MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MRF1002MA
MRF1002MB
MRF1002MC

The RF Line

2.0 W PEAK 960-1215 MHz

MICROWAVE POWER TRANSISTORS

NPN SILICON

MICROWAVE PULSE POWER TRANSISTORS

. . . designed for Class B and C *common base* amplifier applications in short and long pulse TACAN, IFF, DME, and radar transmitters.

- Guaranteed Performance @ 1090 MHz, 35 Vdc
  Output Power = 2.0 Watts Peak
  Minimum Gain = 10 dB
- 100% Tested for Load Mismatch at All Phase Angles with 10:1 VSWR
- Industry Standard Package
- Nitride Passivated
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration
- Compatible with Other 1002M Types
- Internal Input Matching for Broadband Operation

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	20	Vdc
Collector-Base Voltage	V_{CBO}	50	Vdc
Emitter-Base Voltage	V_{EBO}	3.5	Vdc
Collector-Current — Continuous	I_C	250	mAdc
Total Device Dissipation @ T_C = 25°C (1) Derate above 25°C	P_D	7.0 40	Watts mW/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

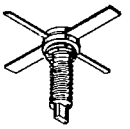
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	$R_{\theta JC}$	25	°C/W

(1) These devices are designed for RF operation. The total device dissipation rating applies only when the devices are operated as RF amplifiers.

(2) Thermal Resistance is determined under specified RF operating conditions by infrared measurement techniques.

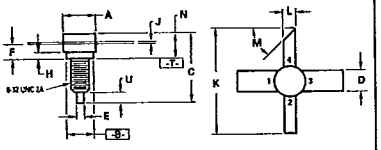
MRF1002MA
CASE 332-04



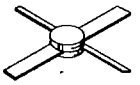
NOTES
1. DIM B IS DATUM.
2. POSITIONAL TOLERANCE FOR LEADS.
3. T IS SEATING PLANE.
4. DIMENSION K APPLIES TWO PLACES.
5. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	6.86	7.62	0.270	0.300
B	6.13	6.60	0.240	0.260
C	15.25	16.76	0.640	0.660
D	4.95	5.21	0.195	0.205
E	1.40	1.65	0.055	0.065
F	2.67	4.32	0.105	0.170
H	1.40	1.65	0.055	0.065
J	0.08	0.18	0.003	0.007
K	15.24	—	0.600	—
L	2.41	2.67	0.095	0.105
M	45° Nom.		45° Nom.	
N	4.57	5.22	0.180	0.205
U	2.92	3.68	0.115	0.145

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

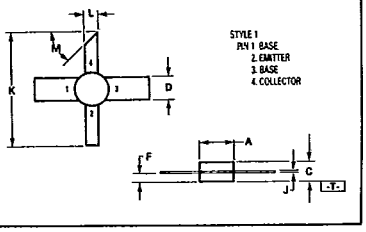


MRF1002MB
CASE 332A-01



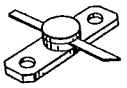
NOTES
1. DIM A IS DATUM
2. POSITIONAL TOLERANCE FOR LEADS
3. T IS SEATING PLANE.
4. DIM K APPLIES 2 PLACES.
5. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

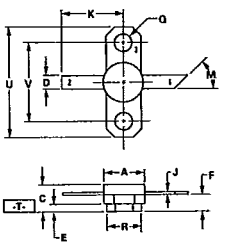
DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	6.85	7.34	0.270	0.290
C	3.30	3.81	0.130	0.150
D	4.95	5.21	0.195	0.205
F	1.40	1.78	0.055	0.070
J	0.08	0.18	0.003	0.007
K	15.24	—	0.600	—
L	2.41	2.67	0.095	0.105
M	45° NOM		45 NOM	



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

MRF1002MC
CASE 361A-01





NOTES
1. DIMENSIONS R AND U ARE DATUMS AND T IS A DATUM SURFACE AND SEATING PLANE.
2. POSITIONAL TOLERANCE FOR MOUNTING HOLES.
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	7.06	7.26	0.278	0.286
C	4.44	5.20	0.175	0.205
D	2.56	2.74	0.093	0.107
E	1.29	1.77	0.055	0.070
F	2.66	3.42	0.105	0.135
J	0.10	0.15	0.004	0.006
K	11.04	—	0.435	—
M	45° NOM		45° NOM	
Q	3.04	3.42	0.120	0.135
R	6.09	6.66	0.240	0.260
U	20.06	20.57	0.790	0.810
V	14.27 BSC		0.562 BSC	

STYLE 1
PIN 1 COLLECTOR
2. EMITTER
3. BASE

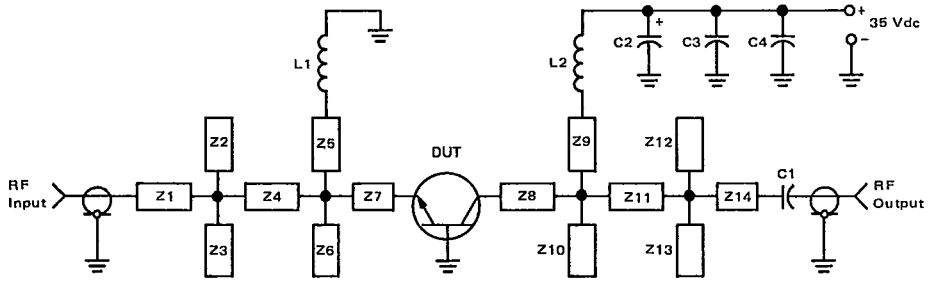
MRF1002MA, MRF1002MB, MRF1002MC

T-33-05

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 5.0 mAdc, I_B = 0)	$V_{(BR)CEO}$	20	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 5.0 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	50	—	—	Vdc
Collector-Base Breakdown Voltage (I_C = 5.0 mAdc, I_E = 0)	$V_{(BR)CBO}$	50	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 1.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	3.5	—	—	Vdc
Collector Cutoff Current (V_{CB} = 35 Vdc, I_E = 0)	I_{CBO}	—	—	0.5	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 100 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	10	—	100	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 35 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	—	2.5	5.0	pF
FUNCTIONAL TESTS (Pulse Width = 10 μs, Duty Cycle = 1.0%)					
Common-Base Amplifier Power Gain (V_{CC} = 35 Vdc, P_{out} = 2.0 W pk, f = 1090 MHz)	G_{PB}	10	12	—	dB
Collector Efficiency (V_{CC} = 35 Vdc, P_{out} = 2.0 W pk, f = 1090 MHz)	η	40	45	—	%
Load Mismatch (V_{CC} = 35 Vdc, P_{out} = 2.0 W, f = 1090 MHz VSWR = 10:1 All Phase Angles)	ψ	No Degradation in Power Output			

FIGURE 1 – 1090 MHz TEST CIRCUIT



C1, C3 – 220 pF Chip Capacitor, 100 mil ATC
C2 – 20 μF/50 Vdc Electrolytic
C4 – 0.1 μF Erie Redcap
L1, L2 – 2 Turns #18 AWG, 1/8" ID
Z1-Z14 – Distributed Microstrip Elements – See Figure 9
Board Material – 0.031" Thick Teflon-Fiberglass, ϵ_r = 2.56

FIGURE 2 – OUTPUT POWER versus INPUT POWER

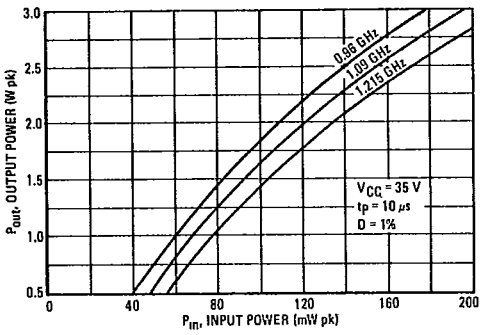
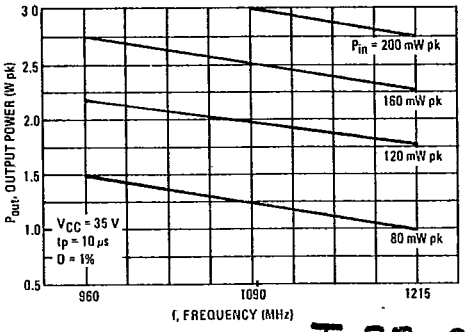


FIGURE 3 – OUTPUT POWER versus FREQUENCY



T-33-05

FIGURE 4 – OUTPUT POWER versus SUPPLY VOLTAGE

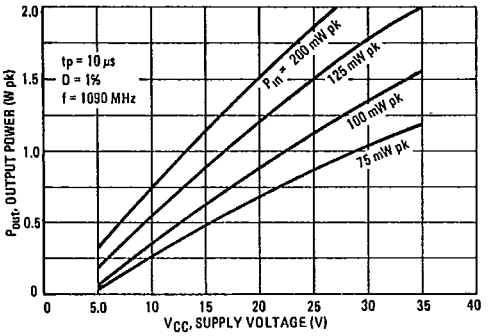


FIGURE 5 – POWER GAIN versus FREQUENCY

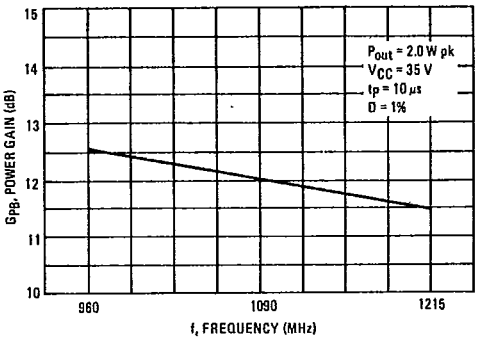
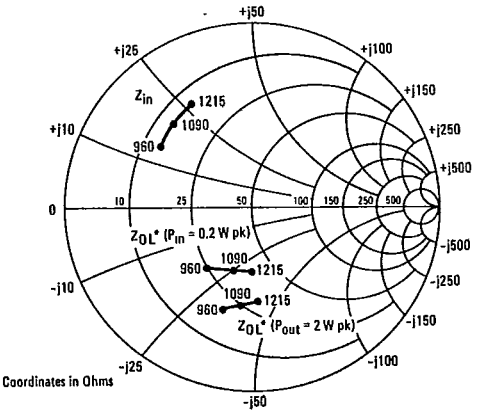


FIGURE 6 – SERIES EQUIVALENT INPUT/OUTPUT IMPEDANCE



V_{CC} = 35 Vdc,
tp = 10 μs, D = 1.0%

f MHz	Z_{in} Ohms	Z_{OL}* Ohms P_{out} = 2 W pk	Z_{OL}* Ohms P_{in} = 0.2 W pk
960	15.5 + j16.5	20 + j32.5	25 + j21
1090	15 + j20	25 + j34	31 + j26
1215	14 + j27	33.5 + j42.5	37 + j32.5

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

FIGURE 7 – 1090 MHz TEST AMPLIFIER

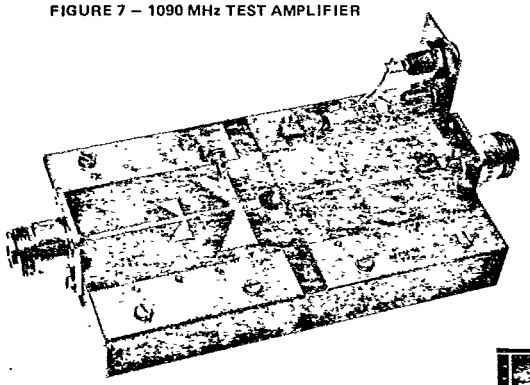


FIGURE 8 – TYPICAL LONG PULSE PERFORMANCE

P_{out} = 2.0 W pk
V_{CC} = 35 V
t_P = 1.0 ms
D = 10%
f = 1090 MHz

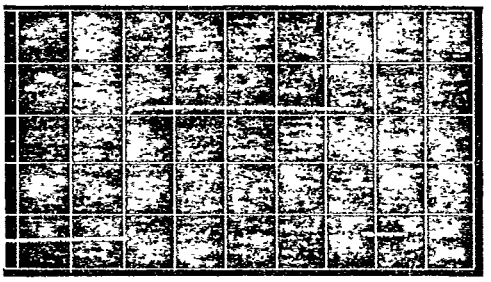
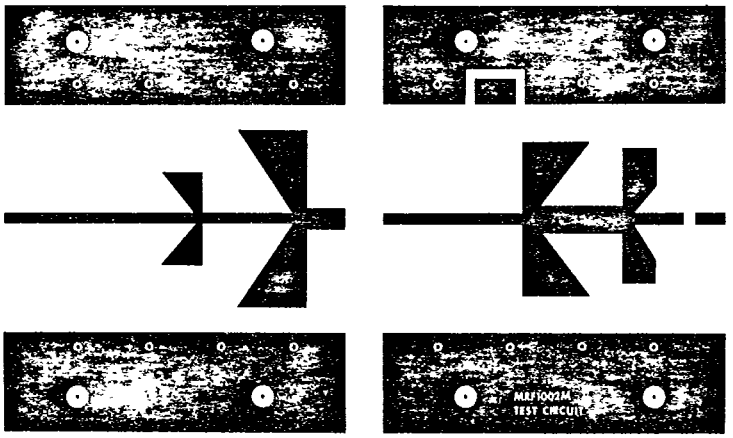


FIGURE 9 – PRINTED CIRCUIT BOARD LAYOUT – 1090 MHz TEST CIRCUIT



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