

BURR-BROWN



August 1967 CATALOG

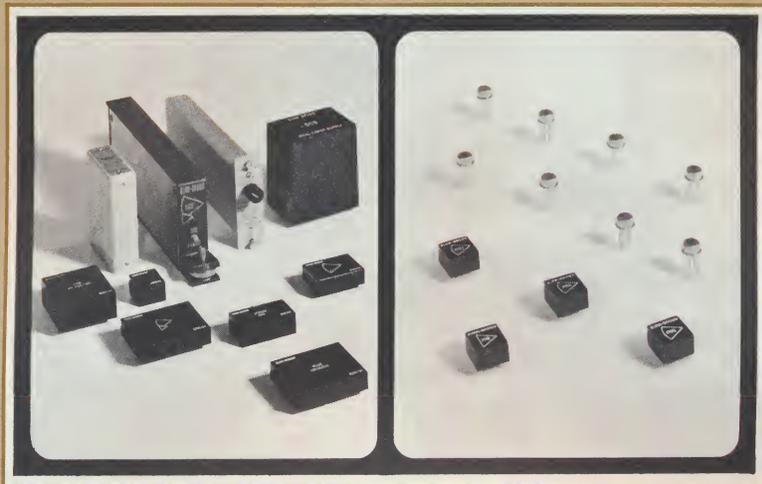
OPERATIONAL AMPLIFIERS

INCLUDING NEW MONOLITHIC INTEGRATED CIRCUITS

FUNCTION MODULES

INCLUDING NEW ENCAPSULATED QUARTER-SQUARE
MULTIPLIERS, SAMPLE/HOLD MODULES AND ACTIVE FILTERS

BURR-BROWN PROVIDES...



MAXIMUM VALUE:

THE RIGHT PRODUCT...

Burr-Brown provides the industry's broadest line of operational amplifiers. . . both Discrete Components and Monolithic Integrated Circuits, as well as a wide variety of Active Filters, Instrumentation Amplifiers, and Function Modules. To facilitate your designs, Burr-Brown offers a complete line of connectors, accessories, and power supplies. If the unit you need is not in the catalog, ask about it. Burr-Brown design capabilities can provide customized units for your engineered component requirements.

AT THE RIGHT PRICE...

Product performance per dollar is higher when you buy from Burr-Brown. Unit prices are listed right in the specification tables to facilitate price/performance comparisons. A 10 percent discount is applied to all purchases of 10 to 24 units. Attractive quantity discounts as well as OEM pricing are available. Annual purchase agreements may be arranged for your continuing requirements.

DELIVERED WHEN YOU NEED IT...

Burr-Brown's exclusive **JET STOCK** program was initiated to provide rapid delivery to you - the customer. Many of the popular operational amplifiers, connectors, and accessories are stocked by your local Representative for your prototype needs.

Quantity orders are shipped directly from the factory. . .delivered when you need them. . .100% tested and ready to plug into your system.

BY THE COMPANY THAT GIVES YOU SERVICE.

BB



CUSTOMER SERVICES

DEMONSTRATION UNITS

Your evaluation of our products is encouraged. Contact your local representative to try any Burr-Brown unit in your application.

PRODUCT PERFORMANCE

Burr-Brown products are designed for maximum overall accuracy and system performance. Minimums and Maximums are not just guesswork. We warrant all units to operate within their rated specifications. Each unit undergoes complete electrical and mechanical inspection before being shipped to assure uniform performance in your designs.

GUARANTEED SOURCE

Any product that we have ever manufactured is still available for your follow-on requirements.

RELIABILITY

Mean-Time-To-Failure (MTTF) documents, including electrical stress analysis, are available on all Burr-Brown products.

QUALITY ASSURANCE

Our quality control procedures are based on MIL-Q-9858A, MIL-I-45208A, MIL-C-45662A, and NASA NPC-200-3 specifications. Request a copy

of our Quality Control Manual; or if you prefer, we encourage your personal inspection of our facilities.

COMPLIMENTARY HANDBOOKS

Our two industry reference handbooks: Handbook of Operational Amplifier Active RC Networks (104 pages) and Handbook of Operational Amplifier Applications (96 pages) describing theory, applications, and circuits are available upon request.

APPLICATIONS CONSULTING

Burr-Brown maintains a full-time staff of application engineers to provide immediate answers to your most perplexing problems. Our application engineers and your local Representatives have provided design consultation to hundreds of customers for thousands of applications of operational amplifiers and function modules.

LOCAL ENGINEERING REPRESENTATIVES

Your local Representatives attend periodic training sessions at the factory in Tucson to stay fully informed on the latest products and applications. A call to the specialist nearest you puts the complete services of Burr-Brown at your immediate disposal. For a complete listing, see the back cover of this catalog.

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GENERAL PURPOSE OPERATIONAL AMPLIFIERS

Typical performance at 25°C and at rated power supply (unless otherwise noted). Storage temperature is -55°C to +100°C.

	MODEL	RATED OUTPUT		DC GAIN	BANDWIDTH		SLEW RATE	INPUT VOLTAGE OFFSET (1)			INPUT BIAS CURRENT (see note 2)																																																																				
				Open Loop	Unity Gain	Full Power		at 25°C	Average Drift -25°C to +85°C		at 25°C	Drift -25°C to +85°C																																																																			
		Basic Model No.	Module See P. 19	min Volts	min mA	typ dB	typ MHz	min kHz	min V/μs	typ mV	typ μV/°C	max μV/°C	typ nA	typ nA/°C	max nA/°C																																																																
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<table border="0"> <tr> <td>3072/25</td> <td>± 10</td> <td>± 20</td> <td>150</td> <td>15</td> <td>800</td> <td>50</td> <td>±0.02</td> <td>±0.5</td> <td>±1.0</td> <td>±0.03</td> <td>±0.001</td> <td>±0.002</td> </tr> <tr> <td>3011/25</td> <td>± 10</td> <td>± 20</td> <td>160</td> <td>15</td> <td>800</td> <td>50</td> <td>±0.02</td> <td>±0.5</td> <td>±1.0</td> <td>±0.03</td> <td>±0.001</td> <td>±0.002</td> </tr> </table>															3072/25	± 10	± 20	150	15	800	50	±0.02	±0.5	±1.0	±0.03	±0.001	±0.002	3011/25	± 10	± 20	160	15	800	50	±0.02	±0.5	±1.0	±0.03	±0.001	±0.002																																							
3072/25	± 10	± 20	150	15	800	50	±0.02	±0.5	±1.0	±0.03	±0.001	±0.002																																																																			
3011/25	± 10	± 20	160	15	800	50	±0.02	±0.5	±1.0	±0.03	±0.001	±0.002																																																																			
COMMERCIAL GRADE																																																																															
General Usage, 2μV/°C																																																																															
Universal																																																																															
-High Supply Rejection																																																																															
-High CMRR (See note 6)																																																																															
TRANSISTOR INPUT																																																																															
Low Voltage, ±2V to ±28V Output																																																																															
<table border="0"> <tr> <td>3044/15</td> <td>note 6</td> <td>± 10</td> <td>120</td> <td>3.0</td> <td>note 6</td> <td>1.0</td> <td>±0.3</td> <td>± 5</td> <td>± 10</td> <td>± 5</td> <td>± 0.3</td> <td>± 0.7</td> </tr> </table>															3044/15	note 6	± 10	120	3.0	note 6	1.0	±0.3	± 5	± 10	± 5	± 0.3	± 0.7																																																				
3044/15	note 6	± 10	120	3.0	note 6	1.0	±0.3	± 5	± 10	± 5	± 0.3	± 0.7																																																																			
FET INPUT																																																																															
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High Voltage, ±20V to ± 115V Output																																																																															
<table border="0"> <tr> <td>3062/15</td> <td>note 6</td> <td>± 5</td> <td>110</td> <td>1.5</td> <td>note 6</td> <td>1.2</td> <td>±0.5</td> <td>± 10</td> <td>± 15</td> <td>±0.02</td> <td>doubles/+10°C</td> <td></td> </tr> <tr> <td>3038/25</td> <td>note 6</td> <td>± 20</td> <td>115</td> <td>3.0</td> <td>note 6</td> <td>18</td> <td>±0.5</td> <td>± 15</td> <td>± 30</td> <td>± 0.1</td> <td>doubles/+10°C</td> <td></td> </tr> </table>															3062/15	note 6	± 5	110	1.5	note 6	1.2	±0.5	± 10	± 15	±0.02	doubles/+10°C		3038/25	note 6	± 20	115	3.0	note 6	18	±0.5	± 15	± 30	± 0.1	doubles/+10°C																																								
3062/15	note 6	± 5	110	1.5	note 6	1.2	±0.5	± 10	± 15	±0.02	doubles/+10°C																																																																				
3038/25	note 6	± 20	115	3.0	note 6	18	±0.5	± 15	± 30	± 0.1	doubles/+10°C																																																																				

SAME DAY SHIPMENT from your local representative's JET STOCK of many of these operational amplifiers, connectors and accessories is provided for your prototype design needs. Contact your nearest U.S. representative.

FOOTNOTES:

Note 1: Voltage Offset

All Burr-Brown operational amplifiers operate with low offset voltages without the use of balancing potentiometers; however, each amplifier has provision for externally balancing the offset to zero.

Note 2: Bias Current

Bias Current is the error current that may appear at either input of the amplifier. The difference between the magnitudes of these two input bias currents (differential offset current) is typically 2-5 times less than the bias at either input.

Note 3: Power Supply Voltage

All 10 V amplifiers operate with ± 12 Vdc to ± 18 Vdc power supply voltage, except models listed as Universal Amplifiers which operate over a much wider range. See note 6.

Note 4: Noise Specifications

Complete noise curves are available upon request for Models 3019/15, 3071/25, and 3072/25. Summary specifications are as follows:

Equivalent Input Noise	Model 3019/15	Model 3071/25	Model 3072/25
rms(6Hz to 1kHz)* Voltage (max) Current (max)	0.4 μ V 0.05nA	2 μ V 3pA	4 μ V 6pA
peak (dc to 1kHz)* Voltage (max) Current (max)	2 μ V 0.25nA	7 μ V 15pA	12 μ V 30pA

*(Effective Noise Bandwidth)

Note 5: Settling Time

Settling time to 1% for Model 3013/15 is less than 1.5 μ s.

Note 6: Universal Operational Amplifiers

These unique amplifiers not only operate from unregulated power supplies but also feature high common-mode rejection ratios (CMRR).

MODEL	3044/15	3062/15	3038/25
Power Supply Range	± 6 to ± 32 V	± 6 to ± 32 V	± 40 to ± 135 V
Input Voltage Drift vs. Power Supply	$\pm 5 \mu$ V/V (max)	$\pm 15 \mu$ V/V (max)	$\pm 25 \mu$ V/V (max)
Input Bias Current Drift vs. Power Supply	± 1.0 nA/V (max)	± 0.001 nA/V (max)	± 0.02 nA/V (max)
Output Voltage	Power Supply less 4 V	Power Supply less 5 V	Power Supply less 20 V

The common-mode voltage limit is the same as the rated output voltage to allow 100% feedback.

Full-power response (in kHz) is equal to $10^3 \times$ Slew Rate (in V/ μ s) divided by $2\pi E_o$ where E_o is the peak output voltage (in volts).

	INPUT NOISE		INPUT R OPEN LOOP		OUTPUT R	COMMON MODE		POWER SUPPLY (see note 3)		UNIT PRICE
	dc to 10 kHz typ μ V/rms	Diff typ M μ	CM typ M μ	Open Loop typ k μ	Input Limit max Volts	CMRR typ dB	Rated typ Volts	Quies max mA	See Price List U.S. \$	
	3	0.5	50	5	± 10	80	± 15	5	85	
	3	1.0	500	0.5	± 10	80	± 15	5	75	
	6	0.5	50	5	± 10	80	± 15	6	95	
	6	0.5	—	0.1	SINGLE-ENDED		± 15	15	95	
note 4	0.5	50	5	± 10	80	± 15	5	70		
	3	0.5	50	5	± 10	80	± 15	5	65	
	3	0.5	50	5	± 10	80	± 15	5	55	
	3	0.5	50	5	± 10	80	± 15	5	40	
	4	0.5	50	5	± 10	80	± 15	5	50	
	4	0.5	50	5	± 10	80	± 15	5	40	
	4	0.5	50	5	± 10	80	± 15	5	30	
	5	0.5	—	5	SINGLE-ENDED		± 15	6	55	
	5	0.5	50	5	± 10	80	± 15	5	40	
	5	0.5	50	5	± 10	80	± 15	5	30	
	5	0.5	50	5	± 10	80	± 15	5	20	
	6	10 ¹¹ _n	10 ¹¹ _n	0.5	± 10	60	± 15	8	105	
	3	10 ¹¹ _n	10 ¹¹ _n	0.5	± 12	106	± 15	8	95	
	10	10 ¹¹ _n	—	0.1	SINGLE-ENDED		± 15	20	110	
	10	10 ¹¹ _n	10 ¹¹ _n	5	± 10	60	± 15	8	85	
	6	10 ¹¹ _n	10 ¹¹ _n	0.5	± 10	60	± 15	8	75	
	10	10 ¹⁰ _n	10 ¹⁰ _n	5	± 10	60	± 15	8	50	
	10	10 ¹⁰ _n	10 ¹⁰ _n	5	± 10	60	± 15	8	45	
note 4	0.5	—	5	SINGLE-ENDED		± 15	10	175		
6	0.5	—	5	SINGLE-ENDED		± 15	15	165		
6	0.5	—	5	SINGLE-ENDED		± 15	10	155		
note 4	0.5	—	5	SINGLE-ENDED		± 15	10	145		
6	0.5	—	5	SINGLE-ENDED		± 15	10	125		
10	0.5	—	5	SINGLE-ENDED		± 15	10	95		
3	0.5	5000	5	note 6	120	note 6	7	75		
3	10 ¹¹ _n	10 ¹¹ _n	0.5	note 6	106	note 6	8	95		
10	10 ¹¹ _n	10 ¹¹ _n	10	note 6	95	note 6	10	175		



MICROMINIATURE OPERATIONAL AMPLIFIERS

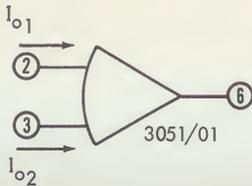
Performance at 25°C (except as noted) and with ± 15 V Power Supply. Power Supply range is ± 9 V to ± 18 V. Storage temperature is -65°C to +150°C

Monolithic Integrated Circuit	MODEL	RATED OUTPUT		DC GAIN	BANDWIDTH (see note 2)		SLEW RATE	INPUT VOLTAGE OFFSET			INPUT BIAS CURRENT (see note 1)		
	Basic Model No. / Module See P. 19	min Volts	min mA	Open Loop	Unity Gain	Full Power	at 25°C	Average Drift Over Temp. Range		at 25°C	Drift Over Temp. Range		
				typ dB	typ MHz	min kHz		min V/μs	typ mV	typ μV/°C	max μV/°C	typ nA	typ nA/°C
MILITARY TEMPERATURE RANGE													
Low Noise, 5μV/°C (max)	3050/01	±10	± 10	100	1.5	20	1.2	± 1	± 2	± 5	± 200	±0.3	±0.6
5μV/°C (max), -55°C to +125°C	3051/01	±10	± 10	100	1.5	20	1.2	± 1	± 2	± 5	± 200	±0.3	±0.6
10μV/°C (max), -55°C to +125°C	3052/01	±10	± 10	96	1.5	20	1.2	± 2	± 5	± 10	± 300	±0.4	±0.8
30μV/°C (max), -55°C to +125°C	3053/01	±10	± 10	93	1.2	15	1.0	± 3	± 10	± 30	± 400	±0.5	±1.0
COMMERCIAL TEMPERATURE RANGE													
Low Noise, 5μV/°C (max)	3054/01	±10	± 5	100	1.5	20	1.2	± 1	± 2	± 5	± 200	±0.3	±0.6
5μV/°C (max), -25°C to +85°C	3055/01	±10	± 5	100	1.5	20	1.2	± 1	± 2	± 5	± 200	±0.3	±0.6
10μV/°C (max), -25°C to +85°C	3056/01	±10	± 5	96	1.2	15	1.0	± 2	± 5	± 10	± 300	±0.4	±0.8
30μV/°C (max), -25°C to +85°C	3057/01	±10	± 5	93	1.0	10	.6	± 3	± 10	± 30	± 400	±0.5	±1.0

MONOLITHIC INTEGRATED CIRCUIT FOOTNOTES:

Note 1: Current Offset

Input bias current is defined as the error current which flows into either input. The maximum limit established by Burr-Brown quality control for this bias current is the maximum into either input, not the average of the two. Differential offset current is the difference between the two bias currents,



I_o = input bias current
 I_{o1} is not necessarily equal to I_{o2} , therefore,
 $I_{o1} - I_{o2}$ = differential offset current.

The differential offset currents and drifts for the Burr-Brown monolithic operational amplifiers are given in the adjacent table.

MODEL	DIFFERENTIAL OFFSET CURRENT			
	at 25°C	Drift		
	typ nA	typ nA/°C	max nA/°C	Temp. Range °C
3050/01	± 15	±0.10	±0.2	-55 to +125
3051/01	± 15	±0.10	±0.2	-55 to +125
3052/01	± 20	±0.15	±0.3	-55 to +125
3053/01	± 30	±0.20	±0.4	-55 to +125
3054/01	± 15	±0.10	±0.2	-25 to + 85
3055/01	± 15	±0.10	±0.2	-25 to + 85
3056/01	± 20	±0.15	±0.3	-25 to + 85
3057/01	± 30	±0.20	±0.4	-25 to + 85

Note 2: Bandwidth - Phase Compensation

Bandwidth specifications shown in the top chart are with the amplifier phase compensated for unconditional stability at unity gain. The monolithic operational amplifiers can be easily compensated by the user for operation at any gain. The adjacent illustration shows pin connections for the monolithic amplifiers. Frequency stability is guaranteed for the unity-gain phase compensation values shown.

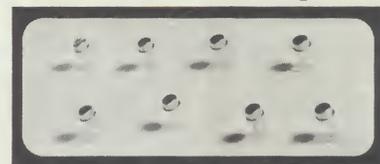
Discrete and Hybrid	MODEL	RATED OUTPUT		DC GAIN	BANDWIDTH		SLEW RATE	INPUT VOLTAGE OFFSET			INPUT BIAS CURRENT		
	Basic Model No. / Module See P. 19	min Volts	min mA	Open Loop	Unity Gain	Full Power	at 25°C	Average Drift -25°C to +85°C		at 25°C	Drift -25°C to +85°C		
				typ dB	typ MHz	min kHz		min V/μs	typ mV	typ μV/°C	max μV/°C	typ nA	typ nA/°C
MILITARY TYPE													
MIL-STD-202C and -810 (note 1)	1901/19	±10	±20	106	1.5	20	1.2	±0.3	± 5	± 10	± 5	±0.2	±0.5
MIL-STD-202C and -810 (note 1)	1902/19	±10	± 2	96	1.5	20	1.2	±0.3	± 5	± 10	± 5	±0.2	±0.5
MIL-E-5272C (note 1)	1903/19	±10	± 2	96	1.5	10	0.6	±0.3	± 10	± 15	± 10	±0.4	±0.8
FET-Wide Temp. Range (note 1)	1554/15	±10	±20	106	1.5	90	5.5	±0.5	± 10	± 15	±0.05	Doubles/+10°C	
COMMERCIAL TYPE													
Transistor Input	1706/17	±10	±10	106	2.0	20	1.2	±0.5	± 5	± 15	± 5	±0.2	±0.5
FET Input	1752/17	±10	±10	96	2.0	100	6	±0.5	± 10	± 30	±0.02	Doubles/+10°C	
Wideband Differential	3034/17	±10	±10	90	7.0	200	12	±1.0	± 15	± 30	±0.02	Doubles/+10°C	
Chopper Stabilized	3049/15	±10	±10	160	10	300	18	±0.05	±0.5	±1.0	±0.05	±0.001	±0.002
Wideband Inverting	1701/17	±10	±10	92	3	30	1.8	±0.5	± 5	± 15	± 20	± 1	±2.0
Low Cost	3068/17	±10	±10	100	1.5	20	1.2	±0.3	± 5	± 10	± 5	±0.5	±1.5
Power Booster (note 2)	1719/17	±10	±50	0									

Performance at 25°C (except as noted) and with ± 15 V Power Supply. Power Supply range is ±12V to ± 18 V.

Small Quantity Linear IC Unit Prices (U.S. \$)								
Quantity	-55°C to +125°C				-25°C to +85°C			
	3050/01	3051/01	3052/01	3053/01	3054/01	3055/01	3056/01	3057/01
1-9	60.00	55.00	35.00	20.00	33.00	28.00	18.00	12.00
10-24	54.00	49.50	31.50	18.00	29.70	25.20	16.20	10.80
25-99	48.00	44.00	28.00	16.00	26.40	22.40	14.40	9.60
100-249	45.00	41.00	26.00	15.00	25.00	21.00	12.00	8.00

Contact factory with your production requirements.

The New BBIC Op Amps



BURR-BROWN Monolithic IC

Burr-Brown monolithic IC's have the repeatability and uniform performance from unit to unit that you would expect from the technological leader of the operational amplifier field. Burr-Brown's unique and proprietary design (patent pending) is a major breakthrough in overcoming the limitations of the monolithic process. Only Burr-Brown offers IC operational amplifiers that are fully tested and have guaranteed performance. For example: Burr-Brown drift specifications include maximums not just typicals.

Phase compensation is consistent from unit to unit; no "hand tuning" is required. The amplifier output may be indefinitely shorted to ground without damage to the unit and the input is protected to supply. Both voltage noise and current noise are completely specified for Models 3050/01 and 3054/01. The amplifier's unique design assures unity-gain stability with virtually any capacitive loading without changing phase compensation or adding a decoupling resistor. Burr-Brown IC Operational Amplifiers are truly general purpose units.

INPUT NOISE	INPUT R OPEN LOOP		OUTPUT R	COMMON MODE		SPECIFICATION TEMP.		POWER SUPPLY		UNIT PRICE	
	dc to 10 kHz	Diff		CM	Open Loop	Input Limit	CMRR	min °C	max °C		Rated
typ μV , rms	typ $\text{M}\Omega$	typ $\text{M}\Omega$	typ $\text{k}\Omega$	typ $\text{k}\Omega$	max Volts	typ dB			typ Volts	max mA	See Price List U.S. \$
(note 3)	0.3	200	4	± 11	100	-55	+125	± 15	6	60	
3	0.3	200	4	± 11	100	-55	+125	± 15	6	55	
3	0.3	200	4	± 11	100	-55	+125	± 15	6	35	
3	0.3	200	4	± 11	100	-55	+125	± 15	6	20	
(note 3)	0.3	200	4	± 11	100	-25	+85	± 15	6	33	
3	0.3	200	4	± 11	100	-25	+85	± 15	6	28	
4	0.3	150	5	± 11	100	-25	+85	± 15	6	18	
4	0.2	150	5	± 11	100	-25	+85	± 15	6	12	

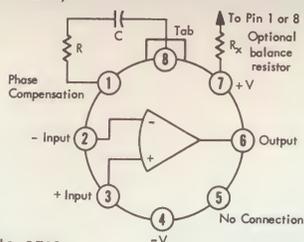
Gain	R ohms	C pF	Gain Bandwidth Product	Typical Feedback Resistor
X1	390	2200	1 MHz	10 $\text{k}\Omega$
X10	1K	2200	10 MHz	10 $\text{k}\Omega$
X100	10K	2200	100 MHz	100 $\text{k}\Omega$
X1000	0	10	1000 MHz	1 $\text{M}\Omega$

Note 3: Noise Specifications

Complete noise curves are available upon request for Models 3050/01 and 3054/01. A graph of the equivalent input noise voltage versus source resistance for various constant amplifier bandwidths and an equation for calculating amplifier noise figure are also available. Summary specifications are as follows:

CONNECTION DIAGRAM (TOP VIEW)

Interchangeable with standard 8 pin 709 type amplifiers.



NOTE: Pin 4 connected to case.

Equivalent Input Noise	
rms (6 Hz to 1 kHz)*	
Voltage	0.8 μV , rms (max)
Current	0.03 nA, rms (max)
peak (DC to 1 kHz)*	
Voltage	3 μV , peak (max)
Current	0.15 nA, peak (max)

*(Effective noise bandwidth)

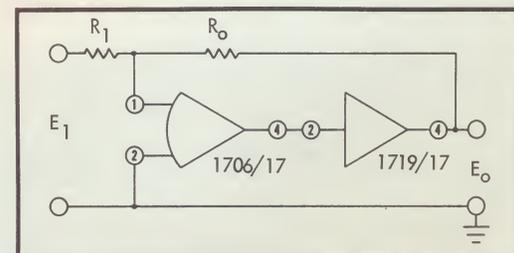
INPUT NOISE	INPUT R OPEN LOOP		OUTPUT R	COMMON MODE		SPECIFICATION TEMP.		POWER SUPPLY		UNIT PRICE	
	dc to 10 kHz	Diff		CM	Open Loop	Input Limit	CMRR	min °C	max °C		Rated
typ μV , rms	typ $\text{M}\Omega$	typ $\text{M}\Omega$	typ $\text{k}\Omega$	typ $\text{k}\Omega$	max Volts	typ dB			typ Volts	max mA	See Price List U.S. \$
5	0.5	50	5	± 10	80	-25	+85	± 15	5	75	
5	0.5	50	1.2	± 10	80	-25	+85	± 15	15	65	
5	0.5	30	0.2	± 3	80	-55	+125	± 15	15	105	
6	10 ¹¹ Ω	10 ¹¹ Ω	0.5	± 10	80	-55	+125	± 15	8	125	
3	0.5	50	5	± 10	80	-25	+85	± 15	5	75	
6	10 ¹¹ Ω	10 ¹¹ Ω	5	± 10	60	-25	+85	± 15	6	95	
6	10 ¹¹ Ω	10 ¹¹ Ω	5	± 10	60	-25	+85	± 15	6	95	
6	0.5	-	5	single ended	-	-25	+85	± 15	15	165	
3	0.3	-	0.2	single ended	-	-25	+85	± 15	6	75	
3	0.3	50	5	± 11	80	-25	+85	± 15	6	65	
						-25	+85	± 15	5	45	

Note 1: Military Type

Models 1901/19 and 1902/19 have been certified under MIL-STD-202C and MIL-STD-810 for humidity, shock, altitude, acceleration, thermal shock and vibration. The Model 1903/19 is designed to meet environmental requirements of MIL-E-5272C. Mean-time-to-failure (including electrical stress analysis) is available for many Burr-Brown amplifiers.

Note 2: Power Booster

May be used with any 10-Volt Operational Amplifier as shown.





SPECIAL PURPOSE OPERATIONAL AMPLIFIERS

	MODEL	RATED OUTPUT		DC GAIN	BANDWIDTH		SLEW RATE	INPUT VOLTAGE OFFSET (1)			INPUT BIAS CURRENT (see note 2)			
				Open Loop	Unity Gain	Full Power		offset 25°C	Average Drift -25°C to +85°C		Drift at 25°C		-25°C to +85°C	
		Basic Model No.	Module See P. 19	min Volts	min mA	typ dB	typ MHz	min kHz	min V/μs	typ mV	typ μV/°C	max μV/°C	typ nA	typ nA/°C
Battery Powered														
Transistor Input (See note 4)	3001/15		± 4	± 5	100	0.8	5	0.1	±0.3	± 5	± 10	± 5	±0.3	±0.5
FET Input (See note 4)	3002/15		± 4	± 5	96	1.0	30	0.7	±0.5	± 10	± 15	±0.05	Doubles/	+10°C
High Voltage														
20 VOLT OUTPUT														
Transistor Input	1540/15		± 20	± 10	106	1.5	10	1.2	±0.3	± 5	± 10	± 10	±0.3	±0.5
FET Input	1543/15		± 20	± 10	103	1.5	50	6	±0.5	± 5	± 15	±0.1	Doubles/	+10°C
Chopper Stabilized	1548/25		± 20	± 10	160	15.0	100	12	±0.02	±0.5	±1.0	±0.03	±0.001	±0.002
Low Cost	1547/15		± 20	± 5	100	1.0	10	1.2	±0.5	± 10	± 20	± 20	±0.5	±1.0
50 VOLT OUTPUT														
Transistor Input	1541/25		± 50	± 10	110	0.4	3	0.9	±0.3	± 10	± 25	± 10	±0.5	±1.0
FET Input	1544/25		± 50	± 20	110	1.0	20	6	±0.5	± 10	± 25	±0.1	Doubles/	+10°C
Chopper Stabilized	1643A/16		± 50	± 20	160	3.0	50	15	Adj.	±0.5	±1.0	±0.05	±0.01	±0.02
100 VOLT OUTPUT														
Transistor Input	1542/25		±100	± 10	110	0.4	3	1.8	±0.5	± 10	± 25	± 10	±0.5	±1.0
FET, High Common Mode (See note 5)	3038/25		±100	± 20	115	3.0	note 5	18	±0.5	± 15	± 30	±0.1	Doubles/	+10°C
FET, General Purpose	1545/25		±100	± 10	110	1.0	20	12	±0.5	± 10	± 25	±0.1	Doubles/	+10°C
Chopper Stabilized	1644A/16		±100	± 10	160	3.0	.50	30	Adj.	±0.5	±1.0	±0.05	±0.01	±0.02
High Power														
LOW VOLTAGE														
High Supply Rejection, 1000 mA (note 5)	3045/16		± 10	±1000	120	1.5	10	0.6	±0.03	± 5	± 10	± 5	±0.2	±0.5
High Supply Rejection, 500 mA (note 5)	3063/40		± 10	±500	120	1.5	10	0.6	±0.3	± 5	± 10	± 5	±0.2	±0.5
Wideband Differential	1527/25		± 10	±100	100	15	1000	60	±0.5	± 10	± 15	± 5	±0.2	±0.5
FET Input	1555/25		± 10	±100	95	15	1000	60	±0.5	± 10	± 25	±0.1	Doubles/	+10°C
Low Cost, 500 mA	3046/40		± 10	±500	100	1.5	10	0.6	±0.2	± 5	± 15	± 5	±0.5	±1.5
Low Cost, 100 mA	3043/15		± 10	±100	100	1.5	20	1.2	±0.2	± 5	± 15	± 5	±0.5	±1.5
Low Cost, 50 mA	3015/15		± 10	± 50	100	1.5	10	0.6	±0.5	± 10	± 25	± 10	±0.5	±1.0
HIGH VOLTAGE														
High Supply Rejection, 600 mA (note 5)	3042/16		± 20	±600	120	1.5	10	1.2	±0.03	± 5	± 10	± 5	±0.2	±0.5
High Supply Rejection, 300 mA (note 5)	3070/40		± 20	±300	120	1.5	10	1.2	±0.3	± 5	± 10	± 5	±0.2	±0.5
POWER BOOSTER														
10 Volt, 100 mA	1520/15		± 10	±100	0	—	300	18	May be used with any General Purpose Operational Amplifier with the same rated output voltage. Overall bandwidth is determined by the amplifier-booster combination.					
10 Volt, 200 mA	3016/25		± 10	±200	0	—	300	18						
10 Volt, 500 mA	3069/49		± 10	±500	0	—	50	3						
10 Volt, 500 mA	1634A/16		± 10	±500	0	—	50	3						
20 Volt, 100 mA	3017/25		± 20	±100	0	—	300	18						
Differential Output														
Transistor Input (See note 6)	1514/15		± 10	± 20	106	0.7	10	0.6	±0.3	± 5	± 15	± 10	±0.3	±0.5

Typical performance at 25°C and at rated power supply (unless otherwise noted). Storage temperature is -55°C to +100°C.



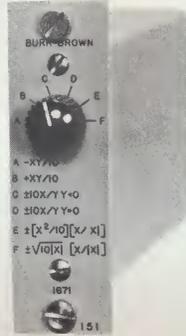
QUARTER-SQUARE MULTIPLIERS

APPLICATIONS:

- DYNAMIC GAIN CONTROL
- TRIGONOMETRIC COMPUTATION
- POWER MEASUREMENT
- CORRELATION COMPUTATION
- RMS MEASUREMENT
- ANALOG SIMULATION



Model 4012/25



Model 1671/16

$$\frac{-E_1 E_2}{10}, \frac{+E_1 E_2}{10}$$

$$\pm \frac{10 E_1}{E_2}, E_2 > 0$$

$$\pm \frac{10 E_1}{E_2}, E_2 < 0$$

$$\pm \frac{E_1^2}{10} \text{ Sign } E_1$$

$$\pm \sqrt{10 |E_1|} \text{ Sign } E_1$$

Models 1661/16 and 1671/16 are high-speed, accurate analog function modules for performing four-quadrant multiplication and two-quadrant division. Model 1671/16 features a six-position switch for selecting any one of the functions listed above. Model 1661/16 features a two-position switch for selecting the inverting multiply mode or a two-quadrant ($E_2 > 0$) divide mode ($E_o = -10 E_1/E_2$).

Models 4001/40 and 4012/25 are encapsulated quarter-square multipliers designed for accurate, wide-bandwidth multiplication and division. Model 4001/40 requires two external amplifiers for four-quadrant operation; Model 4012/25 is encapsulated with the amplifiers internal. The following functions may be performed by the Model 4012/25: $-E_1 E_2/10$, $E_1 E_2/10$, $\pm 10 E_1/E_2$ for $E_2 > 0$, $\pm 10 E_1/E_2$ for $E_2 < 0$, $\pm (E_1^2/10) \text{ sign } E_1$, $\pm \sqrt{10 |E_1|} \text{ sign } E_1$. See page 19 for /16, /40, and /25 module dimensions.

MODEL	1661/16	1671/16	4001/40	4012/25
Accuracy, ⁽¹⁾ % f.s. typ. max.	± 1.0% ± 2.0%	± 0.15% ± 0.25%	± 0.15% ± 0.25%	± 0.15% ± 0.25%
Bandwidth, 1% abs. error 5° Phase Shift - 3 dB	2 kHz 5 kHz 50 kHz	50 kHz 100 kHz 1 MHz	50 kHz 100 kHz 1 MHz	50 kHz 250 kHz 1 MHz
Rated Input Input R, min	± 10 V 25 k Ω	± 10 V 2 k Ω	± 10 V 2 k Ω	± 10 V 2 k Ω
Rated Output	± 10 V ± 10 mA	± 10 V ± 20 mA	± 10 V ± 20 mA	± 10 V ± 10 mA
Output Drift, mV/°C, typ. max.	± 5 ± 10	± 1.5 ± 2.5	± 1 ± 2	± 2.5 ± 5.0
Quies. @ ± 15 V	± 60 mA	± 55 mA	± 45 mA	± 30 mA
Temp. Range, °C	-25/+85	-25/+85	-25/+85	-25/+85
Unit Price	\$ 595	\$ 735	\$ 495	\$ 695

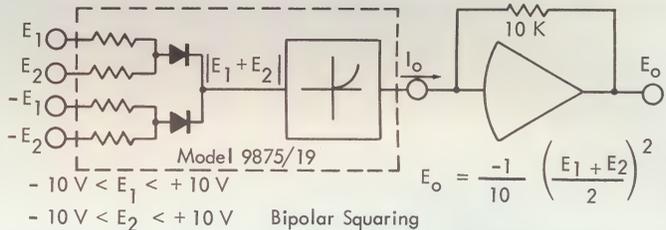
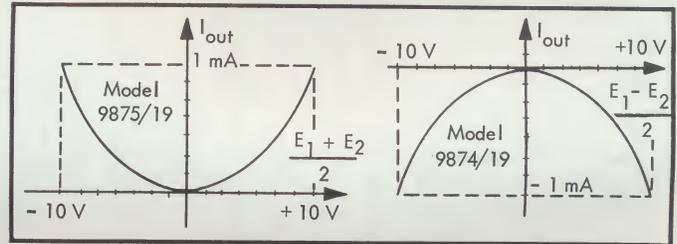
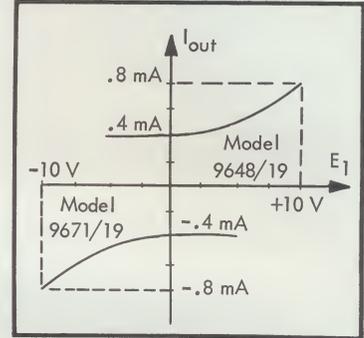
(1) Accuracy is inversely proportional to the magnitude of E_2 in the divide mode.

Contact your engineering representative listed on the back cover for detailed data sheets.

SQUARING MODULES

APPLICATIONS:

- RMS COMPUTATION
- SQUARE-ROOTING
- MULTIPLYING
- SQUARING



These encapsulated modules provide an output current proportional to the square of the input voltage. They can perform squaring and square-rooting when used with an operational amplifier. RMS computation, odd-value squaring, and multiplication can be accomplished by combining two or more units. Models 9874/19 and 9875/19 are two-quadrant squaring modules that may be used to square the sum or the difference of two input signals. Both positive and negative output units are available. See page 19 for /19 module dimensions.

MODEL	OUTPUT CURRENT, mA	
9648/19	$I_o = \frac{1}{25} \left(\frac{E_1^2}{10} + 10 \right)$	$0 < E_1 < +10 \text{ V}$
9671/19	$I_o = \frac{-1}{25} \left(\frac{E_1^2}{10} + 10 \right)$	$-10 \text{ V} < E_1 < 0$
9875/19	$I_o = \frac{1}{100} \left(\frac{E_1 + E_2}{2} \right)^2$	
9874/19	$I_o = \frac{-1}{100} \left(\frac{E_1 - E_2}{2} \right)^2$	

MODEL	9648/19	9671/19	9875/19	9874/19
Accuracy, ⁽¹⁾ max.	± 0.25%	± 0.25%	± 0.1%	± 0.1%
Bandwidth, ⁽²⁾	10 kHz	10 kHz	100 kHz	100 kHz
Input R, min.	5 k Ω	5 k Ω	5 k Ω	5 k Ω
Drift, % f.s./°C, max.	0.015	0.015	0.025	0.025
Quies. @ ± 15 V	± 17 mA	± 17 mA	± 3 mA	± 3 mA
Temp. Range, °C	-25/+85	-25/+85	0/+60	0/+60
Unit Price	\$ 145	\$ 145	\$ 195	\$ 195

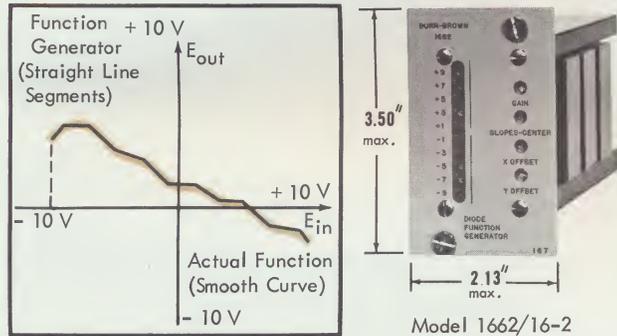
(1) Worst-case error from dc to 2 kHz.

(2) With an absolute error of 1% f.s. Includes both phase shift and amplitude error.

DIODE FUNCTION GENERATOR

APPLICATIONS:

- NONLINEAR GAIN CONTROL
- SIGNAL COMPRESSION
- LINEARIZING TRANSDUCER OUTPUTS
- WAVE SHAPING
- TRIGONOMETRIC FUNCTION APPROXIMATION



Diode function generators are used to provide arbitrary, nonlinear shaping of an input voltage. The Model 1662/16-2 fits nonlinear functions of an input voltage by eleven straight-line segments. Ten fixed breakpoints are equally spaced from -10 to +10 volts. Eleven slope controls are provided on the front panel for slope adjustment. The slope of each segment can be varied ± 2 V/V. X-offset and Y-offset controls are also included so that the X and Y axes may be shifted. An input buffer gain control permits reduction of the effective breakpoint spacing for input signals of less than 10 volts peak amplitude. The gain control and X-offset control may be employed to concentrate all of the breakpoints to the right or left of the Y-axis, therefore providing an 11 segment output function, for unipolar input signals. See page 19 for /16-2 module description.

MODEL	1662/16-2
Number of Segments	11
Slope Adjustment Range	± 2 V/V
Relative Breakpoint Spacing	1 V to 2 V
Frequency Responses, $\pm 1\%$	dc to 10 kHz
Input/Output Voltage Rating	± 10 V
Input R	10 k Ω
Output Stability	± 5 mV/ $^{\circ}$ C
Temperature Range	0 $^{\circ}$ to 50 $^{\circ}$ C
Quiescent @ ± 15 V	± 30 mA
Unit Price	\$ 625

ABSOLUTE VALUE CIRCUITS

Model 4004/16 is a rack-mounted unit that produces the instantaneous absolute value of the input signal. The unit may be used as a very precise full-wave rectifier over a ± 10 V range.

Model 1668/16 is a precision rectifier designed to convert ac input signals to a dc output. A multipolar active filter network is used to provide fast dc output response with low ripple.

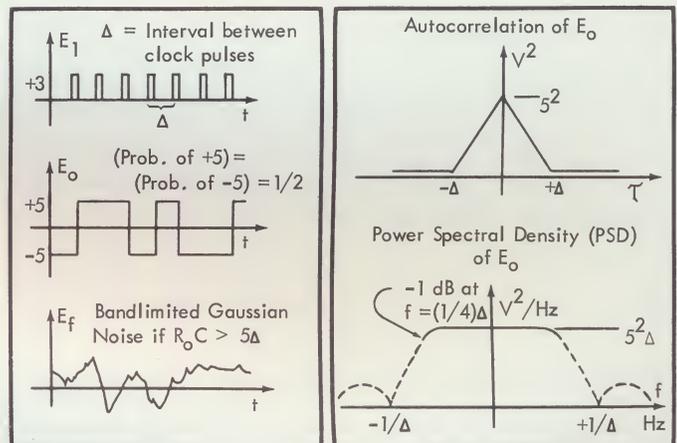
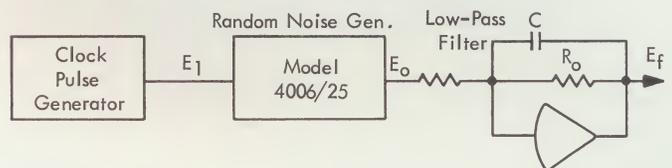
MODEL	4004/16	1668/16
Function	$E_o = E_1 $	$E_o = \text{Avg. } \frac{10}{3} E_1 $
Accuracy, (worst-case)	$\pm 0.25\%$	$\pm 1.0\%$
Accuracy, dc to 10 kHz	$\pm 1.0\%$	-
100 Hz to 10 kHz	-	$\pm 1\%$
10 Hz to 100 kHz	-	± 1 dB
Input Level, max	± 10 V	3.0 V, rms
Input R	5 k Ω	5 k Ω
Rated Output	± 10 V @ ± 10 mA	± 10 V @ ± 10 mA
Output Ripple at 10 Hz	-	1%
Quiescent @ ± 15 V	± 10 mA	± 15 mA
Temperature Range	0 $^{\circ}$ C to +60 $^{\circ}$ C	0 $^{\circ}$ C to +50 $^{\circ}$ C
Unit Price	\$ 165	\$ 295

RANDOM NOISE GENERATOR

APPLICATIONS:

- COMMUNICATIONS TESTING
- SERVO SYSTEM DESIGN
- VIBRATION TESTING
- SIGNAL GENERATOR FOR ANALOG COMPUTERS
- BIO-MEDICAL RESEARCH

The Model 4006/25 Noise Generator is useful as a general-purpose source of random test signals with precise spectral characteristics. It is a highly stable noise source that generates a random binary waveform with transitions occurring at a rate determined by an external clock signal. Its output is a ± 5 volt clocked random ("coin-toss") square wave. The clocking rate establishes the amplitude and upper-frequency limit of the noise spectrum. Low-pass and band-pass output filters may be added to obtain a gaussian-distributed noise source with precisely controlled rms level and spectrum shape. See page 19 for /25 module description.



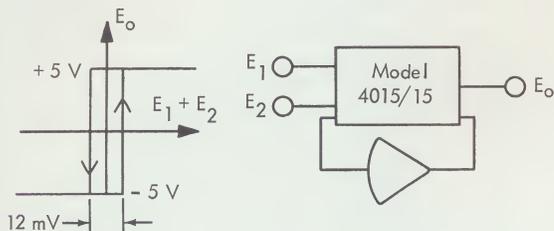
MODEL	4006/25
Output:	
Voltage Levels	+5 V and -5 V
Level Accuracy (1)	± 50 mV
Level Stability vs. Temperature vs. Load (0 to 20 mA) vs. Supply	± 2.5 mV/ $^{\circ}$ C ± 100 mV ± 2 mV/ $^{\circ}$
Rise Time	0.05 ms
Rated Output Current	± 20 mA
Average Voltage, max	± 0.2 V
Stability of Average, (worst-case)	± 6 mV/ $^{\circ}$ C
Clock Pulse Requirements (2)	
Input R	1 k Ω
Clock Frequency	dc to 1 MHz
Temperature Range	0 $^{\circ}$ C to 60 $^{\circ}$ C
Quiescent @ ± 15 V	+80 mA, -20 mA
Unit Price	\$ 295

- (1) An error of ± 50 mV in output level implies an error of only 2% in the amplitude of the autocorrelation function and in the amplitude of the power spectrum.
- (2) The clocking signal must be a periodic waveform. It must make a negative-going transition from a positive level of at least +1.2 V down to a level of less than +0.2 V. This transition time (fall time) must be less than 1 μ s. A pulse amplitude of +3 V is recommended, but amplitudes up to +12 V are satisfactory.

COMPARATORS

APPLICATIONS:

- A/D CONVERSION
- PULSE-HEIGHT DETECTOR
- ZERO-CROSSING DETECTORS
- SINE-TO-SQUARE WAVE CONVERSION



Model 4015/15 is a very fast analog comparator with high resolution and excellent noise immunity. This module is used with a Model 1510/25 operational amplifier, or equivalent, as shown above.

Model 9892/25 is an encapsulated unit that also is used in combination with a high-speed operational amplifier as shown above. This unit features an adaptive noise immunity capability. For slowly varying signals, the comparator will switch within ± 1 mV; for high-speed signals, the transition is initiated within ± 5 mV of the true zero-crossing point. Switching speed of the output transition is 200 n sec, virtually independent of the input signal rate-of-change (a square-wave input is not required to achieve this speed). For noise immunity the comparator adapts itself by introducing ± 15 mV hysteresis as the output changes state. For accurate comparison, this hysteresis is removed whenever the input sum exceeds ± 100 mV.

Model 4002/16 contains a Model 9892/25 comparator, a Model 1510/25 operational amplifier, and a voltage-offset potentiometer in a /16 rack-mount package. See page 19 for dimensions.

MODEL	9892/25	4002/16	4015/15
Summing Inputs	2	2	2
Input Signal Level, max	± 10 V	± 10 V	± 10 V
Input R (each input)	2 k Ω	2 k Ω	2 k Ω
Summing Accuracy	$\pm 0.1\%$	$\pm 0.1\%$	$\pm 0.1\%$
Switching Error (1)	± 1 mV	± 1 mV	± 1 mV
Input Drift	$\pm 50 \mu\text{V}/^\circ\text{C}$	$\pm 50 \mu\text{V}/^\circ\text{C}$	$\pm 50 \mu\text{V}/^\circ\text{C}$
Switching Time (2) max	0.3 μs	0.3 μs	0.2 μs
Hysteresis	(3)	(3)	± 6 mV
Output Level ($E_1 + E_2 > 0$)	+5 V	+5 V	+5 V
($E_1 + E_2 < 0$)	-5 V	-5 V	-5 V
Output Current	± 20 mA	± 20 mA	± 20 mA
Quiescent @ ± 15 V	± 5 mA	± 20 mA	± 15 mA
Temperature Range, $^\circ\text{C}$	0/+60	0/+60	0/+60
Unit Price	\$ 95	\$ 215	\$ 95

- (1) Static zero-crossing error; adjustable to zero by balancing the operational amplifier.
- (2) Total switching time; includes delay time and rise time.
- (3) Hysteresis is zero or ± 15 mV depending on the input signal characteristics. See text above for description of adaptive hysteresis.

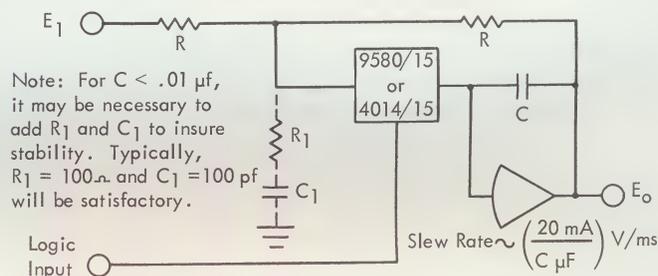
SOLID-STATE SWITCHES

APPLICATIONS:

- SAMPLE/HOLD
- INTEGRATOR MODE CONTROL
- PULSE-CODE DEMODULATION
- PEAK DETECTION ● MULTIPLEXING

These encapsulated electronic modules are designed to operate into operational amplifier summing junctions as current switches. The input signal must be from a resistive source. Models 4014/15 and 9580/15 are switched current amplifiers for use in very fast SAMPLE/HOLD circuits. The high output current in the ON state and low offset current in the OFF state provide a minimum ON/OFF ratio of 2×10^8 .

Model 9859/15 is a general-purpose FET electronic switch for multiplexers, integrator mode control circuits, and gating applications. While somewhat slower than the other switches, it has zero ON state offset and is ideal for low-frequency applications.



Note: For $C < .01 \mu\text{f}$, it may be necessary to add R_1 and C_1 to insure stability. Typically, $R_1 = 100 \Omega$ and $C_1 = 100 \text{ pf}$ will be satisfactory.

MODEL	9859/15	9580/15	4014/15
Current Gain, min	1	1000	20,000
Switching Times (1) - ON	3 μs	0.4 μs	0.2 μs
- OFF	5 μs	0.2 μs	0.05 μs
Input R	(5)	50 k Ω	$10^{11} \Omega$
Output R	(5)	15 Ω	0.1 Ω
Output Current Rating	± 1 mA	± 20 mA	± 20 mA
ON-State Offsets			
Input Voltage (2), max	(5)	± 30 mV	± 2 mV
Input Current, max	(5)	± 300 nA	± 0.1 nA
OFF-State Output Offsets, max	(5)	± 0.1 nA	± 0.1 nA
Stability (ON) vs. Temperature	(5)	$\pm 100 \mu\text{V}/^\circ\text{C}$ $\pm 10 \text{ nA}/^\circ\text{C}$	$\pm 50 \mu\text{V}/^\circ\text{C}$ (3)
vs. Supply	(5)	$\pm 200 \mu\text{V}/\%$	$\pm 100 \mu\text{V}/\%$
Offset Charge (turn OFF)	± 10 pC	± 50 pC	± 50 pC
Logic Levels (4)			
ON State	+5 V	0	+3 V
OFF State	0	+5 V	0
Noise Immunity	0.5 V	0.5 V	0.5 V
Switch Input R	22 k Ω	22 k Ω	10 k Ω
Temp. Range, $^\circ\text{C}$	-25/+85	0/+60	0/+60
Quiescent @ ± 15 V	± 11 mA	± 15 mA	± 20 mA
Unit Price	\$ 75	\$ 75	\$ 95

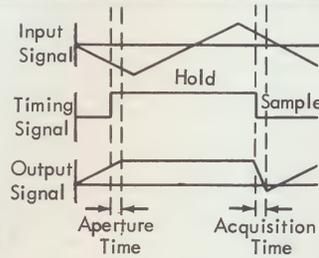
NOTES:

- (1) Driven with 40 n sec rise-time square wave (slower rates may be used).
- (2) May be adjusted to near zero by using a balance potentiometer.
- (3) Doubles every 10°C . Typically less than 0.7 nA at 60°C .
- (4) Other logic levels are available on request.
- (5) Passive resistance — 100 Ω in ON state and $10^{12} \Omega$ in OFF state. Drift is $0.25 \text{ nA}/^\circ\text{C}$.

SAMPLE/HOLD MODULES

APPLICATIONS:

- A/D CONVERSION
- MULTIPLEXING
- TIME DELAY
- HYBRID COMPUTERS
- PULSE-SAMPLE DEMODULATION



Sample and Hold (or Track and Store) modules follow a time-varying analog input signal and hold or store the value of the signal at a precisely controlled point in time. Aperture time specifies the time between a HOLD command and completion of the transition to hold. Acquisition time specifies the time to acquire an input for the worst-case condition of a 20-volt transition and settle to 0.1% of final value. Acquisition time determines maximum sampling rate; aperture time determines the accuracy in tracking fast signals. The units may also be used as switched integrators; i.e., will integrate for a specified time and reset to an initial condition on command.

Model 1666/16, 1663/16, and 1673/16 are rack-mounted units with the summing resistors and holding capacitor self-contained. Model 4013/25 is an encapsulated unit with the integrator input resistors and holding capacitor external. Model 4013/25 may be ordered with the capacitor internal for $C < .01 \mu\text{f}$, if desired. For detailed specifications contact your engineering representative listed on the back cover.

MODEL	1666/16	1663/16	1673/16	4013/25
SAMPLE/HOLD MODE				
Accuracy, %f.s.	±0.1%	±0.1%	±0.1%	±0.1%
Full Power Response, kHz	3	40	500	0.4/C ⁽¹⁾
Input R	10 k.Ω	2 k.Ω	1 k.Ω	10 k.Ω
Aperture Time, μ sec (max)	0.4	0.1	0.1	0.1
Acquisition Time, μ sec (max)	100	10	3	10 + 1000C ⁽¹⁾
HOLD Mode Decay, V/sec	±0.002	±0.1	±0.1	±0.0001/C ⁽¹⁾
Output Drift (mV/°C)				
HOLD (for 1 sec)	± 2.0	± 100	± 100	±0.2/C
TRACK	±0.2	±0.1	±0.1	±0.1
SWITCHED INTEGRATOR MODE (INTEGRATE/RESET)				
Input R - Input 1	100 k.Ω	10 k.Ω	—	Adj.
- Input 2	1 M.Ω	100 k.Ω	—	Adj.
Integrator Gain (Inverting)				
- Input 1	100	10 ⁴	—	1/R ₁ C ⁽¹⁾
- Input 2	10	10 ³	—	1/R ₂ C ⁽¹⁾
Gain Accuracy	± 1%	±0.25%	—	(1)
ALL MODES				
Rated Input - Volts	±10 V	±10 V	±10 V	±10 V
Rated Output - Volts	±10 V	±10 V	±10 V	±10 V
- Current	±20 mA	±20 mA	±20 mA	±20 mA
Switch Logic Levels (Other logic levels available upon request)				
TRACK (RESET)	0 V	-6 V	-6 V	+3 V
HOLD (COMPUTE)	+5 V	0 V	0 V	0 V
Rise Time, max	100 ns	40 ns	40 ns	1 μs
Quiescent @ ± 15 V	±20 mA	±35 mA	±35 mA	±35 mA
Temp. Range, °C	0/+60	0/+60	0/+60	0/+60
Unit Price	\$275	\$335	\$395	\$225

(1) Several performance factors are dependent on the size of the holding capacitor C. Capacitor C has the units of μF's in the table - choose its size to optimize performance in your application. External C must be 0.01μF or larger. For C < 0.01μF, consult our applications engineers.

THREE-MODE INTEGRATOR

APPLICATIONS:

- REP-OP COMPUTERS
- HYBRID COMPUTERS
- PROCESS CONTROL
- SIGNAL AVERAGING

The Model 4003/16 features electronic switching on external digital command into one of three operating modes:

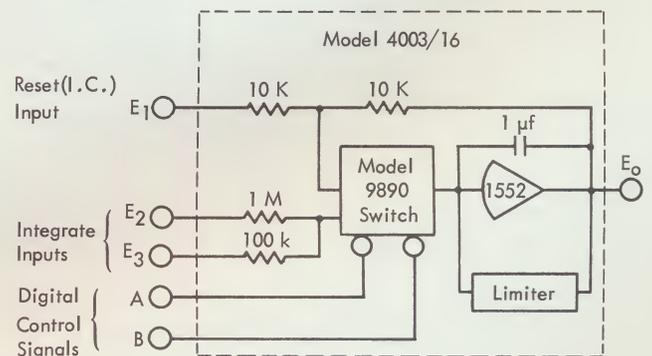
	RESET	INTEGRATE	HOLD
Control Signal A	0 V	+5 V	+5 V
Control Signal B	0 V	0 V	+5 V

Other logic levels are available on special order. Two different integrate inputs are available for summing or time scaling flexibility. In the INTEGRATE mode:

$$E_o = - (E_1)_{t=0} - \int_0^t (E_2 + 10 E_3) dt$$

In the RESET mode the unit acquires an external initial condition voltage (E₁) in the ± 10 V range within one millisecond. Balance control and output voltage limiting is internal. For detailed specifications, contact your engineering representative.

MODEL	4003/16
Integrator Gain Accuracy, % f.s.	±0.25% (worst-case)
Gain - Input E ₂	1 V/sec
- Input E ₃	10 V/sec
Reset Gain Accuracy, % f.s.	±0.5% (worst-case)
Reset Time	1 m sec (worst-case)
Rated Output	±10 V at ±10 mA
Rate Limit	±30 V/m sec
Control Signal A - RESET	0 V
- INTEGRATE/HOLD	+5 V
Control Signal B - RESET/INTEGRATE	0 V
- HOLD	+5 V
Output Stability	±1 mV/sec (worst-case)
Quiescent @ ±15 V	±40 mA
Temperature Range	0° to +60° C
Unit Price	\$ 295



THREE-MODE SWITCH

The Model 9890/25 is the encapsulated electronic switch module used in the Model 4003/16 Three-Mode Integrator. Model 9890/25 is a combination of the Model 9580/15 and 9859/15 (page 12) with interconnecting logic to provide RESET/INTEGRATE/HOLD capability. Model 9890/25 is available at a unit price of \$125.

LOGARITHMIC AMPLIFIERS

APPLICATIONS:

- SIGNAL COMPRESSION
- MULTIPLICATION
- DIVISION
- CUBING OF VARIABLES
- PROCESS SIMULATION



Carefully matched silicon transistors are employed to obtain the linear-to-log conversion, and special temperature-sensitive resistors are used to aid in temperature compensating the units. As a result, exceptionally low-output drifts are achieved. Both gain and offset are stable with temperature.

MODEL	OUTPUT FUNCTION	
1664/16	$E_o = -10 \log_{10} E_1$	$+0.1 \leq E_1 \leq +10 \text{ V}$
1674/16	$E_o = -\frac{20}{3} \log_{10} (\sqrt{10} E_1)$	$+0.01 \leq E_1 \leq +10 \text{ V}$
1665/16	$E_o = -10 \log_{10} (E_1/E_2)$	$+0.1 < (E_1/E_2) < +10 \text{ V}$
1667/16	$E_o = \text{Antilog}_{10} \left(-\frac{E_1}{10} \right)$	$-10 < E_1 < +10 \text{ V}$
4007/40	$E_o = -10 \log_{10} E_1$	$+0.1 < E_1 < +10 \text{ V}$
4008/40	$E_o = -\frac{20}{3} \log_{10} (\sqrt{10} E_1)$	$+0.01 < E_1 < +10 \text{ V}$

See page 19 for /16 and /40 module description.

ENCAPSULATED LOG AMPLIFIERS

MODEL	4007/40	4008/40
Function	40 dB Log	60 dB Log
Accuracy ⁽¹⁾	± 2.0%	± 2.0%
Bandwidth (± 1 dB)	5 kHz	2.5 kHz
Input R	10 k Ω	10 k Ω
Rated Output - Volts	± 10 V	± 10 V
- Current	± 10 mA	± 10 mA
Output Stability vs. Temperature	5 mV/°C	5 mV/°C
vs. Supply	100 mV/%	100 mV/%
Temperature Range, °C	0/+60	0/+60
Unit Price	\$ 275	\$ 275

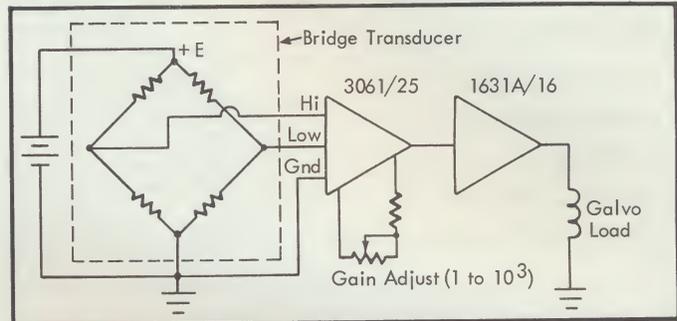
RACK-MOUNTING LOG AMPLIFIERS

MODEL	1664/16	1674/16	1665/16	1667/16
Function	40 dB Log	60 dB Log	40 dB Log Ratio	40 dB Antilog
Accuracy ⁽¹⁾	± 1.0%	± 1.0%	± 1.0%	± 1.0%
Bandwidth (± 1 dB)	10 kHz	5 kHz	5 kHz	10 kHz
Input R	10 k Ω	10 k Ω	10 k Ω	100 k Ω
Rated Output - Volts	± 10 V	± 10 V	± 10 V	+0.1 to +10
- Current	± 20 mA	± 20 mA	± 20 mA	± 20 mA
Output Stability vs. Temperature, mV/°C	5	5	10	10
vs. Supply, mV/%	100	100	100	100
Temperature Range, °C	0/+60	0/+60	0/+60	0/+60
Unit Price	\$ 295	\$ 295	\$ 365	\$ 295

(1) Worst case, % of full scale.

Quiescent current is ± 15 mA for all units with rated supply of ± 15 V.

INSTRUMENTATION AMPLIFIERS



Model 1505B/15 is an encapsulated differential-input amplifier featuring high input-impedance independent of gain. The gain of Model 1505B/15 is set by an external feedback network of four resistors. Directions for setting the gain, balancing the amplifier, and for adjusting the common-mode rejection are supplied with each unit. The small size of this encapsulated unit allows the user to place it near the physical location of the transducer, thereby reducing noise pickup.

Model 3061/25 is an encapsulated differential-input amplifier with exceptionally low drift and low output noise. The gain is adjustable from 1 to 1000 by only one external resistor. An output sensing point is also included on this unit. This module may also be placed near the transducer bridge to avoid noise-pickup problems. Output offset is continuously adjustable over the total output range for zero-suppression purposes.

Model 1631A/16 is a rack-mounted unit designed to drive a fluid-damped optical galvanometer or other recording equipment. Gain is continuously adjustable from 1 to 11 with a 10-turn potentiometer. Standoffs are provided for series and shunt damping resistors. Output offset is adjustable over the full output voltage range.

Models 1505B/15 and 3061/25 are also available as rack-mounted units with factory-set gain. Contact your engineering representative listed on the back cover for detailed specifications. See page 19 for description of /15, /25, and /16 modules.

MODEL	1505B/15	3061/25	1631A/16
Input R-			
Differential	10 ¹¹ Ω	10 ⁸ Ω	11 k Ω
Common Mode	10 ¹¹ Ω	10 ⁸ Ω	---
Voltage Gain	10 to 10 ³	1 to 10 ³	1 to 11
Gain Accuracy	(1)	(1)	(1)
Static Linearity, Worst Case	± 0.1%	± 0.1%	± 0.1%
Common Mode Inputs, max.	± 5 V	± 11 V	---
CMRR, dc to 100 Hz, min.			
Balanced Source	80 dB ⁽²⁾	80 dB ⁽²⁾	---
10 k Ω Source Unbalance	60 dB ⁽²⁾	60 dB ⁽²⁾	---
Frequency Response ⁽³⁾			
± 1% Accuracy	10 kHz	5 kHz	25 kHz
± 3 dB	50 kHz	30 kHz	---
Rated Output - Volts	± 10 V	± 10 V	± 10 V
- Current	± 20 mA	± 10 mA	± 80 mA
Output Impedance	5 Ω	5 Ω	1 Ω
Rated Capacitance Load	1000 pF	1000 pF	1000 pF
Output Stability at Max. Gain vs. Temperature ⁽⁴⁾ , mV/°C, max	± 10	± 3	± 1
vs. Supply, mV/%	± 50	± 5	± 1
Output Noise at Max. Gain (dc to 10 kHz)	± 20 mVrms	± 3 mVrms	± 1 mVrms
Quiescent @ ± 15 V	± 6 mA	± 10 mA	± 25 mA
Temperature Range, °C	-25/+85	-25/+85	0/+60
Unit Price	\$ 75	\$ 125	\$ 195

(1) Adjustable to any desired accuracy (4-resistor network for 1505B/15, 1 resistor for 3061/25).

(2) Adjustable to over 100 dB by means of an external potentiometer.

(3) At gain of 100 for Models 1505B/15 and 3061/25 and 11 for Model 1631A/16.

(4) The drift is correspondingly less for lower gain.

ACTIVE FILTERS

ACTIVE FILTER MODULES

These low-pass active RC networks employ Burr-Brown's high performance DC operational amplifiers in unique combination with quality passive elements.

By employing the operational amplifier as the foundation of an active filter Burr-Brown can use its experience and knowledge in the amplifier field to optimize your filter designs. Burr-Brown offered the industry's first solid-state operational amplifier. Now, it is first to offer the combination of operational amplifiers and passive elements to fulfill your active filter requirements.

Whether you specify low-pass, high-pass, band-pass, or band-rejection, Burr-Brown active filters provide:

- STABLE CUTOFF FREQUENCY
- LOW OUTPUT IMPEDANCE
- HIGH INPUT IMPEDANCE
- DC STABILITY
- SMALL, LIGHT-WEIGHT MODULES
- INVERTING OR NON-INVERTING GAIN

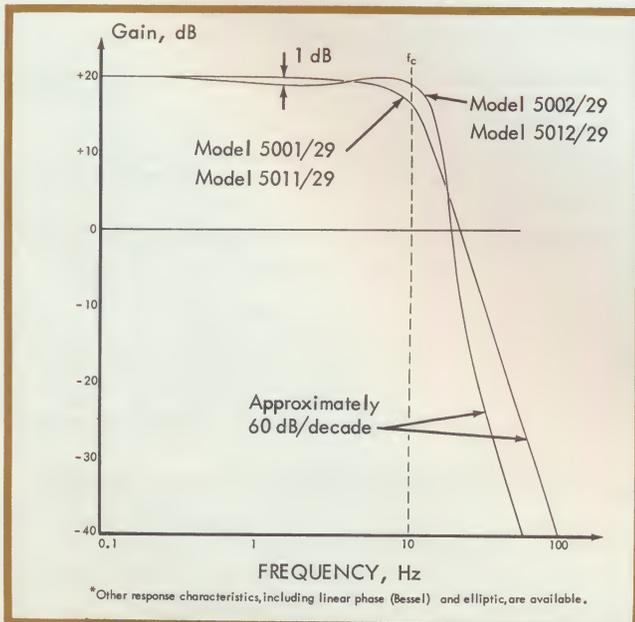
Models 5001/29 (inverting) 5011/29 (non-inverting)

These low-pass active filter modules provide maximally-flat response (Butterworth) with 60 dB per decade rolloff above the 3 dB frequency (f_c). Fixed bandpass gain and fixed cutoff frequency (f_c) may be specified within the wide ranges indicated. Because of the high input impedance (more than 10 k Ω), the low output impedance (less than 10 Ω), and the gain (± 0.5 to ± 200 V/V), these units can function both as filters and amplifiers in your circuit designs.

Models 5002/29 (inverting) 5012/29 (non-inverting)

These low-pass active filter modules provide equal ripple response (Tchebyscheff). The initial rolloff rate is increased as the specified maximum ripple is increased. Cutoff frequency (f_c) is defined as the point on the frequency response curve at which the response is down by the amount of the allowable ripple; that is, 1 dB down for a 1 dB maximum ripple filter.

TYPICAL FREQUENCY RESPONSE*



ACTIVE FILTERS

Description	BUTTERWORTH RESPONSE	TCHEBYSCHIEFF RESPONSE	SPECIAL RESPONSE
Models	Model 5001/29 (inverting) Model 5011/29 (non-inverting)	Model 5002/29 (inverting) Model 5012/29 (non-inverting)	Custom
Type	Low Pass	Low Pass	LP, HP, BP, BR
No. of Poles	3	3	2 to 7
Characteristic	Max. Flat	Equal Ripple	As Required
Pass Band Gain	-6 dB to +46 dB	-6 dB to +46 dB	-20 dB to +60 dB
Cutoff Frequency (f_c)	5 Hz to 20 kHz	5 Hz to 20 kHz	0.1 Hz to 100 kHz
Frequency Stability	$\pm 0.05\%/^{\circ}\text{C}$	$\pm 0.05\%/^{\circ}\text{C}$	± 0.01 to $1\%/^{\circ}\text{C}$
Roll off Rate	60 dB/decade	≈ 60 dB/decade	40 to 140 dB/dec.
Maximum Ripple	± 0.1 dB	± 0.5 to ± 3 dB	± 0.1 to ± 3 dB
Input	Single Ended	Single Ended	Single Ended
Input Impedance	10 k Ω	10 k Ω	1 k Ω to 10 M Ω
Output Offset	Ext. Adj. to 0	Ext. Adj. to 0	Ext. Adj. to 0
Output Swing at Output Current	± 10 V ± 10 mA	± 10 V ± 10 mA	± 4 V to ± 100 V ± 1 mA to ± 50 mA
Rated Power Supply Range	± 15 V ± 12 V to ± 18 V	± 15 V ± 12 V to ± 18 V	± 6 V to ± 120 V As Required
Quies. Current	± 10 mA	± 10 mA	As Required
Operating Temperature	-25°C to $+85^{\circ}\text{C}$	-25°C to $+85^{\circ}\text{C}$	Submit your requirements for a special quotation
Module Type	/29	/29	
Unit Price (U.S.)	\$175.00	\$195.00	

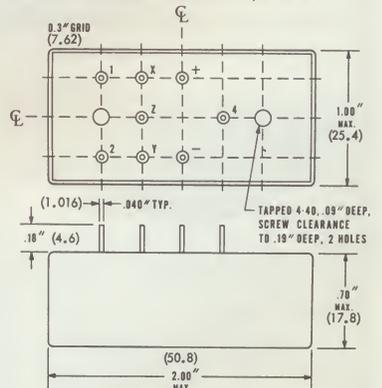
SPECIAL ORDER Active Filters

Active filters for low-pass, high-pass, band-pass, and band-rejection applications are all available from Burr-Brown. During the past ten years, but particularly since we "wrote the book" on Operational Amplifier Active RC Networks, Burr-Brown has designed and produced a wide range of industrial and military active filters. The above chart lists ranges of performance typical of those currently feasible in active filters. Our applications staff is uniquely qualified to discuss your particular requirements.

ORDERING INFORMATION

- When ordering any Burr-Brown active filter, be sure to specify:
- REQUIREMENT
Low-Pass, Band-Pass, High-Pass, Band-Rejection
 - RESPONSE
Butterworth, Tchebyscheff, linear phase (Bessel), elliptic, etc.
 - CUTOFF FREQUENCIES
 - PASS BAND GAIN
 - MAXIMUM RIPPLE
(For Tchebyscheff Filters)

Dimensions in millimeters are shown in parentheses.



/29 MODULE

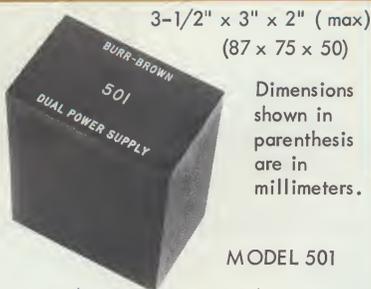
Connector - 1500MC
Weight - 1.5 oz typ. (43 grams)

POWER SUPPLIES AND REGULATORS

Typical performance at 25°C unless otherwise specified.

POWER SUPPLIES

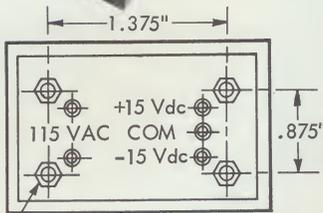
- $\pm 0.1\%$ regulation vs. line (105 to 125 and 210 to 250 Vac) or load (no load to full load).
- Low dynamic output impedance (typically 0.1Ω at 10 kHz and 1.0Ω at 100 kHz).
- 0.5 mV, rms noise and ripple on all ± 15 V units, less than 3.0 mV, rms on all other units.
- Short-circuit protected by current-limiting circuit.
- 47 Hz to 420 Hz line frequency.
- Wide stability margins, all units are stable regardless of external capacitive loading.
- Epoxy cast units available with 115 Vac or 230 Vac input, all others have integral switch for 115 Vac or 230 Vac operation.
- Wide temperature range (-40° C to $+85^\circ$ C for epoxy units, -40° C to $+71^\circ$ C for all others).



3-1/2" x 3" x 2" (max)
(87 x 75 x 50)

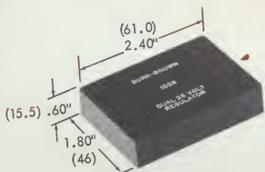
Dimensions shown in parenthesis are in millimeters.

MODEL 501



Tapped 6-32, .09" Deep, Screw Clearance to .25" Deep, 4 Holes.

MODEL 1526/25



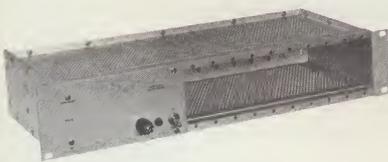
Dimensions - (max)

5" x 3" x 12" (max)
(125 x 60 x 300)



MODEL 503A

3-1/2" x 19" x 9-1/2" (max)
(90 x 475 x 250)



MODEL 508/16



MODELS 2600-16R and 508/26

Dimensions: (max)

Models 506/26 and 507/26
3-3/8" x 4-1/4" x 9"
(86 x 108 x 230)

Models 508/26 and 509/26
3-3/8" x 6-3/8" x 9"
(86 x 160 x 230)

DESCRIPTION	MODEL	RATED OUTPUT		OUTPUT VOLTAGE ACCURACY % max	OUTPUT TEMP. STABILITY %/°C	UNIT PRICE U.S. \$
		Vdc	mA			
Epoxy Cast Modules: Chassis mount with solder lugs. 3-1/2" x 3" x 2"						
For 115 Vac line	501	± 15	± 120	± 0.5	± 0.005	148
For 230 Vac line	521	± 15	± 120	± 0.5	± 0.005	148
For 115 Vac line	505	± 26	± 60	± 0.5	± 0.005	148
For 230 Vac line	525	± 26	± 60	± 0.5	± 0.005	148
Plug-in Modules: Mount with modules in 2600-16R rack adapter.						
Four modules wide	506/26	± 15	± 1000	± 0.3	± 0.005	280
Four modules wide	507/26	± 26	± 600	± 0.3	± 0.005	320
Six modules wide	508/26	± 60	± 500	± 0.3	± 0.003	420
Six modules wide	509/26	± 120	± 250	± 0.3	± 0.003	420
Powered Rack Adapters: Houses /16 amplifier modules for 19" rack mounting. 3-1/2" x 19" x 9-1/2"						
Mounts 12 modules	506/16	± 15	± 1000	± 0.3	± 0.005	340
Mounts 12 modules	507/16	± 26	± 600	± 0.3	± 0.005	380
Mounts 10 modules	508/16	± 60	± 500	± 0.3	± 0.003	480
Mounts 10 modules	509/16	± 120	± 250	± 0.3	± 0.003	480
Bench Supply: Provides five way binding posts for bench use.						
Fixed output voltages	503A	± 15	± 1000	± 0.3	± 0.005	280

DUAL REGULATORS

Dual regulator modules provide $\pm 0.1\%$ regulation (line and load) to power operational amplifiers and analog modules from a center tapped unregulated source. Output noise of $10 \mu\text{V}$, rms and stability of $\pm .02\%/^\circ\text{C}$ from -25°C to $+85^\circ\text{C}$ are features. Basic module type is /25. Connector is 1500MC-1.

MODEL	DC RATED OUTPUT		DC INPUT VOLTAGE			UNIT PRICE U.S. \$
	Volts	mA	min	nominal	max	
	nominal	min				
1515/25	± 15	± 100	± 20	± 26	± 32	95
1526/25	± 26	± 60	± 30	± 38	± 45	98



Burr-Brown's new "Jet Stock" program provides immediate or overnight replenishment of your local representative's inventory of many of the popular operational amplifiers, connectors and accessories for your prototype design needs. Your order is shipped immediately from your local Representative's office. Call your nearest Representative today!

CONNECTORS AND ACCESSORIES

FOR /01 MODULES

MATING CONNECTOR accommodates all monolithic integrated circuit amplifiers. Barnes MF-15-8B: \$5

FOR /15, /15C, /25, /29 and /40 MODULES

MATING CONNECTOR (as shown) accommodates all these operational amplifiers for plug-in installation or test. Model 1500MC: \$3

MATING CONNECTOR is similar to the 1500MC for mounting dual regulators. Model 1500MC-1: \$3

MATING CONNECTOR for encapsulated multipliers is similar to the 1500MC. Order Model 1500MC-4: \$3

FEEDBACK BOARD provides solder terminals for feedback components. Model 1500FB: \$10

CIRCUIT SIMULATOR (as shown) is a patch panel with 3/4" spaced jacks for feedback elements. Includes offset control. Accommodates all operational amplifiers and adapters having standard 8-pin configuration. Model 1500CS: \$25

FOR /17 MODULES

MATING CONNECTOR (as shown) accommodates all /17 modules for plug-in installation. Model 1700MC: \$3

ADAPTER PLUGS allow use of /17 units on 1500CS Circuit Simulator. Model 1700AP (for Model 1701): \$6. Model 1700AP-1 (for all other /17 units): \$6

FOR /19 MODULES

MATING CONNECTOR (as shown) accommodates all /19 operational amplifiers. Model 1900MC: \$3. For Model 9874 and 9875 squaring modules use the Model 1900MC-1: \$3

ADAPTER PLUG allows use of 1500CS Circuit Simulator. Model 1900AP: \$6

FOR /16 MODULES

RACK ADAPTER holds 16 units in a 3-1/2" x 19" rack space. Model 1600-16R: \$80

WIRED RACK ADAPTER is identical to the 1600-16R but includes mating connectors and power bus wire. Model 1600-16RW: \$100

HALF RACK ADAPTER holds 7 units in a 3-1/2" x 9-1/2" rack space. Model 1600-7R: \$50

POWERED RACK ADAPTER - See Power Supplies, 506/16, 507/16, 508/16, 509/16.

MATING CONNECTOR (Burdby EC4206P5) is furnished with unit. Extra connectors: \$2

BLANK PANEL provides uniform appearance of the rack. Model 1600 BP: \$2

CARD EXTENDER allows testing without disconnecting unit from rack. Model 1600CE: \$30

BLANK MODULE is the same enclosure as the /16 module. Terminals for each pin are mounted next to the connector on the printed circuit board. Model 1600M: \$25

FOR /16-2 MODULES

BLANK MODULE is similar to the /16 with the exception of double width. Model 1600M-2: \$35

MATING CONNECTOR same as /16 is furnished with unit. Extra connectors: \$2

FOR /26 MODULES

RACK ADAPTER holds 16 units in 3-1/2" x 19" rack space. Model 2600-16R: \$80

MATING CONNECTOR (Amphenol 143-012-01) is furnished with unit. Extra connectors: \$2

BLANK MODULE is the same enclosure as the /26 module. Terminals for each pin are mounted next to the connector on the printed circuit board. Model 2600M: \$25



MODEL 1700MC
ASSEMBLED



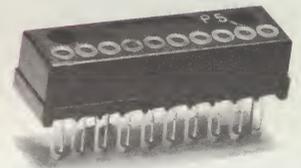
MODEL 1700MC



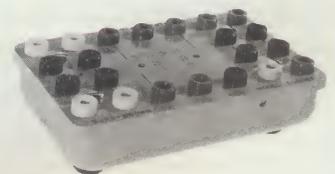
MODEL 1900MC



MODEL 1500MC



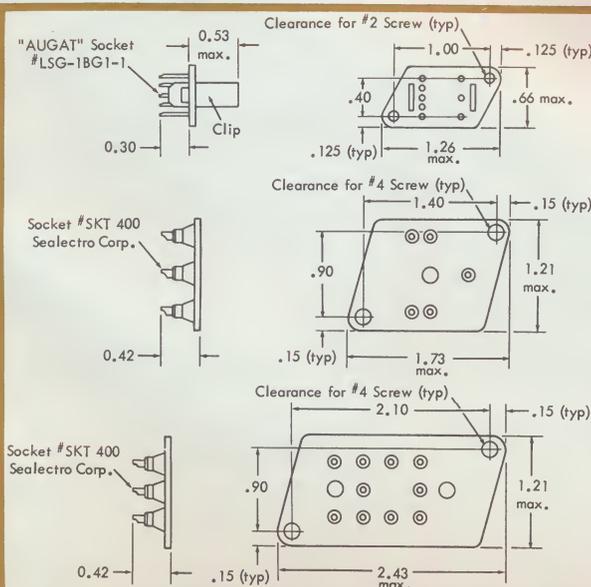
BURNDY EC4206P5



MODEL 1500CS

POWER SUPPLIES AND CONNECTORS

WITH ONE OF THESE POWER SUPPLIES AND THE RIGHT CONNECTOR, YOU CAN PLUG IN YOUR AMPLIFIER OR FUNCTION MODULE THE DAY IT ARRIVES.



1700MC

MATERIAL: .062 Thick Black Formica
GRADE: LE or Equivalent
SOCKET CONTACTS:
Beryllium Copper
Gold Flash Over Nickel

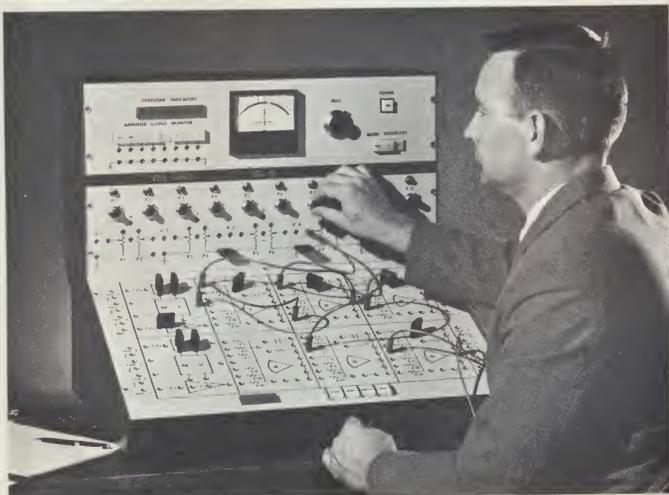
1900MC

MATERIAL: .062 Aluminum Alloy 6061
FINISH: Hard Black Anodize
SOCKET CONTACTS:
Beryllium Copper
Gold Flash Over Silver

1500MC

MATERIAL: .062 Aluminum Alloy 6061
FINISH: Hard Black Anodize
SOCKET CONTACTS:
Beryllium Copper
Gold Flash Over Silver

All dimensions shown in inches.

BB

EDUCATIONAL ANALOG SIMULATOR

The Model 600 Educational Analog Simulator is specifically designed for teaching. A proven aid for teaching computer familiarity, analog techniques, systems design and analysis, and mathematics, the simulator is equally at home in the university and industrial laboratory.

In the universities, the Model 600 Simulator is being used in classroom demonstrations as well as laboratory courses to enhance understanding of difficult theoretical concepts and student experience in analog computing techniques. The large fixed patch field and economical price promote efficiency in student grasp per hour per dollar. The ease of use and meaningful results provide real motivation for the students as evidenced by their initiative in pursuing additional problems and verifying their own theories. High school seniors with little or no knowledge of either calculus or electronics have successfully mastered the Model 600. The Model 600 is truly a versatile educational instrument.

In industry, the Model 600 can be used to train engineers and technicians in analog techniques, thus freeing larger, more complex computers for design and analysis. The Model 600 can be used to solve smaller design problems, to check portions of larger problems before going to a large computer, and, by slaving several Model 600 simulators, to handle entire programs. The desk-top size of this instrument permits easy movement from office to laboratory to test stand where actual systems or system components can be included in the computer loop.

A wide range of meaningful linear and nonlinear problems can be solved with the complement of computing elements provided. Complete with 10 amplifiers, 2 multipliers, 10 coefficient potentiometers, reference voltages, and a null system, the ± 10 Volt Model 600 employs components and computing elements of better than 1% accuracy. Terminals are provided for external components to further expand the computing capability. Repetitive operation (REP OP) with solution rates of up to 100 solution per second is available.

The software available includes an Operator's Handbook, a Maintenance Manual, and a Student Laboratory Manual containing 40 experiments. Accessories including X-Y Recorder and Patch Kit are also offered.

For a copy of our 12 page brochure or a demonstration of the Model 600 contact your nearest representative today.

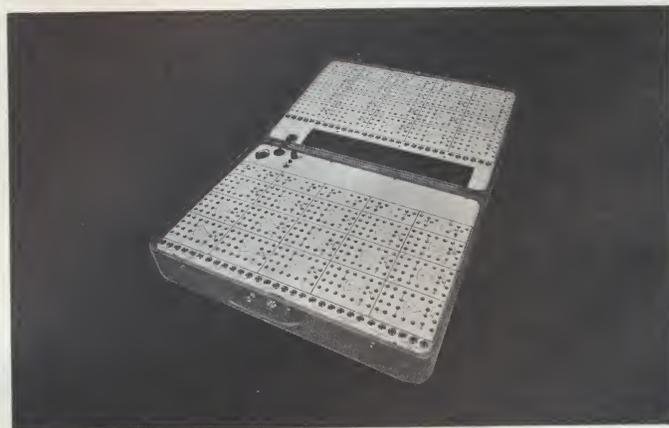


GEOPHYSICAL INSTRUMENTS

Induced polarization instruments for field exploration and laboratory modeling in the Earth Sciences are the result of our five years of design and development at Burr-Brown. Widely used for the detection of disseminated mineralization associated with porphyry coppers, induced polarization has become the principal geophysical method employed in mineral exploration.

Standard products offered include: a transmitter capable of delivering up to 600 Volt-Amperes at four selectable frequencies from 0.05 to 5Hz; a receiver capable of reading voltages from 1 mV to 100 V full scale with selectable filtering in the range of 0.05 to 20 Hz; a precision square wave generator/voltage source for calibration of induced polarization receivers or for use as a laboratory reference; and a constant current pulse generator/receiver for laboratory or field measurements on rock samples.

For an 8 page brochure on Burr-Brown Induced Polarization Instruments, contact the Tucson office.



SPECIAL PURPOSE ANALOG COMPUTERS

Special Purpose Analog Computers for process control and instrumentation can be furnished in desk top, suitcase, or rack mounting configurations. The range of catalog and custom analog and hybrid modules available at Burr-Brown provide a broad and versatile base for the design and production of customer computers. Contact your nearest Burr-Brown representative for an economical hardware solution to your special requirements.

MECHANICAL SPECIFICATIONS

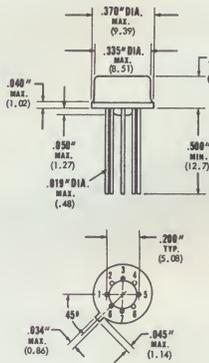
The /15, /17, /19, /25, /29, and /40 epoxy cast modules may be secured to a printed circuit board or chassis with 4-40 machine screws (or locking clip for the /17 module). The gold-flashed pins may be hand or dip soldered or plugged into an optional mating connector.

The /49 module is the same as /40 module except .70" max (17.8). The /13, /16, and /26 plug-in units are furnished with internal control and mating connectors. Up to 16 of the /16 or /26 modules may be mounted in a 3-1/2" x 19" rack adapter.

The /01 module is a standard TO-99 can (low profile TO-5) with kovar pins which may be soldered or welded for installation.

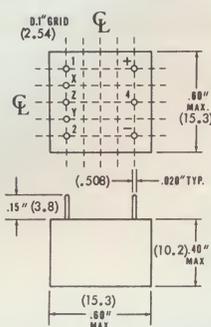
Pin locations are typical. Detailed pin configurations are contained in product data sheets which are available upon request.

NOTE: Dimensions in millimeters and weights in grams are shown in parentheses.



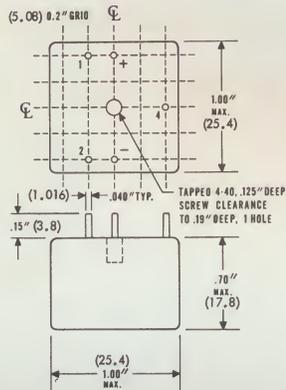
/01 MODULE

Connector-Barnes-MF-15-8B
Weight - 0.04 oz. typ.
(1.12 grams)



/17 MODULE

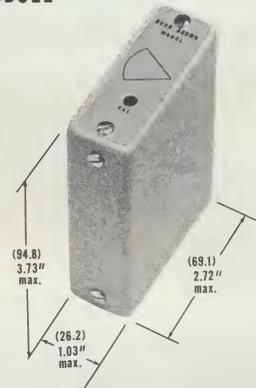
Connector - 1700MC
Weight - 0.2 oz typ.
(6 grams)



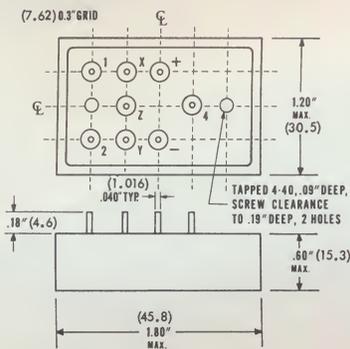
/19 MODULE

Connector - 1900MC
Weight - 0.8 oz typ.
(23 grams)

/13 MODULE

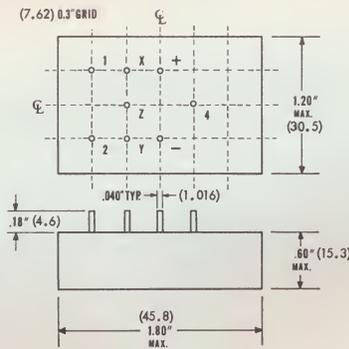


Mating Connector (Burdyn EC4206P5) furnished with each unit.



/15 MODULE

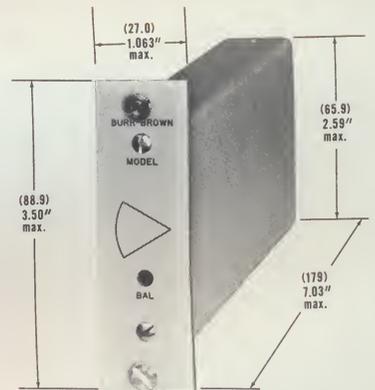
Connector - 1500MC
Weight - 1.3 oz typ.
(37 grams)



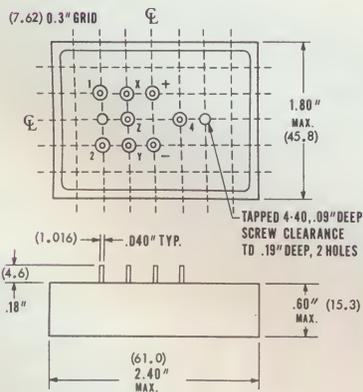
/15C MODULE

Connector - 1500MC
Weight - 1.3 oz typ.
(37 grams)

/16 MODULE

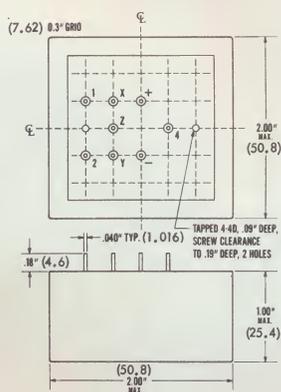


Mating Connector (Burdyn EC4206P5) furnished with each unit. The /16-2 module is identical to the /16 package except that it is twice the width.



/25 MODULE

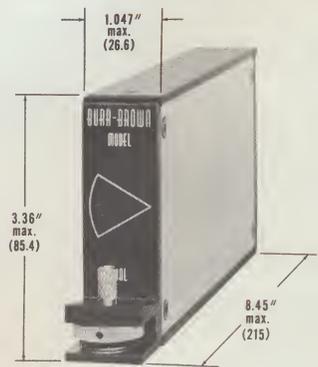
Connector - 1500MC
Weight - 2.6 oz typ.
(74 grams)



/40 MODULE

Connector - 1500MC
Weight - 4 oz typ.
(120 grams)

/26 MODULE



Mating Connector (Amphenol 143-012-01) furnished with each unit.

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