MRF1000MA
MRF1000MB
MRF1000MC

The RF Line

0.7 W 960-1215 MHz

CLASS A/AB MICROWAVE POWER TRANSISTOR

NPN SILICON

MICROWAVE PULSE POWER TRANSISTOR

. . . 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

3

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	200	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

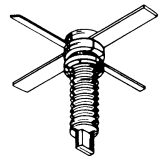
THERMAL CHARACTERISTICS

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.

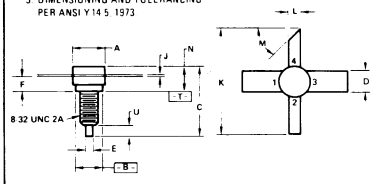
MRF1000MA
CASE 332-01



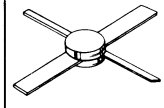
DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	7.01	7.62	0.276	0.300
B	6.20	6.50	0.244	0.256
C	16.26	16.76	0.640	0.660
D	4.95	5.21	0.195	0.205
E	1.40	1.65	0.055	0.065
F	2.92	3.43	0.115	0.135
J	0.08	0.18	0.003	0.007
K	15.24	–	0.600	–
L	2.41	2.67	0.095	0.105
M	45° Nom		45° Nom	
N	5.08	5.46	0.200	0.215
U	2.92	3.68	0.115	0.145

NOTES:
1. DIM B IS DATUM.
2. POSITIONAL TOLERANCE FOR LEADS:
   ⌖ 0.76(0.030) Ⓜ T B Ⓜ
3. T IS SEATING PLANE.
4. DIMENSION K APPLIES TWO PLACES.
5. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

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



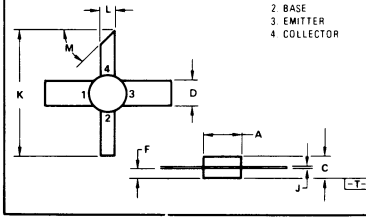
MRF1000MB
CASE 332A-01



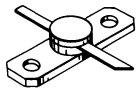
DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	7.01	7.62	0.276	0.300
B	6.20	6.50	0.244	0.256
C	3.30	3.81	0.130	0.150
D	4.95	5.21	0.195	0.205
F	1.40	1.78	0.055	0.070
J	0.08	0.18	0.003	0.007
K	15.24	–	0.600	–
L	2.41	2.67	0.095	0.105
M	45° NOM		45° NOM	

NOTES:
1. DIM A IS DATUM.
2. POSITIONAL TOLERANCE FOR LEADS:
   ⌖ 0.76(0.030) Ⓜ T A Ⓜ
3. T IS SEATING PLANE.
4. DIM K APPLIES 2 PLACES.
5. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

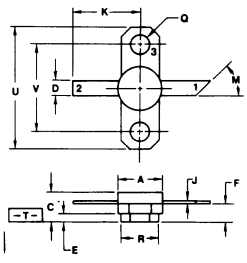
STYLE 2
PIN 1. EMITTER
2. BASE
3. EMITTER
4. COLLECTOR



MRF1000MC



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



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:
   ⌖ ∅ 0.38 (0.015) Ⓜ T U Ⓜ R Ⓜ
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

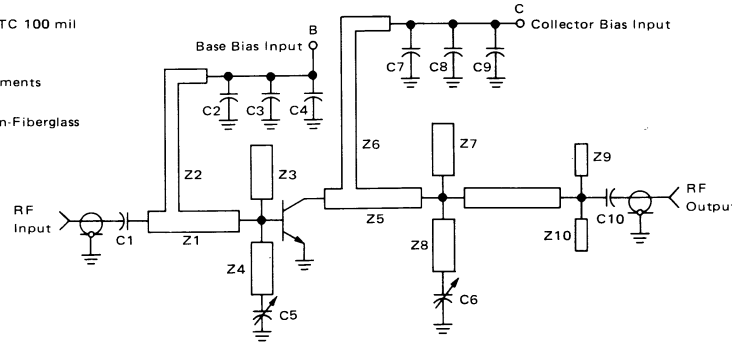
DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	7.06	7.26	0.278	0.286
C	4.44	5.20	0.175	0.205
D	2.36	2.71	0.093	0.107
E	1.39	1.77	0.055	0.070
F	2.66	3.42	0.105	0.135
J	0.10	0.15	0.004	0.006
K	11.04	–	0.435	–
M	45° NOM		45° NOM	
Q	3.04	34.2	0.120	0.135
R	6.09	6.86	0.240	0.260
U	20.06	20.57	0.790	0.810
V	14.27 BSC		0.562 BSC	

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

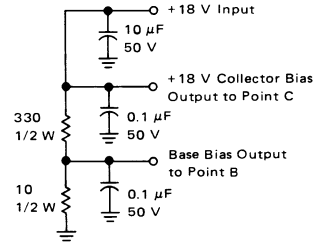
Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 5.0 mAdc, I_B = 0)	$V_{(BR)CEO}$	20	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 5.0 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	50	—	—	Vdc
Collector-Base Breakdown Voltage (I_C = 5.0 mAdc, I_E = 0)	$V_{(BR)CBO}$	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} = 20 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} = 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 mAdc, 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 mAdc, f = 1090 MHz, P_{out} = 0.7 W)	G_{PE}	—	10.7	—	dB
Load Mismatch — Class A (V_{CE} = 18 Vdc, I_C = 100 mAdc, 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.

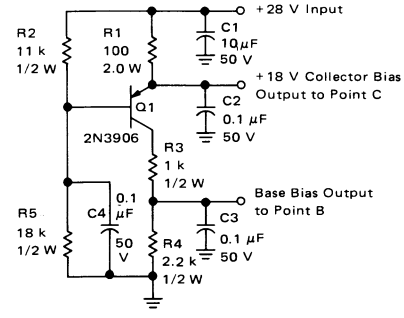


FIGURE 2 – OUTPUT POWER versus INPUT POWER

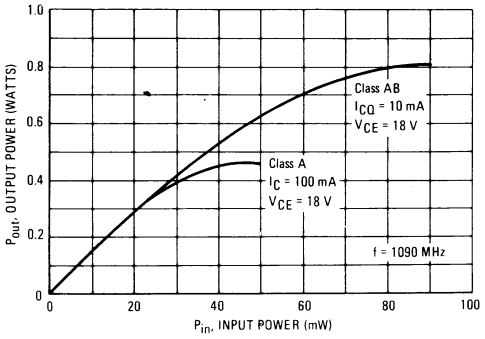


FIGURE 3 – OUTPUT POWER versus FREQUENCY

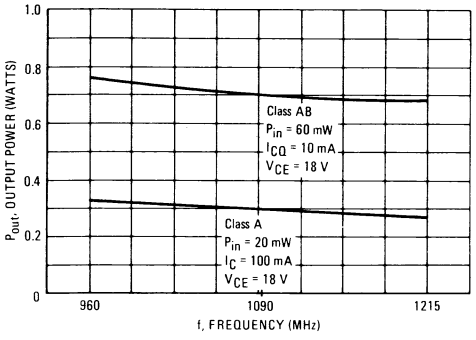


FIGURE 4 – DC SAFE OPERATING AREA

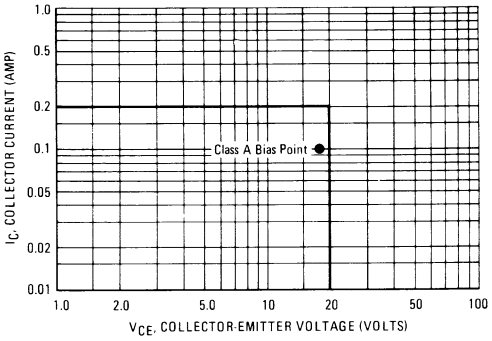


FIGURE 5 – POWER GAIN versus FREQUENCY

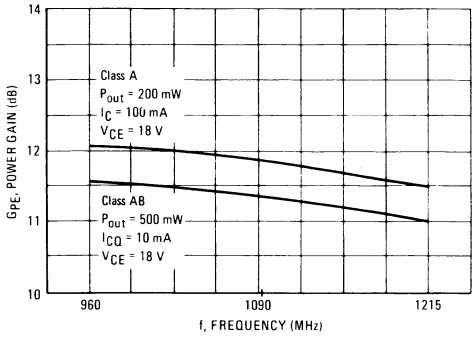
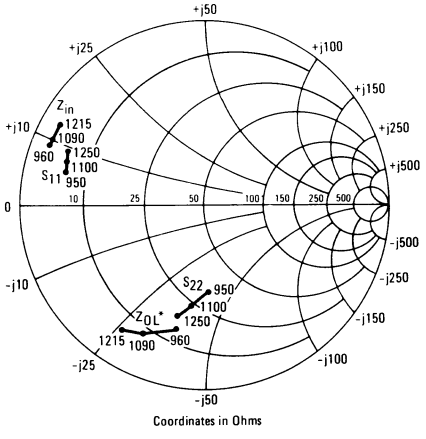


FIGURE 6 – COMMON-EMITTER S-PARAMETERS AND SERIES EQUIVALENT INPUT/OUTPUT IMPEDANCES



SERIES EQUIVALENT IMPEDANCES
P_{out} = 0.5 W, V_{CE} = 18 Vdc,
I_{CQ} = 10 mAdc, Class AB

f MHz	Z_{in} Ohms	Z_{OL}^* Ohms
960	3.0 + j9.0	16 – j40
1090	3.2 + j10	8.5 – j31
1215	2.8 + j12	7.0 – j26

*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 mAdc, Class A

f	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	$\|S_{11}\|$	∠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

FIGURE 7 – 1090 MHz TEST AMPLIFIER

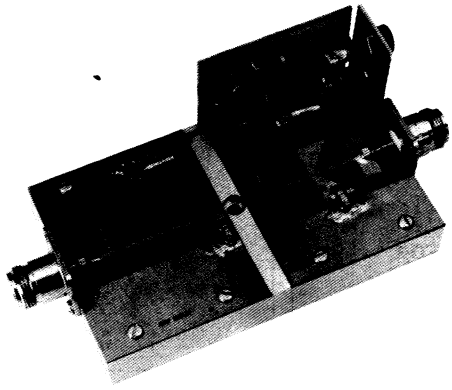
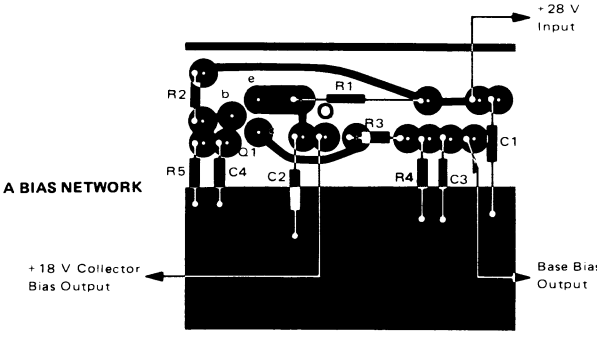
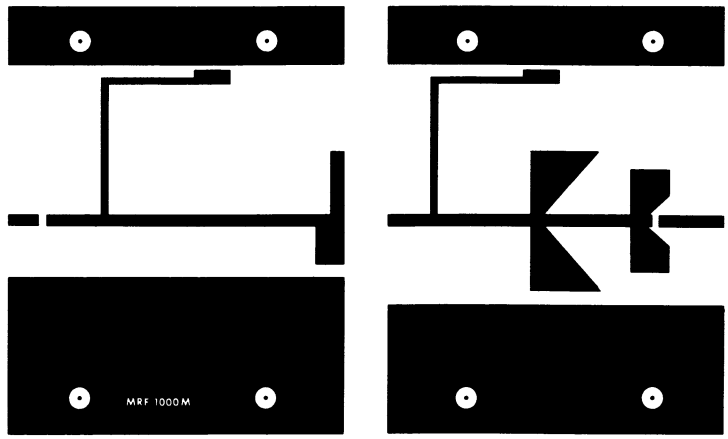


FIGURE 8 – PRINTED CIRCUIT BOARD
LAYOUT – 1090 MHz TEST CIRCUIT



AMPLIFIER



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

3

MRF1002MA
MRF1002MB
MRF1002MC

The RF Line

2.0 W PEAK 960-1215 MHz

MICROWAVE POWER TRANSISTOR

NPN SILICON

MICROWAVE PULSE POWER TRANSISTOR

. . . 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

3

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

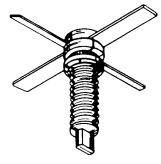
THERMAL CHARACTERISTICS

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.

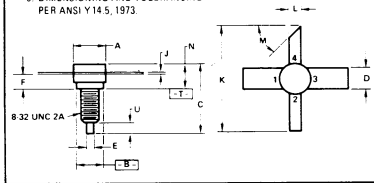
MRF1002MA
CASE 332-01



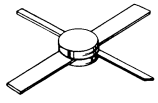
DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	7.01	7.62	0.276	0.300
B	6.20	6.50	0.244	0.256
C	16.26	16.76	0.640	0.660
D	4.95	5.21	0.195	0.205
E	1.40	1.65	0.055	0.065
F	2.92	3.43	0.115	0.135
J	0.08	0.18	0.003	0.007
K	15.24	–	0.600	–
L	2.41	2.67	0.095	0.105
M	45° Nom		45° Nom	
N	5.08	5.46	0.200	0.215
U	2.92	3.68	0.115	0.145

NOTES:
1. DIM [B] IS DATUM.
2. POSITIONAL TOLERANCE FOR LEADS:
   ⌖ 0.76(0.030)Ⓜ T BⓂ
3. [T] IS SEATING PLANE.
4. DIMENSION K APPLIES TWO PLACES.
5. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

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



MRF1002MB
CASE 332A-01



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B	6.20	6.50	0.244	0.256
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	0.18	0.003	0.007
K	15.24	–	0.600	–
L	2.41	2.67	0.095	0.105
M	45° NOM		45° NOM	

NOTES:
1. DIM [A] IS DATUM.
2. POSITIONAL TOLERANCE FOR LEADS:
   ⌖ 0.76(0.030)Ⓜ T AⓂ
3. [T] IS SEATING PLANE.
4. DIM K APPLIES 2 PLACES.
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STYLE 1:
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2. EMITTER
3. BASE
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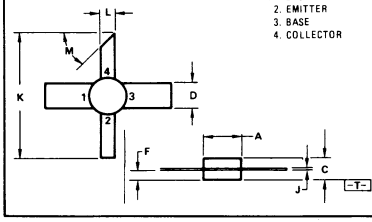
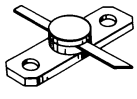
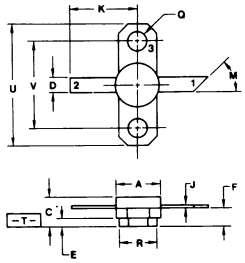


MRF1002MC



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



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:
   ⌖ ∮ 0.38 (0.015) Ⓜ T U Ⓜ R Ⓜ
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

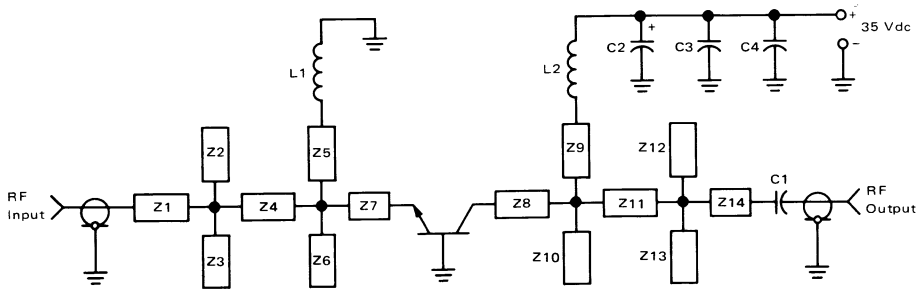
DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	7.06	7.26	0.278	0.286
C	4.44	5.20	0.175	0.205
D	2.36	2.71	0.093	0.107
E	1.39	1.77	0.055	0.070
F	2.66	3.42	0.105	0.135
J	0.10	0.15	0.004	0.006
K	11.04	–	0.435	–
M	45° NOM		45° NOM	
Q	3.04	34.2	0.120	0.135
R	6.09	6.86	0.240	0.260
U	20.08	20.67	0.790	0.810
V	14.27 BSC		0.562 BSC	

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)	$V_{(BR)EBO}$	4.0	—	—	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			

3

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

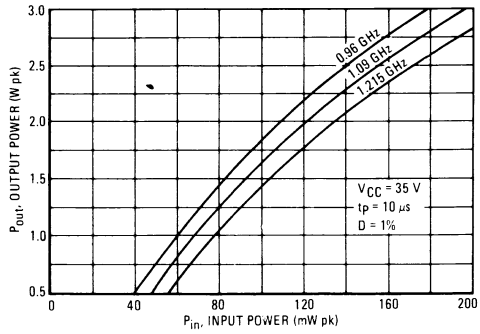


FIGURE 3 – OUTPUT POWER versus FREQUENCY

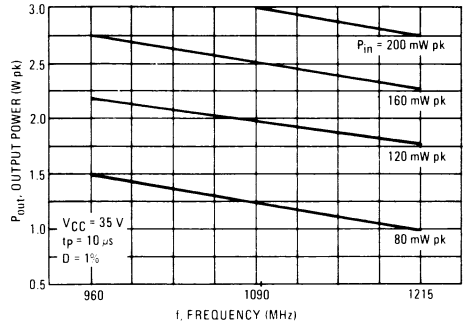


FIGURE 4 – OUTPUT POWER versus SUPPLY VOLTAGE

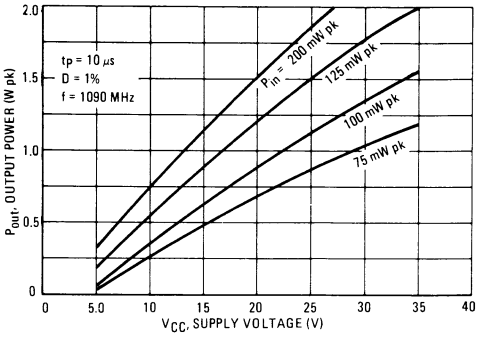


FIGURE 5 – POWER GAIN versus FREQUENCY

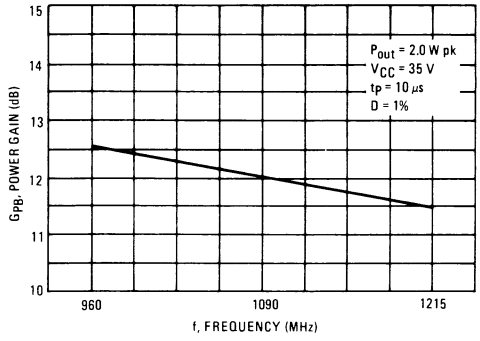
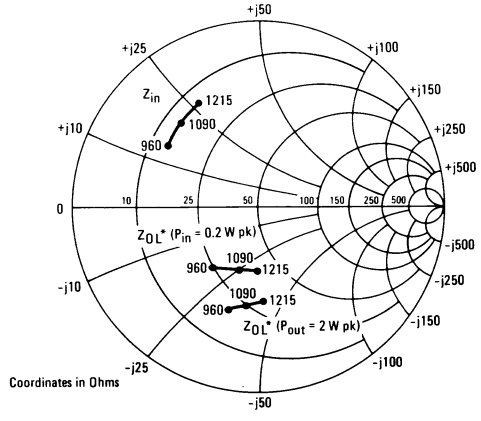


FIGURE 6 – SERIES EQUIVALENT INPUT/OUTPUT IMPEDANCE



V_{CC} = 35 Vdc,
t_p = 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

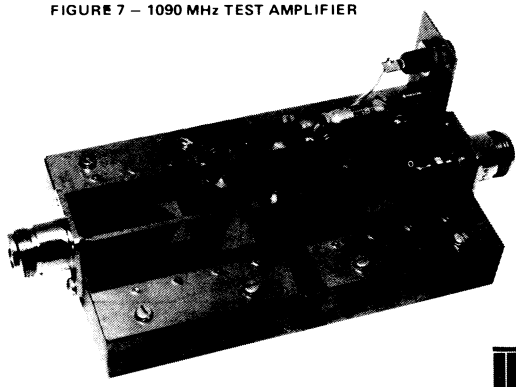


FIGURE 8 – TYPICAL LONG PULSE PERFORMANCE

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

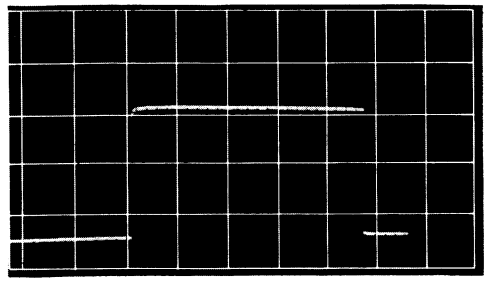
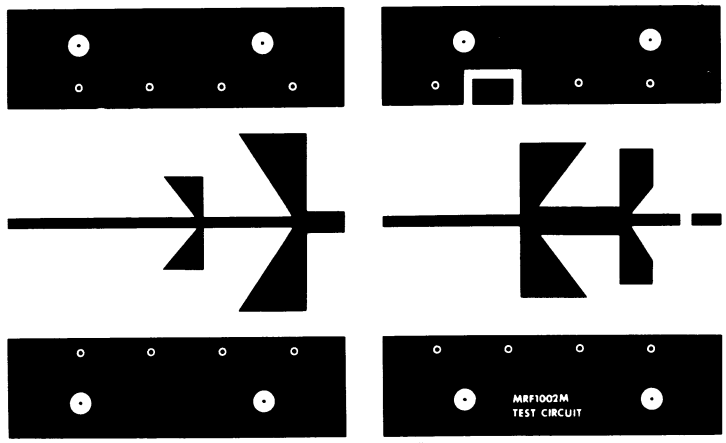


FIGURE 9 – PRINTED CIRCUIT BOARD LAYOUT – 1090 MHz TEST CIRCUIT



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

MRF1004MA
MRF1004MB
MRF1004MC

The RF Line

4.0 W 960-1215 MHz

MICROWAVE POWER TRANSISTOR

NPN SILICON

MICROWAVE PULSE POWER TRANSISTOR

. . . 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 = 4.0 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 1004M 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

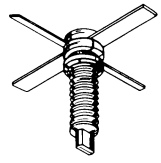
THERMAL CHARACTERISTICS

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.

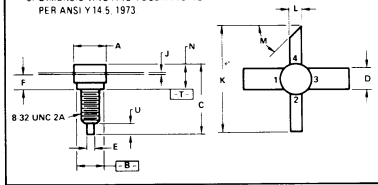
MRF1004MA
CASE 332-01



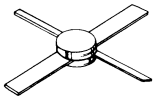
DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	7.01	7.62	0.276	0.300
B	6.20	6.50	0.244	0.256
C	16.26	16.76	0.640	0.660
D	4.95	5.21	0.195	0.205
E	1.40	1.65	0.055	0.065
F	2.92	3.43	0.115	0.135
J	0.08	0.18	0.003	0.007
K	15.24	–	0.600	–
L	2.41	2.67	0.095	0.105
M	45° Nom		45° Nom	
N	5.08	5.46	0.200	0.215
U	2.92	3.68	0.115	0.145

NOTES:
1. DIM B IS DATUM.
2. POSITIONAL TOLERANCE FOR LEADS:
   ⌖ 0.76(0.030) Ⓜ T B Ⓜ
3. T IS SEATING PLANE.
4. DIMENSION K APPLIES TWO PLACES.
5. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

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



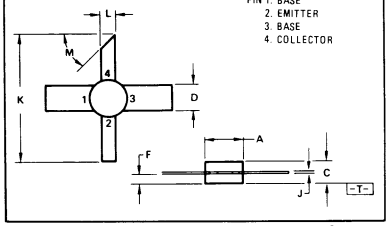
MRF1004MB
CASE 332A-01



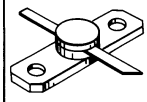
DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	7.01	7.62	0.276	0.300
B	6.20	6.50	0.244	0.256
C	3.30	3.81	0.130	0.150
D	4.95	5.21	0.195	0.205
F	1.40	1.78	0.055	0.070
J	0.08	0.18	0.003	0.007
K	15.24	–	0.600	–
L	2.41	2.67	0.095	0.105
M	45° NOM		45° NOM	

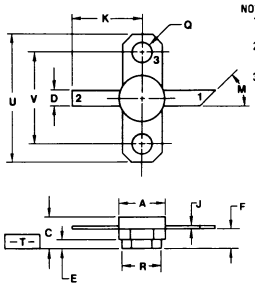
NOTES:
1. DIM A IS DATUM.
2. POSITIONAL TOLERANCE FOR LEADS
   ⌖ 0.76(0.030) Ⓜ T A Ⓜ
3. T IS SEATING PLANE.
4. DIM K APPLIES 2 PLACES.
5. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

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



MRF1004MC
CASE 361A-01





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

NOTES:
1. DIMENSIONS R AND U ARE DATUMS AND T IS A DATUM SURFACE AND SEATING PLANE.
2. POSITIONAL TOLERANCE FOR MOUNTING HOLES:
   ⌖ ∮ 0.38 (0.015) Ⓜ T U Ⓜ R Ⓜ
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

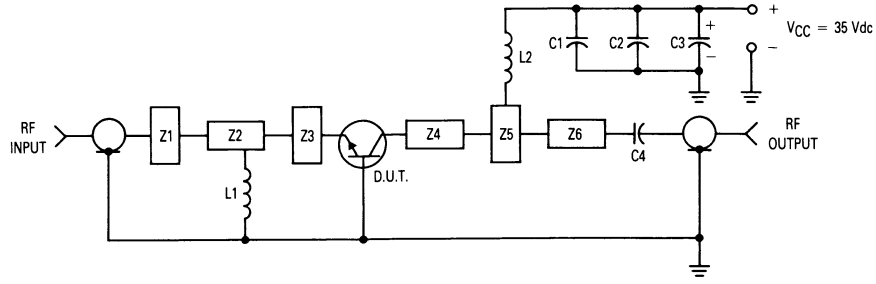
DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	7.06	7.26	0.278	0.286
C	4.44	5.20	0.175	0.205
D	2.36	2.71	0.093	0.107
E	1.39	1.77	0.055	0.070
F	2.66	3.42	0.105	0.135
J	0.10	0.15	0.004	0.006
K	11.04	–	0.435	–
M	45° NOM		45° NOM	
Q	3.04	34.2	0.120	0.135
R	6.08	6.86	0.240	0.260
U	20.06	20.57	0.790	0.810
V	14.27 BSC		0.562 BSC	

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 = 75 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}	—	3.3	5.0	pF
FUNCTIONAL TESTS (Pulse Width = 10 μs, Duty Cycle = 1.0%)					
Common-Base Amplifier Power Gain (V_{CC} = 35 Vdc, P_{out} = 4.0 W pk, f = 1090 MHz)	G_{PB}	10	11	—	dB
Collector Efficiency (V_{CC} = 35 Vdc, P_{out} = 4.0 W pk, f = 1090 MHz)	η	40	45	—	%
Load Mismatch (V_{CC} = 35 Vdc, P_{out} = 4.0 W pk, f = 1090 MHz VSWR = 10:1 All Phase Angles)	ψ	No Degradation in Power Output			

3

FIGURE 1. 1090 MHz TEST CIRCUIT



L1, L2 — 3 Turns #18 AWG, ⅛" ID
C1 — 0.1 μF
C2, C4 — 220 pF Chip Capacitor
C3 — 20 μF, 50 V Electrolytic
Board Material — 0.031" Thick Glass Teflon
Z1–Z6 Distributed Microstrip Elements — See Figure 9

FIGURE 2 – OUTPUT POWER versus INPUT POWER

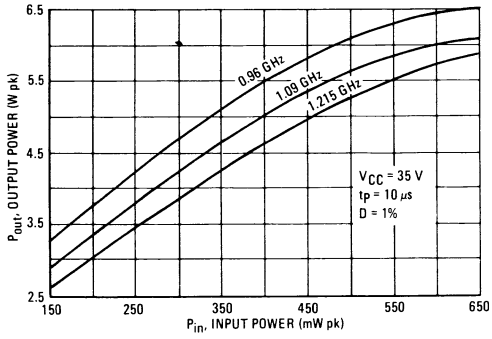


FIGURE 3 – OUTPUT POWER versus FREQUENCY

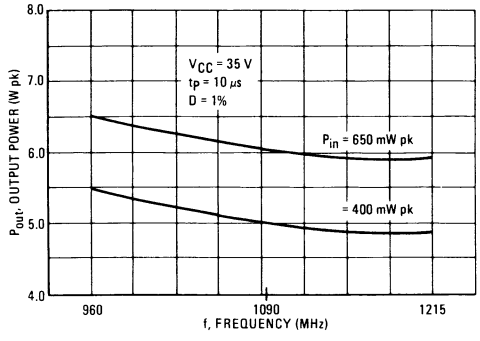


FIGURE 4 – OUTPUT POWER versus SUPPLY VOLTAGE

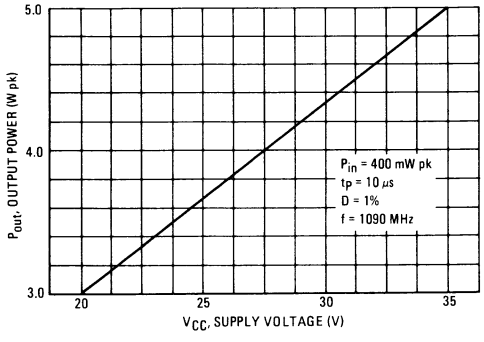


FIGURE 5 – POWER GAIN versus FREQUENCY

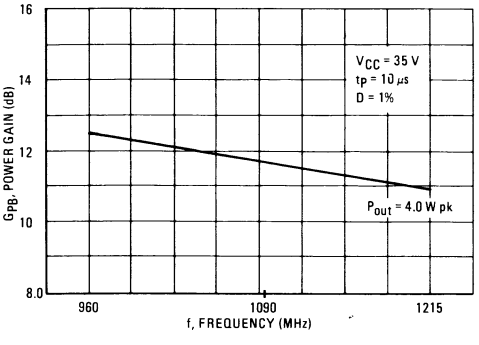
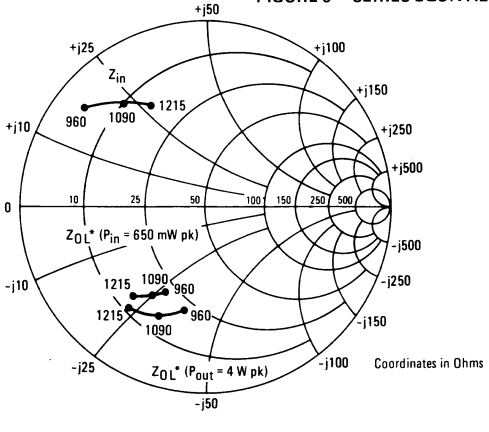


FIGURE 6 – SERIES EQUIVALENT INPUT/OUTPUT IMPEDANCE



f MHz	Z_{in} Ohms	Z_{OL}* (P_{in} = 400 mW pk) Ohms	Z_{OL}* (P_{out} = 4 W pk) Ohms
960	5.0 + 17.5	23.5 – j26	22.5 – j36
1090	10 + j23	18.5 – j25	15 – j32.5
1215	16 + j29.5	15.5 – j23.5	11 – j23

*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

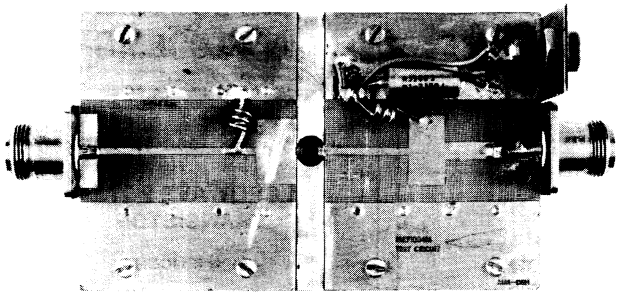


FIGURE 8 – TYPICAL LONG PULSE PERFORMANCE

P_{out} = 4.0 W pk
V_{CC} = 35 V
t_P = 1.0 ms
D = 10%
f = 1090 MHz

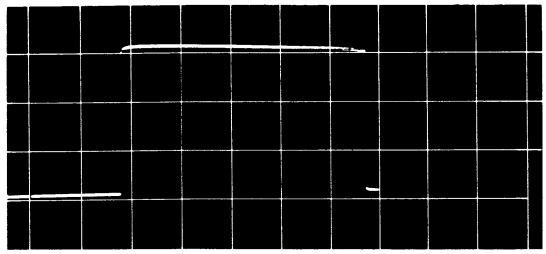
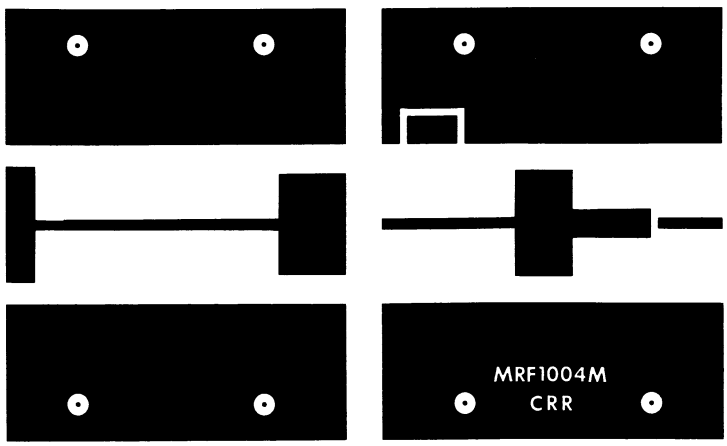


FIGURE 9 – PRINTED CIRCUIT BOARD LAYOUT – 1090 MHz TEST CIRCUIT



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

MRF1008MA
MRF1008MB
MRF1008MC

The RF Line

8.0 W PEAK 960-1215 MHz

MICROWAVE POWER TRANSISTOR

NPN SILICON

MICROWAVE PULSE POWER TRANSISTOR

. . . 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 = 8.0 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 1008M 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	500	mAdc
Total Device Dissipation @ T_C = 25°C (1) Derate above 25°C	P_D	11.6 67	Watts mW/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

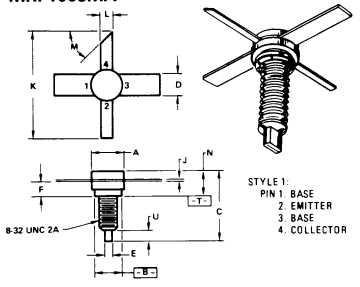
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	$R_{\theta JC}$	15	°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.

MRF1008MA

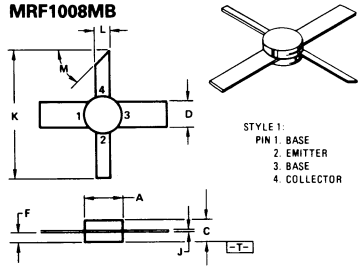


DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	7.01	7.62	0.276	0.300
B	6.20	6.50	0.244	0.256
C	16.26	16.76	0.640	0.660
D	4.95	5.21	0.195	0.205
E	1.40	1.65	0.055	0.065
F	2.92	3.43	0.115	0.135
J	0.08	0.18	0.003	0.007
K	15.24	–	0.600	–
L	2.41	2.67	0.095	0.105
M	45° Nom		45° Nom	
N	5.08	5.46	0.200	0.215
U	2.92	3.68	0.115	0.145

NOTES:
1. DIM [B] IS DATUM.
2. POSITIONAL TOLERANCE FOR LEADS:
   ⌖ 0.76(0.030)Ⓜ T BⓂ
3. [T] IS SEATING PLANE.
4. DIMENSION K APPLIES TWO PLACES.
5. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

CASE 332-01

MRF1008MB

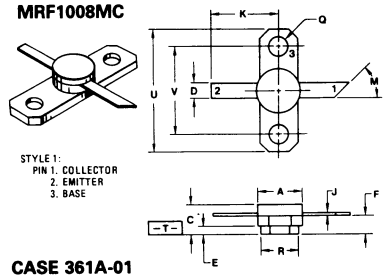


NOTES:
1. DIM [A] IS DATUM.
2. POSITIONAL TOLERANCE FOR LEADS:
   ⌖ 0.76 (0.030)Ⓜ T AⓂ
3. [T] IS SEATING PLANE.
4. DIM K APPLIES 2 PLACES.
5. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	7.01	7.62	0.276	0.300
B	6.20	6.50	0.244	0.256
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	

CASE 332A-01

MRF1008MC



NOTES:
1. DIMENSIONS R AND U ARE DATUMS AND T IS A DATUM SURFACE AND SEATING PLANE.
2. POSITIONAL TOLERANCE FOR MOUNTING HOLES:
   ⌖ ∮ 0.38 (0.015) Ⓜ T Ⓤ Ⓜ R Ⓜ
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	2.38	2.71	0.093	0.107
E	1.39	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	34.2	0.120	0.135
R	6.06	6.86	0.240	0.260
U	20.06	20.57	0.790	0.810
V	14.27 BSC		0.562 BSC	

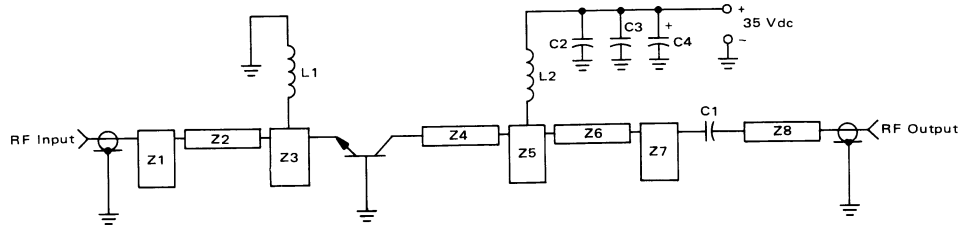
CASE 361A-01

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 = 150 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}	—	3.5	6.0	pF
FUNCTIONAL TESTS (Pulse Width = 10 μs, Duty Cycle =1%)					
Common-Base Amplifier Power Gain (V_{CC} = 35 Vdc, P_{out} = 8.0 W Peak, f = 1090 MHz)	G_{PB}	10	12	—	dB
Collector Efficiency (V_{CC} = 35 Vdc, P_{out} = 8.0 W Peak, f = 1090 MHz)	η	40	45	—	%
Load Mismatch (V_{CC} = 35 Vdc, P_{out} = 8.0 W Peak, f = 1090 MHz, VSWR = 10:1 All Phase Angles)	ψ	No Degradation in Output Power			

3

FIGURE 1 – 1090 MHz TEST CIRCUIT



C1, C2 – 220 pF 100 mil Chip Capacitor
C3 – 0.1 μF
C4 – 10 μF/50 V Electrolytic Capacitor

L1, L2 – 3 Turns #18 AWG, 1/8" ID
Z1 – Z8 – Microstrip, See Photomaster
Board Material – 0.031" Glass Teflon, ϵ_r = 2.5

FIGURE 2 – OUTPUT POWER versus INPUT POWER

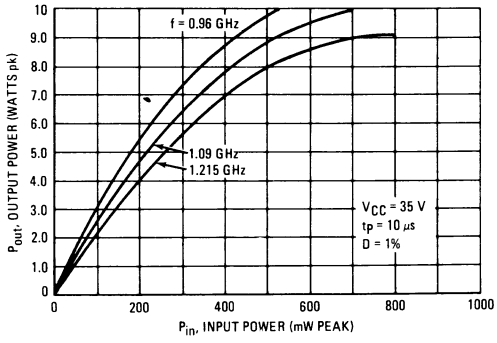


FIGURE 3 – OUTPUT POWER versus FREQUENCY

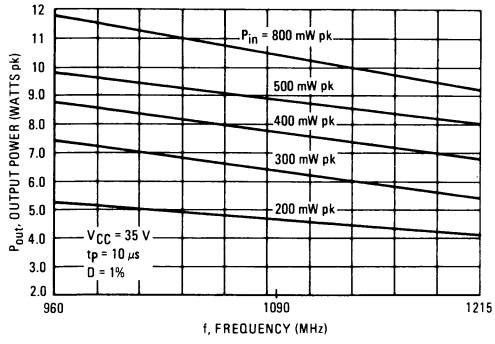


FIGURE 4 – OUTPUT POWER versus SUPPLY VOLTAGE

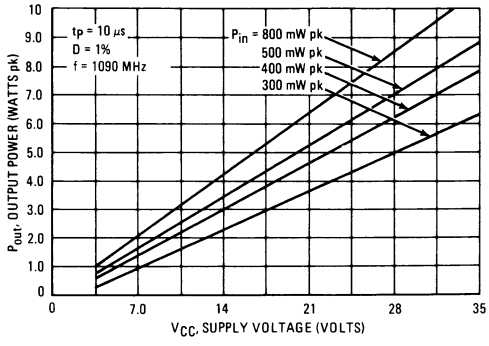


FIGURE 5 – POWER GAIN versus FREQUENCY

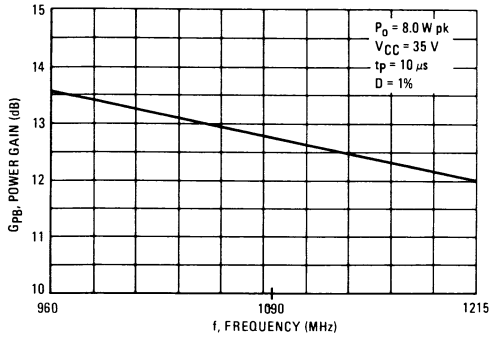
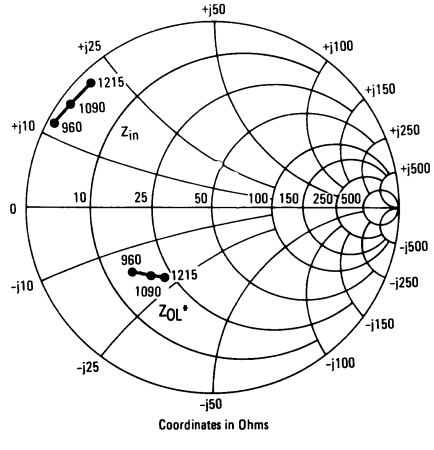


FIGURE 6 – SERIES EQUIVALENT INPUT/OUTPUT IMPEDANCES



Coordinates in Ohms

V_{CC} = 35 V
P_o = 8.0 W pk

f MHz	Z_{in} Ohms	$*Z_{OL}$ Ohms
960	1.5 + j13	17 – j16
1090	2.0 + j17	20 – j18.5
1215	3.0 + j20	23 – j20

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

FIGURE 7–1090 MHz TEST AMPLIFIER

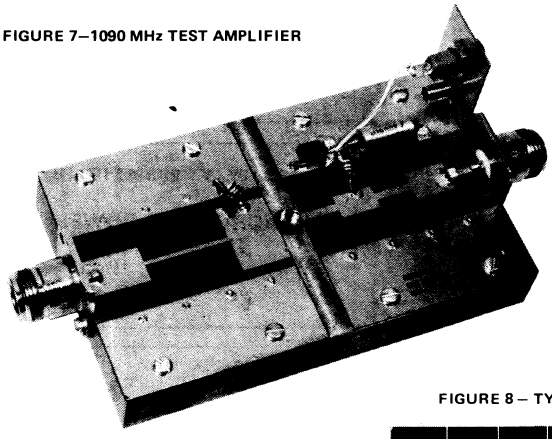


FIGURE 8 – TYPICAL LONG PULSE PERFORMANCE

P_{out} = 8.0 W peak
V_{CC} = 35 V
t_p = 1 ms
D = 10%
f = 1090 MHz

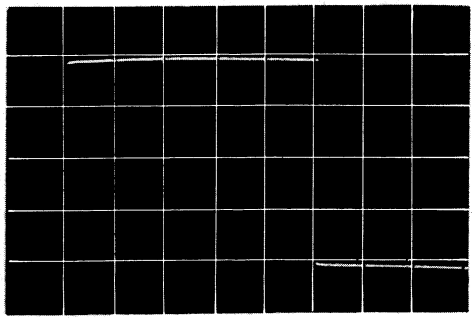
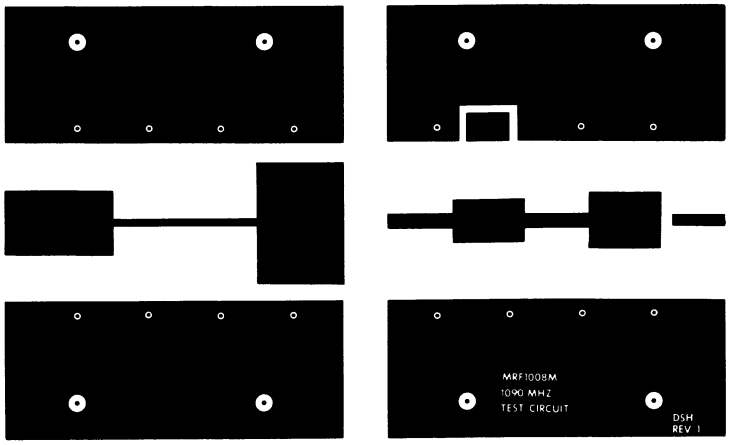


FIGURE 9–PRINTED CIRCUIT BOARD LAYOUT–1090 MHz TEST CIRCUIT



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

o Soldered Eyelet

MRF1015MA
MRF1015MB
MRF1015MC

The RF Line

15 W PEAK 960-1215 MHz

MICROWAVE POWER TRANSISTOR

NPN SILICON

MICROWAVE PULSE POWER TRANSISTOR

. . . 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, 50 Vdc
  Output power = 15 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 1015M Types
- Internal Input Matching for Broadband Operation

MAXIMUM RATINGS

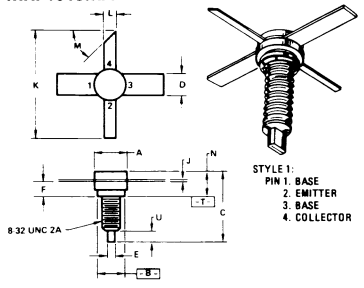
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CES}	60	Vdc
Collector-Base Voltage	V_{CBO}	60	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector-Current — Continuous	I_C	1.0	Adc
Total Device Dissipation @ T_C = 25°C (1) Derate above 25°C	P_D	17.5 100	Watts mW/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	$R_{\theta JC}$	10	°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.

MRF1015MA

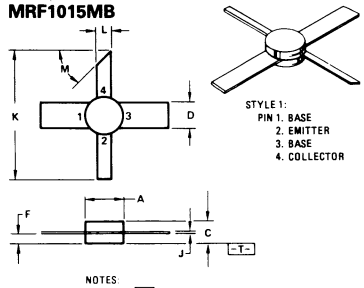


DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	7.01	7.62	0.276	0.300
B	6.20	6.50	0.244	0.256
C	16.26	16.76	0.640	0.660
D	4.95	5.21	0.195	0.205
E	1.40	1.65	0.055	0.065
F	2.92	4.32	0.115	0.170
J	0.08	0.18	0.003	0.007
K	15.24	–	0.600	–
L	2.41	2.67	0.095	0.105
M	45° Nom		45° Nom	
N	4.57	6.22	0.180	0.245
U	2.92	3.68	0.115	0.145

NOTES:
1. DIM [B] IS DATUM.
2. POSITIONAL TOLERANCE FOR LEADS:
   [⌖] 0.76(0.030) Ⓜ [T] [B] Ⓜ
3. [T] IS SEATING PLANE.
4. DIMENSION K APPLIES TWO PLACES.
5. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

CASE 332-03

MRF1015MB

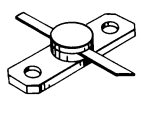


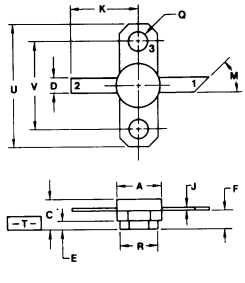
NOTES:
1. DIM [A] IS DATUM.
2. POSITIONAL TOLERANCE FOR LEADS:
   [⌖] 0.76(0.030) Ⓜ [T] [A] Ⓜ
3. [T] IS SEATING PLANE.
4. DIM K APPLIES 2 PLACES.
5. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	7.01	7.62	0.276	0.300
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	

CASE 332A-01

MRF1015MC





NOTES:
1. DIMENSIONS R AND U ARE DATUMS AND T IS A DATUM SURFACE AND SEATING PLANE.
2. POSITIONAL TOLERANCE FOR MOUNTING HOLES:
   [⌖] Ø 0.38 (0.015) Ⓜ [T] [U] Ⓜ [R] Ⓜ
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	7.06	7.26	0.278	0.286
C	4.44	5.20	0.175	0.205
D	2.36	2.71	0.093	0.107
E	1.39	1.77	0.055	0.070
F	2.68	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	6.09	6.86	0.240	0.260
U	20.06	20.57	0.790	0.810
V	14.27 BSC		0.562 BSC	

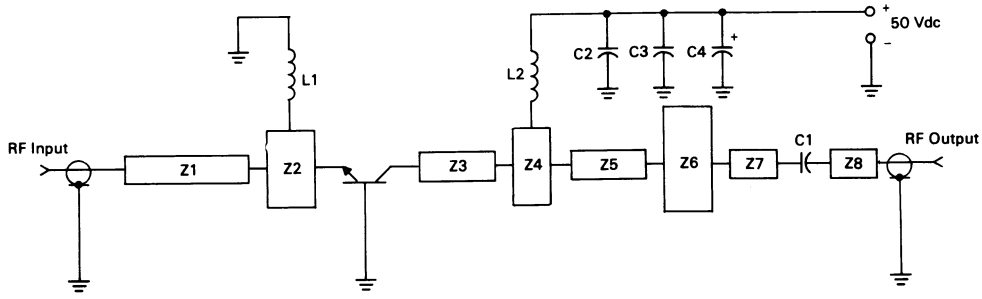
CASE 361A-01

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 10 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	60	—	—	Vdc
Collector-Base Breakdown Voltage (I_C = 10 mAdc, I_E = 0)	$V_{(BR)CBO}$	60	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 1.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	—	—	Vdc
Collector Cutoff Current (V_{CB} = 50 Vdc, I_E = 0)	I_{CBO}	—	—	1.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 250 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	10	40	100	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 50 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	—	5.0	7.5	pF
FUNCTIONAL TESTS (Pulse Width = 10 μs, Duty Cycle = 1%)					
Common-Base Amplifier Power Gain (V_{CC} = 50 Vdc, P_{out} = 15 W Peak, f = 1090 MHz)	G_{PB}	10	12.5	—	dB
Collector Efficiency (V_{CC} = 50 Vdc, P_{out} = 15 W Peak, f = 1090 MHz)	η	30	35		%
Load Mismatch (V_{CC} = 50 Vdc, P_{out} = 15 W Peak, f = 1090 MHz) (VSWR = 10:1 All Phase Angles)	ψ	No Degradation in Power Output			

3

FIGURE 1 — 1090 MHz TEST CIRCUIT



C1, C2 — 220 pF 100 mil Chip Capacitor
C3 — 0.1 μF
C4 — 47 μF/75 V Electrolytic Capacitor
L1, L2 — 3 Turns #18 AWG, 1/8" ID
Z1-Z8 — Microstrip, See Photomaster, Figure 8
Board Material — 0.032" Glass Teflon
ϵ_r = 2.5

FIGURE 2 — OUTPUT POWER versus INPUT POWER

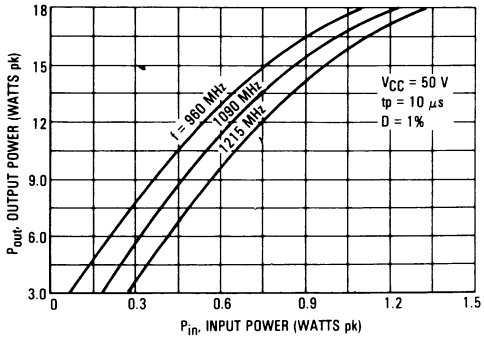


FIGURE 3 — OUTPUT POWER versus FREQUENCY

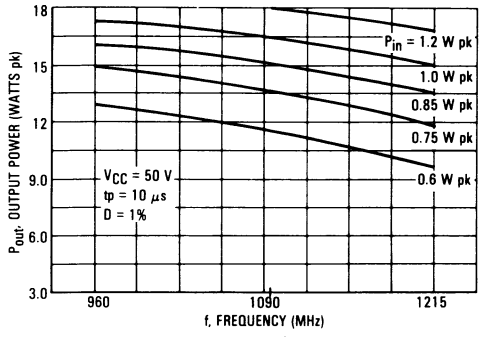


FIGURE 4 - OUTPUT POWER versus SUPPLY VOLTAGE

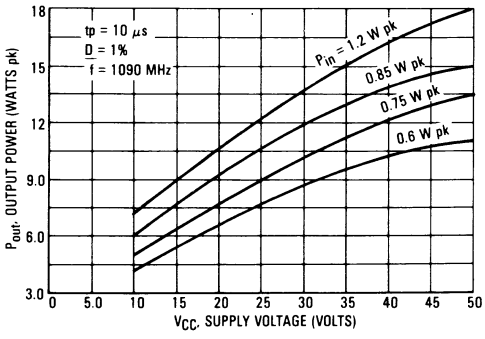


FIGURE 5 — POWER GAIN versus FREQUENCY

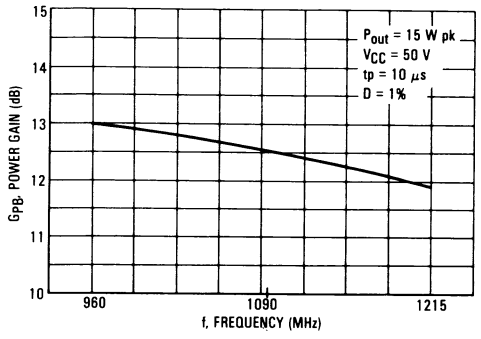
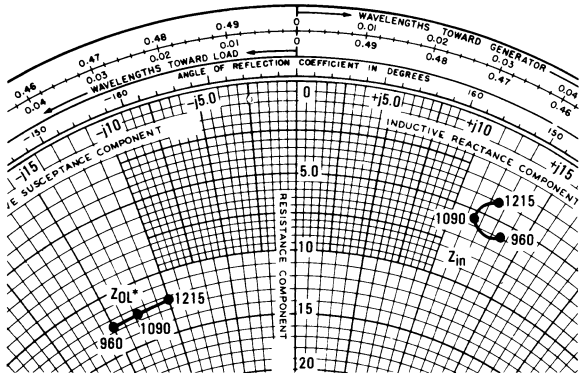


FIGURE 6 — SERIES EQUIVALENT INPUT/OUTPUT IMPEDANCES



Coordinates in Ohms

P_{out} = 15 W pk V_{CC} = 50 V
tp = 10 μs D = 1%

f MHz	Z_{in} Ohms	Z_{OL}* Ohms
960	5.9 + j13.6	12.5 – j15
1090	5.5 + j11.5	12.4 – j12.8
1215	4.0 + j12.5	12.1 – j10

*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

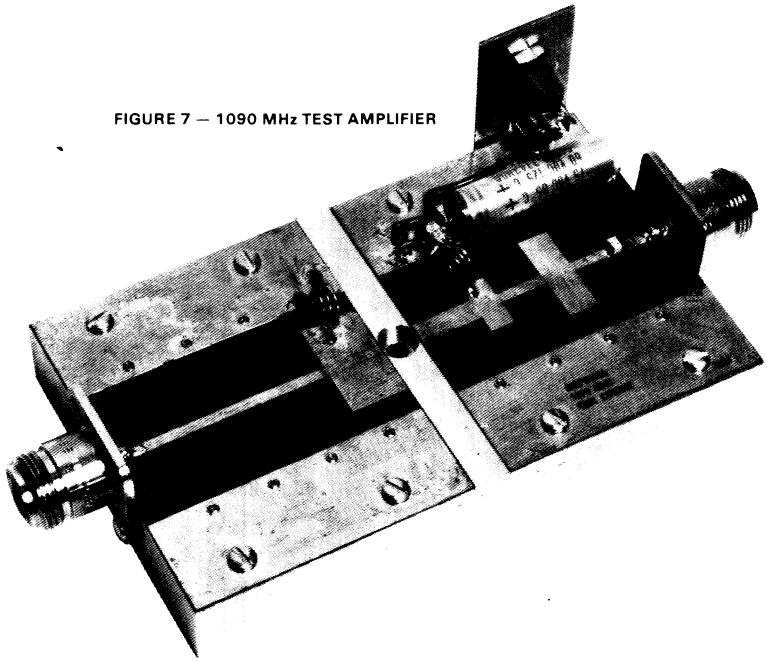
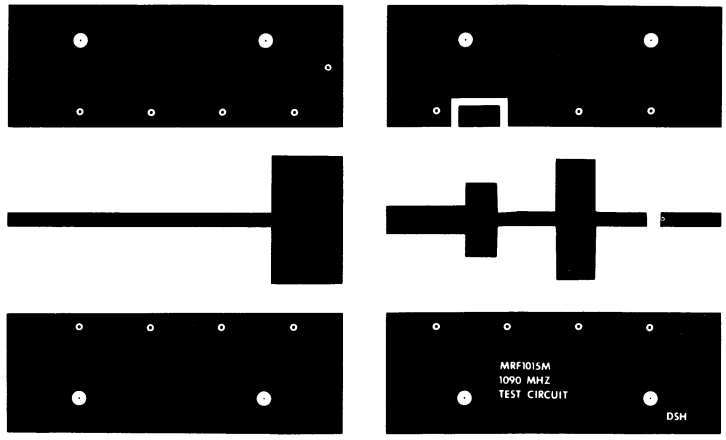


FIGURE 8 — PRINTED CIRCUIT BOARD LAYOUT — 1090 MHz TEST CIRCUIT



⊙ Soldered Eyelet
⊙ 4-40 Screw Placement

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