MRF1250M

The RF Line

MICROWAVE PULSE POWER TRANSISTOR

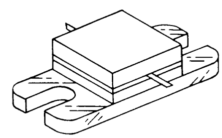
. . . designed for Class B and C *common base* amplifier applications in short pulse TACAN, IFF, and DME transmitters.

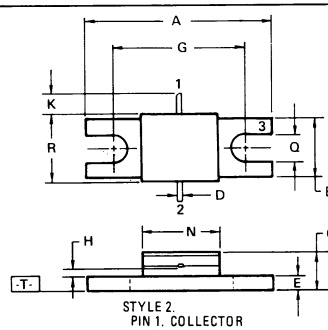
- Guaranteed Performance @ 1090 MHz, 50 Vdc
  Output Power = 250 Watts Peak
  Minimum Gain = 6.0 dB
- 100% Tested for Load Mismatch at All Phase Angles with 10:1 VSWR
- Industry Standard Package
- Nitride Passivated
- Gold Metallized for Long Life and Resistance to Metal Migration
- Compatible with Other 1250M Types
- Internal Input and Output Matching for Broadband Operation

250 W PEAK, 1020-1150 MHz

MICROWAVE POWER TRANSISTOR

NPN SILICON





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

NOTES:
1. DIMENSIONS -A- AND -B- ARE DATUMS.
2. POSITIONAL TOLERANCE FOR MOUNTING HOLES:
⌖ .76(0.030) Ⓜ T A Ⓜ B Ⓜ
3. -T- IS SEATING PLANE.
4. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	22.61	23.11	0.890	0.910
B	9.65	9.91	0.380	0.390
C	4.06	5.84	0.160	0.230
D	0.51	0.76	0.020	0.030
E	1.40	1.65	0.055	0.065
G	16.51 BSC		0.650 BSC	
H	1.14	1.77	0.045	0.070
K	2.54	–	0.100	–
N	9.91	10.41	0.390	0.410
Q	3.00	3.61	0.118	0.142
R	9.91	10.41	0.390	0.410

CASE 336-03

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	70	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector-Current — Peak (1, 2)	I_C	24	Adc
Peak Device Dissipation @ T_C = 25°C (1, 2) Derate above 25°C	P_D	1166 6.67	Watts W/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (1,2,3)	$R_{\theta JC}$	0.15	°C/W

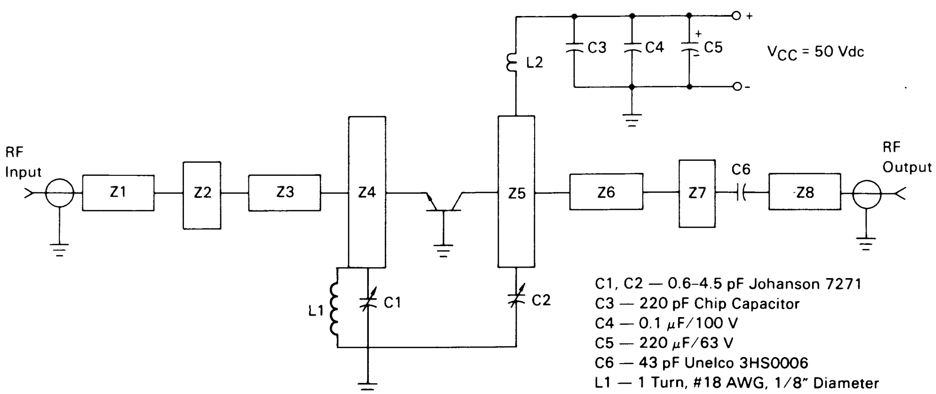
(1) Pulse Width = 10 μs, Duty Cycle = 1%.
(2) These devices are designed for RF operation. The total device dissipation rating applies only when the devices are operated as RF short pulse amplifiers.
(3) Thermal Resistance is determined under specified RF operating conditions by infrared measurement techniques.

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 100 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	70	—	—	Vdc
Collector-Base Breakdown Voltage (I_C = 100 mAdc, I_E = 0)	$V_{(BR)CBO}$	70	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	—	—	Vdc
Collector Cutoff Current (V_{CB} = 50 Vdc, I_E = 0)	I_{CBO}	—	—	20	mAdc
ON CHARACTERISTICS					
DC Current Gain* (I_C = 10 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	10	30	—	—
FUNCTIONAL TESTS (Pulse Width = 10 μs, Duty Cycle = 1.0%)					
Common-Base Amplifier Power Gain (V_{CC} = 50 Vdc, P_{out} = 250 W pk, f = 1090 MHz)	G_{PB}	6.0	7.2	—	dB
Collector Efficiency (V_{CC} = 50 Vdc, P_{out} = 250 W pk, f = 1090 MHz)	η	33	—	—	%
Load Mismatch (V_{CC} = 50 Vdc, P_{out} = 250 W pk, f = 1090 MHz, VSWR = 10:1 All Phase Angles)	ψ	No Degradation in Power Output			

*80 μs Pulse on Tektronix 576 or equivalent.

FIGURE 1 — 1090 MHz TEST CIRCUIT



C1, C2 — 0.6–4.5 pF Johanson 7271
C3 — 220 pF Chip Capacitor
C4 — 0.1 μF/100 V
C5 — 220 μF/63 V
C6 — 43 pF Unelco 3HS0006
L1 — 1 Turn, #18 AWG, 1/8″ Diameter
L2 — 2 Turns, #18 AWG, 1/8″ Diameter
Z1-Z8 — Distributed Microstrip Elements — See Figure 9
Board Material — 0.062″ Thick Teflon*-Fiberglass, ϵ_r = 2.55

*Registered Trademark of DuPont

FIGURE 2 — OUTPUT POWER versus INPUT POWER

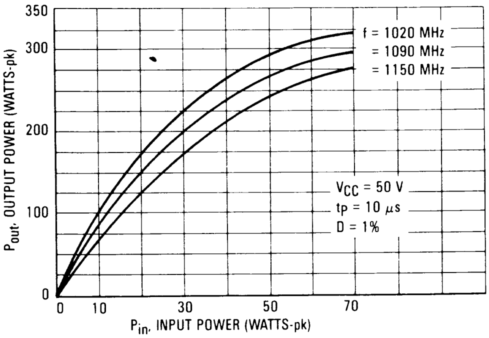


FIGURE 3 — OUTPUT POWER versus FREQUENCY

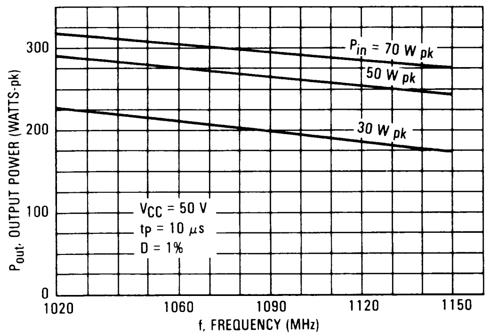


FIGURE 4 — OUTPUT POWER versus SUPPLY VOLTAGE

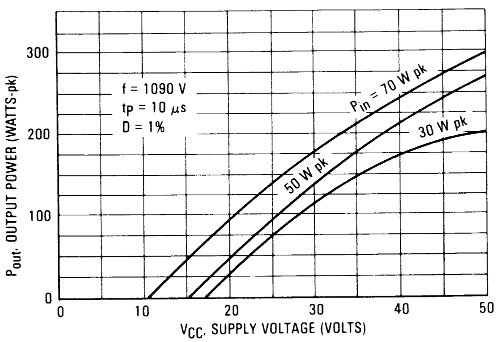


FIGURE 5 — POWER GAIN versus FREQUENCY

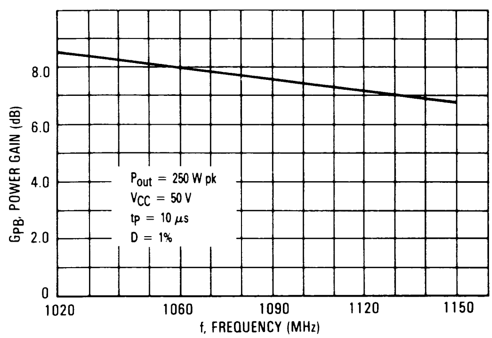
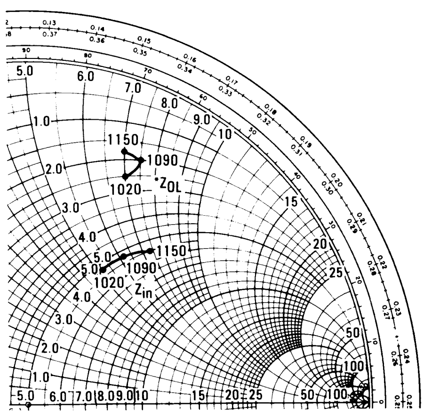


FIGURE 6 — SERIES EQUIVALENT INPUT/OUTPUT IMPEDANCE



P_{out} = 250 W-pk V_{CC} = 50 V
tp = 10 μs   D = 1%

f MHz	Z_{in} Ohms	Z_{OL}* Ohms
1020	5.2 + j5.2	2.5 + j7.0
1090	5.2 + j6.2	2.0 + j7.5
1150	5.5 + j7.3	1.8 + j7.0

*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

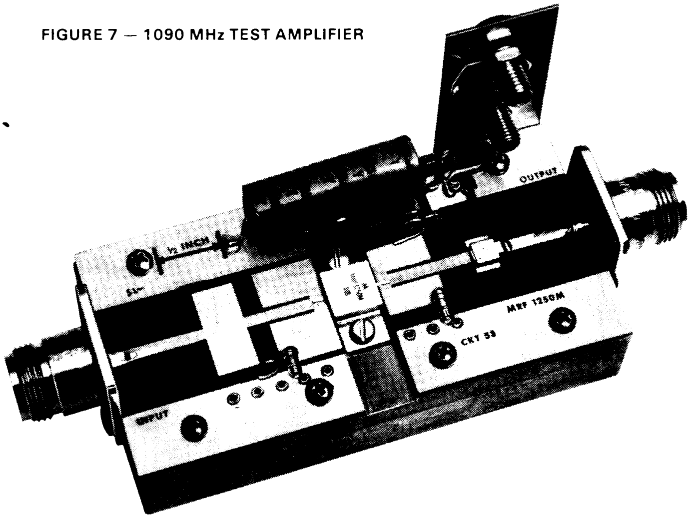


FIGURE 8 — TYPICAL PULSE PERFORMANCE

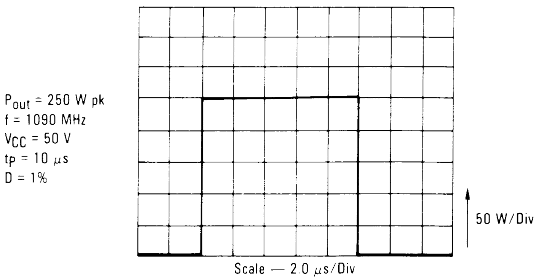
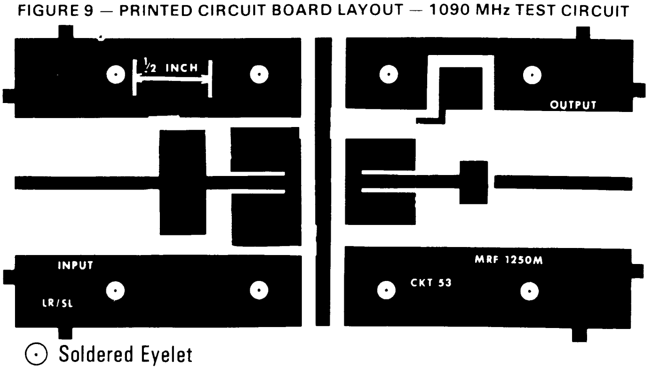


FIGURE 9 — PRINTED CIRCUIT BOARD LAYOUT — 1090 MHz TEST CIRCUIT



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

MRF1325M

The RF Line

MICROWAVE PULSE POWER TRANSISTOR

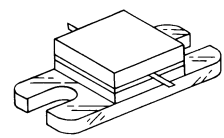
. . . designed for Class B and C *common base* amplifier applications in short pulse TACAN, IFF, and DME transmitters.

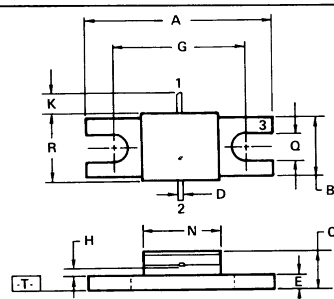
- Guaranteed Performance @ 1090 MHz, 50 Vdc
  Output Power = 325 Watts Peak
  Minimum Gain = 6.0 dB
- 100% Tested for Load Mismatch at All Phase Angles with 10:1 VSWR
- Industry Standard Package
- Nitride Passivated
- Gold Metallized for Long Life and Resistance to Metal Migration
- Compatible with Other 1325M Types
- Internal Input and Output Matching for Broadband Operation

325 W PEAK, 1020-1150 MHz

MICROWAVE POWER TRANSISTOR

NPN SILICON





STYLE 2.
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2. EMITTER
3. BASE

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2. POSITIONAL TOLERANCE FOR MOUNTING HOLES: ⊕ .76(0.030) Ⓜ 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	22.61	23.11	0.890	0.910
B	9.65	9.91	0.380	0.390
C	4.06	5.84	0.160	0.230
D	0.51	0.76	0.020	0.030
E	1.40	1.65	0.055	0.065
G	16.51 BSC		0.650 BSC	
H	1.14	1.77	0.045	0.070
K	2.54	–	0.100	–
N	9.91	10.41	0.390	0.410
Q	3.00	3.61	0.118	0.142
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CASE 336-03

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	70	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector-Current — Peak (1, 2)	I_C	24	Adc
Peak Device Dissipation @ T_C = 25°C (1, 2) Derate above 25°C	P_D	1166 6.67	Watts W/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

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Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (1,2,3)	$R_{\theta JC}$	0.15	°C/W

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Emitter-Base Breakdown Voltage (I_E = 10 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	—	—	Vdc
Collector Cutoff Current (V_{CB} = 50 Vdc, I_E = 0)	I_{CBO}	—	—	20	mAdc
ON CHARACTERISTICS					
DC Current Gain* (I_C = 10 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	10	30	—	—
FUNCTIONAL TESTS (Pulse Width = 10 μs, Duty Cycle = 1.0%)					
Common-Base Amplifier Power Gain (V_{CC} = 50 Vdc, P_{out} = 325 W pk, f = 1090 MHz)	G_{PB}	6.0	7.2	—	dB
Collector Efficiency (V_{CC} = 50 Vdc, P_{out} = 325 W pk, f = 1090 MHz)	η	33	—	—	%
Load Mismatch (V_{CC} = 50 Vdc, P_{out} = 325 W pk, f = 1090 MHz, VSWR = 10:1 All Phase Angles)	ψ	No Degradation in Power Output			

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3

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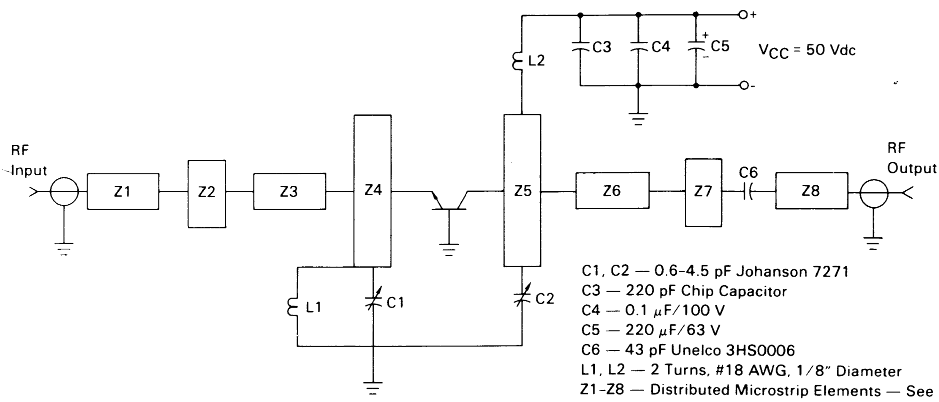

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C4 — 0.1 μF/100 V
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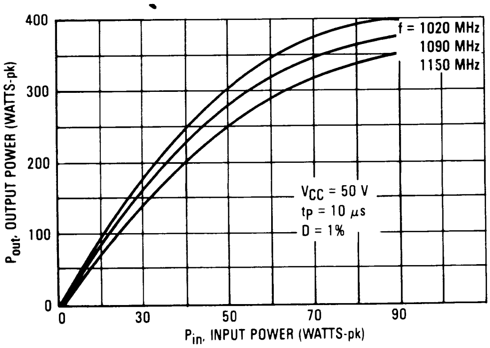

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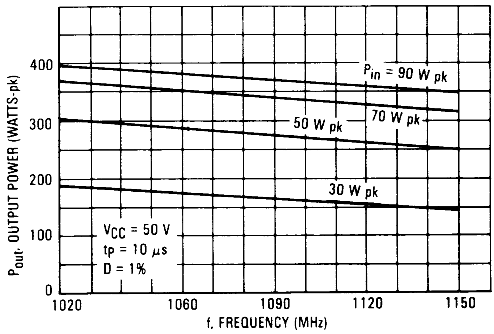

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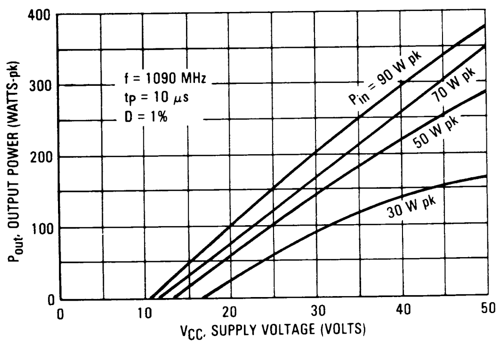

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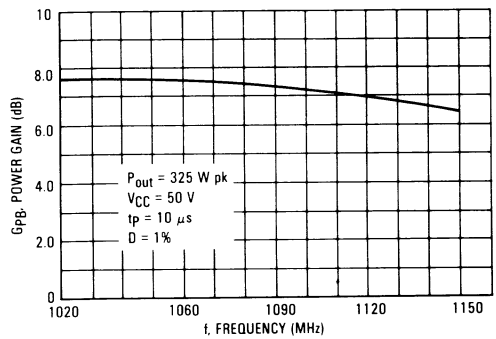

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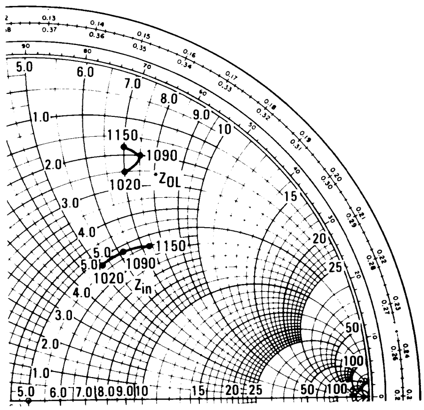


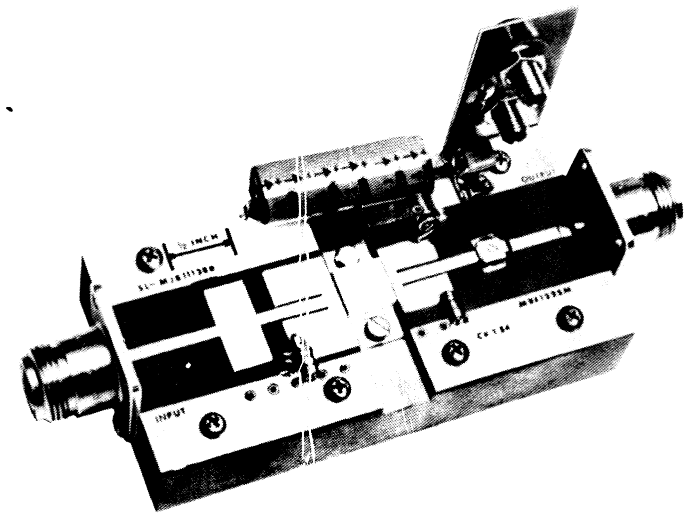
P_{out} = 325 W-pk V_{CC} = 50 V
tp = 10 μs D = 1%

f MHz	Z_{in} Ohms	Z_{OL}* Ohms
1020	5.2 + j5.2	2.5 + j7.0
1090	5.2 + j6.2	2.0 + j7.5
1150	5.5 + j7.3	1.8 + j7.0

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

3

FIGURE 7 — 1090 MHz TEST AMPLIFIER



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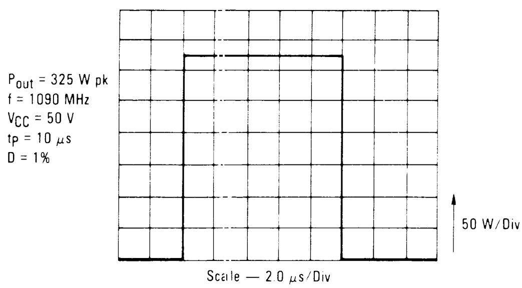

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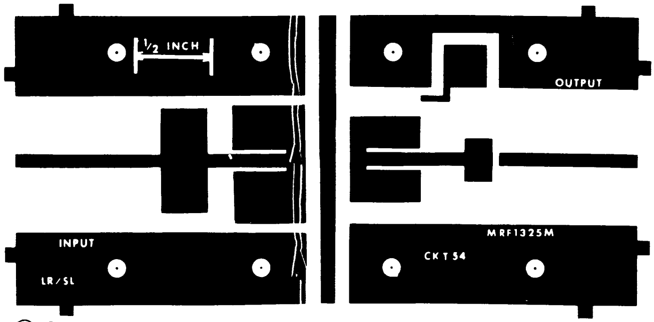


⊙ Soldered Eyelet

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

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MRF1946
MRF1946A

The RF Line

30 W 136–220 MHz

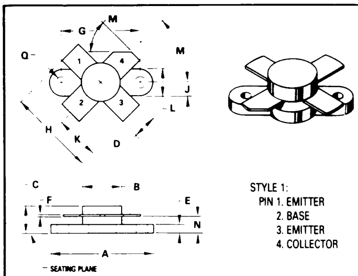
RF POWER TRANSISTOR

NPN SILICON

NPN SILICON POWER TRANSISTOR

Designed for 12.5 volt large-signal power amplifiers in commercial and industrial equipment.

- High Common Emitter Power Gain
- Specified 12.5 V, 175 MHz Performance
  Output Power = 30 Watts
  Power Gain = 10 dB
  Efficiency = 60%
- Diffused Emitter Resistor Ballasting
- Characterized to 220 MHz
- Load Mismatch at High Line and Overdrive Conditions



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

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	24.38	25.15	0.960	0.990
B	9.40	9.91	0.370	0.390
C	5.82	7.14	0.229	0.281
D	5.46	5.97	0.215	0.235
E	2.16	2.67	0.085	0.105
F	0.10	0.15	0.004	0.006
G	18.29	18.54	0.720	0.730
H	20.07	20.57	0.790	0.810
K	10.03	10.29	0.395	0.405
L	6.22	6.48	0.245	0.255
M	40°	50°	40°	50°
N	3.81	4.57	0.150	0.180
Q	2.87	3.30	0.113	0.130

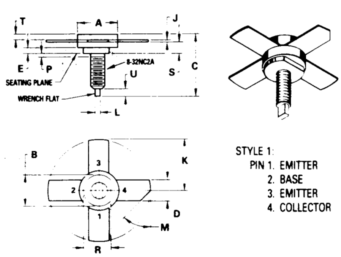
CASE 211-07
MRF1946

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	16	Vdc
Collector-Base Voltage	V_{CBO}	36	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector-Current — Continuous	I_C	8.0	Adc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	100 0.57	Watts W/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C
Junction Temperature	T_J	200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.75	°C/W



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

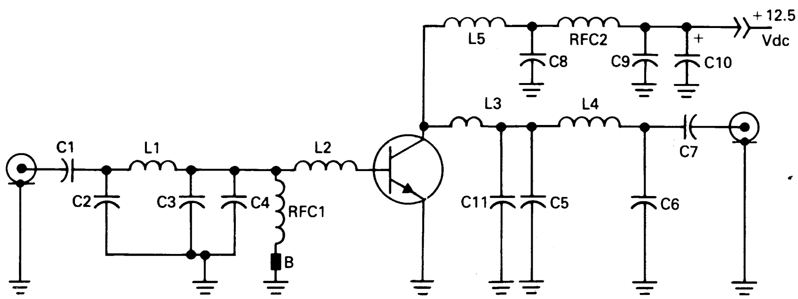
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.40	9.78	0.370	0.385
B	8.13	8.38	0.320	0.330
C	17.02	20.07	0.670	0.790
D	5.46	5.97	0.215	0.235
E	1.78	—	0.070	—
J	0.08	0.18	0.003	0.007
K	12.45	—	0.490	—
L	1.40	1.78	0.055	0.070
M	45° NOM		45° NOM	
P	—	1.27	—	0.050
R	7.59	7.80	0.299	0.307
S	4.01	4.52	0.158	0.178
T	2.11	2.54	0.083	0.100
U	2.49	3.35	0.098	0.132

CASE 145A-09
MRF1946A

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 25 mAdc, I_B = 0)	$V_{(BR)CEO}$	16	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 25 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	36	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 5.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	—	—	Vdc
Collector Cutoff Current (V_{CE} = 15 Vdc, V_{BE} = 0, T_C = 25°C)	I_{CES}	—	—	5.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 1.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	40	75	150	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 15 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	—	75	100	pF
FUNCTIONAL TESTS					
Common-Emitter Amplifier Power Gain (V_{CC} = 12.5 Vdc, P_{out} = 30 W, f = 175 MHz)	G_{pe}	10	11	—	dB
Collector Efficiency (V_{CC} = 12.5 Vdc, P_{out} = 30 W, f = 175 MHz)	η	60	70	—	%
Load Mismatch (V_{CC} = 15.5 Vdc, P_{in} = 2.0 dB Overdrive, Load VSWR = 30:1)	ψ	No Degradation in Output Power			

FIGURE 1 — BROADBAND TEST CIRCUIT SCHEMATIC



C1 = 56 pF Mini-Unelco, 3HS0006-56
C2 = 47 pF Mini-Unelco, 3HS0006-47
C3, C4 = 180 pF Chip Cap, ATC 100B181JC500
C5 = 150 pF Unelco, J101-150
C6 = 39 pF Mini-Unelco, 3HS0006-39
C7, C8 = 1000 pF Chip Cap, ATC 100B102JC50
C9 = 0.1 μF Ceramic Capacitor
C10 = 10 μF, 25 V Electrolytic Capacitor
C11 = 56 pF Mini-Unelco, 3HS0006-56

L1 = 2 Turns #18 AWG, 0.125″ ID
L2, L3 = Circuit Board and Mounting Pad Inductance
L4 = 3 Turns #18 AWG, 0.125″ ID
L5 = 6 Turns #16 Enameled, 0.250″ ID

RFC1 = 0.15 μH Molded Choke w/Ferrite Bead
RFC2 = Ferrite Choke, Fair Rite VK200-4B

Board Material = 1/32″ Glass Teflon, 1 oz. Cu Plating

Bead — Ferroxcube

3

FIGURE 2 — OUTPUT POWER versus INPUT POWER

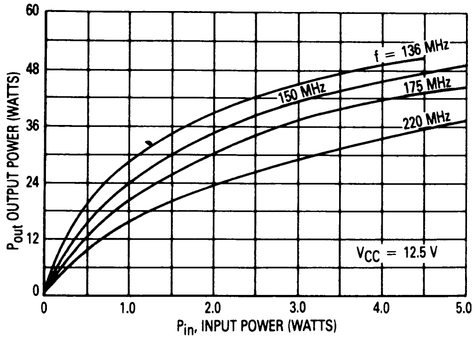


FIGURE 3 — OUTPUT POWER versus FREQUENCY

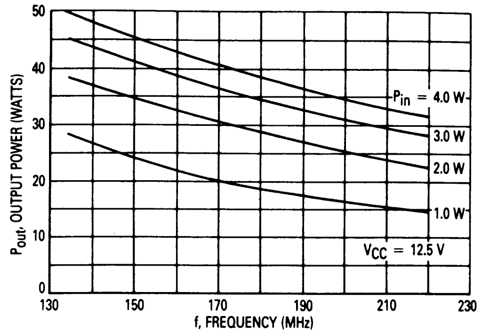


FIGURE 4 — OUTPUT POWER versus SUPPLY VOLTAGE
f = 220 MHz

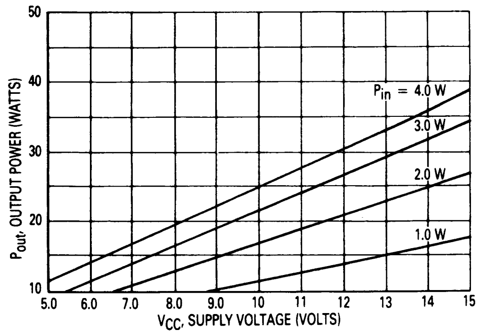


FIGURE 5 — OUTPUT POWER versus SUPPLY VOLTAGE
f = 175 MHz

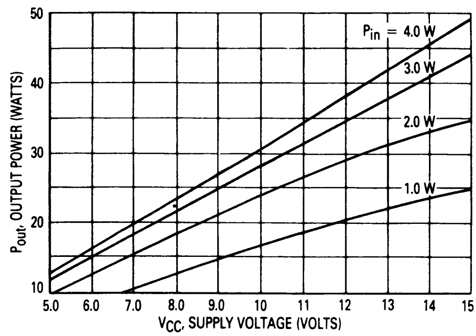


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FIGURE 6 — OUTPUT POWER versus SUPPLY VOLTAGE
f = 150 MHz

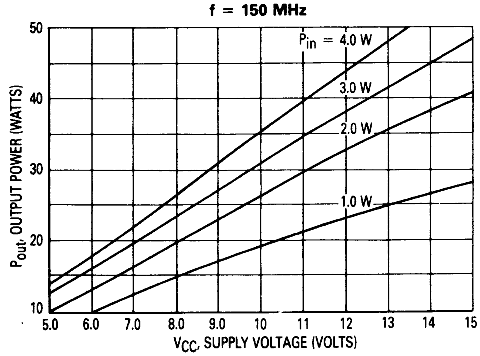


FIGURE 7 — OUTPUT POWER versus SUPPLY VOLTAGE
f = 136 MHz

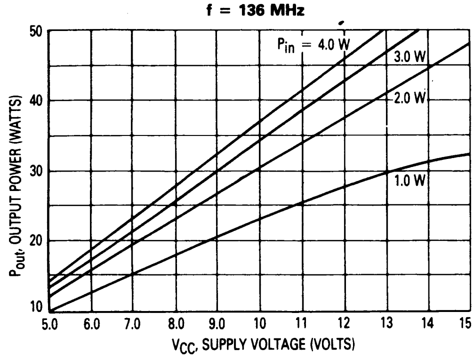


FIGURE 8 — TYPICAL PERFORMANCE IN A BROADBAND CIRCUIT

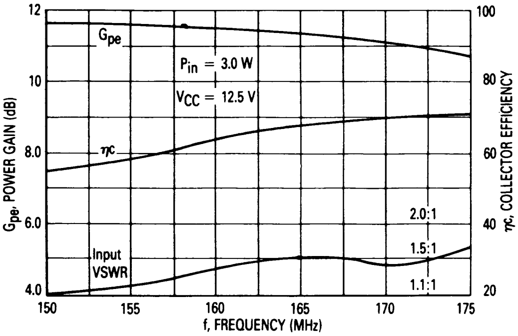
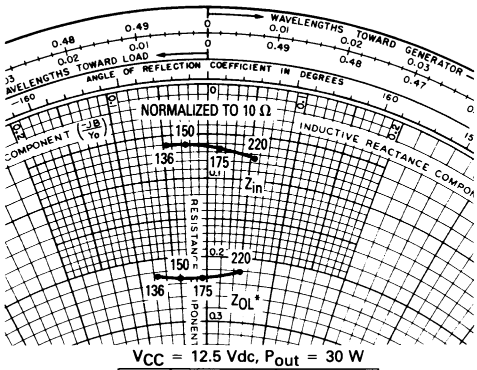


FIGURE 9 — SERIES EQUIVALENT INPUT AND OUTPUT IMPEDANCE



V_{CC} = 12.5 Vdc, P_{out} = 30 W

f MHz	Z_{in} Ohms	Z_{OL}* Ohms
136	0.60 − j0.48	2.22 − j0.74
150	0.63 − j0.26	2.30 − j0.40
175	0.62 + j0.13	2.35 − j0.04
220	0.73 + j0.57	2.20 + j0.43

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

3

FIGURE 10 — BROADBAND TEST CIRCUIT