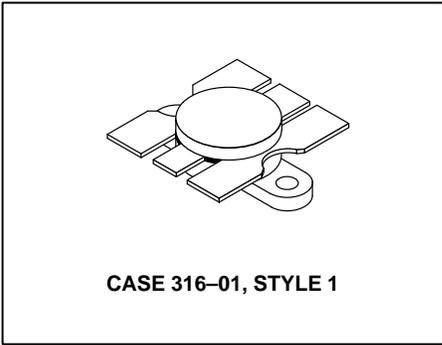


# The RF Line

## NPN Silicon

### RF Power Transistor



Designed for 12.5 Volt UHF large-signal amplifier applications in industrial and commercial FM equipment operating to 520 MHz.

- Guaranteed 440, 470, 512 MHz 12.5 Volt Characteristics  
Output Power = 50 Watts  
Minimum Gain = 5.2 dB @ 440, 470 MHz  
Efficiency = 55% @ 440, 470 MHz  
IRL = 10 dB
- Characterized with Series Equivalent Large-Signal Impedance Parameters from 400 to 520 MHz
- Built-In Matching Network for Broadband Operation
- Triple Ion Implanted for More Consistent Characteristics
- Implanted Emitter Ballast Resistors
- Silicon Nitride Passivated
- 100% Tested for Load Mismatch Stress at all Phase Angles with 20:1 VSWR @ 15.5 Vdc, 2.0 dB Overdrive
- Circuit board photomaster available upon request by contacting RF Tactical Marketing in Phoenix, AZ.

#### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CEO}$	16.5	Vdc
Collector-Emitter Voltage	$V_{CES}$	38	Vdc
Emitter-Base Voltage	$V_{EBO}$	4.0	Vdc
Collector Current — Continuous	$I_C$	12	Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	135 0.77	Watts W/°C
Storage Temperature Range	$T_{stg}$	-65 to +150	°C
Operating Junction Temperature	$T_J$	200	°C

#### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.3	°C/W

#### ELECTRICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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#### OFF CHARACTERISTICS

Collector-Emitter Breakdown Voltage ( $I_C = 50 \text{ mAdc}$ , $I_B = 0$ )	$V_{(BR)CEO}$	16.5	—	—	Vdc
Collector-Emitter Breakdown Voltage ( $I_C = 50 \text{ mAdc}$ , $V_{BE} = 0$ )	$V_{(BR)CES}$	38	—	—	Vdc
Emitter-Base Breakdown Voltage ( $I_E = 10 \text{ mAdc}$ , $I_C = 0$ )	$V_{(BR)EBO}$	4.0	—	—	Vdc
Collector Cutoff Current ( $V_{CE} = 15 \text{ Vdc}$ , $V_{BE} = 0$ , $T_C = 25^\circ\text{C}$ )	$I_{CES}$	—	—	5.0	mAdc

#### ON CHARACTERISTICS

DC Current Gain ( $I_C = 1.0 \text{ Adc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )	$h_{FE}$	20	70	120	—
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#### DYNAMIC CHARACTERISTICS

Output Capacitance ( $V_{CB} = 12.5 \text{ Vdc}$ , $I_E = 0$ , $f = 1.0 \text{ MHz}$ )	$C_{ob}$	—	135	170	pF
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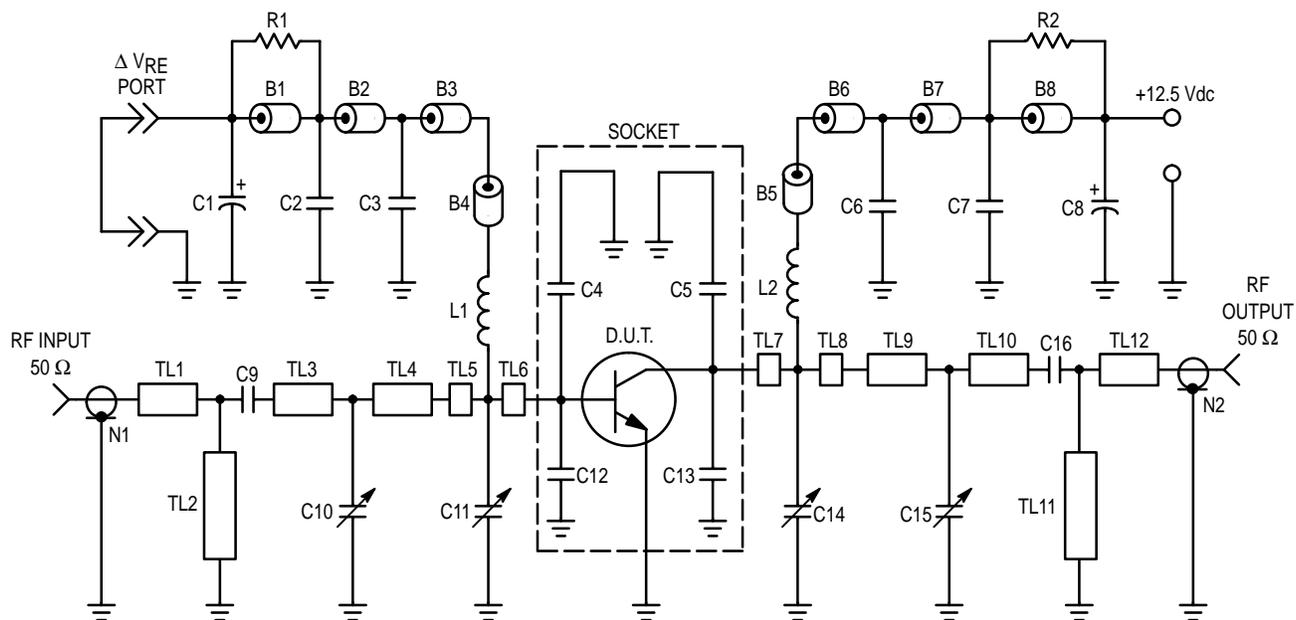
(continued)

**ELECTRICAL CHARACTERISTICS — continued** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>FUNCTIONAL TESTS</b> (In Motorola Test Fixture. See Figure 1.)					
Common-Emitter Amplifier Power Gain ( $V_{CC} = 12.5\text{ Vdc}$ , $P_{out} = 50\text{ W}$ , $f = 440, 470\text{ MHz}$ )	$G_{pe}$	5.2	6.1	—	dB
Common-Emitter Amplifier Power Gain ( $V_{CC} = 12.5\text{ Vdc}$ , $P_{out} = 50\text{ W}$ , $f = 512\text{ MHz}$ )	$G_{pe}$	5.0	5.9	—	dB
Input Return Loss ( $V_{CC} = 12.5\text{ Vdc}$ , $P_{out} = 50\text{ W}$ , $f = 440, 470, 512\text{ MHz}$ )	IRL	10	15	—	dB
Collector Efficiency ( $V_{CC} = 12.5\text{ Vdc}$ , $P_{out} = 50\text{ W}$ , $f = 440, 470\text{ MHz}$ )	$\eta$	55	65	—	%
Collector Efficiency ( $V_{CC} = 12.5\text{ Vdc}$ , $P_{out} = 50\text{ W}$ , $f = 512\text{ MHz}$ )	—	50	60	—	%
Output Mismatch Stress ( $V_{CC} = 15.5\text{ V}$ , 2.0 dB Overdrive, $f = 470\text{ MHz}$ , VSWR = 20:1, All Phase Angles) (1)	$\psi$ (2)	No Degradation in Output Power			

**NOTES:**

- $P_{in} = 2.0\text{ dB}$  above drive requirement for 50 W output at 12.5 Vdc.
- $\psi$  = Mismatch stress factor — the electrical criterion established to verify the device resistance to load mismatch failure. The mismatch stress test is accomplished in the standard test fixture (Figure 1) terminated in a 20:1 minimum load mismatch at all phase angles.



- B1, B8 — Ferrite Bead Ferroxcube VK200 20-4B
- B2, B3, B4, B5, B6, B7 — Ferrite Bead Ferroxcube #56-590-3B
- C1, C8 — 10  $\mu\text{F}$ , 25 V, 25%, Electrolytic, ECS TE-1204
- C2, C7 — 1000 pF, Chip Cap, 5%, ATC 100B102JC50
- C3, C6 — 91 pF, 5%, Mica, SAHA 3HS0006-91
- C4, C5, C12, C13 — 36 pF, 5%, SAHA 3HS0006-36
- C9, C16 — 220 pF, Chip Cap, 5%, ATC 100B221JC200
- C10, C11, C15 — 0.8-10 pF, Variable, Johanson JMC501 PG26J200
- C14 — 1.0-20 pF, Variable, Johanson JMC5501 PG26J200
- L1, L2 — 3 Turns, 18 AWG, 0.19" ID — Total Length 3.5"
- N1, N2 — N Coaxial Conn., Omni-Spectra 3052-1648-10
- R1, R2 — 10 Ohm, 10%, 1.0 W, Carbon, RCA 831010

- TL1, TL12 —  $Z_0 = 50\text{ Ohm}$
- TL2 — See Photomaster
- TL3 — See Photomaster
- TL4 — See Photomaster
- TL5 — See Photomaster
- TL6 — See Photomaster
- TL7 — See Photomaster
- TL8 — See Photomaster
- TL9 — See Photomaster
- TL10 — See Photomaster
- TL11 — See Photomaster

Transmission Line Boards: 1/16" Glass-Teflon  
Keene GX-0600-55-22  
2 oz. Cu Clad Both Sides  
 $\epsilon_r = 2.55$

Bias Boards: 1/16" G10 or Equivalent  
2 oz. Cu Clad Double Sided

**Figure 1. 440 to 512 MHz Broadband Test Circuit Schematic**

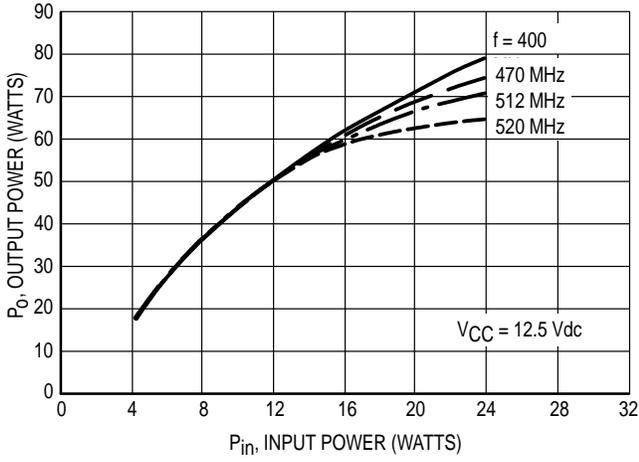


Figure 2. Output Power versus Input Power

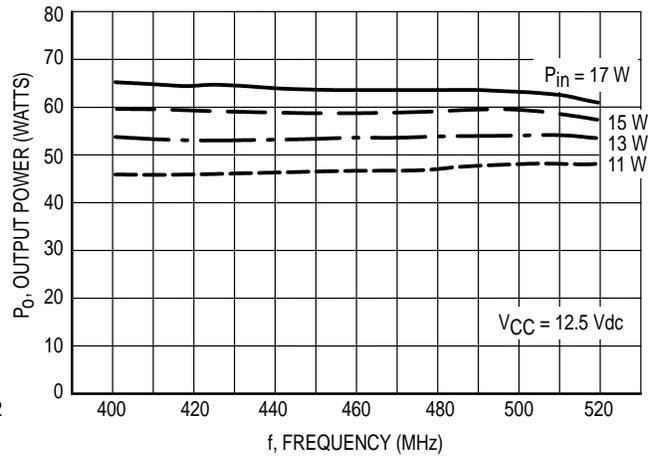


Figure 3. Output Power versus Frequency

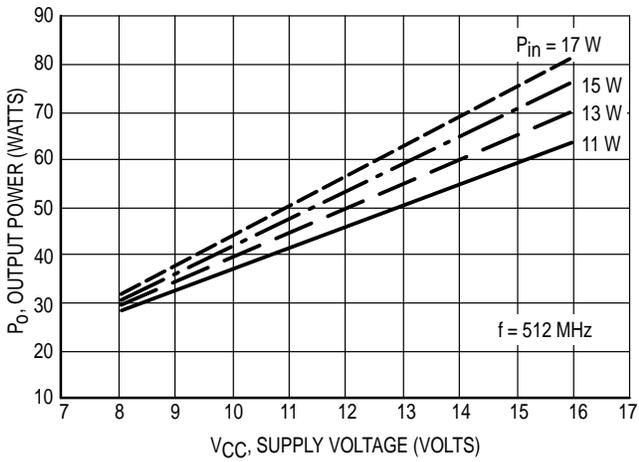


Figure 4. Output Power versus Supply Voltage

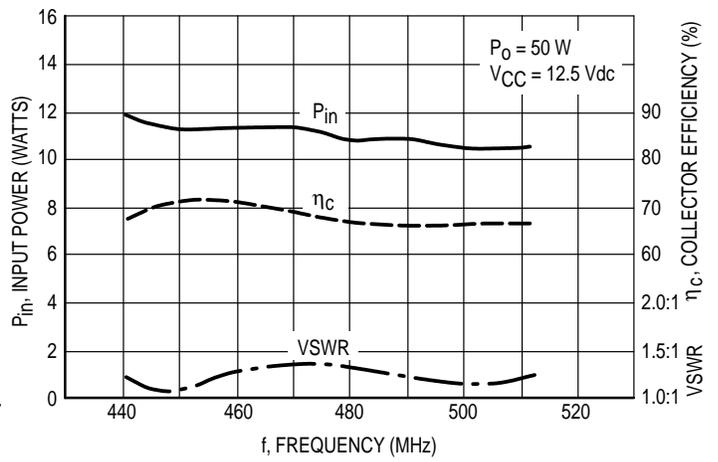
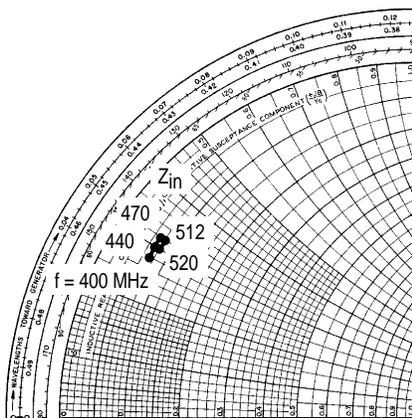


Figure 5. Broadband Performance for  $P_o = 50$  W

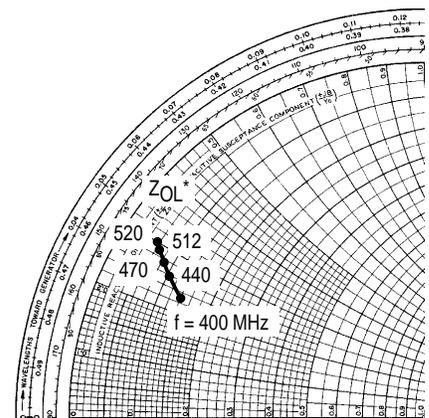


$P_{out} = 50$  W,  $V_{CC} = 12.5$  Vdc

TUNED FOR MAXIMUM GAIN AT  $P_o = 50$  W

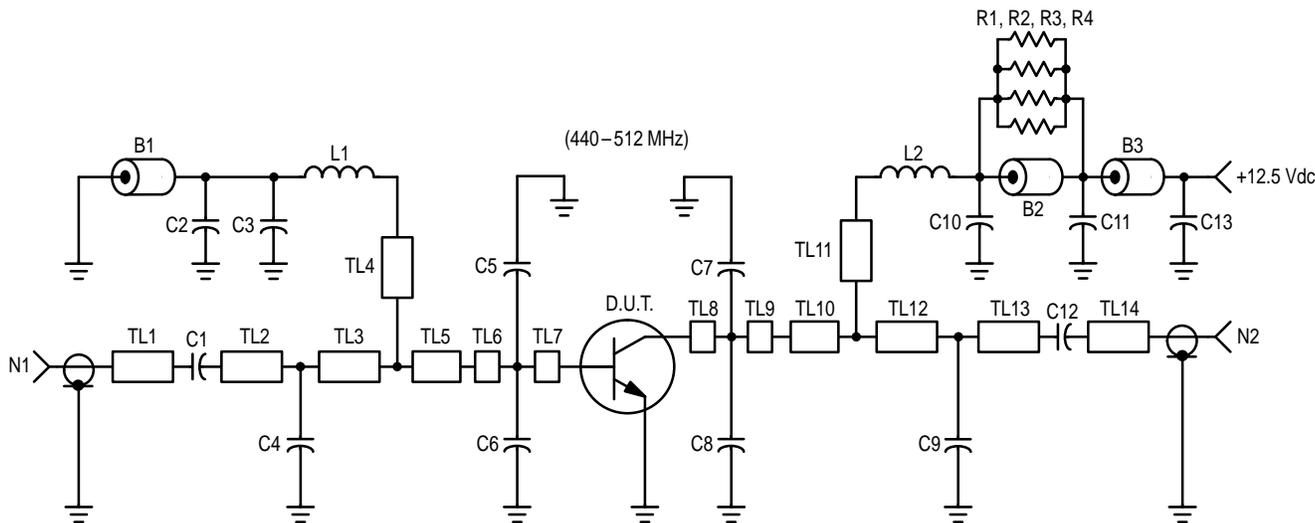
f (MHz)	$Z_{in}$ Ω	$Z_{OL}^*$ Ω
400	$0.7 + j2.8$	$1.4 + j2.3$
440	$0.7 + j3.2$	$1.1 + j2.6$
470	$0.8 + j3.3$	$0.8 + j2.7$
512	$0.8 + j3.2$	$0.7 + j2.9$
520	$0.7 + j3.0$	$0.6 + j3.0$

NOTE:  $Z_{in}$  &  $Z_{OL}^*$  are given from base-to-base and collector-to-collector respectively.



$Z_{OL}^*$  = Conjugate of the optimum load impedance into which the device operates at a given output power, voltage and frequency.

Figure 6. Input and Output Impedance Normalized to 10 Ohms  
Circuit Tuned for Maximum Gain @  $P_o = 50$  W



B1, B2 — Ferrite Bead Fair Rite Products Corp.  
 B3 — Ferrite Bead Fair Rite Products Corp.  
 C2, C11 — 820 pF, 5%  
 C3, C10 — 91 pF, 5%, Mica, SAHA 3HS0006-91  
 C1, C12 — 220 pF, 5%, Murata Erie  
 C4 — 9.1 pF, 5%, Murata Erie  
 C5, C6, C7, C8 — 43 pF, 5%, Mica SAHA 3HS0006-43  
 C9 — 10 pF, 5%, Murata Erie  
 C13 — 10  $\mu$ F, Electrolytic, 50 V, Panasonic  
 L1 — 7 Turns, 24 AWG, ID Dia. 0.116"  
 L2 — 5 Turns, 18 AWG, ID Dia. 0.165"  
 N1, N2 — SMA Flange Mount, Omni-Spectra  
 2052-1618-02

R1, R2, R3, R4 — 39 Ohm 1/8 W 5% Rohm  
 TL1 —  $Z_0 = 50$  Ohm  
 TL2 —  $Z_0 = 50$  Ohm  
 TL3 —  $Z_0 = 50$  Ohm  
 TL4 — See Photomaster  
 TL5 —  $Z_0 = 50$  Ohm  
 TL6 — See Photomaster  
 TL7 — See Photomaster  
 TL8 — See Photomaster  
 TL9 — See Photomaster  
 TL10 —  $Z_0 = 50$  Ohm  
 TL11 — See Photomaster  
 TL12 —  $Z_0 = 50$  Ohm  
 TL13 —  $Z_0 = 50$  Ohm  
 TL14 —  $Z_0 = 50$  Ohm  
 Board Material: 1/16" G10,  $\epsilon_r = 4.5$   
 2 oz. Cu Clad Both Sides

Figure 7. Schematic of Broadband Demonstration Amplifier (3)

### PERFORMANCE CHARACTERISTICS OF BROADBAND DEMONSTRATION AMPLIFIER

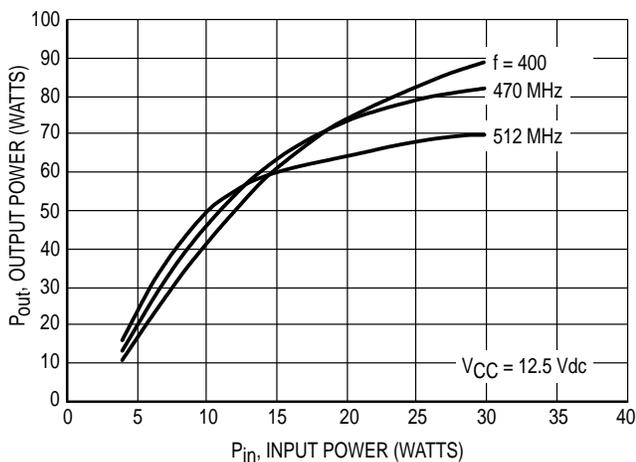


Figure 8. Output Power versus Input Power

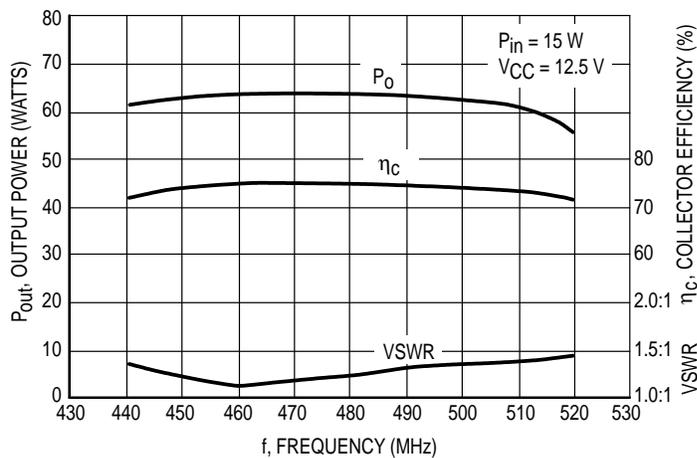
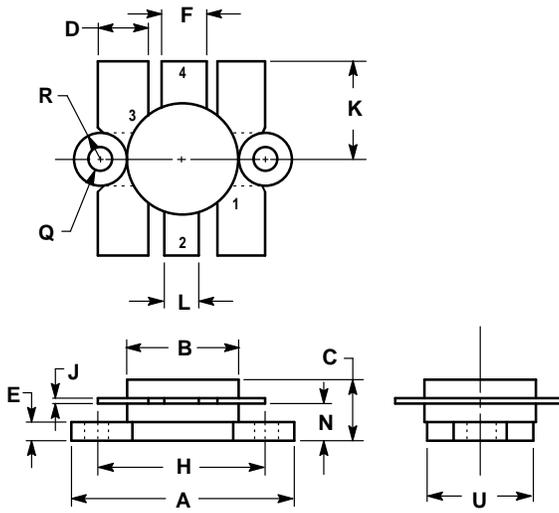


Figure 9.  $P_o$ ,  $\eta_c$  and VSWR versus Frequency

(3) Detailed design and performance information available from Motorola upon request.

# PACKAGE DIMENSIONS



NOTES:  
1. FLANGE IS ISOLATED IN ALL STYLES.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	24.38	25.14	0.960	0.990
B	12.45	12.95	0.490	0.510
C	5.97	7.62	0.235	0.300
D	5.33	5.58	0.210	0.220
E	2.16	3.04	0.085	0.120
F	5.08	5.33	0.200	0.210
H	18.29	18.54	0.720	0.730
J	0.10	0.15	0.004	0.006
K	10.29	11.17	0.405	0.440
L	3.81	4.06	0.150	0.160
N	3.81	4.31	0.150	0.170
Q	2.92	3.30	0.115	0.130
R	3.05	3.30	0.120	0.130
U	11.94	12.57	0.470	0.495

STYLE 1:  
PIN 1. EMITTER  
2. COLLECTOR  
3. EMITTER  
4. BASE

**CASE 316-01  
ISSUE D**

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