

**MOTOROLA**  
**SEMICONDUCTOR**  
TECHNICAL DATA

**MRF2001M**

**The RF Line**

**NPN SILICON MICROWAVE POWER TRANSISTOR**

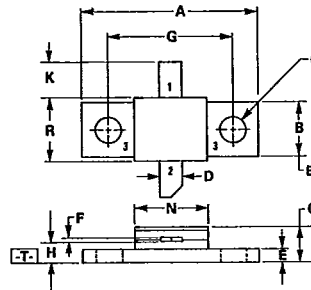
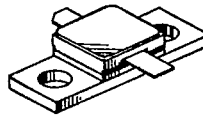
... designed for Class B and C *common base* broadband amplifier applications in the 1.7 to 2.3 GHz frequency range.

- Internal Input Matching for Broadband Operation
- Guaranteed Performance @ 2 GHz, 24 Vdc  
Output power = 1.0 Watt  
Minimum Gain = 8.5 dB
- 100% Tested for Load Mismatch at All Phase Angles with 10:1 VSWR
- Hermetically Sealed Industry Standard Package
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration
- Silicon Nitride Passivation
- Characterized for Operation from 20 V to 28 V Supply Voltages

1.0 W 2 GHz

**MICROWAVE POWER TRANSISTOR**

NPN SILICON



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

- NOTES:
1. DIMENSIONS [A] AND [B] ARE DATUMS.
  2. POSITIONAL TOLERANCE FOR MOUNTING HOLES:  
Ⓢ 0.13 (0.005) Ⓢ T A Ⓢ B Ⓢ
  3. -T- IS SEATING PLANE.
  4. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	20.07	20.57	0.790	0.810
B	6.48	6.73	0.255	0.265
C	3.68	4.06	0.145	0.160
D	2.29	2.79	0.090	0.110
E	1.42	1.73	0.056	0.068
F	0.05	0.15	0.002	0.006
G	14 27 BSC		0.560 BSC	
H	2.29	2.79	0.090	0.110
K	3.43	4.19	0.135	0.165
N	7.87	8.38	0.310	0.330
O	3.05	3.30	0.120	0.130
R	7.24	7.49	0.285	0.295

CASE 337-02

**MAXIMUM RATINGS**

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V <sub>CEO</sub>	20	Vdc
Collector-Base Voltage	V <sub>CBO</sub>	45	Vdc
Emitter-Base Voltage	V <sub>EBO</sub>	4.0	Vdc
Collector-Current -- Continuous	I <sub>C</sub>	250	mAdc
Total Device Dissipation @ T <sub>C</sub> = 25°C (1) Derate above 25°C	P <sub>D</sub>	7.0 40	Watts mW/°C
Storage Temperature Range	T <sub>stg</sub>	-65 to +200	°C

**THERMAL CHARACTERISTICS**

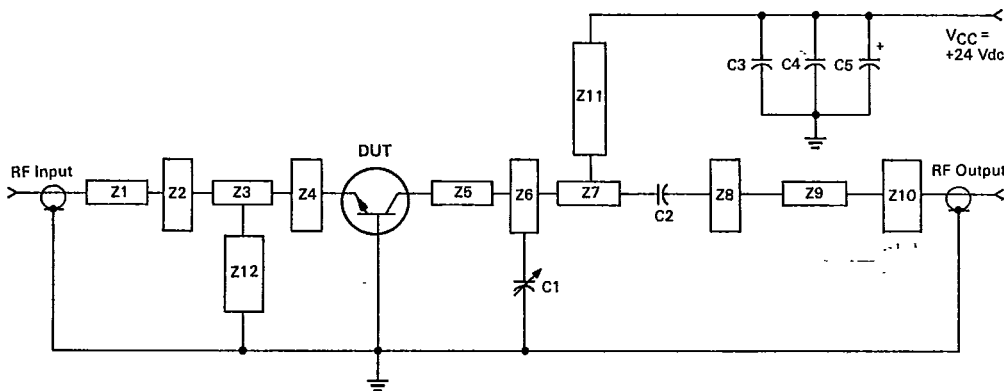
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	R <sub>θJC</sub>	25	°C/W

- (1) This device is designed for RF operation. The total device dissipation rating applies only when the device is operated as an RF amplifier.  
(2) Thermal Resistance is determined under specified RF operating conditions by infrared measurement techniques.

ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Collector-Emitter Breakdown Voltage (I <sub>C</sub> = 5.0 mA, I <sub>E</sub> = 0)	V <sub>(BR)CEO</sub>	20	—	—	Vdc
Collector-Emitter Breakdown Voltage (I <sub>C</sub> = 5.0 mA, V <sub>BE</sub> = 0)	V <sub>(BR)CES</sub>	45	—	—	Vdc
Collector-Base Breakdown Voltage (I <sub>C</sub> = 5.0 mA, I <sub>E</sub> = 0)	V <sub>(BR)CBO</sub>	45	—	—	Vdc
Emitter-Base Breakdown Voltage (I <sub>E</sub> = 1.0 mA, I <sub>C</sub> = 0)	V <sub>(BR)EBO</sub>	4.0	—	—	Vdc
Collector Cutoff Current (V <sub>CB</sub> = 28 Vdc, I <sub>E</sub> = 0)	I <sub>CBO</sub>	—	—	0.5	mA
<b>ON CHARACTERISTICS</b>					
DC Current Gain (I <sub>C</sub> = 100 mA, V <sub>CE</sub> = 5.0 Vdc)	h <sub>FE</sub>	10	—	100	—
<b>DYNAMIC CHARACTERISTICS</b>					
Output Capacitance (V <sub>CB</sub> = 24 Vdc, I <sub>E</sub> = 0, f = 1.0 MHz)	C <sub>ob</sub>	—	4.0	6.0	pF
<b>FUNCTIONAL TESTS</b>					
Common-Base Amplifier Power Gain (V <sub>CC</sub> = 24 Vdc, P <sub>out</sub> = 1.0 W, f = 2.0 GHz)	G <sub>PB</sub>	8.5	9.5	—	dB
Collector Efficiency (V <sub>CC</sub> = 24 Vdc, P <sub>out</sub> = 1.0 W, f = 2.0 GHz)	η	35	40	—	—
Load Mismatch (V <sub>CC</sub> = 24 Vdc, P <sub>out</sub> = 1.0 W, f = 2.0 GHz) VSWR = 10:1 All Phase Angles)	ψ	No Degradation in Power Output			

FIGURE 1 — 2.0 GHz TEST CIRCUIT



Z1-Z12 — Microstrip, See Photomaster  
 C1 — 0.6-4.5 pF Johanson 7271  
 C2, C3 — 56 pF Chip Capacitor  
 C4 — 0.1 μF  
 C5 — 10 μF, 35 V  
 Board Material — 0.0312" Teflon Fiberglass  
 ε<sub>r</sub> = 2.5 ± 0.05

FIGURE 2 -- OUTPUT POWER versus INPUT POWER  
(f = 1.7 GHz)

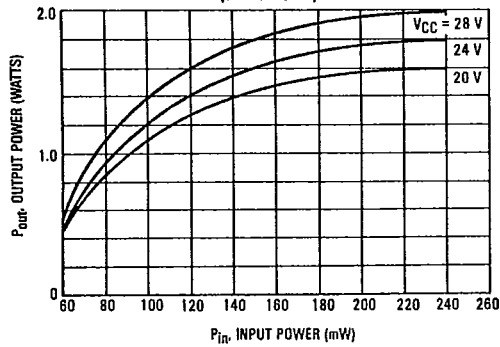


FIGURE 3 -- OUTPUT POWER versus INPUT POWER  
(f = 2.0 GHz)

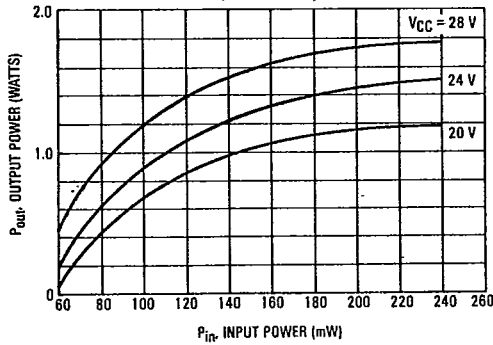


FIGURE 4 -- OUTPUT POWER versus INPUT POWER  
(f = 2.3 GHz)

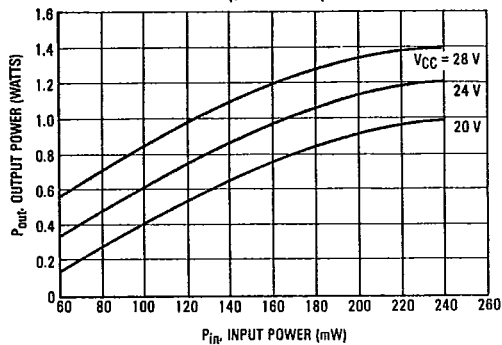


FIGURE 5 -- POWER GAIN versus FREQUENCY

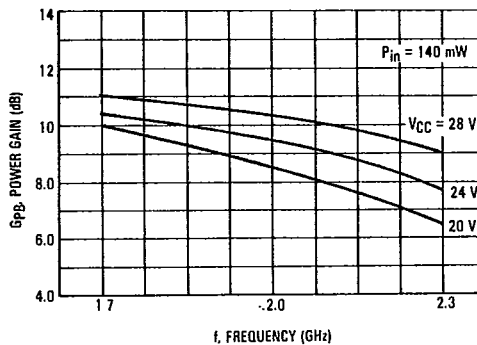
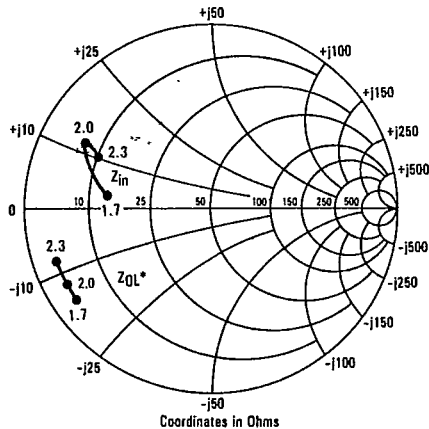


FIGURE 6 -- SERIES EQUIVALENT INPUT/OUTPUT IMPEDANCE



VCC = 24 V, P<sub>in</sub> = 140 mW

f GHz	Z <sub>in</sub> Ohms	Z <sub>OL</sub> <sup>*</sup> Ohms
1.7	15.5 + j 3.0	4.5 - j15.0
2.0	7.5 + j11.0	4.0 - j12.0
2.3	10.0 + j10.0	3.0 - j 7.0

\*Z<sub>OL</sub> = Conjugate of the optimum load impedance into which the device output operates at a given output power, voltage and frequency.

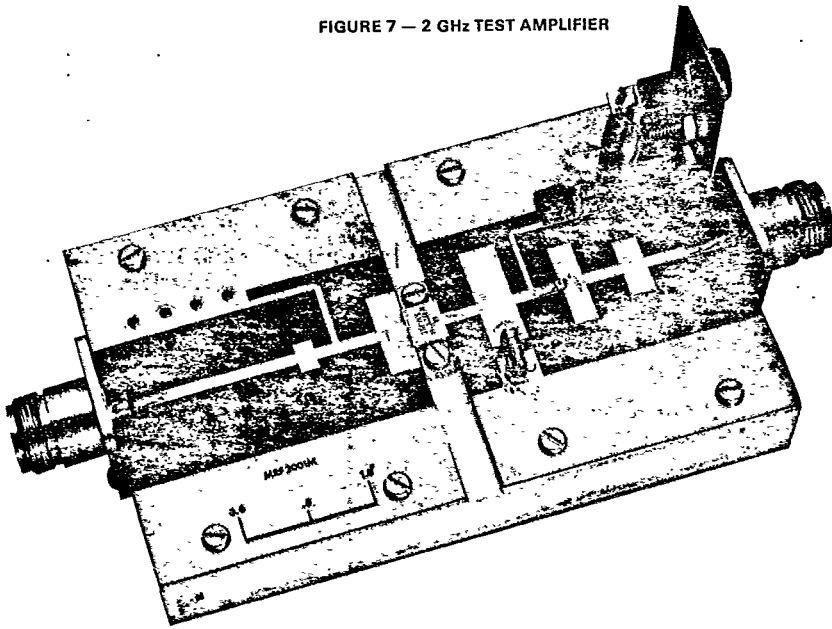
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MOTOROLA SC XSTRS/R F

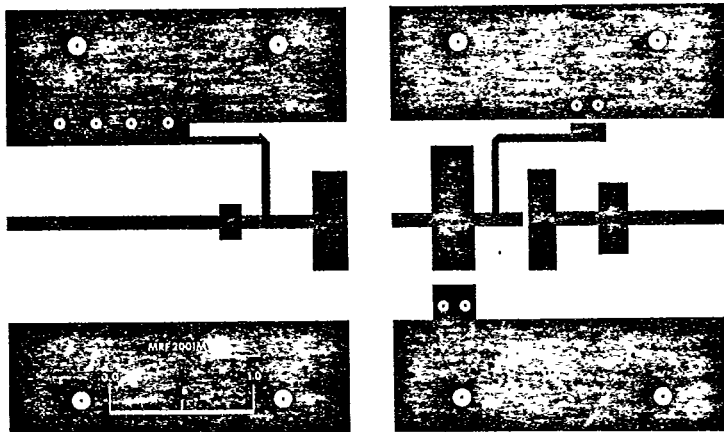
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FIGURE 7 — 2 GHz TEST AMPLIFIER



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FIGURE 8 — PRINTED CIRCUIT BOARD LAYOUT — 2.0 GHz TEST CIRCUIT



⊙ Denotes Eyelet

⊙ 4-40 Screw Placement

NOTE: The Printed Circuit Board shown is 75% of the original.

MOTOROLA RF DEVICE DATA

2-999