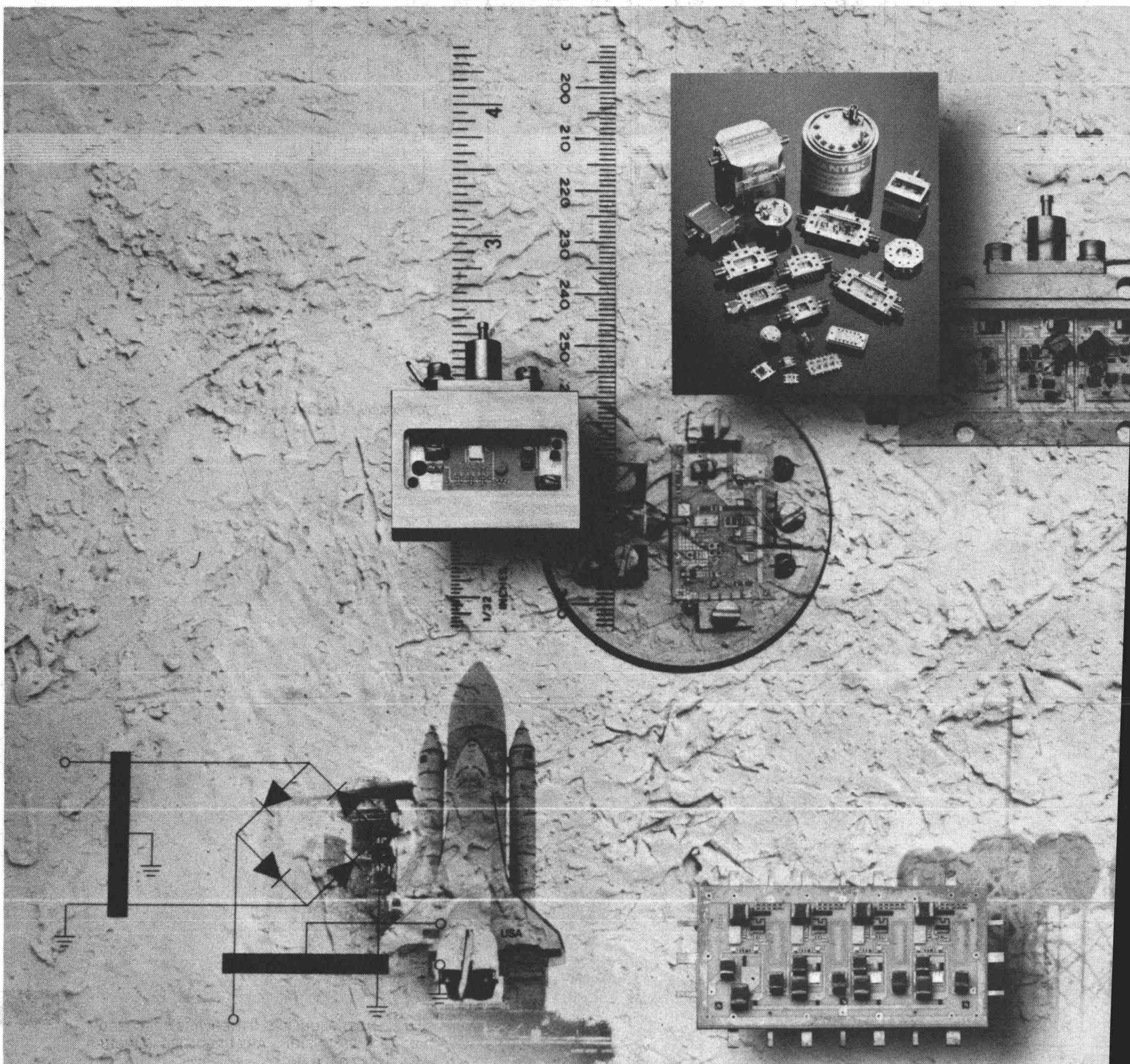
APPROXIMATE WEIGHT 1.7 GRAMS

DIMENSIONS ARE SPECIFIED IN INCHES

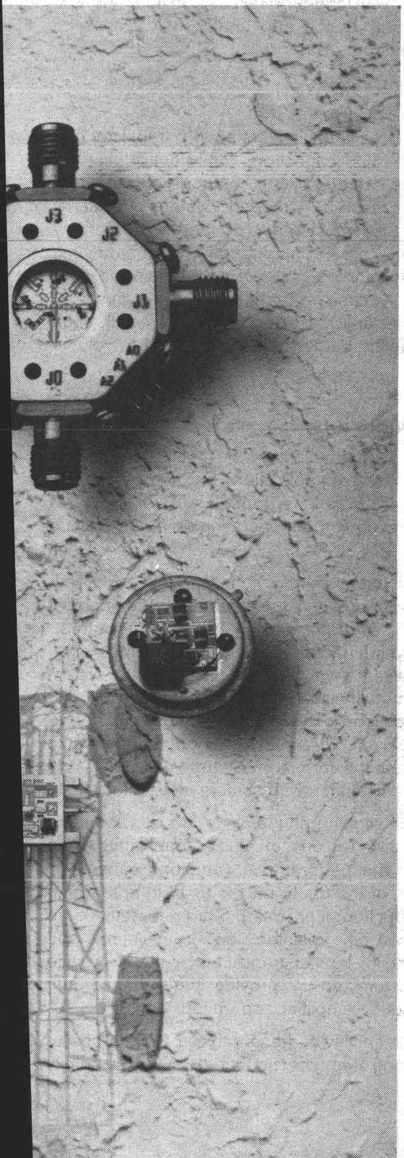


APPROXIMATE WEIGHT 5.0 GRAMS

NOTES (UNLESS OTHERWISE SPECIFIED):
1. DIMENSIONS ARE SPECIFIED IN INCHES
2. TOLERANCES: xx ± .02
   xxx ± .010


USA

HIGH RELIABILITY SCREENING



INTRODUCTION

First and Foremost, Built for Reliability

All Avantek® hybrid components are reliable by design. They are built with pre-qualified components using state-of-the-art process technology. All active and passive components used in them are supported by a comprehensive internal control and documentation program. Avantek has maintained lot processing traceability records for all fabrication processes beginning with the first UTO Series amplifier manufactured in June, 1970. Standard production procedures include the collection of lot performance data and subsequent user-experience monitoring. Inventory control of all components, including the wafer qualification of Avantek-produced semiconductors, assures lot-to-lot repeatability. These hybrid products are backed by an extensive research and development effort to ensure the optimum quality, performance and reliability of all amplifier substrates and transistor die. This is all a part of in-production procedures for *standard* products that do not require additional high-reliability screening.

Avantek thin-film hybrid substrates start out as select-grade ceramic wafers, chosen for both electrical uniformity and surface finish. Thin-film circuitry is deposited using advanced RF sputtering technology in a high-vacuum system, and multilayer metallization is used throughout to combine excellent adherence to the ceramic substrate with optimal electrical performance. All circuit conductors—including RF indicators—are fabricated with a top layer of high-purity gold for excellent conductivity and corrosion resistance, and to assure reliable bonds to interconnecting wires and to the eutectically-attached chip components. All resistors are thin-film tantalum nitride treated at a high temperature for stability and, in many amplifier modules, automatically laser-trimmed to within ±2% of the design value.

Circuit patterns are defined by high-resolution photolithography capable of producing consistent 1-mil line widths and 0.5-mil line spacing. This makes the circuitry repeatable and consistent, as well as eliminating the possibility of component failure due to insufficient conductor widths and excessive current density.

All interconnections between the chip components and the circuit, as well as between the circuit substrate and the RF and DC connection pins on the package, are made with thermosonic-bonded gold-alloy wires. Many of the modules are built on computer-controlled wire-bonding equipment which provides extremely consistent loops and bonds as well as making the production faster and more efficient—other units are manually wire bonded by highly skilled, well-trained operators.

Reliable by Design

From the beginning, Avantek chose thin-film construction for its microwave hybrid products because of the performance capability and the inherent reliability of this construction technique. With *over 20 years* of thin-film hybrid experience Avantek has perfected the design and processing of these thin-film modules. Using the most reliable metal systems available and state-of-the-art processing equipment, Avantek produces all modules with long-term reliability in mind. All new designs are thoroughly tested and analyzed for reliability before being released to production.

Process Control

Since Avantek produces virtually all of its own transistor die, thin-film circuits and MOS capacitors, total control over the quality and reliability of each circuit component through all processing steps is assured. A modern system of material control, using computer tracking and bonded stores for key components, ensures rigid control through all operations. Traceability down to starting material is maintained for all components and, in the case of purchased items, to unique lot numbers. Each material lot is extensively qualified through actual production builds before being committed to volume production.

Avantek Semiconductors

Avantek semiconductors have proven themselves in some of the most critical microwave applications and are extensively used in military communications, radar and ECM/EW/ESM systems as well as in equipment operating on board orbiting spacecraft.

Avantek semiconductors are fabricated with a gold and refractory metal system with proven excellence in junction/contact performance, bond strength and freedom from current-induced metal migration under high current and temperature conditions. The present Avantek gold-based metal system produces uniform metallization in the 1 µm width range and assures complete coverage of even abrupt contours on the surface of the chip. Even GaAs FET gate structures are gold metallized to eliminate the corrosion, intermetallic growth and burn-out problems associated with some metal systems.

Avantek uses a self-aligning nitride/oxide process to define the locations of active regions of bipolar transistors. This process eliminates the performance variations caused by minor misalignment of the photo masks used in processing and allows the production of precise 0.5 µm geometries. Ion implantation, diffused bias resistors, and both arsenic and phosphorous doping of bipolar transistors emitters provide device literally customized to provide performance and reliability in the modular amplifier application.

And, to assure the reliability of these transistors, all processing and manufacturing steps are monitored using rigid quality control.

Program Management

The *Modular and Oscillator Components Division* maintains a Program Office to provide service to customers with special requirements, and to maintain data on product reliability. Working closely with manufacturing, engineering and the Quality Department, the Program Office plans, directs and monitors the product flow for products which require special handling. Each order is reviewed upon receipt and individually documented to ensure that all processing is done to the customer's requirements.

In addition, the Program Office is responsible for periodically conducting tests on key products to maintain up-to-date files on quality and reliability characteristics. In many cases, generic data is available on representative products for qualification by similarity.

MTBF

The stringent screening of Avantek modular components yields Mean Time Between Failure (MTBF) calculations of hundreds of thousands of hours under the most severe conditions. This reliability reflects the construction, screening, handling and rigid process controls employed by Avantek in the manufacture of components. The following MTBF analysis data for the listed screened units is based on MIL-STD-217E.

MTBF calculations on oscillator products can be provided upon customer request. Specific calculations are done on a case-by-case basis.

"R" SERIES—MODULAR AND OSCILLATOR COMPONENTS

Avantek "R" Series Screening was developed over 20 years ago to satisfy a market for screened thin-film amplifiers and oscillators. The "R" Series processing has proven to be an effective screen for increasing reliability and reducing infant mortality.

We now offer this cost and time effective approach on the following product lines. It is specified by adding an "R" suffix to the unscreened standard Avantek model number (example: UTO-502R). Typical delivery to be added to the standard parts is 3 to 4 weeks.

TO-Products "R" Series

Test	Method Reference MIL-STD-883	Condition
Quality Visual	(Note 1)	AWS-104355-800
Pre-Seal Bake		T_A = 150°C, 2 Hrs., Min.
Stabilization Bake	1008	B: T_A = 125°C, 24 Hrs., Min.
Temperature Cycle	1010	B: 10 cycles, –55 to +125°C
Centrifuge	2001	D: Y_1, 20 kg's
Fine Leak	1014	A
Gross Leak	1014	C
Burn-in	1015 (Note 2)	B: 168 Hrs., T_C = +71° to + 125°C
Final Electrical	(Note 3)	25°C
External Visual	2009	

NOTES:
1. Internal visual written to meet the intent of Method 2017 MIL-STD-883 for microwave devices. For reference see Avantek procedure AWS-014355-800.
2. See specific specification (catalog) for burn-in temperature and bias conditions. Oscillator Tc = 85°C.
3. See specific specification (catalog) for test conditions.

PlanarPak "R" Series

Test	Method Reference MIL-STD-883	Condition
Quality Visual	(Note 1)	AWS-104355-800
Pre-Seal Bake		T_A = 125°C, 16 Hrs., Min.
Stabilization Bake	1008	B: T_A = 125°C, 24 Hrs., Min.
Temperature Cycle	1010	B: 10 cycles, –55° to +125°C
Centrifuge	2001	D: Y_1, 20 kg's
Fine Leak	1014	A
Gross Leak	1014	C
Burn-in	1015 (Note 2)	B: 168 Hrs., T_o = +71° to + 125°C
Final Electrical	(Note 3)	25°C
External Visual	2009	

NOTES:
1. Internal visual written to meet the intent of Method 2017 MIL-STD-883 for microwave devices. For reference see Avantek procedure AWS-014355-800.
2. See specific specification (catalog) for burn-in temperature and bias conditions.
3. See specific specification (catalog) for test conditions.

"R" Series (continued)

Avanpak ACT Amplifiers/Oscillators "R" Series

Test	Method Reference MIL-STD-883	Condition
Quality Visual	(Note 1)	AWS-104355-800
Pre-Seal Bake		T_A = 125°C, 4 Hrs., Min.
Stabilization Bake	1008	B: T_A = 125°C, 24 Hrs., Min.
Temperature Cycle	1010	B: 10 cycles, –55 to +125°C
Centrifuge	2001	A: Y_1, 5 kg's
Fine Leak	1014	A
Gross Leak	1014	C
Burn-in	1015 (Note 2)	B: 168 Hrs., T_C = +71° to + 125°C
Final Electrical	(Note 3)	25°C
External Visual	2009	

Mixer "R" Series

Test	Method Reference MIL-STD-883	Condition
Quality Visual	(Note 1)	AWS-104355-800
Pre-Seal Bake		T_A = 125°C, 2 Hrs., Min.
Stabilization Bake	1008	B: T_A = 125°C, 24 Hrs., Min.
Temperature Cycle	1010	B: 10 cycles, –55° to +125°C
Centrifuge	2001	B: Y_1, 10 kg's
Fine Leak	1014	A: 5 x 10^{-7} atm cc/sec, Max.
Gross Leak	1014	C
Final Electrical	(Note 3)	25°C Tests
External Visual	2009	

Control Devices "R" Series

Test	Method Reference MIL-STD-883	Condition
Quality Visual	(Note 1)	AWS-104355-800
Pre-Seal Bake		T_A = 125°C, 4 Hrs., Min.
Stabilization Bake	1008	B: T_A = 125°C, 24 Hrs., Min.
Temperature Cycle	1010	B: 10 cycles, –55 to +125°C
Centrifuge	2001	B: Y_1, 10 kg's
Fine Leak	1014	A
Gross Leak	1014	C
Burn-in	1015 (Note 2)	D: 168 Hrs., T_C = +125°C
Final Electrical	(Note 3)	25°C Tests
External Visual	2009	

Dialectrically Stabilized Oscillator (DSO) "R" Series

Test	Method Reference MIL-STD-883	Condition
Quality Visual	(Note 1)	AWS-104355-800
Pre-Seal Bake		T_A = 150°C, 2 Hrs., Min.
Stabilization Bake	1008	B: T_A = 125°C, 24 Hrs., Min.
Temperature Cycle	1010	B: 10 cycles, –55 to +125°C
Mechanical Shock	2002	A: Y_1, 500 g
Fine Leak	1014	A
Gross Leak	1014	C
Burn-in	1015 (Note 2)	B: 168 Hrs., T_C = +85°C
Final Electrical	(Note 3)	25°C Tests
External Visual	2009	

NOTES:
1. Internal visual written to meet the intent of Method 2017 MIL-STD-883 for microwave devices. For reference see Avantek procedure AWS-014355-800.
2. See specific specification (catalog) for burn-in bias—delete burn-in for limiters. Oscillator Tc = 85°C
3. See specific specification (catalog) for test conditions.

MOC MTFBs
MIL–HDBK–217E
"R" Series Screened Components Only

Model	A_{UF}, 90°C	N_S, 55°C	G_F, 25°C	Model	A_{UF}, 90°C	N_S, 55°C	G_F, 25°C
ATTENUATORS							
PPF-30	792,400	7,868,000	27,810,000	UTF-030	640,700	6,849,000	25,360,000
UTF-015	1,029,000	7,589,000	31,570,000	UTF-040	364,300	2,999,000	12,140,000
UTF-025	896,600	7,342,000	28,330,000				
DETECTORS							
PPD-2001	1,025,000	8,122,000	42,590,000	UTD-1001	1,417,000	10,470,000	42,720,000
PPD-6002	522,700	3,738,000	21,410,000	UTD-2002	657,700	4,865,000	26,150,000
UTD-1000	1,369,000	10,390,000	43,040,000	UTD-2004	173,700	1,676,000	9,909,000
GPD AMPLIFIERS (See page 3–235)							
LIMITERS							
UTL-1001	1,075,000	9,470,000	29,990,000	UTL-1002	1,049,000	9,056,000	28,800,000
LIMITING AMPLIFIERS							
PPL-504	256,200	1,644,000	6,180,000	UTL-502	505,300	4,259,000	14,110,000
UDL-502	149,300	1,291,000	4,564,000	UTL-503	1,403,000	9,821,000	38,850,000
UDL-503	293,200	2,341,000	9,304,000				
MIXERS							
DBX-1824H	95,540	1,111,000	2,204,000	TFX-18075M	1,375,000	12,730,000	55,870,000
DBX-1824M	109,900	1,177,000	2,318,000	TFX-1824H	540,900	2,175,000	2,802,000
DBX-185H	187,600	2,019,000	4,050,000	TFX-1824M	548,400	2,180,000	2,807,000
DBX-185L	227,500	2,184,000	4,351,000	TFX-84H	1,646,000	17,450,000	73,590,000
DBX-185M	215,200	2,129,000	4,242,000	TFX-184L	1,776,000	18,010,000	78,280,000
TFX-18075H	1,330,000	12,580,000	54,550,000	TFX-184M	1,739,000	17,830,000	76,580,000
TFX-18075L	1,401,000	12,830,000	56,880,000				
PLANARPAK AMPLIFIERS							
PPA-210	934,000	2,491,000	2,949,000	PPA-1007	1,794,000	11,520,000	55,970,000
PPA-210	799,500	2,387,000	2,885,000	PPA-1043	705,900	2,247,000	2,856,000
PPA-253	3,375,000	19,610,000	84,770,000	PPA-1044	662,100	2,218,000	2,839,000
PPA-509	539,900	4,757,000	14,820,000	PPA-2012	416,600	4,021,000	14,410,000
PPA-519	632,900	5,290,000	16,680,000	PPA-2013	261,400	2,780,000	9,596,000
PPA-520	1,701,000	10,710,000	52,360,000	PPA-4132	102,900	1,123,000	3,772,000
PPA-543	697,700	2,219,000	2,844,000	PPA-6232	92,050	1,015,000	3,480,000
PPA-544	656,100	2,195,000	2,829,000	PPA-18232	523,800	3,307,000	21,110,000
PPA-1005	561,200	4,631,000	16,640,000	PPA-18632	47,860	482,500	1,658,000
PPA-1006	878,600	6,729,000	24,610,000				

NOTE: The MTBFs shown are based on the 7.0 value of π_A for GaAs low-noise FETs given in MIL-HDBK-217D (not the reportedly erroneous 0.7 value of MIL-HDBK-217E). The failure rates also reflect the use of the 0.24 value of π_Q for GaAs FETs given in MIL-HDBK-217 tables (not the 0.12 value for JANTXV FETs as apparently directed by the hybrid model instructions).

Key to Environments: A_{UF} = Airborne, Uninhabited Fighter
N_S = Naval, Shelterd
G_F = Ground, Fixed

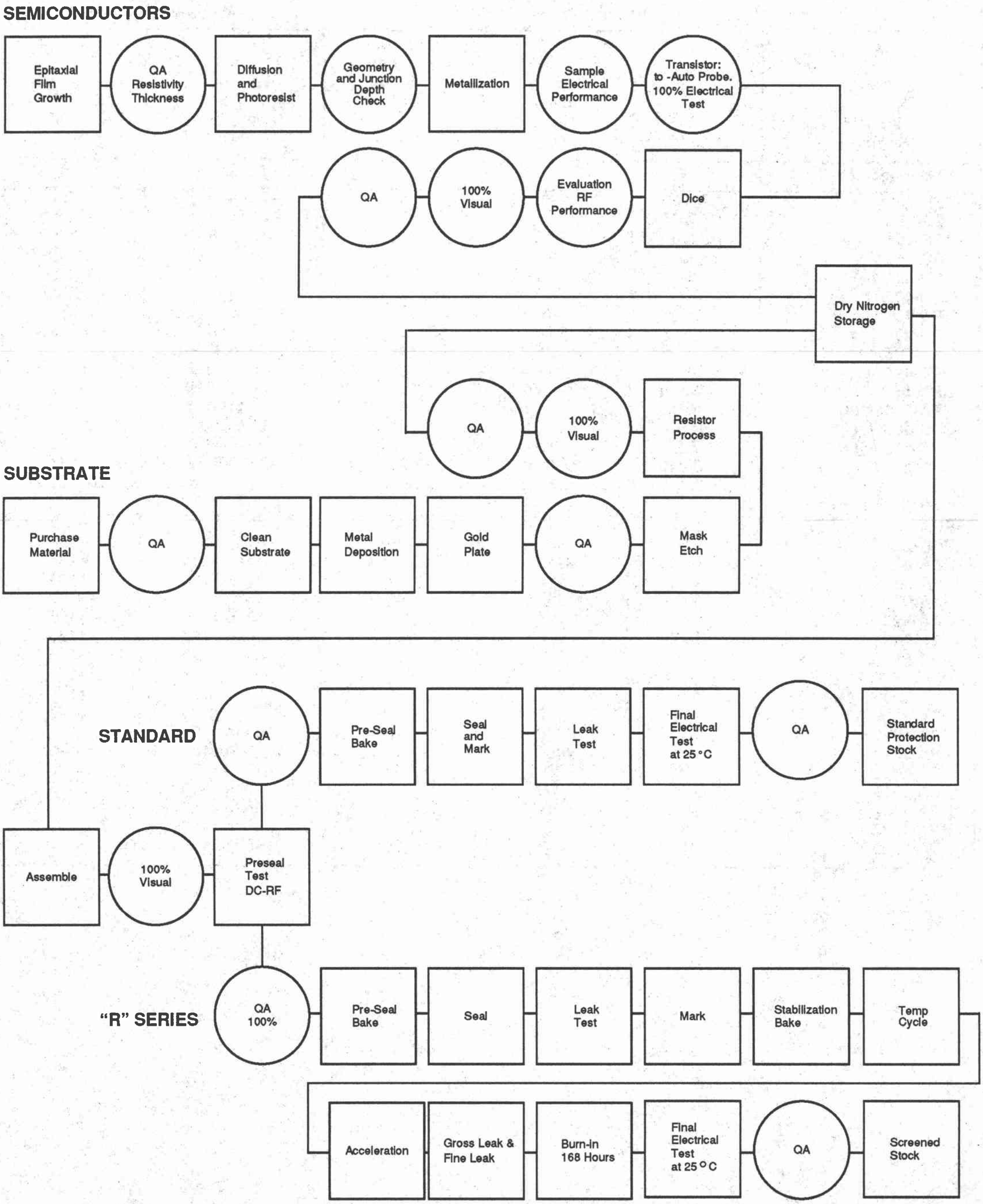
Model	A_{UF}, 90°C	N_S, 55°C	G_F, 25°C	Model	A_{UF}, 90°C	N_S, 55°C	G_F, 25°C
SWITCHES							
PPS-010	85,500	8,213,000	31,370,000	SP3T/DRV	106,800	1,029,000	4,979,000
SPST	827,700	8,226,000	31,510,000	SP4T	94,060	977,300	4,385,000
SPST/DRV	462,900	4,032,000	18,930,000	SP4T/DRV	78,930	757,200	3,531,000
SPDT	243,800	2,431,000	9,617,000	SP5T	73,370	761,200	3,326,000
SPDT/DRV	176,800	1,611,000	7,180,000	SP5T/DRV	62,420	596,100	2,712,000
SP3T	126,700	1,320,000	6,150,000				
TO-8 CASCADABLE AMPLIFIERS							
UTO-101	653,900	3,284,000	6,140,000	UTO-558	572,300	3,614,000	17,350,000
UTO-102	564,100	3,164,000	5,974,000	UTO-561	452,800	1,850,000	2,694,000
UTO-103	892,100	3,813,000	6,822,000	UTO-571	537,400	1,912,000	2,726,000
UTO-104	848,400	3,725,000	6,788,000	UTO-572	539,400	3,773,000	15,580,000
UTO-210	1,375,000	8,263,000	39,130,000	UTO-1001	1,156,000	7,831,000	31,720,000
UTO-211	604,000	2,111,000	2,778,000	UTO-1002	1,246,000	8,263,000	34,970,000
UTO-221	689,800	5,568,000	19,930,000	UTO-1006	743,600	5,635,000	20,620,000
UTO-222	568,100	2,012,000	2,745,000	UTO-1007	1,645,000	10,390,000	50,860,000
UTO-250	974,800	5,743,000	26,810,000	UTO-1011	1,452,000	9,611,000	40,840,000
UTO-410	957,900	6,271,000	27,100,000	UTO-1012	1,253,000	8,519,000	35,990,000
UTO-416	1,257,000	8,001,000	36,350,000	UTO-1013	1,249,000	8,396,000	34,630,000
UTO-421	448,000	3,123,000	12,220,000	UTO-1021	575,400	4,149,000	14,950,000
UTO-440	526,724	3,032,790	5,856,214	UTO-1023	410,200	3,233,000	11,620,000
UTO-441	523,897	3,113,198	5,933,502	UTO-1024	454,100	3,420,000	12,540,000
UTO-442	437,500	1,901,000	2,672,000	UTO-1033	1,291,000	8,773,000	36,410,000
UTO-443	629,500	2,101,000	2,842,000	UTO-1043	767,000	2,279,000	2,889,000
UTO-444	627,400	2,097,000	2,840,000	UTO-1044	955,100	6,615,000	29,170,000
UTO-501	1,170,000	7,969,000	30,030,000	UTO-1052	1,550,000	9,808,000	48,320,000
UTO-502	1,165,000	7,436,000	31,930,000	UTM-1053	535,000	3,701,000	25,050,000
UTO-503	1,178,000	6,101,000	24,940,000	UTO-1054	575,700	3,624,000	17,440,000
UTO-504	624,100	4,574,000	15,920,000	UTM-1056	284,100	1,797,000	11,400,000
UTO-505	991,900	7,344,000	30,770,000	UTM-1057	161,700	886,300	4,842,000
UTO-509	486,500	3,893,000	13,140,000	UTO-1058	572,300	3,614,000	17,350,000
UTO-510	957,900	6,271,000	27,100,000	UTO-1501	1,228,000	7,950,000	34,970,000
UTO-511	924,700	5,989,000	27,660,000	UTO-1502	1,363,000	8,354,000	38,560,000
UTO-512	684,000	5,172,000	21,560,000	UTO-1511	1,421,000	8,540,000	39,000,000
UTO-513	1,221,000	7,735,000	36,010,000	UTO-1522	550,200	4,079,000	15,120,000
UTO-514	1,649,000	10,210,000	43,460,000	UTO-1524	586,100	4,267,000	15,170,000
UTO-515	1,328,000	9,108,000	39,760,000	UTO-2012	299,200	3,047,000	10,410,000
UTO-516	1,320,000	8,310,000	37,550,000	UTO-2013	361,600	3,938,000	12,820,000
UTO-517	1,158,000	8,102,000	33,780,000	UTO-2021	1,044,000	6,590,000	31,030,000
UTO-518	422,100	3,425,000	12,480,000	UTO-2022	814,700	5,683,000	23,560,000
UTO-519	785,200	6,286,000	23,500,000	UTO-2023	664,200	5,321,000	21,800,000
UTO-520	1,012,000	6,548,000	33,320,000	UTO-2024	741,300	4,823,000	19,620,000
UTO-521	492,300	3,275,000	13,240,000	UTO-2025	217,400	2,051,000	7,400,000
UTO-523	1,276,000	8,517,000	33,100,000	UTO-2026	356,100	2,707,000	9,148,000
UTO-524	538,800	3,876,000	14,650,000	UTO-2027	383,000	2,854,000	10,080,000
UTO-533	693,000	5,668,000	20,950,000	UTO-2031	685,900	3,162,000	13,380,000
UTO-543	1,682,000	9,761,000	43,520,000	UTO-2032	797,500	5,684,000	23,600,000
UTO-544	1,137,000	7,651,000	33,440,000	UTO-2033	701,700	4,923,000	17,720,000
UTO-545	1,103,000	8,394,000	29,920,000	UTO-2302	752,100	5,529,000	22,270,000
UTO-546	366,400	1,077,000	1,414,000	UTO-2303	691,800	5,754,000	23,740,000
UTO-552	1,483,000	9,297,000	46,020,000	UTO-2311	1,282,000	8,356,000	41,080,000
UTO-554	575,700	3,624,000	17,440,000	UTO-2321	366,000	2,476,000	9,733,000

NOTE: The MTBFs shown are based on the 7.0 value of π_A for GaAs low-noise FETs given in MIL-HDBK-217D (not the reportedly erroneous 0.7 value of MIL-HDBK-217E). The failure rates also reflect the use of the 0.24 value of π_Q for GaAs FETs given in MIL-HDBK-217 tables (not the 0.12 value for JANTXV FETs as apparently directed by the hybrid model instructions).

Key to Environments: A_{UF} = Airborne, Uninhabited Fighter
N_S = Naval, Shelterd
G_F = Ground, Fixed

*For Oscillators, contact the factory.

"R" SERIES THIN-FILM MODULAR/OSCILLATOR FLOW CHART



Thermal Characteristics and Maximum Ratings for Cascadable Amplifiers

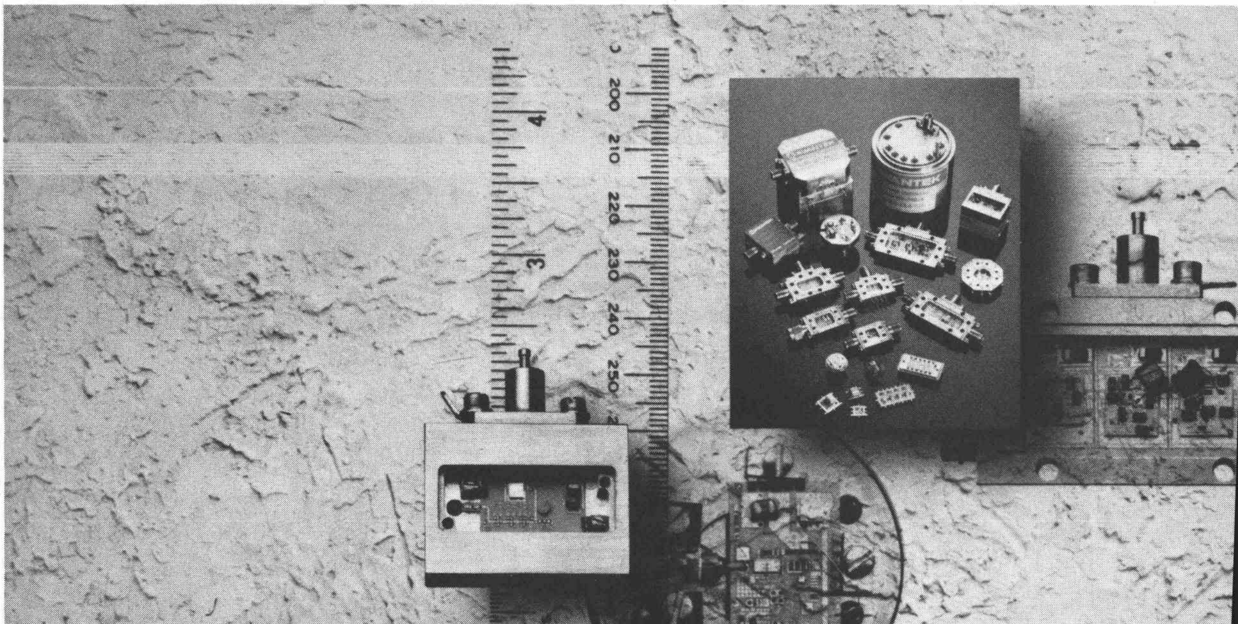
Model Number	Thermal Characteristics: θ_{JC} (°C/W)	Thermal Characteristics: Device Power Dissipation (mW)	Thermal Characteristics: Junction Temperature Above Case Temperature (°C)	Maximum Ratings: Operating Case Temperature (°C)	Maximum Ratings: "R" Series Burn-In Temperature (°C)
GPD Series					
GPD-201	105/105	15/33	2/3	–55 to +125	+125
GPD-202	105/105	69/116	7/12	–55 to +125	+125
GPD-251	105/105	25/43	2/5	–55 to +125	+125
GPD-252	105	20	2	–55 to +125	+125
GPD-401/461	90	14	2	–55 to +125	+125
GPD-402/462	80	82	7	–55 to +125	+125
GPD-403/463	85	175	23	–55 to +125	+125
GPD-404/464	85	330	28	–55 to +115	+115
GPD-405	55	750	41	–55 to +100	+100
GPD-411	105	24	3	–55 to +125	+125
GPM-552	240/240	170/170	41/41	–55 to +100	+100
GPD-1001/1061	105	37	4	–55 to +125	+125
GPD-1002/1062	105	82	9	–55 to +125	+125
GPD-1003/1063	75	185	14	–55 to +125	+125
GPM-1052	240/240	250/350	60/84	–55 to + 71	+71
PlanarPak Series					
PPA-210	120	7/12	9	–55 to +125	+125
PPA-211	120	250	30	–55 to +125	+125
PPA-253	160/160	24/43	4/7	–55 to +125	+125
PPA-509	75	413	31	–55 to +115	+115
PPA-519	75	637	48	–55 to +100	+100
PPA-520	105	108	11.4	–55 to +125	+125
PPA-543	105	176	19	–55 to +125	+125
PPA-544	105	256	27	–55 to +125	+125
PPA-1005	75	413	31	–55 to +115	+115
PPA-1006	75	640	48	–55 to +100	+100
PPA-1007	105	110	11.4	–55 to +125	+125
PPA-1043	105	176	19	–55 to +125	+125
PPA-1044	105	256	27	–55 to +125	+125
PPA-2012	100	250	25	–55 to +125	+125
PPA-2013	60	900	54	–55 to +100	+125
PPA-4132	100/100	290/370	29/37	–55 to +115	+115
PPA-6232	100	420	42	–55 to +100	+100
PPA-18232	40	410	16	–55 to +100	+100

Thermal Characteristics and Maximum Ratings for Cascadable Amplifiers (continued)

Model Number	Thermal Characteristics			Maximum Ratings	
	θ_{JC} (°C/W)	Device Power Dissipation (mW)	Junction Temperature Above Case Temperature (°C)	Operating Case Temperature (°C)	"R" Series Burn-In Temperature (°C)
UTO Series					
UTO-101	105	162	17	–55 to +125	+125
UTO-102	105	162	17	–55 to +125	+125
UTO-103	105	47	5	–55 to +125	+125
UTO-104	105	47	5	–55 to +125	+125
UTO-210	120	77	9	–55 to +125	+125
UTO-211	120	250	30	–55 to +125	+125
UTO-221	105/105	69/230	7/24	–55 to +125	+125
UTO-222	87/87	123/410	11/36	–55 to +115	+115
UTO-250	90/90	13/18	1/2	–55 to +125	+125
UTO-410	105	67	7	–55 to +125	+125
UTO-416	85	180	15	–55 to +125	+125
UTO-421	75/105	82/114	7/12	–55 to +125	+125
UTO-440	105	114	12	–55 to +125	+125
UTO-441	105	275	29	–55 to +125	+125
UTO-442	75	560	42	–55 to +100	+100
UTO-443	105	28	3	–55 to +125	+125
UTO-444	105	45	5	–55 to +125	+125
UTO-501	90	67	6	–55 to +125	+125
UTO-502	90	120	11	–55 to +125	+125
UTO-503	85	360	31	–55 to +115	+115
UTO-504	85	380	32	–55 to +115	+115
UTO-505	55	510	28	–55 to +125	+125
UTO-509	75	413	31	–55 to +115	+115
UTO-510	105	67	7	–55 to +125	+125
UTO-511	105	67	7	–55 to +125	+100
UTO-512	105	190	20	–55 to +125	+125
UTO-513	85	260	22	–55 to +125	+125
UTO-514	85	48	4	–55 to +125	+125
UTO-515	75	600	45	–55 to +100	+100
UTO-516	85	180	15	–55 to +125	+125
UTO-517	105	170	18	–55 to +125	+125
UTO-518	75	580	43	–55 to +100	+100
UTO-519	75	637	48	–55 to +100	+100
UTO-520	105	108	11.4	–55 to +125	+125
UTO-521	105/75	16/92	2/7	–55 to +125	+125
UTO-523	75/70	90/321	7/22	–55 to +125	+125
UTO-524	105/75	131/410	14/31	–55 to +115	+115
UTO-533	75	475	36	–55 to +115	+115
UTO-543	105	176	19	–55 to +125	+125
UTO-544	105	256	27	–55 to +125	+125
UTO-545	75	720	54	–55 to +100	+100
UTO-546	55	840	46	–55 to +85	+85
UTO-552	105	59	6	–55 to +125	+125
UTO-561	55	950	52	–55 to +100	+100
UTO-571	105/105	150/180	16/19	–55 to +125	+125
UTO-572	105/105	150/180	16/19	–55 to +125	+125

Thermal Characteristics and Maximum Ratings for Cascadable Amplifiers (continued)

Model Number	Thermal Characteristics: θ_{JC} (°C/W)	Thermal Characteristics: Device Power Dissipation (mW)	Thermal Characteristics: Junction Temperature Above Case Temperature (°C)	Maximum Ratings: Operating Case Temperature (°C)	Maximum Ratings: "R" Series Burn-In Temperature (°C)
UTO Series					
UTO-1002	90	67	6	–55 to +125	+125
UTO-1002	90	120	11	–55 to +125	+125
UTO-1004	55	770	42	–55 to +85	+85
UTO-1005	75	413	31	–55 to +115	+115
UTO-1006	75	640	48	–55 to +100	+100
UTO-1007	105	110	11.4	–55 to +125	+125
UTO-1011	105	45	5	–55 to +125	+125
UTO-1012	105	120	13	–55 to +125	+125
UTO-1013	105	200	21	–55 to +125	+125
UTO-1021	105/75	230/460	24/34	–55 to +115	+115
UTO-1023	52	924	48	–55 to +100	+100
UTO-1024	72	663	48	–55 to +100	+100
UTO-1033	75	400	30	–55 to +115	+115
UTO-1043	105	176	19	–55 to +125	+125
UTO-1044	105	256	27	–55 to +125	+125
UTO-1052	105	59	6	–55 to +125	+125
UTM-1053	130/130/130	125/125/175	16/16/23	–55 to +125	+125
UTM-1055	90/90	300/480	27/43	–55 to +100	+100
UTM-1056	100/90/90	175/240/308	18/22/28	–55 to +125	+125
UTM-1057	100/90/90	175/300/480	18/27/43	–55 to +100	+100
UTO-1501	90	67	6	–55 to +125	+125
UTO-1502	90	120	11	–55 to +125	+125
UTO-1511	105	43	5	–55 to +125	+125
UTO-1522	105/75	187/460	20/34	–55 to +115	+115
UTO-1524	105/75	102/340	11/26	–55 to +125	+125
UTO-2012	100	250	25	–55 to +125	+125
UTO-2013	60	900	54	–55 to +100	+100
UTO-2021	105	126	13	–55 to +125	+125
UTO-2022	105	216	23	–55 to +125	+125
UTO-2023	75	600	45	–55 to +100	+100
UTO-2024	105/87	85/170	9/15	–55 to +125	+125
UTO-2025	36	1280	46	–55 to +100	+100
UTO-2031	105	126	13	–55 to +125	+125
UTO-2032	105	216	23	–55 to +125	+125
UTO-2033	75	600	45	–55 to +100	+100
UTO-2302	105	130	13	–55 to +125	+125
UTO-2303	105	250	27	–55 to +125	+125
UTO-2311	105	70	7	–55 to +125	+125
UTO-2321	105/75	180/450	19/34	–55 to +115	+115



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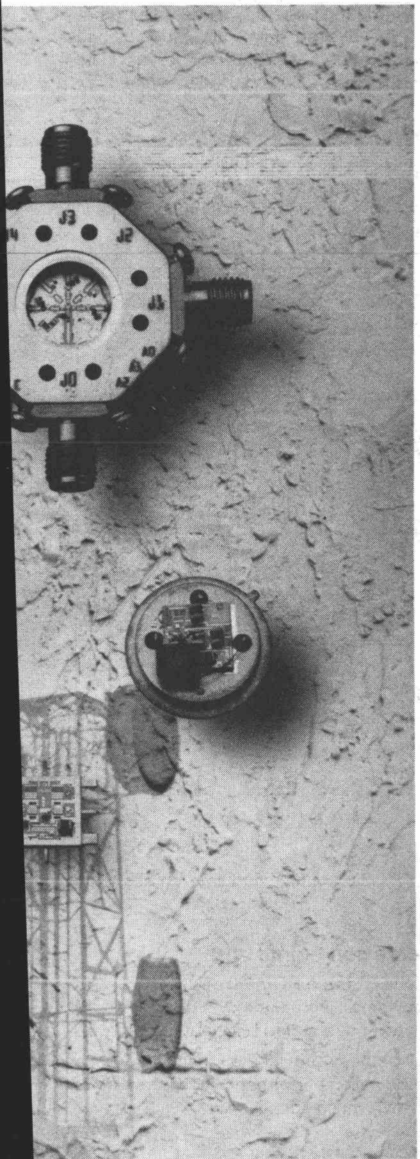
GLOSSARY, CHARTS AND CONVERSION TABLES



AGC

Automatic Gain Control—A feedback control circuit which maintains the gain or output power level of an amplifier constant over a wide range of input signal levels.

Alumina

(Aluminum Oxide, Al_2O_3)—Alumina ceramic is used as the substrate material on which is deposited thin conductive and resistive layers for thin-film microwave integrated circuits.

AM Noise

The random and/or systematic variations in output power amplitude. Usually expressed in terms of dBc in a specified video bandwidth at a specified frequency removed from the carrier.

AM-PM Conversion

AM-PM conversion represents a shift in the phase delay of a signal when a transistor changes from small-signal to large-signal operating conditions. This parameter is specified for Avantek communications amplifiers, since AM-PM conversion results in distortion of a signal waveform.

Analog Driver

An accessory circuit for an oscillator or filter which permits its frequency to be changed by a continuously varying signal.

Balanced Amplification

A transistor amplifier stage in which two identical single-ended amplifier circuits ("channels") are used, and the input signal and output power are equally divided between them. This technique produces approximately twice the output power of a single-ended amplifier stage with generally improved dynamic range and reduced VSWR.

Balanced Module

A gain module of an amplifier which utilizes a 3 dB input splitter and a 3 dB output coupler to combine the power of 2 or more paralleled FETs. Balanced modules have the characteristics of good input and output VSWR which lends to the cascadability of several modules in an amplifier. Balanced modules also have the benefit of indirect stability under adverse source and load conditions.

BIT/BITE

Built-In Test/Built-In Test Equipment—Some Avantek products have provisions for connection to customer-supplied test or test equipment that is a part of the system in which the products are used. Generally, a military/aerospace term for equipment that contains an automatic self-testing function.

Cascadable

A device is cascadable if the output port of one such device can be connected to the input port of another such device without additional impedance matching being required.

Cascade

A series of microwave amplifier stages connected in sequence (sometimes including limiters, attenuators or other elements) to produce the desired gain, power output and other performance characteristics. Avantek modular products are designed to be cascaded in a 50Ω microstrip system.

Combined Ripple and Spurious

The worst case transmission loss (in dB) within the YIG filter 3 dB passband due to the presence of passband spurious (Item E, Figure 1) and/or passband ripple (Item F, Figure 1) responses. See Item G, Figure 1.

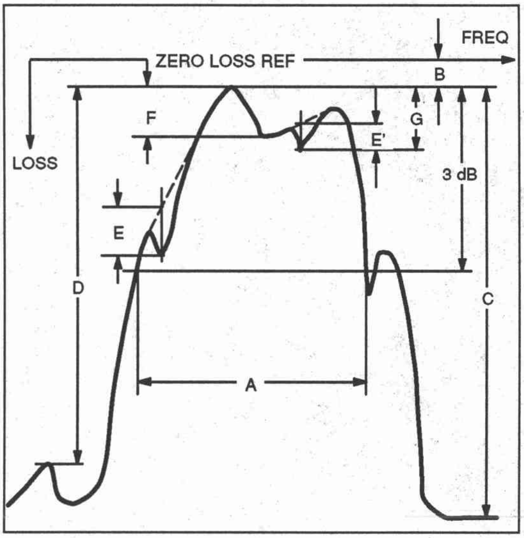


Figure 1

Control Device

A component used to switch, limit, modulate or attenuate microwave signals.

Conversion Compression Point (1 dB)

The specification which states the RF input power (in dBm) at which the IF output power will increase only 9 dB for a 10 dB increase in RF input power at a stated LO input power level.

Conversion compression point provides an indication of the mixer two-tone intermodulation performance and is usually of most concern in high level mixing applications.

Conversion Loss

The ratio (in dB) of the IF output power of a mixer to the RF input power. All conversion loss measurements and specifications are normally based on the mixer being installed in a system with wideband 50Ω resistive terminations on all ports and a stated LO signal power level being applied.

Cross Modulation Distortion

The amount of modulation impressed on an unmodulated carrier when a modulated signal is simultaneously applied to the RF port of a mixer under specified operating conditions. The tendency of a mixer to produce cross modulation is decreased with an increase in conversion compression point and intercept point.

dB

Decibel — A unit of gain equal to ten times the common logarithm of the ratio of two power levels or 20 times the common logarithm of the ratio of two voltage levels.

dBc

Decibels relative to the signal carrier level.

dBm

Decibels relative to 1 mW — The standard unit of power level used in microwave work. For example, 0 dBm = 1 mW, +10 dBm = 10 mW, +20 dBm = 100 mW, etc.

Desensitization

The compression in the IF output power from a desired RF input signal caused by a second high level signal being simultaneously applied to the RF port of a mixer. As a rule of thumb, in low level mixers, an undesired RF input 3 dB below the mixer conversion compression point will begin to cause desensitization.

Dielectric Resonator

A high Q, temperature stable ceramic microwave resonator which is used in microwave oscillator circuits. It can exist in any regular geometrical form and resonates in various modes at frequencies determined by its dimensions and shielding conditions.

Dielectric Resonator Material

Low loss, high permittivity (E_r = 30 to 40) temperature stable ceramic material. Some of the commonly used materials are $Ba_2Ti_9O_{20}$, (Zr, Sn) TiO_4, $BaTi_4O_9$ etc. The composition of these materials can be controlled to achieve any frequency variation with temperature between +10 and –10 ppm.

Dielectric Resonator Quality Factor (Q)

Q is $2\pi f$ times the ratio of energy stored in the dielectric resonator and in the shield to the losses in the resonator and the surrounding metallic walls. Typically the product of f_o(GHz)xQ remains constant and is of the order of 40k to 60k.

Digital Driver

An accessory circuit for an oscillator or filter which permits its frequency to be varied by varying a digital "word". A digital driver is also an accessory circuit interfacing a switch or attenuator to a digital command circuit.

Drive Level

The power level of the local oscillator signal applied to the LO port of a mixer. Operating a mixer with the maximum recommended LO drive level will result in the best two-tone performance, lowest conversion loss and flattest conversion loss vs. frequency characteristics. A reduced LO drive level may help reduce mixer-generated intermodulation products and minimize 1/f noise in the output signal. A higher-than recommended LO power level will result in an increased noise figure and higher LO feedthrough at both the RF and IF ports of the mixer.

dV/dT

Device voltage temperature coefficient.

Dynamic Range

The range from the minimum, which is at a level at or below the amplifier's internally-generated noise, to a maximum input signal level that a component can accept and amplify without distortion.

In regard to mixers, the range of RF input power levels over which a mixer can operate within the specified range of performance. The upper limit of the mixer dynamic range is controlled by the conversion compression point (also a function of LO drive level), and the lower limit is set by the mixer noise figure.

Electronic Tuning

The maximum output frequency deviation which can be achieved without significantly affecting oscillator performance characteristics. This is achieved by adjusting the varactor diode coupled to the dielectric resonator. Typical DSO electronic tuning ranges are ±0.1 of the center frequency.

EMI

Electromagnetic Interference — Unintentional interfering signals generated within or external to electronic equipment. Typical sources could be power-line transients, noise from switching-type power supplies and/or spurious radiation from oscillators. EMI is suppressed with power-line filtering, shielding, etc. EMI suppression requirements are frequently specified for military equipment.

EW

Electronic Warfare — Electronic warfare is military action involving the use of electromagnetic energy to determine, exploit, reduce or prevent hostile use of the electromagnetic spectrum and actions to retain friendly use of the electromagnetic spectrum.

Flatpack

In general microwave usage, a miniature hermetic package for MIC components, designed for a minimum height, with pins for RF and DC connections exiting through the sides (narrowest dimension), and designed to be surface mounted or "dropped in" to a cutout in a microstrip printed circuit board. The leads and the largest surface of the package are in parallel planes.

fmax

Maximum Frequency of Oscillation—The frequency at which unilateral gain equals unity.

FM Noise/Phase Noise

The short-term frequency variations in the output frequency which appear as energy at frequencies other than the carrier. It is usually expressed in terms of dBc or as a RMS frequency deviation in a specified video bandwidth at a specified frequency removed from the carrier. See Figure 2.

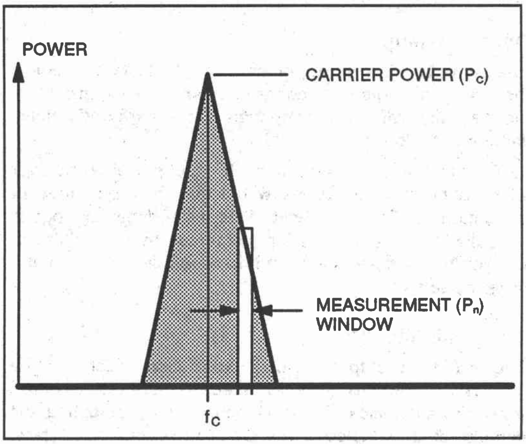


Figure 2

Frequency Accuracy

The maximum output frequency deviation from a specified tuning function under specified conditions. May be expressed in MHz, ppm, or ppm/°C.

Frequency Drift Over Operating Temperature,Max.

The maximum change in output frequency as a result of a specified change in operating temperature.

In regard to oscillators, a measure of the change in frequency over the specified operating temperature range. It is commonly expressed as parts-per-million per degree Celsius (ppm/°C) or as a percentage figure. From a system applications view, the total frequency drift with temperature is sometimes specified around the frequency set at room temperature in ± total parts per million.

Frequency Pulling

The difference between the maximum and minimum values of the oscillator frequency when the phase angle of the load impedance reflection coefficient varies through 360°. Typically this load impedance has a VSWR of 1.67:1.

Frequency Pushing

The incremental output frequency change produced by an incremental change in supply voltage (ΔMHz/ΔV). If supply voltage ripple, frequency range, and amplitude are not specified, measurements will be conducted at a DC rate.

Frequency Range

Usually presented as the minimum and maximum frequencies between which a particular component will meet all guaranteed specifications.

f_T

Gain-Bandwidth Product—(Also called transition frequency). It is the frequency at which the magnitude of the small-signal common-emitter current gain equals unity.

f3 dB

Frequency at 3 dB Gain Point—The frequency at which gain has been reduced 3 dB from the gain at a specified reference frequency.

G_A

Associated Gain—The tuned gain of a device when it is biased for optimum noise figure.

GaAs FET

Gallium Arsenide Field Effect Transistor—(Also called GaAs MESFET for Metal Epitaxial Semiconductor Field Effect Transistor). A field effect transistor with a reverse-biased Schottky-barrier gate fabricated on a gallium arsenide substrate. Roughly equivalent to a silicon MOSFET, Avantek GaAs FETs are depletion mode devices. Because charge carriers reach approximately twice the velocity as in silicon, for a given geometry a given gain can be reached at about twice the frequency.

Gain Block

A single stage of gain or a cascaded series of gains stages.

GΔ

Gain Flatness—The variation of gain over a specified frequency range.

Gmax

Maximum Available Gain—The gain achieved when a transistor is unconditionally stable and the input and output ports are simultaneously conjugately matched. Also designated MAG.

$G_{1\,dB}$

1 dB Gain Compression Point—The level of gain from a device which is 1 dB less than the gain measured under small-signal conditions for a given input level. See also $P_{1\,dB}$.

Harmonic Intermodulation Distortion

The ratio (in dB) of distortion to the IF output waveform caused by mixer-generated harmonics of the RF and LO input signals. This characteristic is extremely dependent on input frequency, RF and LO signal levels and the precise impedance characteristics of all terminations at the operating frequency.

Harmonic Signals

Signals which are coherently related to the output frequency. In general these signals are integer multiples of the output frequency.

Hybrid Integrated Circuits

The combination of thin-film or thick-film circuitry deposited on substrates with chip transistors, capacitors and other components. Thin-film construction is used for Avantek microwave integrated circuits (MICs).

Hysteresis (Electrical)

In regard to threshold detectors, an upward change in the threshold voltage to ensure positive switching activity.

Hysteresis (Magnetic)

The phenomenon causing the values of the magnetic flux density to lag behind the values of the magnetizing force so that the increasing and decreasing fields differ in magnitude.

In regard to YIG-Tuned Oscillators, a magnetic lag effect of the magnetic components of a YIG device that occurs when the tuning coil current is changed. Hysteresis is measured in terms of the maximum resulting frequency difference at a particular magnet current when the device is tuned from high to low frequency and then from low to high frequency through the device operating frequency range. See Figure 3.

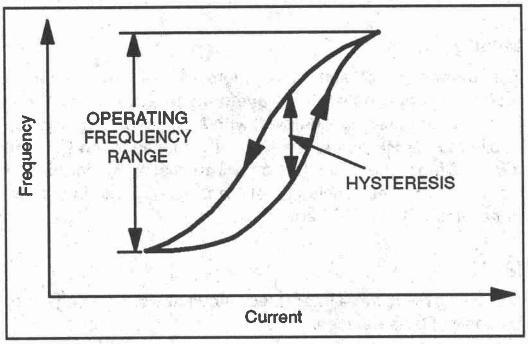


Figure 3

Incidental FM

The peak to peak variations of the carrier frequency due to external variations with the unit operating at a fixed frequency at any point in the tunable frequency range.

Insertion Loss

The transmission loss measured in dB at that point in the passband which exhibits the minimum value. **See Item B, Figure 1.**

Integrated Spurious Output Power

The total power of all spurious outputs in and out of the specified frequency range.

Intercept Point

A figure (expressed in dBm) that indicates the linearity and distortion characteristics of a microwave component. It represents the point where the fundamental power output and spurious responses (usually third-order) intersect, when plotted on a log-log scale with output power as ordinate and input power as abscissa.

Intercept Point, 3rd Order

Third Order Intercept Point—The intersection point of the fundamental POUT vs. PIN extrapolated line and the third-order intermodulation products extrapolated line. Also referred to as IP_3.

In regard to mixers, this parameter is highly dependent on the LO and RF frequency, the LO drive level, and the impedance characteristics of all terminations at the operating frequency.

IP_3

Third Order Intercept Point.

Isolation

The ratio (in dB) of the power level applied at one port of a mixer to the resulting power level at the same frequency appearing at another port.. Commonly specified isolation parameters of mixers are:

1. LO to RF Port: The degree of attenuation of the LO signal measured at the RF port with the IF port properly terminated.
2. LO to IF port: The degree of attenuation of the LO signal measured at the IF port with the RF port properly terminated.
3. RF to IF port: The degree of attenuation of the RF signal measured at the IF port with the LO port properly terminated.

Normally the inverse isolation characteristics (such as RF to LO, IF to LO, and IF to RF) are essentially equivalent in a double-balanced mixer.

Isolator

A device that permits microwave energy to pass in one direction while providing high isolation to reflected energy in the reverse direction. Used primarily at the input of communications-band microwave amplifiers to provide good reverse isolation and minimize VSWR. Consists of a microwave circulator with one port (port 3) terminated in the characteristic impedance.

Limiting Amplifier

Relating to analog signals and their processing. Also refers to the operating range of an amplifier where little or no distortion occurs.

Limiting Level

The input power level at which the input/output characteristics exhibit compression (i.e., the transfer function becomes non-linear in that the output increases less than 1 dB for a 1 dB increase in the input).

Linearity

Any deviation from a best fit straight-line approximation under specified conditions. **See Figure 4.**

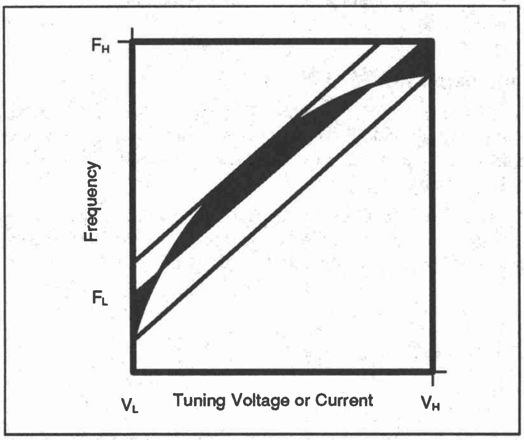


Figure 4

In regard to YIG-tuned and voltage-controlled oscillators, the maximum output frequency deviation from a best fit straight-line approximation of the tuning curve under specified load and constant temperature conditions.

In regard to YIG-tuned filters, the maximum deviation (in MHz) of the measured resonant frequency vs. coil current curve from the ideal linear tuning line over the YIG filter's operating frequency range.

Loss Bandwidth

The frequency span (in MHz) at a given insertion loss referenced to the passband minimum insertion loss.

MAG

Maximum Available Gain—Gain at a frequency where the transistor is unconditionally stable (k>1) and the input and output ports are simultaneously, conjugately matched. Also designated: $GZ_{(max)}$, G_{max}.

Magnetic Susceptibility

The output frequency deviation due to magnetic field measured in kHz/Gauss.

Mechanical Tuning

Maximum output frequency deviation which can be achieved without significantly affecting dielectrically stabilized oscillator characteristics. This is achieved by adjusting the air gap spacing between the dielectric resonator and tuning screw located directly above the resonator. Typically mechanical tuning range is ±1% of the center frequency.

MIC

Microwave Integrated Circuit—In microwave industry parlance, a hybrid circuit using thin- or thick-film conductors and passive components on a ceramic substrate combined with chip-form active and passive components. All Avantek MIC products use thin-film hybrid construction.

MICamp®

Microwave Integrated Circuit Amplifier—A registered trademark of Avantek, Inc. for microwave integrated circuit amplifiers and related products.

Microstrip

(Microstripline)—A transmission line consisting of a metallized strip and a solid ground plane metallization separated by a thin, solid dielectric. This transmission line configuration is used in virtually all Avantek products since it permits accurate fabrication of 50Ω transmission line elements on a ceramic or PC board substrate.

Mixer Ports

The input/output terminals of a mixer, are identified as RF, LO and IF. In most double balanced mixers, the LO and RF ports are either transformer or transmission line-coupled to the mixer diodes, and therefore have a limited low-frequency response, while the IF port is usually direct-coupled with an essentially unlimited low frequency response. In upconverting applications, the low frequency input signal is often applied to the IF port with the higher-frequency output signal being taken from the RF port.

Mixing

The generation of sum and difference frequencies which result from applying two AC waveforms to a non-linear circuit element. In mixer applications, with a signal of frequency f_{RF} applied to the RF port and a signal f_{LO} applied to the LO port, the resulting signal at the IF port will consist of two carriers (or sidebands) of frequencies $f_{RF} + f_{LO}$ and $f_{RF} - f_{LO}$ with internally-generated LO and RF harmonics.

MMIC

Monolithic Microwave Integrated Circuit designed using either Silicon or GaAs devices.

MODAMP™

Avantek trademark for its line of silicon monolithic amplifiers and related products.

Modular

At Avantek, any of many small, essentially complete functional circuits capable of being combined with other modular circuits to form a complete product. Often used singly in higher order assemblies.

Modulation or Tuning Sensitivity

The slope or the first derivative of the tuning curve in ΔMHz/ΔV. Where necessary the fine grain or incremental slopes and the ratio of the slope should be specified over the frequency range.

Modulation or Tuning Sensitivity Variation

The change in the first derivative as a function of tuning voltage and/or frequency. Usually specified as percentage change of the first derivative over an incremental frequency range. Direction of tuning for measurement should be specified. Also may be specified as the ratio of the maximum to minimum value of the first derivative.

Modulation Response Bandwidth

The modulation frequency range where for a reference deviation bandwidth, all included modulation frequencies of equal amplitude will result in no less than a ratio of 1.414 (3 dB) of minimum to maximum deviation. The types of modulation should be specified as well as the internal impedance of the modulation source.

MSA

Microwave Silicon Amplifier.

MTBF

Mean Time Between Failure—A calculated figure representing the estimated average lifetime of a device before it fails.

Noise Figure (NF)

The ratio (in dB) between the signal-to-noise ratio applied to the input of a microwave component and the signal-to-noise ratio measured at its output. It is an indication of the amount of noise added to a signal by the component during normal operation. Lower noise figures mean less degradation and better performance.

NF_{50}

Optimum Noise Figure—A measure of the noise generated by a transistor when tuned for minimum noise figure at a given frequency. Also designated NF_{min}, NF_{opt}, F_{min} and F_{opt}.

$NF_{50\Omega}$

50Ω Noise Figure—Noise figure of a transistor at a given frequency when driven from a 50Ω generator.

Noise Floor

The lowest input signal power level which will produce a detectable output signal from a microwave component, determined by the thermal noise generated within the microwave component itself. The noise floor limits the ultimate sensitivity to weak signals of a microwave system, since any signal below the noise floor will result in an output signal with a signal-to-noise ratio of less than one and will be more difficult to recover.

Noise Temperature

The amount of thermal noise present in a system, expressed in Kelvins. Technically, it is the temperature of a passive system having an available noise power per unit bandwidth equal to that of the actual terminals. The noise temperature of a simple resistor is the actual temperature of the resistor, while the noise temperature of another component could be many times the observed absolute temperature. Used in microwave communications and sometimes radar, it is the equivalent of noise figure expressed in Kelvins (e.g. an amplifier with 1.5 dB noise figure has an effective noise temperature of 120 K).

Non-Harmonic Signals

Signals which are not coherently related to the output frequency.

Non-Operating Signal Rejection

The amount of signal rejection (in dB) referenced to the insertion loss, measured at any point across the frequency range with zero current through the tuning coil.

Octave

In microwave parlance, a band of frequencies, the limits of which have a 2:1 ratio. For example, 1-2 GHz, 4-8 GHz. Many components used in EW systems require an octave or greater than octave bandwidth.

Off Resonance Isolation

The amount of signal rejection (in dB) referenced to the passband minimum insertion loss measured at a point outside the YIG filter passband skirts. See Item C, Figure 1.

Off Resonance Spurious

The amount of suppression (in dB), referenced to the passband minimum insertion loss, of spurious responses outside the YIG filter passband skirts. See Item D, Figure 1.

1 dB Gain Compression

(1 dB GCP, Gain Compression Point, $P_{1\,dB}$)—The maximum output power of an amplifier at which amplification is nearly linear (higher power levels result in compression). As input power applied to an amplifier is increased, some point will be reached where a 10 dB increase in input signal results in only 9 dB of output signal increase—this is the 1 dB gain compression point. Other compression points such as 0.1 dB or 2 dB are sometimes specified.

Oscillator Load

The maximum VSWR seen by the oscillator at the output port, referenced to 50Ω.

Output Frequency

The frequency of the desired output of the component. The undesired frequency components may include harmonics, subharmonics, 3/2 harmonics or nonharmonic spurious signals.

Output Power

The minimum and/or maximum output power at the output frequency under all specified conditions. Usually the specified conditions are temperature, load, VSWR and supply voltage variations. It is typically expressed in dBm or milliwatts (mW).

Passband Ripple (YIG-Tuned Filters)

The peak to peak value (in dB) of ripple occurring within the 3 dB passband referenced to the minimum insertion loss. See Item F, Figure 1.

Passband Spurious

The additional transmission loss (in dB) within the 3 dB passband attributable to the presence of spurious resonance (absorption) modes. Skirt spurious modes are referenced to a line tangent to the YIG filter passband skirt (Item E, Figure 1). Spurious modes within the minimum loss (ripple) region are referenced to the normalized filter response curve. See Item E, Figure 1.

Passband Temperature Drift

The change in resonant frequency (at a fixed coil current) associated with the change in operating temperature.

Passband VSWR

The best VSWR as measured at any point within the 3 dB passband.

Passivation

The formation of an insulating layer directly over a circuit or circuit element to protect the surface from contaminants, moisture or particles.

Percent Bandwidth

$(2[f_2 - f_1]/[f_2 + f_1]) \times 100$ where f_1 and f_2 are the lower and upper endpoints, respectively, of the frequency range.

PIN diode

A diode made by diffusing the semiconductor so that a thin intrinsic layer exists between the P and N-doped regions (positive-intrinsic-negative). Such diodes do not rectify at microwave frequencies but behave as variable resistors controlled by the applied DC bias.

PlanarPak™

Avantek registered trademark for modular components packaged in a surface mount package.

$P_{1\,dB}$

Output Power at 1 dB Gain Compression—Essentially the maximum output power available from the transistor while providing linear amplifications. Also designated: PO-1 dB, and in numerous other ways. See also $G_{1\,dB}$.

Post-Tuning Drift (PTD)

The maximum change in frequency (Δf_{PTD}) from the frequency measured at the beginning of the time interval (t_1). The time interval (t_1-t_2) shall be referenced to the application of a tuning command (t_0). The period of measurement ends at time (t_2). See Figure 5.

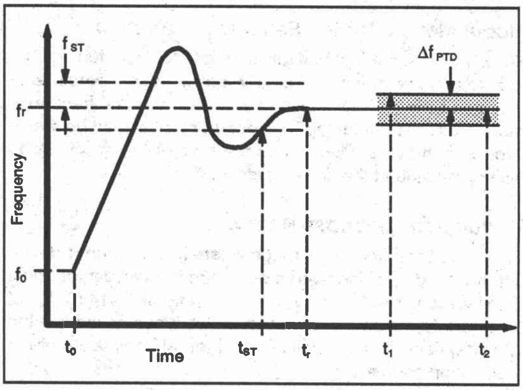


Figure 5

Power Output @ 1 dB Gain Compression

See: 1 dB Gain Compression.

Power Output Variation or Flatness

The maximum peak to peak power variation at all output frequencies in the tunable frequency range under all specified conditions.

P

Total power dissipated in a transistor. $P_T = V_C \times I_C + P_{IN(RF)} - P_{OUT(RF)}$.

Quadrature

Having a characteristic 90° phase shift. Used to describe a coupler in which the two output signals are 90° out of phase, and in telecommunications for modulation techniques such as QPR and QPSK.

"R" Series

Qualified under Avantek's high-reliability screening program.

Resonant Frequency or Passband Center Frequency

The arithmetic mean of the low and high normalized 3 dB frequencies.

Return Loss

When expressed in dB as the ratio of reflected power to incident power, it is a measure of the amount of reflected power on a transmission line when it is terminated or connected to any passive or active device. Once measured, it can be converted by equation to reflection coefficient which can then be converted to VSWR.

Saturated

With respect to microwave components, indicates the maximum output power available when the component is driven beyond its linear region.

Saturated Output Power

The maximum output power of a component. As input power is increased, some point will be reached to where the output power will maximize. This is known as the saturated output power (PSAT) and typically occurs at approximately 5 dB gain compression.

Screening/Sample Test Procedure

A testing procedure that combines LTPD, Quality Test Procedure and A.Q.L. into a single program.

Selectivity

A nominal YIG filter bandpass skirt roll-off as measured in dB per passband octave, typically -6 dB per sphere (stage). See Figure 6.

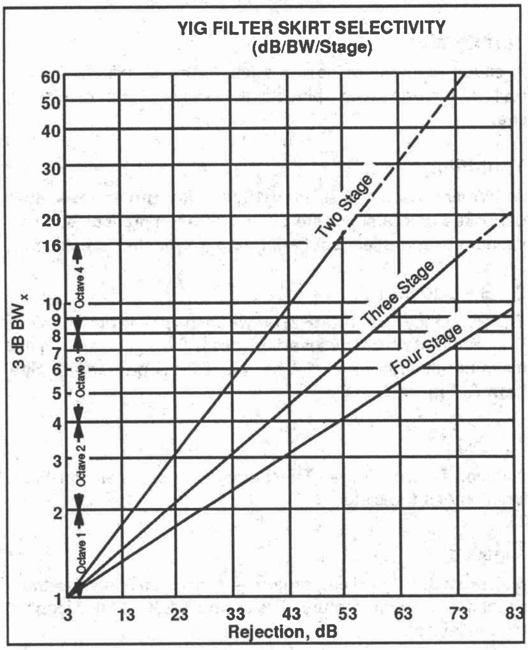


Figure 6

Sensitivity

The normalized change in a YIG component's center frequency resulting from a change in tuning coil current, specified in MHz/mA.

Settling Time

The time (t_{ST}) required for the output frequency to enter and stay within a specified error band ($\pm f_{ST}$) centered around a reference frequency (f_r) after application of a step input voltage (VCO) or current (YTO). The time (t_r) shall be specified for determining the reference frequency (f_r). The period of measurement ends at the reference time (t_r). See Figure 5.

Skirt (Bandpass)

The portions of the bandpass curve above the upper and below the lower 3 dB bandwidth points; and the upper and lower frequency points at which full off-resonance isolation is achieved. See Figure 1.

Skirt Spurious

The amount of additional transmission loss, referenced to the normalized filter skirt curve, outside the 3 dB passband, caused by the spurious resonance (absorption) modes. See Item D, Figure 1.

Slew Rates

The rate which the oscillator frequency can change in response to a step input on the tuning port. The step input waveform should be specified.

Small Signal Gain

The gain characteristics of an amplifier operating in the linear amplification region. Avantek typically measures small signal gain at least 10 dB below the input power level that creates 1 dB gain compression.

Small Signal Gain Flatness

Small signal gain deviation (stated as + and – and not P-P) from a flat reference line measured over the operating frequency of the amplifier at a fixed temperature.

S/N or SNR

Signal-to-Noise Ratio—The ratio of signal power to noise power in a specified bandwidth, expressed in dB.

S-Parameters

Scattering Parameter — Scattering parameters are a group of measurements taken at different frequencies which represent the forward and reverse gain, and the input and output reflection coefficients of a microwave component when the input and output ports of the component are terminated in specified impedances — usually 50Ω.

Magnitude	The length of the vector in the polar plane.
Angle	The direction of the vector in the polar plane.
dB	10 $\log_{10}$ (Power).
S_{11}	S-parameter input reflection coefficient— Expresses the magnitude and phase of the input reflection coefficient, measured with the input and output ports terminated in a pure resistance of 50Ω.
S_{21}	S-parameter forward transfer coefficient— Expresses the forward voltage gain magnitude and phase, measured with the input and output ports terminated in a pure resistance of 50Ω.
S_{12}	S-parameter reverse transfer coefficient— Expresses the reverse voltage gain (sometimes called isolation) magnitude and phase, measured with the input and output ports terminated in a pure resistance of 50Ω.
S_{22}	S-parameter output reflection coefficient— Expresses the magnitude and phase of the output reflection coefficient, measured with the input and output ports terminated in a pure resistance of 50Ω.

Specification Temperature Range

The range of temperatures as measured near the component or device mounting surface over which the operating component or device must meet all guaranteed specifications unless otherwise noted.

Spurious-Free Dynamic Range

The range of input signals lying between the tangential sensitivity level and an upper signal level at which generated in-band spurious outputs exceed the tangential level.

Spurious Signal and Outputs

Undesired signals produced by an active microwave component, usually at a frequency *unrelated* to the desired signal or its harmonics. Spurious outputs are both harmonically and non-harmonically related signals. Their tolerable amplitude should be specified within and out of the frequency range of the oscillator. Typical values range from -60 dBc to -80 dBc.

SSB Conversion Loss

In most applications, only one of the signals ($f_{RF}+f_{LO}$) or ($f_{RF}-f_{LO}$) appearing at the IF port of a mixer is of interest; therefore, only one of these signals (or sidebands) is considered when determining conversion loss in regard to mixers. Single sideband conversion loss is 3 dB higher than the conversion loss when both sidebands are considered (double sideband conversion loss).

Stripline

A transmission line consisting of a conductor above or between extended conducting surfaces. Also see Microstrip.

Substrate

The wafer of ceramic (see alumina, beryllia) on which the thin-film circuit is deposited in hybrid microwave integrated circuit construction.

Suppression

The minimization of undesired side effects in circuit operations (e.g. two-tone intermodulation suppression, spurious output suppression, usually through a design compromise or the addition of specialized components).

T_A

Ambient Temperature — T_A is usually room temperature and is normally assumed to be 25°C if not otherwise specified.

T_{CASE}

Case Temperature — The external temperature of the component package. This temperature is higher than the ambient temperature due to the power dissipation of the device.

t_D

Group Delay — The time required for a signal to pass from input to output. It is calculated from $\Delta S_{21}/\Delta f$.

Termination

A circuit element or device such as an amplifier, divider, resistor, antenna, etc., placed at the end of a transmission line.

Thin-Film

A thin film (usually less than 10,000 Angstroms thickness) deposited onto a substrate by an accretion process such as vacuum evaporation, sputtering or pyrolytic decomposition.

3 dB Bandwidth

The frequency span (in MHz) between the points on the selectivity curve at which the insertion loss is 3 dB greater than the minimum insertion loss. Also called 3 dB passband. See Item A, Figure 1.

T_J

Junction Temperature — The temperature of the emitter-base junction of a transistor.

$T_{J(MAX)}$

Maximum Junction Temperature — Maximum allowable transistor junction temperature. It is normally 200°C for silicon for high reliability.

Transmission Line

The conductive connections between circuit elements which carry signal power. Wire, coaxial cable and waveguide are common examples.

T_{STG}

Storage Temperature — The maximum ambient temperature at which a non-operating transistor may be stored without damage.

Tuning Input Impedance

The small-signal impedance seen at the tuning input port at a specified modulation frequency or frequencies.

Tuning Monotonicity

Continuously increasing or decreasing output frequency for a continuously increasing tuning voltage $f(V_1)<f(V_2)$ for $V_1<V_2$.

Tuning Repeatability

The ability of the oscillator to repeat a frequency within specified limits, Δf, when the original command voltage is reapplied after having been commanded through an arbitrary tuning history. The repeatability window Δf equals $f_{t^1}-f_{t^2}$ with a constant tuning voltage over the time interval t_1 to t_2. Temperature stability and dwell time are to be specified.

Tuning Response Time

The time required for the filter response to come within a specified value of the desired frequency for a specified frequency sweep.

Tuning Sensitivity

The slope of the tuning curve in MHz/mA.

Two-Tone, Third-Order Intermodulation Distortion

The total amount of distortion (dB relative to desired waveform) to the output signal waveform that exists when two simultaneous input frequencies are applied to the RF port of a mixer. Two-tone, third-order intermodulation distortion products are described by $(2f_{R2}-f_{R1})\pm f_{LO}$ and $(2f_{R1}-f_{R2})\pm f_{LO}$. The higher the third-order intercept point and conversion compression points of a mixer, the lower will be the intermodulation for given input signal levels.

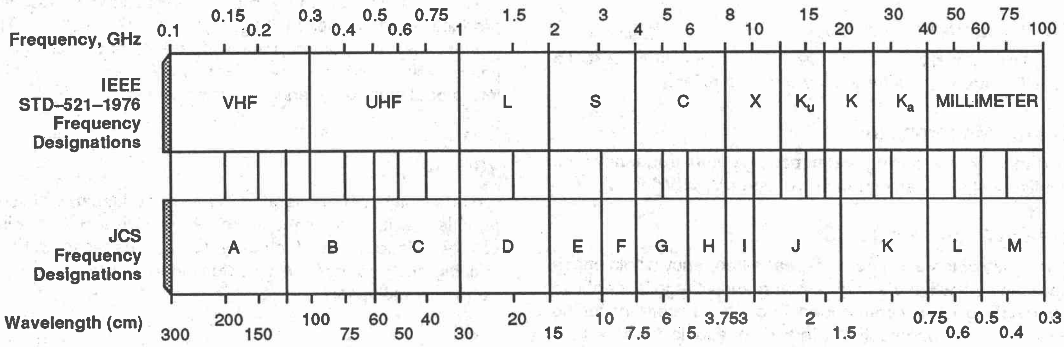
Varactor

A diode which, when operated in a reverse-biased condition, provides a junction capacitance that varies with applied voltage. Used as an "electrically variable" capacitor in tuned circuits (such as those in varactor-tuned oscillators) or as a frequency multiplier.

YIG

Yttrium-iron garnet is a synthetic crystalline ferrite containing yttrium and iron ($Y_3Fe_5O_{12}$). If a single-crystal sphere of YIG is immersed in a magnetic field, and RF energy is coupled into it via a magnetic loop, the crystal will resonate at a frequency linearly proportional to the magnetic field strength. In practical YIG-tuned oscillators and filters, the magnetic field is derived from an electromagnet and the resonant frequency of the YIG sphere is proportional to the current flowing through the magnetic coil.

Frequency Designation Chart



Noise Figure of Cascades

The overall noise figure of a cascade can be calculated with the equation:

$$F_C = F_1 + \frac{F_2 - 1}{G_1} + \frac{F_3 - 1}{G_1 G_2} + \ldots + \frac{F_n - 1}{G_1 G_2 \ldots G_{n-1}}$$

where F_n = Noise figure of the n[th] stage expressed as a numeric

G_n = Gain (in numeric ratio form) of the n[th] stage

F_c = Noise figure of the cascade

NF = Noise figure in dB = $10 \log_{10} F$

Second-Stage Noise Figure Contribution

First-Stage Gain dB	First-Stage Noise Figure dB	Second-Stage Noise Figure 3 dB	5 dB	8 dB	10 dB	12 dB	15 dB	20 dB
20 dB	8.0	0.007	0.015	0.040	0.060	0.100	0.206	0.633
	5.0	0.014	0.030	0.070	0.120	0.200	0.401	1.183
	3.0	0.022	0.050	0.110	0.190	0.310	0.620	1.750
	1.5	0.039	0.070	0.160	0.270	0.430	0.852	2.307
15 dB	8.0	0.022	0.047	0.114	0.190	0.310	0.620	1.750
	5.0	0.043	0.093	0.225	0.370	0.600	1.160	2.989
	3.0	0.068	0.146	0.351	0.580	0.920	1.718	4.098
	1.5	0.096	0.205	0.488	0.800	1.250	2.267	5.074
10 dB	8.0	0.070	0.150	0.350	0.580	0.920	1.718	4.098
	5.0	0.140	0.290	0.670	1.090	1.670	2.941	6.160
	3.0	0.210	0.450	1.030	1.620	2.420	4.039	7.754
	1.5	0.300	0.620	1.386	2.140	3.120	5.008	9.036
7 dB	8.0	0.140	0.290	0.290	1.090	1.670	2.941	6.160
	5.0	0.270	0.560	0.560	1.950	2.870	4.672	8.601
	3.0	0.410	0.850	0.850	2.790	3.950	6.088	10.374
	1.5	0.570	1.160	1.160	3.560	4.910	7.264	11.756

Third Order Two Tone Intercept

$$IP_3 = \frac{\text{Suppression}}{2} + \text{Input Level}$$

Example A

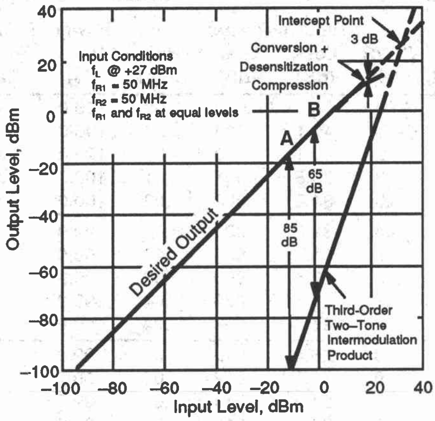
$$IP_3 = \frac{85\ \text{dB}}{2} + (-10) = 32.5\ \text{dB}$$

Example B

$$IP_3 = \frac{65\ \text{dB}}{2} + (-0) = 32.5\ \text{dB}$$

Problem: Predict How Far Down Spurs Will Be With Two –30 dBm Inputs

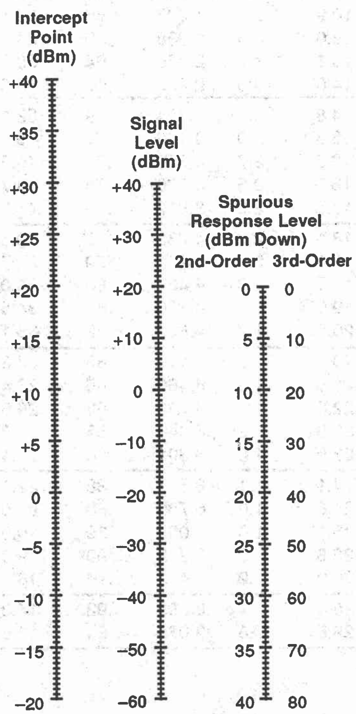
Suppression = 2 (IP – Input Level)
= 2 (32.5–(–30)) = 2 (62.5)
+ 125 dB Down



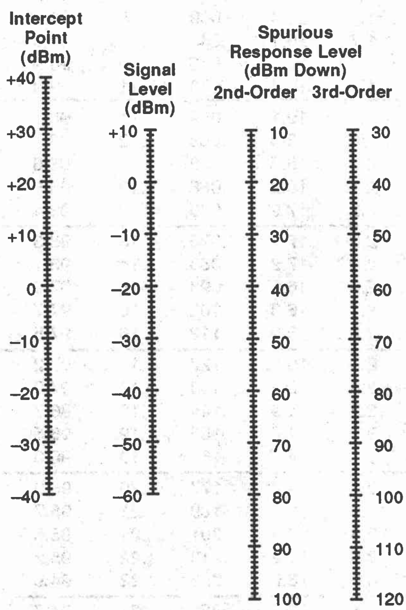
Avantek Dynamic Range Nomograph

(See page 14–4 for instructions.)

NOMOGRAPH NO. 1



NOMOGRAPH NO. 2



THE EFFECT OF VSWR ON TRANSMITTED POWER

VSWR	VSWR (dB)	Return Loss (dB)	Trans/ Loss (dB)	Volt. Refl. Coeff.	Power Trans (%)	Power Refl. (%)
1.00	.0	∞	.000	.00	100.0	.0
1.01	.1	46.1	.000	.00	100.0	.0
1.02	.2	40.1	.000	.01	100.0	.0
1.03	.3	36.6	.001	.01	100.0	.0
1.04	.3	34.2	.002	.02	100.0	.0
1.05	.4	32.3	.003	.02	99.9	.1
1.06	.5	30.7	.004	.03	99.9	.1
1.07	.6	29.4	.005	.03	99.9	.1
1.08	.7	28.3	.006	.04	99.9	.1
1.09	.7	27.3	.008	.04	99.8	.2
1.10	.8	26.4	.010	.05	99.8	.2
1.11	.9	25.7	.012	.05	99.7	.3
1.12	1.0	24.9	.014	.06	99.7	.3
1.13	1.1	24.3	.016	.06	99.6	.4
1.14	1.1	23.7	.019	.07	99.6	.4
1.15	1.2	23.1	.021	.07	99.5	.5
1.16	1.3	22.6	.024	.07	99.5	.5
1.17	1.4	22.1	.027	.08	99.4	.6
1.18	1.4	21.7	.030	.08	99.3	.7
1.19	1.5	21.2	.033	.09	99.2	.8
1.20	1.6	20.8	.036	.09	99.2	.8
1.21	1.7	20.4	.039	.10	99.1	.9
1.22	1.7	20.1	.043	.10	99.0	1.0
1.23	1.8	19.7	.046	.10	98.9	1.1
1.24	1.9	19.4	.050	.11	98.9	1.1
1.25	1.9	19.1	.054	.11	98.8	1.2
1.26	2.0	18.8	.058	.12	98.7	1.3
1.27	2.1	18.5	.062	.12	98.6	1.4
1.28	2.1	18.2	.066	.12	98.5	1.5
1.29	2.2	17.9	.070	.13	98.4	1.6
1.30	2.3	17.7	.075	.13	98.3	1.7
1.32	2.4	17.2	.083	.14	98.1	1.9
1.34	2.5	16.8	.093	.15	97.9	2.1
1.36	2.7	16.3	.102	.15	97.7	2.3
1.38	2.8	15.9	.112	.16	97.5	2.5
1.40	2.9	15.6	.122	.17	97.2	2.8
1.42	3.0	15.2	.133	.17	97.0	3.0
1.44	3.2	14.9	.144	.18	96.7	3.3
1.46	3.3	14.6	.155	.19	96.5	3.5
1.48	3.4	14.3	.166	.19	96.3	3.7
1.50	3.5	14.0	.177	.20	96.0	4.0
1.52	3.6	13.7	.189	.21	95.7	4.3
1.54	3.8	13.4	.201	.21	95.5	4.5
1.56	3.9	13.2	.213	.22	95.2	4.8
1.58	4.0	13.0	.225	.22	94.9	5.1
1.60	4.1	12.7	.238	.23	94.7	5.3
1.62	4.2	12.5	.250	.24	94.4	5.6
1.64	4.3	12.3	.263	.24	94.1	5.9
1.66	4.4	12.1	.276	.25	93.8	6.2
1.68	4.5	11.9	.289	.25	93.6	6.4
1.70	4.6	11.7	.302	.26	93.3	6.7
1.72	4.7	11.5	.315	.26	93.0	7.0
1.74	4.8	11.4	.329	.27	92.7	7.3
1.76	4.9	11.2	.342	.28	92.4	7.6
1.78	5.0	11.0	.356	.28	92.1	7.9
1.80	5.1	10.9	.370	.29	91.8	8.2
1.82	5.2	10.7	.384	.29	91.5	8.5
1.84	5.3	10.6	.398	.30	91.3	8.7
1.86	5.4	10.4	.412	.30	91.0	9.0
1.88	5.5	10.3	.426	.31	90.7	9.3
1.90	5.6	10.2	.440	.31	90.4	9.6
1.92	5.7	10.0	.454	.32	90.1	9.9
1.94	5.8	9.9	.468	.32	89.8	10.2
1.96	5.8	9.8	.483	.32	89.5	10.5
1.98	5.9	9.7	.497	.33	89.2	10.8
2.00	6.0	9.5	.512	.33	88.9	11.1
2.50	8.0	7.4	.881	.43	81.6	18.4
3.00	9.5	6.0	1.249	.50	75.0	25.0
3.50	10.9	5.1	1.603	.56	69.1	30.9
4.00	12.0	4.4	1.938	.60	64.0	36.0
4.50	13.1	3.9	2.255	.64	59.5	40.5
5.00	14.0	3.5	2.553	.67	55.6	44.4
5.50	14.8	3.2	2.834	.69	52.1	47.9
6.00	15.6	2.9	3.100	.71	49.0	51.0
6.50	16.3	2.7	3.351	.73	46.2	53.8
7.00	16.9	2.5	3.590	.75	43.7	56.2
7.50	17.5	2.3	3.817	.76	41.5	58.5
8.00	18.1	2.2	4.033	.78	39.5	60.5
8.50	18.6	2.1	4.240	.79	37.7	62.3
9.00	19.1	1.9	4.437	.80	36.0	64.0
9.50	19.6	1.8	4.626	.81	34.5	65.5
10.00	20.0	1.7	4.807	.82	33.1	66.9
11.00	20.8	1.6	5.149	.83	30.6	69.4
12.00	21.6	1.5	5.466	.85	28.4	71.6
13.00	22.3	1.3	5.762	.86	26.5	73.5
14.00	22.9	1.2	6.040	.87	24.9	75.1
15.00	23.5	1.2	6.301	.88	23.4	76.6
16.00	24.1	1.1	6.547	.88	22.1	77.9
17.00	24.6	1.0	6.780	.89	21.0	79.0
18.00	25.1	1.0	7.002	.89	19.9	80.1
19.00	25.6	.9	7.212	.90	19.0	81.0
20.00	26.0	.9	7.413	.90	18.1	81.9
25.00	28.0	.7	8.299	.92	14.8	85.2
30.00	29.5	.6	9.035	.94	12.5	87.5

DECIBELS — VOLTS — WATTS CONVERSION TABLE FOR A 50 OHM SYSTEM

dBm	V	P_0
+53	100.0	200 W
+50	70.7	100 W
+49	64.0	80 W
+48	58.0	64 W
+47	50.0	50 W
+46	44.5	40 W
+45	40.0	32 W
+44	32.5	25 W
+43	32.0	20 W
+42	28.0	16 W
+41	26.2	12.5 W
+40	22.5	10 W
+39	20.0	8 W
+38	18.0	6.4 W
+37	16.0	5 W
+36	14.1	4 W
+35	12.5	3.2 W
+34	11.5	2.50 W
+33	10.0	2 W
+32	9.0	1.6 W
+31	8.0	1.25 W
+30	7.10	1.0 W
+29	6.40	800 mW
+28	5.80	640 mW
+27	5.00	500 mW
+26	4.45	400 mW
+25	4.00	320 mW
+24	3.55	250 mW
+23	3.20	200 mW
+22	2.80	160 mW
+21	2.52	125 mW
+20	2.25	100 mW
+19	2.00	800 mW
+18	1.80	64 mW
+17	1.60	50 mW
+16	1.41	40 mW
+15	1.25	32 mW
+14	1.15	25 mW
+13	1.00	20 mW
+12	.90	16 mW
+11	.80	12.5 mW
+10	.71	10 mW
+9	.64	8 mW
+8	.58	6.4mW
+7	.500	5 mW
+6	.445	4 mW
+5	.400	3.2 mW
+4	.355	2.5 mW
+3	.320	2.0 mW
+2	.280	1.6 mW
+1	.252	1.25 mW
0	.225	1.0 mW
−1	.200	.80 mW
−2	.180	.64 mW
−3	.160	.50 mW
−4	.141	.400 mW
−5	.125	.32 mW
−6	.115	.25 mW
−7	.100	.20 mW
−8	.090	.16 mW
−9	.080	.125 mW
−10	.071	.10 mW
−11	.064	.07 mW
−12	.058	.06 mW
−13	.050	.05 mW
−14	.045	.04 mW
−15	.040	.03 mW
−16	.0355	.02 mW

dBm	mV	P_0
−17	31.5	.02 mW
−18	28.5	.01 mW
−19	25.1	.01 mW
−20	22.5	.01 mW
−21	20.0	
−22	17.9	
−23	15.9	
−24	14.1	
−25	12.8	
−26	11.5	
−27	10.0	
−28	8.9	
−29	8.0	
−30	7.1	.001 mW
−31	6.25	
−32	5.8	
−33	5.0	
−34	4.5	
−35	4.0	
−36	3.5	
−37	3.2	
−38	2.85	
−39	2.5	
−40	2.25	.1 µW
−41	2.0	
−42	1.8	
−43	1.6	
−44	1.4	
−45	1.25	
−46	1.18	
−47	1.00	
−48	0.90	
−49	0.80	
−50	0.71	.01 µW
−51	0.64	
−52	0.57	
−53	0.50	
−54	0.45	
−55	0.40	
−56	0.351	
−57	0.32	
−58	0.28	
−59	0.251	
−60	0.225	.001 µW
−61	0.20	
−62	0.18	
−63	0.16	
−64	0.141	

dBm	µV	P_0
−65	128	
−66	115	
−67	100	
−68	90	
−69	80	
−70	71	.1 nW
−71	65	
−72	58	
−73	50	
−74	45	
−75	40	
−76	35	
−77	32	
−78	29	
−79	25	
−80	22.5	.01 nW
−81	20.0	
−82	18.0	
−83	16.0	
−84	11.1	
−85	12.9	
−86	11.5	
−87	10.0	
−88	9.0	
−89	8.0	
−90	7.1	.001 nW
−91	6.1	
−92	5.75	
−93	5.0	
−94	4.5	
−95	4.0	
−96	3.51	
−97	3.2	
−98	2.9	
−98	2.9	
−99	2.51	
−100	2.25	.1 pW
−101	2.0	
−102	1.8	
−103	1.6	
−104	1.41	
−105	1.27	
−106	1.18	

dBm	nV	P_0
−107	1000	
−108	900	
−109	800	
−110	710	.01 pW
−111	640	
−112	580	
−113	500	
−114	450	
−115	400	
−116	355	
−117	825	
−118	285	
−119	251	
−120	225	.001 pW
−121	200	
−122	180	
−123	160	
−124	141	
−125	128	
−126	117	
−127	100	
−128	90	
−129	80	
−130	71	.1 fW
−131	61	
−132	58	
−133	50	
−134	45	
−135	40	
−136	35	
−137	33	
−138	29	
−139	25	
−140	23	.01 fW

QUALITY ASSURANCE, WARRANTY and ORDER INFORMATION

QUALITY PROGRAM

Avantek's Quality program is a single standard system which utilizes MIL-Q-9858A as the controlling document. The Quality Department maintains its independence from the operation it is overseeing by reporting to a separate division. The crucial communication link is provided via "dotted line" reporting.

A Quality Engineer (QE) is assigned to either a product line or specific customer depending o the size and complexity of the program. The QE is then responsible for approval of all quality-related activities within that program. His or her duties include, but are not limited to,: review of customer request for quotations; review of customer documentation; participation in design reviews; approval of internal manufacturing-related documentations, including changes thereto; participation in material review and failure analysis boards; internal quality audits; configuration management.

Vendor performance is monitored at all Avantek locations by the Incoming Inspection Department. The IID's responsibilities include the maintenance of the vendor performance report, vendor surveys, corrective action, and incoming inspection with related objective verifications.

In-process and final inspection verification gates are established to provide timely information to manufacturing for performance measurements.

Reliability engineering provides design review and analysis as well as expertise for purposes of failure analysis, and participates in corrective action responses.

In-house environmental capabilities include: vibration, shock, temperature shock/cycle, burn-in, acceleration, seal (gross and fine), and PIND. Additionally, the Semiconductor Division has capabilities for detail die evaluation.

The corporate internal calibration facility is equipped to provide full repair and calibration to MIL-STD-45662. Approved suppliers provide additional back-up calibration support beyond the in-house microwave capabilities.

AVANTEK

STANDARD TERMS AND CONDITIONS

Microwave Components and Semiconductor Products

Avantek, Inc. (Seller) submits quotations and receives and accepts orders subject to the following standard Terms and Conditions only.

1. GENERAL CONDITIONS

a) No understanding, promise, or representation, and no waiver, alteration or modification of any of the provisions stated, shall be binding upon Seller unless, accepted in writing by Seller.

b) All orders are subject to credit approval and final acceptance by Seller's management at its California manufacturing sites.

c) Award acknowledgment subject to these terms will be provided by a copy of the avantek Customer Sales Order (CSO) form.

2. DELIVERY

Unless otherwise specifically provided, delivery of the equipment shall be made F.O.B shipping point at which time the title and risk of loss shall pass to the Buyer. Seller shall not be liable for delays in delivery or in performance, or failure to manufacture due to causes beyond its reasonable control (force majeure).

3. PACKING, MARKING AND SHIPPING

Goods shall be packed, marked and shipped using good commercial practices for protection and shipment. Enhanced service will be separately specified and an additional charge will be made to meet the Buyer's prescribed requirements.

4. SUBSTITUTIONS

Minor performance variations, as mutually agreed by the Buyer and Seller, will not be deemed to constitute failures to comply with specification requirements or constitute defects in materials or workmanship. Seller reserves the right to discontinue manufacture of goods and change specifications without prior notice, provided the performance of goods manufactured by Seller are neither affected adversely nor reduced below any contract specifications. Seller also reserves the right to make product improvements without any obligation or responsibility to incorporate such changes in goods previously manufactured or delivered.

5. PRICING

a) Seller reserves the right to revise and announce new prices for the goods covered in quotations. Seller will honor the old prices if an order is received prior to revision of those prices, or prior to the expiration of a valid quotation outstanding at the time of the price change. Subsequent orders for the same goods are subject to the revised or newly-announced prices. Unit prices are applicable only to the specified quantity and are subject to revision if the quantity is changed.

b) Quoted prices exclude technical data rights or computer software rights and existing or prospective proprietary data unless such data is separately defined, priced, and listed.

c) Prices exclude direct charges for special tooling or special test equipment unless separately defined, priced, and listed.

6. SALES OR SIMILAR TAXES

Unless otherwise stated, quoted prices do not include sales, use, excise or similar taxes nor export or import fees. Such taxes and fees will be borne by the Buyer.

7. PAYMENT TERMS

a) Terms of payment are net 30 days after date of invoice, unless otherwise specified on the invoice.

b) If shipments are delayed by the Buyer, payments shall be come due and payable on the date when Seller is prepared to make shipment.

c) Goods held for the Buyer beyond a reasonable period, shall be at the risk of the Buyer and subject to warehouse charges.

d) Seller reserves the right to require payment in advance and otherwise modify credit terms.

8. WARRANTY

Seller warrants to the Buyer that all Seller goods (equipment and component parts) when sold are free from defects in materials and workmanship under normal use and service for a period of one year from the date of shipment, as evidenced by Seller's or its agent's packing list or transportation receipt. Seller's obligation under this warranty shall be limited to the repair or replacement of goods, at Seller's option, which Seller's examination shall disclose to its satisfaction to be defective. In no event shall Seller's liability for any breach of warranty exceed the net selling price of the defective goods. No person, including any dealer, agent or representative of Seller any other liability on its behalf.

Seller has no obligation or responsibility for goods which have been repaired or altered by other than Seller's employees.

THIS WARRANTY IS THE ONLY WARRANTY MADE BY SELLER AND IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, AND WARRANTIES OF MERCHANTABILITY AND FITNESS FOR ANY PARTICULAR PURPOSE ARE SPECIFICALLY EXCLUDED.

9. WARRANTY CLAIM PROCEDURES

Defective goods must be returned, transportation charges prepaid, to Seller for correction. Seller will pay return transportation charges for warranty repair. Upon redelivery of goods corrected under this warranty, the repaired or replaced portions shall be subject to this warranty for a period of 90 days or until expiration of the original warranty, whichever is later. All claims of failed or defective goods must be in writing and received by the Seller within the specified warranty period. Seller will provide Buyer a return authorization number as authority to return the goods and for use in monitoring repair status.

Repair or replacement of defective goods will be at Seller's discretion and for the Buyer's account when the cause of failure is determined by Seller's examination to be misuse, mishandling or abnormal conditions of operation. In such event a firm price quotation for correction of the goods may be submitted to the Buyer. No repair or replacement work will be initiated prior to receipt of the Buyer's written authorization to proceed and approval of price, except as may be necessary to complete Seller's examination of the goods. If returned goods are determined not to be defective or if the Buyer elects not to authorize correction at its expense of goods not covered by this warranty, the Seller may charge a reasonable amount for such evaluation. Any amounts due Seller under these conditions will be subject to the same payment terms as the original sale. The Buyer will not recover from Seller by offset, deduction or otherwise, the price of any goods returned to Seller under this warranty.

10. LIMITATION OF LIABILITY

Seller's liability on any claim of any kind, whether in contract or in tort including negligence, for any loss or damage arising from, connected with, or resulting from this contract (or quotation), or from the performance or breach thereof, or from the design, manufacture, sale, delivery, installation, inspection, operation or use of any equipment covered by or furnished under this contract, shall in no case exceed the purchase price of the goods which give rise to the claim.

In no event, whether as a result of breach of contract or warranty or alleged negligence, shall Seller or its employees, agents, suppliers, or contractors be liable for special, incidental, exemplary, or consequential damages including, but not limited to, loss of profits or revenue, loss of use of the goods or any associated equipment, cost of capital, cost of substitute equipment, facilities or services, downtime costs, or claims of customers of the Buyer for such damages.

11. CANCELLATION

a) The Buyer may cancel this order only upon written notice sixty (60) days prior to shipment, and upon payment to Seller of any reasonable cancellation charges.

b) Order which are cancelled prior to shipment, if standard items, are subject to a 15% restocking charge for those items already in production or in finished goods inventory awaiting shipment to Buyer.

c) Orders which are cancelled prior to shipment, if those items are "special" or "custom" items designed or modified to the Buyer's specifications, are essentially non-cancellable for that portion in production or in finished goods inventory awaiting shipment to the Buyer, and are subject to full recovery costs.

d.) Orders which are cancelled after shipment to the Buyer, whether standard or special, remain the property of the Buyer.

12. PAYMENT AND COPYRIGHT INDEMNITY

a) Seller agrees to defend at its expense any suits against the Buyer based upon a claim that any goods furnished hereunder directly infringe on a U.S. patent or copyright and to pay costs an damages finally awarded in any such suit provided that Seller is notified promptly in writing of the suit and at Seller's request and its expense is given control of said suit and all requested assistance for defense of same if the use or sale of goods furnished hereunder is enjoined as a result of such suit. Seller at its option and at no expense to the Buyer may obtain for the Buyer the right to use and sell said goods or shall substitute equivalent goods acceptable to Buyer and extend this indemnity thereof, or for goods other than semiconductor devices may accept the goods returned and reimburse the Buyer the purchase price therefore less a reasonable charge for wear and tear. This indemnity does not extend to any suit based upon any infringement or alleged infringement of any patent or copyright by the combination of any goods furnished by Seller with other elements nor does it extend to any goods of the Buyer's design or formula. The foregoing states the entire liability of Seller for patent or copyright infringement.

b) The sale of the goods furnished hereunder does not convey any license by implication, estoppel or otherwise under any proprietary or patent rights of Seller covering combinations of these goods with other elements. In no event shall Seller be liable for incidental or consequential damages arising from infringement or alleged infringement of patents or copyrights.

13. GOVERNMENT CONTRACT CONDITIONS

If the Buyer's purchase order contains a U.S. Government contract number and orders products to be used in the performance of said contract those clauses of applicable U.S. Government procurement regulations directed by Federal Statute to be included in U.S. Government subcontracts shall be incorporated herein by this reference.

14. APPLICABLE LAW

The terms of quotations and any resultant orders shall be governed by and interpreted in accordance with the laws of the State of California.

Avantek Sales and Distribution Network

Avantek has a worldwide Sales and Distribution Network to facilitate the servicing of your microwave product needs. See address and telephone listings on the following pages.

Avantek Sales Offices

Regional and district sales offices are located in the U.S. and in Europe. These offices are staffed with Avantek Sales and Administrative personnel to handle all your inquiries regarding microwave products.

Avantek Representatives

Sales representatives, located throughout the U.S. and the rest of the world, provide local coverage for sales inquiries.

Avantek Distributors

Worldwide availability of locally stocked microwave products is provided by the Avantek Distribution Network. This organization is committed to immediate response to our customers' needs for rapid shipment and delivery of product.

All products listed in this Data Book where the frequency range does not exceed 18 GHz are available through the distribution network.

Regional Sales Offices

EASTERN

Avantek, Inc.
Suite N-165
10005 Old Columbia Road
Columbia, MD 21046
(301) 381-2600

CENTRAL

Avantek, Inc.
Countryside Executive Center
1226 W. Northwest Highway
Palatine, IL 60067
(708) 358-8963

WESTERN

Avantek, Inc.
Suite 325
4165 Thousand Oaks Blvd.
Westlake Village, CA 91362
(805) 373-3870

EUROPE

Avantek, Ltd.
Frimley Business Park, Unit 6
Frimley, Camberley
Surrey GU16 5SG
United Kingdom
(44) 276-685753

Direct Sales Offices

NORTHERN CALIFORNIA

Avantek, Inc.
481 Cottonwood Drive
Milpitas, CA 95035-7492
(408) 954-0311

COLORADO

Avantek, Inc.
5690 DTC Blvd.
Suite 130
Englewood, CO 80111
(303) 741-5757

FLORIDA

Avantek, Inc.
1645 Honey Bear Lane
Dunedin, FL 34698
(813) 787-3218

GEORGIA

Avantek, Inc.
3581 West Hampton Drive
Marietta, GA 30064
(404) 421-9007

Avantek Inc.
102 Shenan Court
Warner Robins, GA 31088
(912) 923-9989

INDIANA

Avantek, Inc.
6227 Constitution Drive
Fort Wayne, IN 46804
(219) 432-4965

KANSAS

Avantek, Inc.
Suite 122
10,000 W. 75th Street
Shawnee Mission, KS 66204
(913) 677-3716

MASSACHUSETTS

Avantek, Inc.
Third Floor
128 Wheeler Road
Burlington, MA 01803
(617) 272-7875

NEW JERSEY

Avantek, Inc.
611 Lamanna Drive
River Vale, NJ 07675
(201) 573-8534

NEW YORK

Avantek, Inc.
Suite 102
200 Parkway Drive South
Hauppauge, NY 11788
(516) 864-1054

PENNSYLVANIA

Avantek, Inc.
Suite 200
997 Old Eagle School Road
Wayne, PA 19087
(215) 254-9440

TEXAS

Avantek, Inc.
Woodcreek Plaza, Suite 180
101 W. Renner Road
Richardson, TX 75080
(214) 437-5694

Domestic Distributors

NORTHWEST

CALIFORNIA (Northern), IDAHO MONTANA, NEVADA (Northern), OREGON, WASHINGTON, WYOMING

Penstock, Inc.
520 Mercury Drive
Sunnyvale, CA 94086-4018
(408) 730-0300

Penstock, Inc.
10800 NE 8th Street, Suite 800
Bellevue, WA 98004
(206) 454-2371

SOUTHWEST

ARIZONA, CALIFORNIA (Southern), COLORADO, NEW MEXICO, NEVADA (Southern), TEXAS (El Paso area), UTAH

Sertek, Inc.
5356 Sterling Center Drive
Westlake Village, CA 91361
(818) 707-2872
(800) 334-7127 (Colorado, Utah)

Sertek, Inc.
1046 N. Tustin, Suite "I"
Orange, CA 92667
(714) 997-7311 or 7314
(619) 224-6911 (San Diego)

Sertek, Inc.
2111 East Broadway Road., Suite 5
Tempe, AZ 85282
(602) 894-9405

MIDWEST

ILLINOIS, INDIANA, IOWA, KANSAS, KENTUCKY, MICHIGAN, MISSOURI, MINNESOTA, NEBRASKA, NORTH DAKOTA, OHIO, PENNSYLVANIA (Western), SOUTH DAKOTA, WISCONSIN

Penstock Midwest
Countryside Executive Ctr, Suite 504
1250 W. Northwest Highway
Palatine, IL 60067
(708) 934-3700
(317) 784-3870 (Indiana)

CENTRAL

ARKANSAS, LOUISIANA (West of the Mississippi River), OKLAHOMA, TEXAS, (Except El Paso area)

Thorson Distributing Company
4445 Alpha Road, #109
Dallas, TX 75244
(214) 233-5744 (Dallas)
(512) 345-1985 (Austin)
(713) 558-8205 (Houston)

NORTHEAST

NEW ENGLAND STATES NEW YORK (Upstate)

Sickles Distribution Sales
175 Bedford St., Suite 12
Lexington, MA 02173
(617) 862-5100

DELAWARE, NEW JERSEY, NEW YORK (Metropolitan), PENNSYLVANIA (Central and Eastern)

Penstock East
124B Little Falls Road
Fairfield, NJ 07006
(201) 808-1414

Penstock East
2919 Maple Shade Road
Ardmore, PA 19003
(201) 808-1414

DISTRICT OF COLUMBIA, DELAWARE, MARYLAND, NEW JERSEY, PENNSYLVANIA (Central and Eastern), VIRGINIA, WEST VIRGINIA

Applied Specialties, Inc.
10101 G. Bacon Drive
Beltsville, MD 20705
(301) 595-5393 (Metro D.C.)
(301) 792-2211 (Maryland)
(800) 638-8555

DISTRICT OF COLUMBIA, DELAWARE, MARYLAND, NORTHERN NEW JERSEY, METRO NEW YORK, VIRGINIA, WEST VIRGINIA

Nu Horizons
6000 New Horizons Blvd.
Amityville, NY 11701
(516) 226-6000

Nu Horizons
8975 Guilford Road, Suite 120
Columbia, MD 21046
(301) 995-6330

Nu Horizons
39 US Route 46
Pinebrook, NJ 07058
(201) 882-8300

SOUTHEAST

ALABAMA, FLORIDA, GEORGIA, LOUISIANA (East of the Mississippi River), MISSISSIPPI, NORTH & SOUTH CAROLINA, TENNESSEE

Applied Specialties of Florida
8420 Ulmerton Road, Suite 406
Largo, FL 34641
(813) 530-7309
(800) 722-4599

Component Distributors, Inc.
11309 S. Memorial Parkway, Suite F
Huntsville, AL 35803
(205) 883-7501

Component Distributors, Inc.
312 So. Harbor City Boulevard, Suite 3
Melbourne, FL 32901
(407) 724-9910
(800) 558-2351

Component Distributors, Inc.
6264 Crooked Creek Road, Suite 2
Norcross, GA 30092
(404) 441-3320

Component Distributors, Inc.
5505 Creedmoor Road, Suite 206
Raleigh, NC 27612
(919) 787-7311

International Distributors

CANADA

Allan Crawford Associates
5835 Coopers Avenue
Mississauga, ON L4Z 1Y2
(416) 890-2010

Allan Crawford Associates
6815 8th Street, N.E., Suite 135
Calgary, AB T2E 7H7
(403) 295-0822

Allan Crawford Associates
2625 Queensview Drive
Ottawa, ON K2B 8K2
(613) 596-9300

Allan Crawford Associates
6505 Trans Canada Hwy, Suite 300
St. Laurent, PQ H4T 1S3
(514) 747-7878

Allan Crawford Associates
410-212 Brooksbank Avenue
N. Vancouver, BC V7J 2C1
(604) 988-2195

ENGLAND, SCOTLAND, IRELAND, WALES

Wave Distribution LTD
Laser House
132/140 Goswell Road
London EC1V 7LE
England
(44) 1-251-5181

FRANCE, BELGIUM, LUXEMBURG

Scie Dimes
1, rue Lavoisier Z.I. B.P. 25
91430 Igny, France
(33) 1-69-41-8282

International Distributors (contd.)

International Distributors (continued)

ITALY
BFI Ibexsa SpA
18 Via Massena
20145 Milano, Italy
(39) 2-33100535

BFI Ibexsa SpA
Viale Parioli, 63
00197 Roma, Italy
(39-6) 88-70-191

JAPAN
Yamada Corporation
Shin-Aoyama Building East
1-1, 1-Chome Minamiaoyama
Minato-Ku, Tokyo 107 Japan
(81) 03-475-1121

Yamada Corporation
Higobashi Shimizu Building, 14F
3-7, 1-Chome Tosabori
Nishi-Ku, Osaka-Shi 550 Japan
(81) 6 449-1101

THE NETHERLANDS
BFI Ibexsa B.V.
Bruistensingel 118
5232 AC S'Hertogenbosch
The Netherlands
(31) 0-73-408-256

SWITZERLAND
Kontron Elektronik
8010 Zurich
Bernerstrasse Sud 169
Switzerland
(41) 1-435-41-11

WEST GERMANY, WEST BERLIN, AUSTRIA
Kontron Elektronik GmbH
Oskar-von-Miller Str 1
D-8057 Eching bei Munchen
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A-148/R-4-90

Printed in