

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MRF1000MA
MRF1000MB
MRF1000MC

The RF Line

MICROWAVE PULSE POWER TRANSISTORS

... designed for Class A and AB *common emitter* amplifier applications in the low-power stages of IFF, DME, TACAN, radar transmitters, and CW systems.

- Guaranteed Performance @ 1090 MHz, 18 Vdc — Class A
Output Power = 0.2 Watt
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 1000M Types
- Internal Input Matching for Broadband Operation

MAXIMUM RATINGS

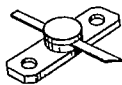
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V _{CEO}	20	Vdc
Collector-Base Voltage	V _{CBO}	50	Vdc
Emitter-Base Voltage	V _{EB0}	3.5	Vdc
Collector-Current — Continuous	I _C	200	mA _{dc}
Total Device Dissipation @ T _C = 25°C (1) Derate above 25°C	P _D	7.0 40	Watts mW/°C
Storage Temperature Range	T _{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

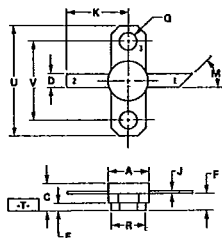
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	R _{θJC}	25	°C/W

- (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.

MRF1000MC
CASE 361A-01



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



- NOTES
1. DIM A, R AND U ARE DATUMS AND T IS A DATUM SURFACE AND SEATING PLANE.
2. POSITIONAL TOLERANCE FOR MOUNTING HOLES
⊕ 0.038 2.0154 ⊕ T | U ⊕ R ⊕
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

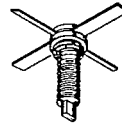
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	7.05	7.25	0.278	0.286
C	4.44	5.20	0.175	0.205
D	2.36	2.71	0.093	0.107
E	1.25	1.27	0.255	0.230
F	2.66	3.42	0.105	0.135
J	0.10	0.15	0.004	0.006
K	11.04	—	0.435	—
M	45° NOM	—	45° NOM	—
Q	3.04	34.2	0.120	0.135
R	6.08	6.66	0.240	0.260
U	20.06	25.57	0.790	0.810
V	14.77 BSC	—	0.581 BSC	—

0.7 W 960-1215 MHz

CLASS A/AB
MICROWAVE POWER
TRANSISTORS

NPN SILICON

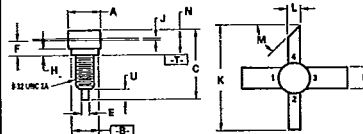
MRF1000MA
CASE 332-04



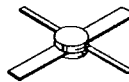
STYLE 2:
PIN 1 EMITTER
2 BASE
3 EMITTER
4 COLLECTOR

- NOTES
1. DIM A IS DATUM.
2. POSITIONAL TOLERANCE FOR LEADS
⊕ 0.076 0.038 ⊕ T | E ⊕
3. T IS SEATING PLANE.
4. DIMENSION E APPLIES TWO PLACES.
5. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	6.85	7.62	0.270	0.300
B	6.10	6.60	0.240	0.260
C	16.25	16.75	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	4.30	0.105	0.170
H	1.40	1.55	0.055	0.065
J	0.08	0.14	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	6.32	0.180	0.245
U	2.92	3.68	0.115	0.145

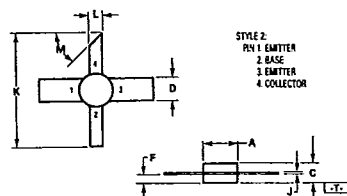


MRF1000MB
CASE 332A-01



- NOTES
1. DIM A IS DATUM.
2. POSITIONAL TOLERANCE FOR LEADS
⊕ 0.076 0.038 ⊕ T | A ⊕
3. T IS SEATING PLANE.
4. DIM E APPLIES 2 PLACES.
5. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	6.85	7.54	0.270	0.295
C	3.30	3.81	0.130	0.150
D	4.95	5.21	0.195	0.205
F	1.40	1.75	0.055	0.070
J	0.08	0.15	0.003	0.007
K	15.24	—	0.600	—
L	2.41	2.67	0.095	0.105
M	45° NOM	—	45° NOM	—



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

MRF1000MA, MRF1000MB, MRF1000MC

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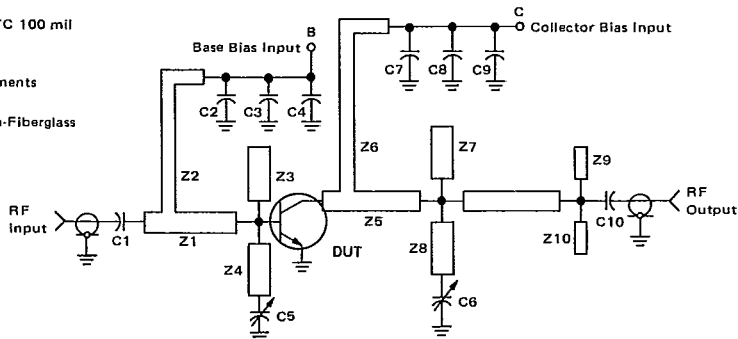
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ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

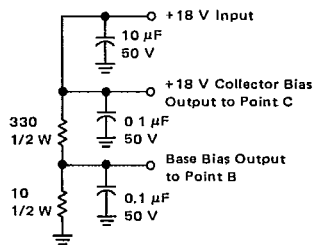
Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I _C = 5.0 mA, I _B = 0)	V _{(BR)CEO}	20	—	—	Vdc
Collector-Emitter Breakdown Voltage (I _C = 5.0 mA, V _{BE} = 0)	V _{(BR)CES}	50	—	—	Vdc
Collector-Base Breakdown Voltage (I _C = 5.0 mA, I _E = 0)	V _{(BR)CBO}	50	—	—	Vdc
Emitter-Base Breakdown Voltage (I _E = 1.0 mA, I _C = 0)	V _{(BR)EBO}	3.5	—	—	Vdc
Collector Cutoff Current (V _{CB} = 20 Vdc, I _E = 0)	I _{CBO}	—	—	0.5	mA
ON CHARACTERISTICS					
DC Current Gain (I _C = 100 mA, V _{CE} = 5.0 Vdc)	h _{FE}	10	—	100	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V _{CB} = 28 Vdc, I _E = 0, f = 1.0 MHz)	C _{ob}	—	2.0	5.0	pF
FUNCTIONAL TESTS					
Common-Emitter Power Gain — Class A (V _{CE} = 18 Vdc, I _C = 100 mA, f = 1090 MHz, P _{out} = 200 mW)	G _{PE}	10	12	—	dB
Common-Emitter Power Gain — Class AB (V _{CE} = 18 Vdc, I _{CQ} = 10 mA, f = 1090 MHz, P _{out} = 0.7 W)	G _{PE}	—	10.7	—	dB
Load Mismatch — Class A (V _{CE} = 18 Vdc, I _C = 100 mA, f = 1090 MHz, P _{out} = 200 mW, VSWR = 10:1 All Phase Angles)	ψ	No Degradation in Power Output			

FIGURE 1 — 1090 MHz TEST CIRCUIT

- C1, C2, C3, C7, C8, C10 — 220 pF ATC 100 mil
- C4, C9 — 4.7 μF 50 V Tantalum
- C5, C6 — 0.8-8 pF Johanson #7290
- Z1-Z10 — Distributed Microstrip Elements — See Figure 8
- Board Material — 0.031" Thick Teflon-Fiberglass
ε_r = 2.56



Class AB Bias Control Circuit
18 V Output I_{CQ} 10 mA Nominal



Class A Constant Current Bias Control Circuit
I_C = 100 mA, V_{CE} = 18 V.

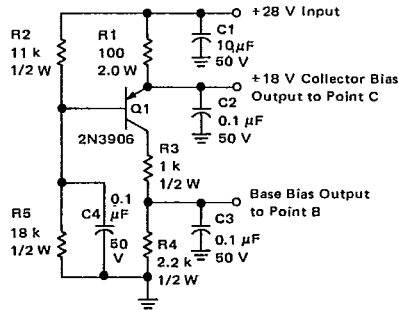


FIGURE 2 – OUTPUT POWER versus INPUT POWER

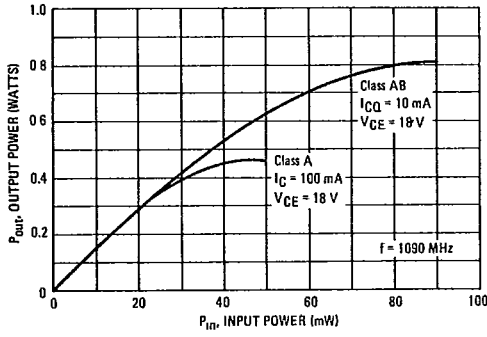


FIGURE 3 – OUTPUT POWER versus FREQUENCY

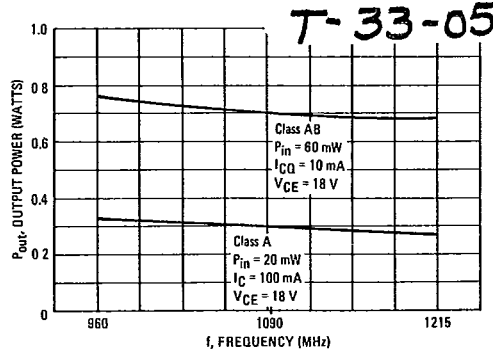


FIGURE 4 – DC SAFE OPERATING AREA

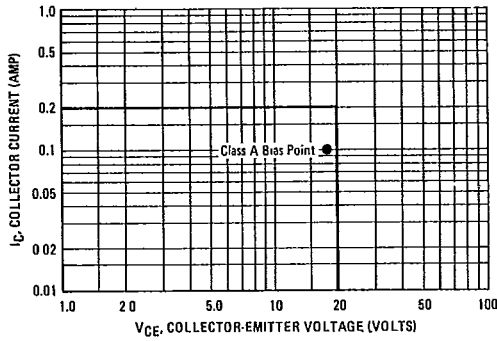


FIGURE 5 – POWER GAIN versus FREQUENCY

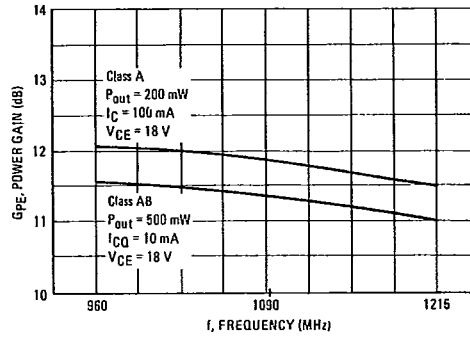
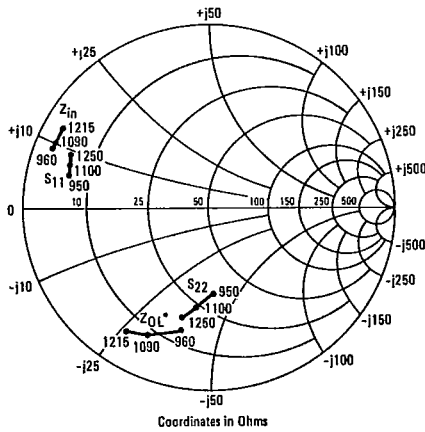


FIGURE 6 – COMMON-EMITTER S-PARAMETERS AND SERIES EQUIVALENT INPUT/OUTPUT IMPEDANCES



SERIES EQUIVALENT IMPEDANCES

P_{out} = 0.5 W, V_{CE} = 18 Vdc,
I_{CQ} = 10 mA dc, Class AB

f MHz	Z _{in} Ohms	Z _{OL} [*] Ohms
960	3.0 + j9.0	16 - j4.0
1090	3.2 + j1.0	8.5 - j3.1
1215	2.8 + j1.2	7.0 - j2.6

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

S PARAMETERS – V_{CE} = 18 Vdc, I_C = 100 mA dc, Class A

f MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	S ₁₁	∠φ	S ₂₁	∠φ	S ₁₂	∠φ	S ₂₂	∠φ
950	0.77	166	2.42	40	0.016	42	0.48	-87
1000	0.78	165	2.36	38	0.016	48	0.50	-90
1050	0.77	163	2.31	33	0.016	46	0.51	-94
1100	0.77	162	2.31	28	0.016	46	0.54	-97
1150	0.78	161	2.20	23	0.015	46	0.57	-100
1200	0.78	159	2.20	19	0.016	47	0.59	-103
1250	0.78	158	2.12	12	0.016	42	0.61	-106

MRF1000MA, MRF1000MB, MRF1000MC

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FIGURE 7 - 1090 MHz TEST AMPLIFIER

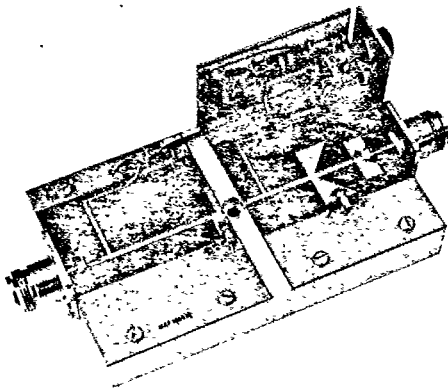
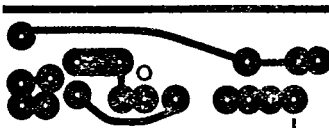


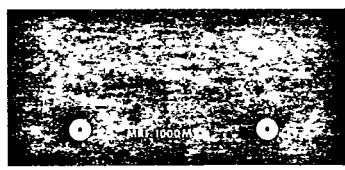
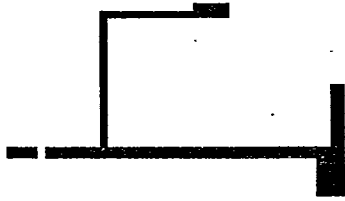
FIGURE 8 - PRINTED CIRCUIT BOARD LAYOUT - 1090 MHz TEST CIRCUIT



CLASS A BIAS NETWORK



AMPLIFIER



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