

# The RF Line

## NPN Silicon

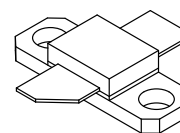
### RF Power Transistor

**MRF15030**

Designed for 26 volts microwave large-signal, common emitter, class A and class AB linear amplifier applications in industrial and commercial FM/AM equipment operating in the range 1400–1600 MHz.

- Specified 26 Volts, 1490 MHz, Class AB Characteristics:
  - Output Power — 30 Watts
  - Gain — 9 dB Min @ 30 Watts (PEP)
  - Efficiency — 30% Min @ 30 Watts (PEP)
  - Intermodulation Distortion — -30 dBc Max @ 30 Watts (PEP)
- Third Order Intercept Point — 53.5 dBm Typ @ 1490 MHz,  $V_{CE} = 24$  Vdc,  $I_C = 2.5$  Adc
- Characterized with Series Equivalent Large-Signal Parameters from 1400–1600 MHz
- Characterized with Small Signal S-Parameters from 1000–2000 MHz
- Silicon Nitride Passivated
- 100% Tested for Load Mismatch Stress at all Phase Angles with 3:1 Load VSWR @ 28 Vdc, at Rated Output Power
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration
- Circuit board photomaster available upon request by contacting RF Tactical Marketing in Phoenix, AZ.

**30 W, 1.5 GHz**  
**RF POWER TRANSISTOR**  
**NPN SILICON**



**CASE 395C-01, STYLE 1**

#### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CEO}$	25	Vdc
Collector-Emitter Voltage	$V_{CES}$	60	Vdc
Emitter-Base Voltage	$V_{EBO}$	4	Vdc
Collector-Current — Continuous	$I_C$	10	Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	125 0.71	Watts W/ $^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	-65 to +150	$^\circ\text{C}$

#### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.40	$^\circ\text{C/W}$

#### 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 ( $I_C = 50$ mAdc, $I_B = 0$ )	$V_{(BR)CEO}$	25	29	—	Vdc
Collector-Emitter Breakdown Voltage ( $I_C = 50$ mAdc, $V_{BE} = 0$ )	$V_{(BR)CES}$	60	64	—	Vdc
Collector-Emitter Breakdown Voltage ( $I_C = 50$ mAdc, $R_{BE} = 100 \Omega$ )	$V_{(BR)CER}$	30	52	—	Vdc

(continued)

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

Characteristic	Symbol	Min	Typ	Max	Unit
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**OFF CHARACTERISTICS — continued**

Emitter–Base Breakdown Voltage ( $I_E = 5 \text{ mAdc}$ , $I_C = 0$ )	$V_{(BR)EBO}$	4	5	—	Vdc
Collector Cutoff Current ( $V_{CE} = 30 \text{ Vdc}$ , $V_{BE} = 0$ )	$I_{CES}$	—	—	10	mAdc

**ON CHARACTERISTICS**

DC Current Gain ( $I_{CE} = 1 \text{ Adc}$ , $V_{CE} = 5 \text{ Vdc}$ )	$h_{FE}$	20	35	80	—
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**DYNAMIC CHARACTERISTICS**

Output Capacitance ( $V_{CB} = 26 \text{ Vdc}$ , $I_E = 0$ , $f = 1 \text{ MHz}$ )	$C_{ob}$	—	38	—	pF
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**FUNCTIONAL TESTS** (Figure 12)

Common–Emitter Amplifier Power Gain ( $V_{CC} = 26 \text{ Vdc}$ , $P_{out} = 30 \text{ W (PEP)}$ , $I_{CQ} = 125 \text{ mA}$ , $f_1 = 1490 \text{ MHz}$ , $f_2 = 1490.1 \text{ MHz}$ )	$G_{pe}$	9.0	9.6	—	dB
Collector Efficiency ( $V_{CC} = 26 \text{ Vdc}$ , $P_{out} = 30 \text{ W (PEP)}$ , $I_{CQ} = 125 \text{ mA}$ , $f_1 = 1490 \text{ MHz}$ , $f_2 = 1490.1 \text{ MHz}$ )	$\eta$	30	34	—	%
Intermodulation Distortion ( $V_{CC} = 26 \text{ Vdc}$ , $P_{out} = 30 \text{ W (PEP)}$ , $I_{CQ} = 125 \text{ mA}$ , $f_1 = 1490 \text{ MHz}$ , $f_2 = 1490.1 \text{ MHz}$ )	IMD	—	– 34	– 30	dBc
Input Return Loss ( $V_{CC} = 26 \text{ Vdc}$ , $P_{out} = 30 \text{ W (PEP)}$ , $I_{CQ} = 125 \text{ mA}$ , $f_1 = 1490 \text{ MHz}$ , $f_2 = 1490.1 \text{ MHz}$ )	IRL	12	15	—	dB
Load Mismatch ( $V_{CC} = 28 \text{ Vdc}$ , $P_{out} = 30 \text{ W (PEP)}$ , $I_{CQ} = 125 \text{ mA}$ , $f_1 = 1490 \text{ MHz}$ , $f_2 = 1490.1 \text{ MHz}$ , Load VSWR = 3:1, All Phase Angles at Frequency of Test)	$\psi$	No Degradation in Output Power			

**TYPICAL CHARACTERISTICS**

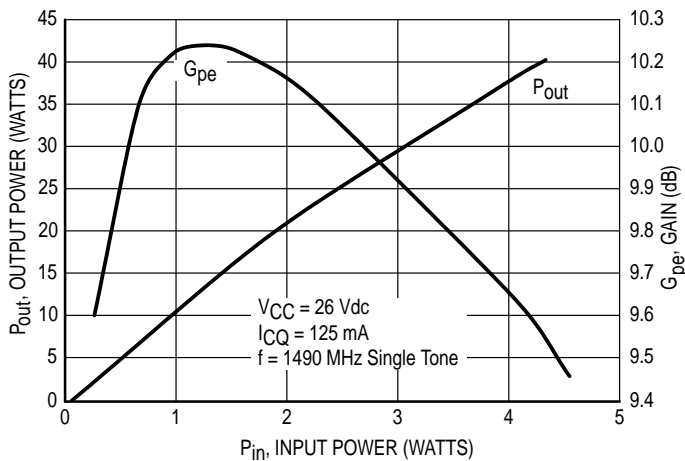


Figure 1. Output Power & Power Gain versus Input Power

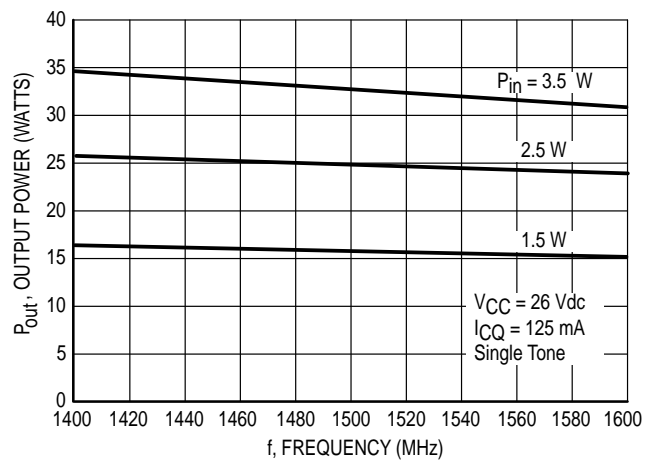
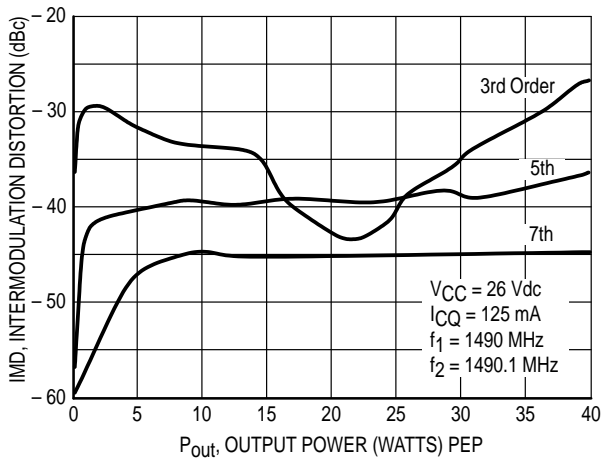
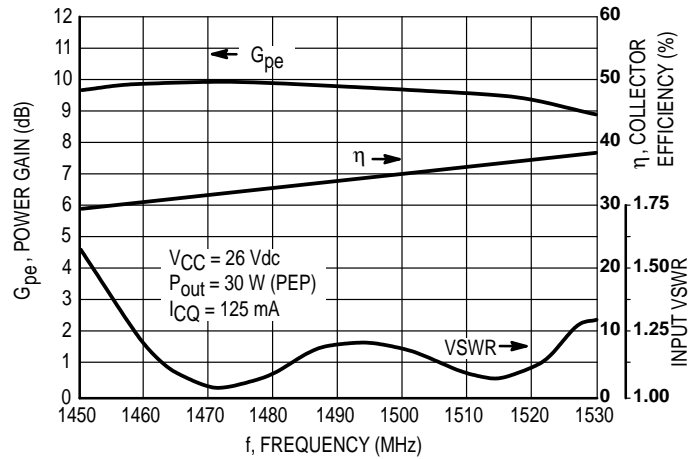


Figure 2. Output Power versus Frequency

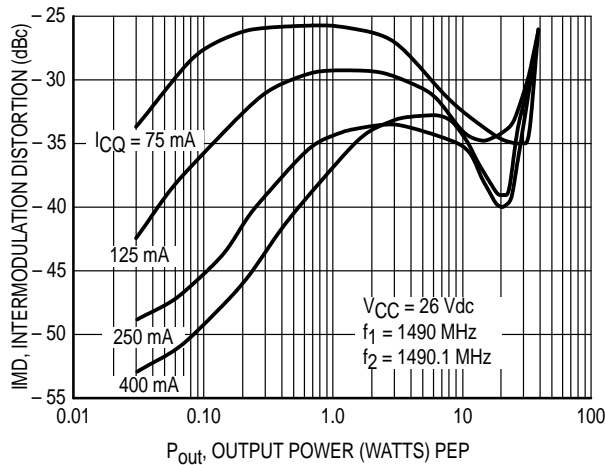
## TYPICAL CHARACTERISTICS



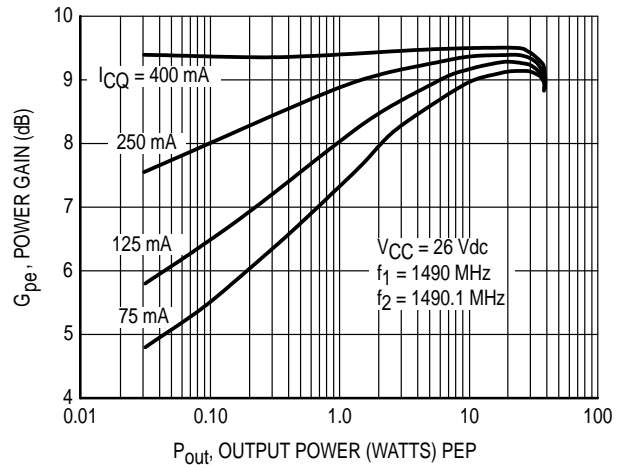
**Figure 3. Intermodulation Distortion versus Output Power**



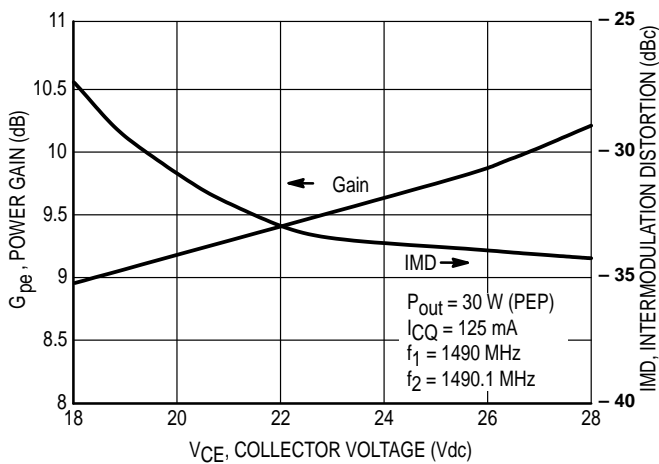
**Figure 4. Performance in Broadband Circuit**



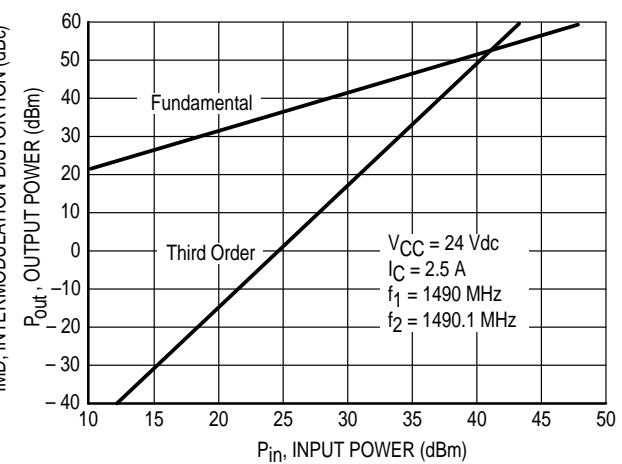
**Figure 5. Intermodulation Distortion versus Output Power**



**Figure 6. Power Gain versus Output Power**



**Figure 7. Power Gain and Intermodulation Distortion versus Collector Voltage**



**Figure 8. Class A Third Order Intercept Point**

## TYPICAL CHARACTERISTICS

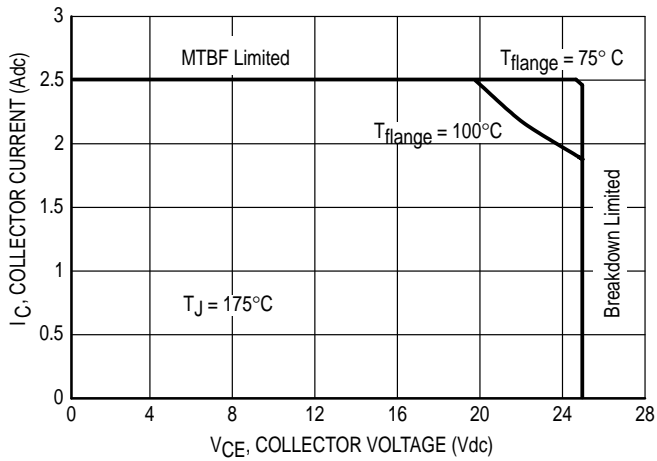


Figure 9. DC Safe Operating Area

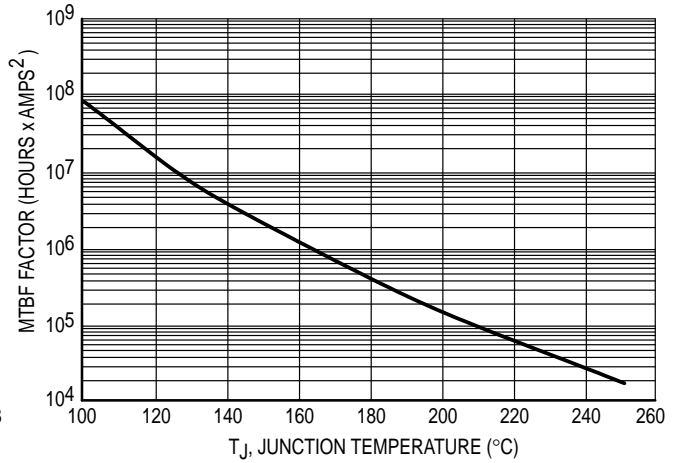
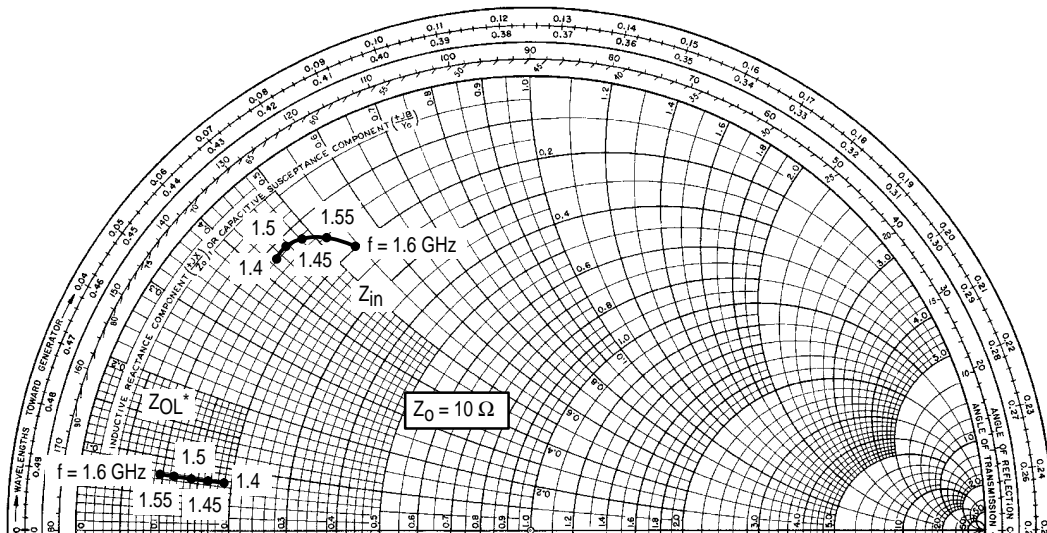


Figure 10. MTBF Factor versus Junction Temperature

The above graph displays calculated MTBF in hours x ampere<sup>2</sup> emitter current. Life tests at elevated temperatures have correlated to better than  $\pm 10\%$  of the theoretical prediction for metal failure. Divide MTBF Factor by  $I_C^2$  for MTBF in a particular application.



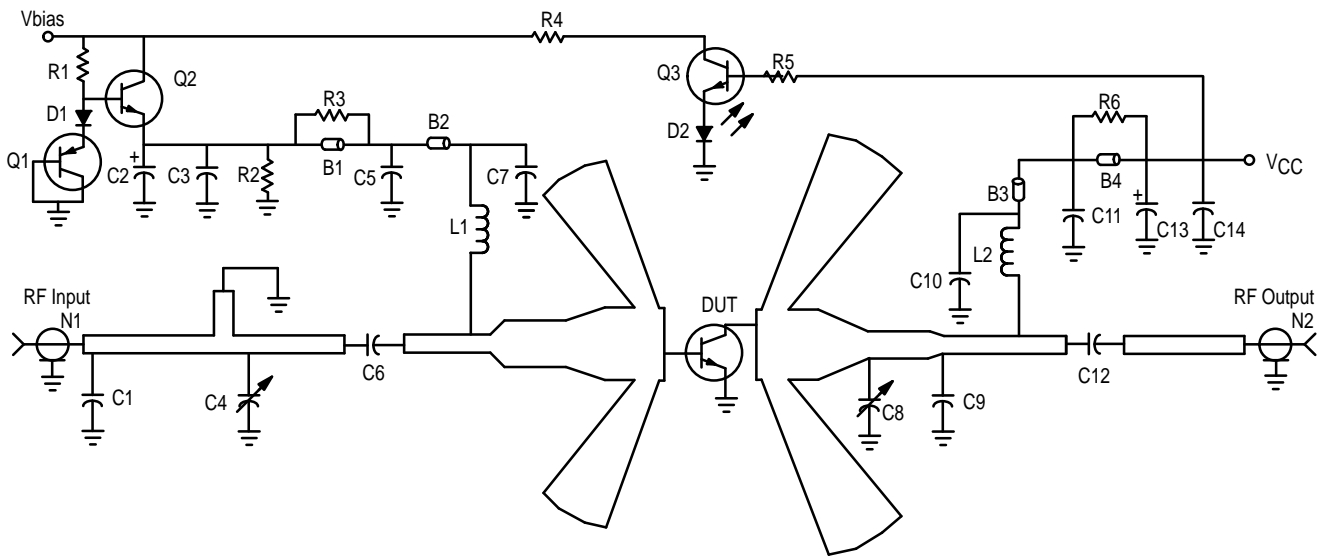
f (GHz)	$Z_{in}$ ( $\Omega$ )	$Z_{OL}^*$ ( $\Omega$ )
1.40	$1.15 + j4.25$	$1.87 + j0.78$
1.45	$1.15 + j4.55$	$1.67 + j0.78$
1.50	$1.20 + j4.80$	$1.47 + j0.78$
1.55	$1.45 + j5.15$	$1.27 + j0.78$
1.60	$1.89 + j5.25$	$1.00 + j0.78$

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

Figure 11. Input and Output Impedances with Circuit Tuned for Maximum Gain @  $P_{out} = 30$  Watts (PEP),  $V_{CC} = 26$  Volts,  $I_{CQ} = 125$  mA, and Driven by Two Equal Amplitude Tones with Separation of 100 KHz

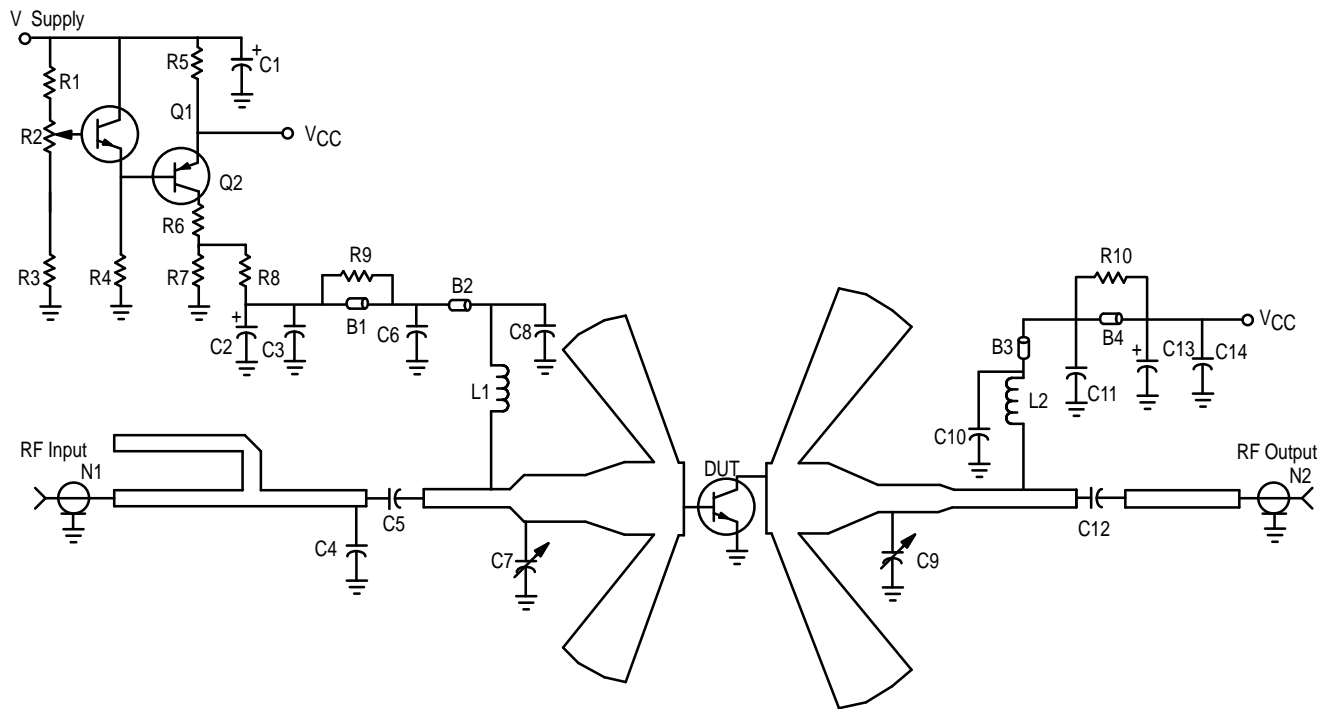
Table 1. Small Signal S Parameters at  $V_{CE} = 24 \text{ Vdc}$ ,  $I_C = 2.5 \text{ Adc}$

f MHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	S <sub>11</sub>	∠φ	S <sub>21</sub>	∠φ	S <sub>12</sub>	∠φ	S <sub>22</sub>	∠φ
1000	0.983	173	0.366	49	0.006	36	0.890	178
1050	0.984	172	0.367	46	0.007	33	0.893	178
1100	0.978	172	0.367	43	0.007	33	0.888	178
1150	0.975	171	0.373	40	0.007	30	0.885	178
1200	0.975	171	0.382	36	0.008	31	0.886	177
1250	0.969	170	0.391	33	0.007	27	0.881	177
1300	0.963	169	0.408	29	0.008	21	0.879	177
1350	0.955	169	0.428	25	0.009	20	0.879	177
1400	0.945	168	0.452	20	0.008	7	0.873	177
1450	0.933	167	0.487	13	0.009	1	0.875	178
1500	0.915	166	0.525	6	0.009	-8	0.875	178
1550	0.889	166	0.572	-3	0.009	-18	0.877	178
1600	0.856	166	0.618	-16	0.009	-35	0.887	178
1650	0.833	168	0.654	-30	0.010	-54	0.901	178
1700	0.820	171	0.654	-48	0.010	-86	0.918	178
1750	0.839	174	0.600	-66	0.010	-120	0.930	177
1800	0.872	175	0.517	-81	0.010	-152	0.932	176
1850	0.909	176	0.435	-94	0.010	-176	0.925	174
1900	0.937	175	0.357	-104	0.011	159	0.924	173
1950	0.957	174	0.296	-112	0.012	148	0.917	173
2000	0.970	173	0.247	-119	0.012	136	0.915	173



- |         |                                           |        |                                                           |
|---------|-------------------------------------------|--------|-----------------------------------------------------------|
| B1, B4  | Long Bead, Fair Rite                      | D1     | Surface Mount Diode, Motorola                             |
| B2, B3  | Short Bead, Fair Rite                     | D2     | Light Emitting Diode, Industrial Devices                  |
| C1      | 0.3 pF, B Case Chip Capacitor, ATC        | L1, L2 | 3 Turn, 20 AWG, 0.126" ID Choke                           |
| C2      | 220 μF, Electrolytic Capacitor, Mallory   | N1, N2 | Type N Flange Mount RF Connector, Omni Spectra            |
| C3, C14 | 0.1 μF, Chip Capacitor, Kemit             | Q1     | Transistor PNP Motorola (BD136)                           |
| C4, C8  | 0.8 to 8 pF, Variable Capacitor, Johanson | Q2, Q3 | Surface Mount Transistor, NPN, Motorola (MJD47)           |
| C5, C11 | 1800 pF, Chip Capacitor, Kemit            | R1     | 2 x 330 Ω, 1/8 Watt Chip Resistors in Parallel, Rohm      |
| C6, C12 | 18 pF, B Case Chip Capacitor, ATC         | R2     | 100 Ω, 1/8 Watt, Chip Resistor, Rohm                      |
| C7, C10 | 51 pF, Chip Capacitor, Murata Erie        | R3, R6 | 4 x 38 Ω, 1/8 Watt, Chip Resistors in Parallel, Rohm      |
| C9      | 1.7 pF, B Case Chip Capacitor, ATC        | R4     | 39 Ω, 1/8 Watt, Chip Resistor, Rohm                       |
| C13     | 470 μF, Electrolytic Capacitor, Mallory   | R5     | 22 KΩ, 1/8 Watt, Chip Resistor, Rohm                      |
|         |                                           | Board  | Glass Teflon®, Arlon GX-0300-55-22, ε <sub>r</sub> = 2.55 |

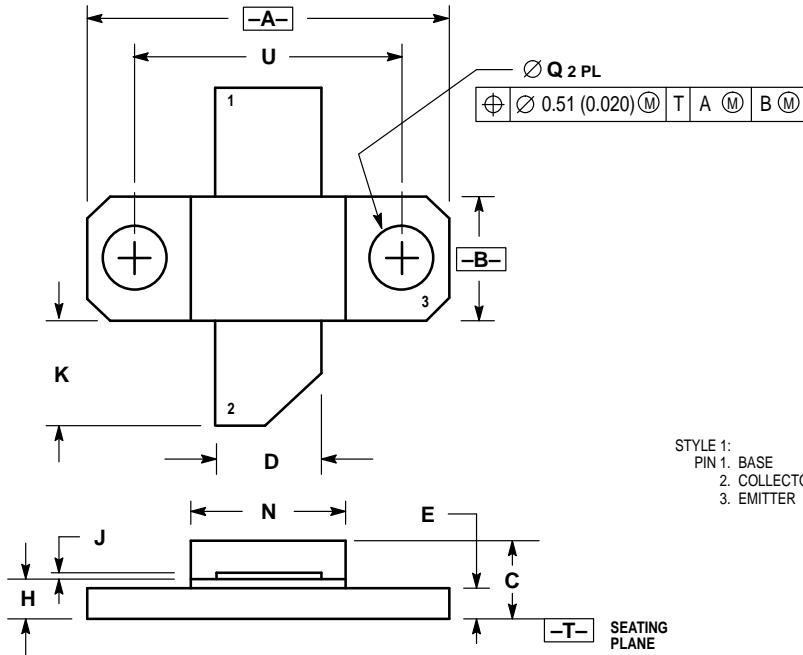
Figure 12. Class AB Broadband Test Fixture Electrical Schematic



B1, B4	Long Bead, Fair Rite	Q1	Transistor NPN Motorola (BD135)
B2, B3	Short Bead, Fair Rite	Q2	Transistor PNP Motorola (BD136)
C1, C2	100 $\mu$ F, Electrolytic Capacitor, Mallory	R1	250 $\Omega$ , 1/8 Watt, Chip Resistor Rohm
C3, C14	0.1 $\mu$ F, Chip Capacitor, Kemit	R2	500 $\Omega$ , 1/4 Watt Potentiometer, State of the Art
C4	1.3 pF, B Case Chip Capacitor, ATC	R3	4.7 K $\Omega$ , 1/8 Watt, Chip Resistor, Rohm
C5, C12	18 pF, B Case Chip Capacitor, ATC	R4	2 x 4.7 K $\Omega$ , 1/8 Watt, Chip Resistors in Parallel, Rohm
C6, C11	1800 pF, Chip Capacitor, Kemit	R5	1.0 $\Omega$ , 10 Watt, Resistor, Dale
C7, C9	0.8 to 8 pF, Variable Capacitor, Johanson	R6	38 $\Omega$ , 1.0 Watt, Resistor
C8, C10	51 pF, Chip Capacitor, Murata Erie	R7	75 $\Omega$ , 1/8 Watt, Chip Resistor, Rohm
C13	470 $\mu$ F, Electrolytic Capacitor, Mallory	R8	2 x 10 $\Omega$ , 1/8 Watt, Chip Resistors in Parallel, Rohm
L1, L2	3 Turn, 20 AWG, 0.126" ID Choke	R9, R10	4 x 38 $\Omega$ , 1/8 Watt, Chip Resistors in Parallel, Rohm
N1, N2	Type N Flange Mount RF Connector, Omni Spectra	Board	Glass Teflon <sup>®</sup> , Arlon GX-0300-55-22, $\epsilon_r = 2.55$

**Figure 13. Class A Test Fixture Electrical Schematic**

# PACKAGE DIMENSIONS




NOTES:  
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
 2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.739	0.750	18.77	19.05
B	0.240	0.260	6.10	6.60
C	0.165	0.198	4.19	5.03
D	0.215	0.225	5.46	5.72
E	0.055	0.070	1.40	1.78
H	0.079	0.091	2.01	2.31
J	0.004	0.006	0.10	0.15
K	0.210	0.240	5.33	6.10
N	0.315	0.330	8.00	8.38
Q	0.125	0.135	3.18	3.42
U	0.560 BSC		14.23 BSC	

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

**CASE 395C-01  
 ISSUE A**

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**JAPAN:** Nippon Motorola Ltd.; Tatsumi-SPD-JLDC, Toshikatsu Otsuki,  
6F Seibu-Butsuryu-Center, 3-14-2 Tatsumi Koto-Ku, Tokyo 135, Japan. 03-3521-8315

**MFAX:** RMFAX0@email.sps.mot.com – TOUCHTONE (602) 244-6609  
**INTERNET:** <http://Design-NET.com>

**HONG KONG:** Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,  
51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298



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**MRF15030/D**

