MRF390

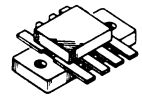
60 WATTS, 30–500 MHz CONTROLLED "Q" BROADBAND PUSH-PULL RF POWER TRANSISTOR NPN SILICON

The RF Line

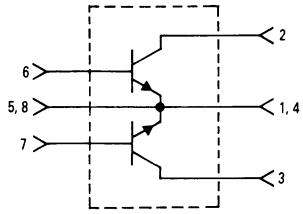
NPN Silicon Push-Pull RF Power Transistor

. . . designed primarily for wideband large-signal output and driver amplifier stages in the 30–500 MHz frequency range.

- Specified 28 Volt, 400 MHz Characteristics —
  Output Power = 60 Watts
  Typical Gain = 9.5 dB
  Efficiency = 55% (Typ)
- Built-In Input Impedance Matching Networks for Broadband Operation
- Push-Pull Configuration Reduces Even Numbered Harmonics
- Gold Metallization System for High Reliability
- 100% Tested for Load Mismatch



CASE 744-02



The MRF390 is two transistors in a single package with separate base and collector leads and emitters common. This arrangement provides the designer with a space saving device capable of operation in a push-pull configuration.

PUSH-PULL TRANSISTORS

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	30	Vdc
Collector-Base Voltage	V_{CBO}	60	Vdc
Emitter-Base Voltage	V_{EBO}	4	Vdc
Collector Current — Continuous	I_C	7	Adc
Total Device Dissipation @ T_C = 25°C (1) Derate above 25°C	P_D	140 0.80	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	$R_{\theta JC}$	1.25	°C/W

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

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS (NOTE 1)					
Collector-Emitter Breakdown Voltage (I_C = 30 mAdc, I_B = 0)	$V_{(BR)CEO}$	30	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 30 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	60	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 3 mAdc, I_C = 0)	$V_{(BR)EBO}$	4	—	—	Vdc
Collector Cutoff Current (V_{CB} = 30 Vdc, I_E = 0)	I_{CBO}	—	—	3	mAdc
ON CHARACTERISTICS (NOTE 1)					
DC Current Gain (I_C = 1 Adc, V_{CE} = 5 Vdc)	h_{FE}	20	—	100	—
DYNAMIC CHARACTERISTICS (NOTE 1)					
Output Capacitance (V_{CB} = 28 Vdc, I_E = 0, f = 1 MHz)	C_{ob}	—	37	50	pF
FUNCTIONAL TEST (NOTE 2 — See Figure 1)					
Common-Emitter Amplifier Power Gain (V_{CC} = 28 Vdc, P_{out} = 60 W, f = 400 MHz)	G_{pe}	7.5	9.5	—	dB
Collector Efficiency (V_{CC} = 28 Vdc, P_{out} = 60 W, f = 400 MHz)	η	50	55	—	%
Load Mismatch (V_{CC} = 28 Vdc, P_{out} = 60 W, f = 400 MHz VSWR = 30:1, all phase angles)	ψ	No Degradation in Output Power			

NOTES:
1. Each transistor chip measured separately.
2. Both transistor chips operating in push-pull amplifier.

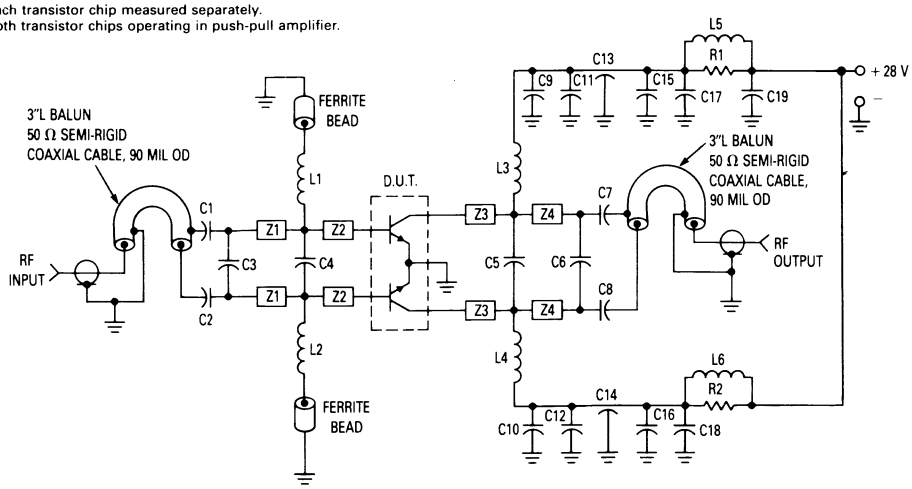


Figure 1. 400 MHz Test Circuit

C1, C2 — 240 pF, 100 Mil Chip
C3 — 12 pF, 100 Mil Chip
C5 — 20 pF, 100 Mil Chip
C4, C6 — 18 pF, 100 Mil Chip
C7, C8 — 270 pF, 100 Mil Chip
C9, C10, C11, C12 — 470 pF, 100 Mil Chip
C13, C14 — 680 pF Feedthru Capacitor
C15, C16, C19 — 0.1 μF Disc Ceramic
C17, C18 — 1 μF, 50 V Tantalum Capacitor
R1, R2 — 910 kΩ, 2 W Carbon Res.

L1, L2 — 10 μH RF Choke With Ferrite Bead
L3, L4 — 5 Turns #20 AWG, 1/4" ID
L5, L6 — 15 Turns #18 AWG Enameled, 0.35" ID Closewound Around R1, R2 Respectively
Z1 — Microstrip Line 850 Mils L x 130 Mils W
Z2, Z3 — Microstrip Line 250 Mils L x 130 Mils W
Z4 — Microstrip Line 830 Mils L x 130 Mils W
Board Material — 0.0625" Teflon Fiberglass ϵ_r = 2.5 ± 0.05, 1 oz. cu. clad, Double Sided

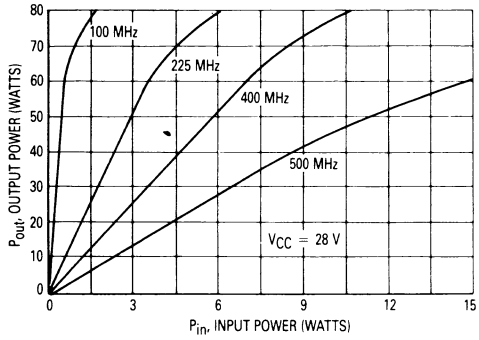


Figure 2. Output Power versus Input Power/Frequency

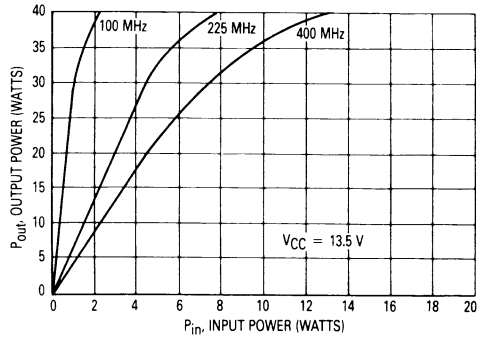


Figure 3. Output Power versus Input Power/Frequency

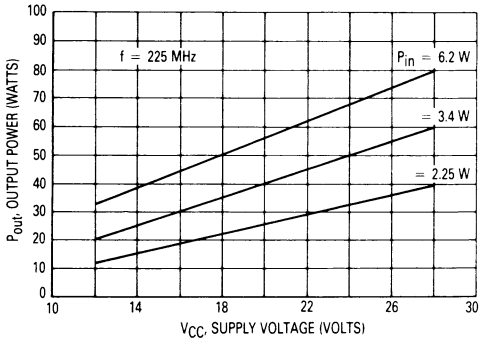


Figure 4. Output Power versus Supply Voltage — 225 MHz

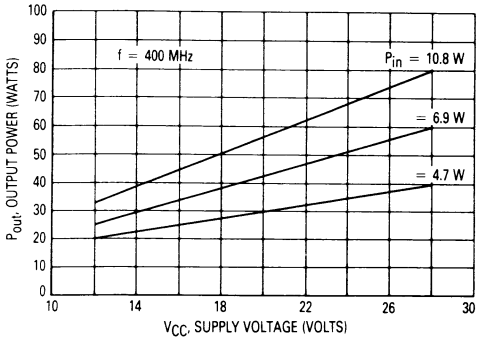
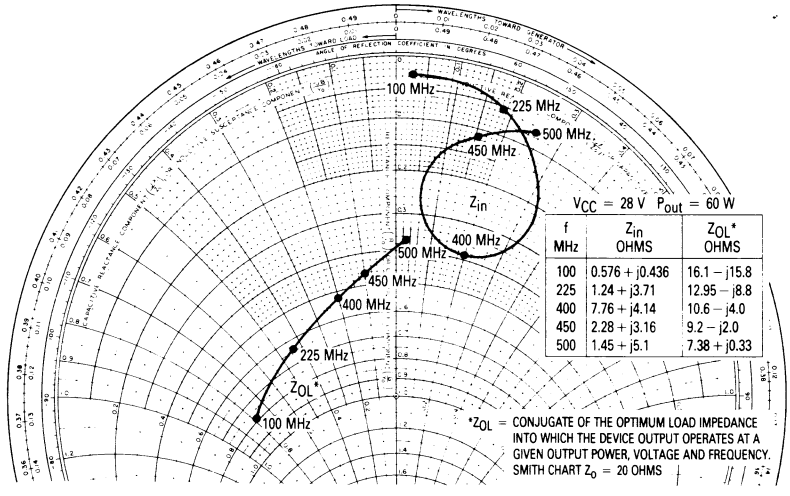
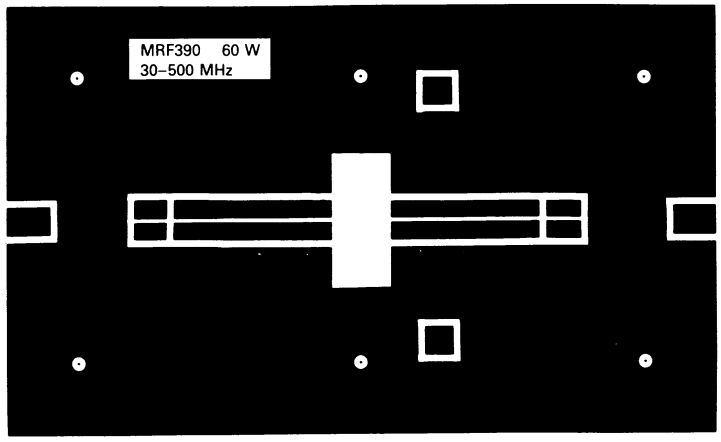


Figure 5. Output Power versus Supply Voltage — 400 MHz



f MHz	Zin OHMS	ZOL* OHMS
100	0.576 + j0.436	16.1 − j15.8
225	1.24 + j3.71	12.95 − j8.8
400	7.76 + j4.14	10.6 − j4.0
450	2.28 + j3.16	9.2 − j2.0
500	1.45 + j5.1	7.38 + j0.33

Figure 6. Series Equivalent Input/Output Impedances



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

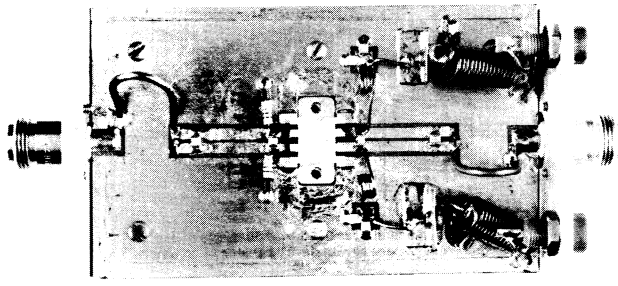
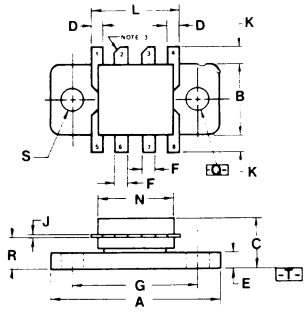


Figure 7. 400 MHz Test Circuit and Photomaster

OUTLINE DIMENSIONS



STYLE 1
PIN 1. EMITTER (COMMON)
2. COLLECTOR
3. COLLECTOR
4. EMITTER (COMMON)
5. EMITTER (COMMON)
6. BASE
7. BASE
8. EMITTER (COMMON)

NOTES:
1. DIMENSION Q IS DATUM.
2. POSITIONAL TOLERANCE FOR S:
   ⌖ ⌀ 0.18(0.007) Ⓜ T Q Ⓜ
3. IDENTIFICATION NOTCH:
   1.0 mm (0.04) MIN X 45°.
4. T IS SEATING PLANE.
5. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

CASE 744-02

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	24.51	25.15	0.965	0.985
B	9.91	10.41	0.390	0.410
C	6.22	7.24	0.245	0.285
D	1.65	1.90	0.065	0.075
E	2.16	2.41	0.085	0.095
F	1.91	2.16	0.075	0.085
G	18.42 BSC		0.725 BSC	
H	–	–	–	–
J	0.08	0.18	0.003	0.007
K	2.29	2.79	0.090	0.110
L	12.55	12.85	0.494	0.506
N	9.91	10.42	0.415	0.435
P	–	–	–	–
Q	3.18	3.43	0.125	0.135
R	3.94	4.45	0.155	0.175
S	3.18	3.43	0.125	0.135
U	1.02	1.27	0.040	0.050
V	0.64	0.89	0.025	0.035

MRF392

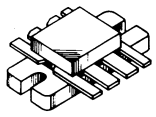
125 WATTS, 30–500 MHz CONTROLLED "Q" BROADBAND PUSH-PULL RF POWER TRANSISTOR NPN SILICON

The RF Line

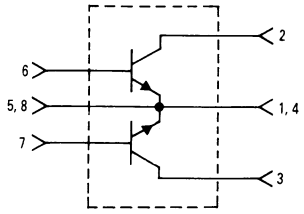
NPN Silicon Push-Pull RF Power Transistor

. . . designed primarily for wideband large-signal output and driver amplifier stages in the 30–500 MHz frequency range.

- Specified 28 Volt, 400 MHz Characteristics —
  Output Power = 125 W
  Typical Gain = 10 dB
  Efficiency = 55% (Typ)
- Built-In Input Impedance Matching Networks for Broadband Operation
- Push-Pull Configuration Reduces Even Numbered Harmonics
- Gold Metallization System for High Reliability
- 100% Tested for Load Mismatch.



CASE 744A-01



The MRF392 is two transistors in a single package with separate base and collector leads and emitters common. This arrangement provides the designer with a space saving device capable of operation in a push-pull configuration.

PUSH-PULL TRANSISTORS

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	30	Vdc
Collector-Base Voltage	V_{CBO}	60	Vdc
Emitter-Base Voltage	V_{EBO}	4	Vdc
Collector Current — Continuous	I_C	16	Adc
Total Device Dissipation @ T_C = 25°C (1) Derate above 25°C	P_D	270 1.54	Watts W/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C
Junction Temperature	T_J	200	°C

THERMAL CHARACTERISTICS

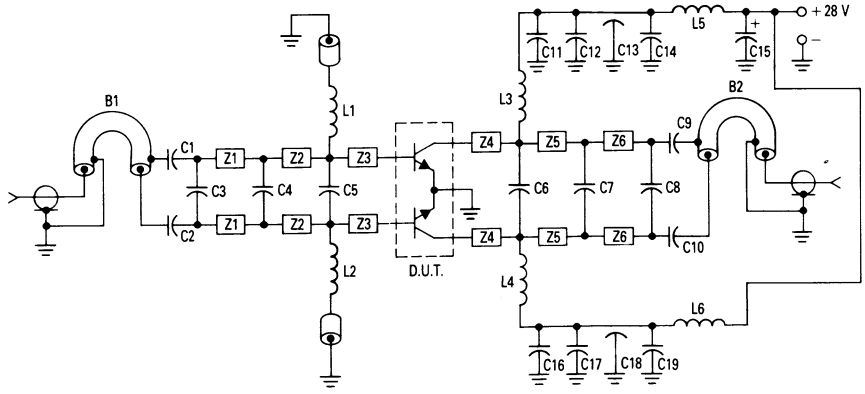
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.65	°C/W

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

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS (NOTE 1)					
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, I_B = 0)	$V_{(BR)CEO}$	30	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	60	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 5 mAdc, I_C = 0)	$V_{(BR)EBO}$	4	—	—	Vdc
Collector Cutoff Current (V_{CB} = 30 Vdc, I_E = 0)	I_{CBO}	—	—	5	mAdc
ON CHARACTERISTICS (NOTE 1)					
DC Current Gain (I_C = 1 Adc, V_{CE} = 5 Vdc)	h_{FE}	20	—	100	—
DYNAMIC CHARACTERISTICS (NOTE 1)					
Output Capacitance (V_{CB} = 28 Vdc, I_E = 0, f = 1 MHz)	C_{ob}	—	75	115	pF
FUNCTIONAL TEST (NOTE 2 — See Figure 1)					
Common-Emitter Amplifier Power Gain (V_{CC} = 28 Vdc, P_{out} = 125 W, f = 400 MHz)	G_{pe}	8	10	—	dB
Collector Efficiency (V_{CC} = 28 Vdc, P_{out} = 125 W, f = 400 MHz)	η	50	55	—	%
Load Mismatch (V_{CC} = 28 Vdc, P_{out} = 125 W, f = 400 MHz VSWR = 30:1, all phase angles)	ψ	No Degradation in Output Power			

NOTES:
1. Each transistor chip measured separately.
2. Both transistor chips operating in push-pull amplifier.



C1, C2 — 240 pF, 100 Mil Chip Cap (ATC) or Equivalent
C3 — 3.6 pF, 100 Mil Chip Cap (ATC) or Equivalent
C4, C8 — 8.2 pF, 100 Mil Chip Cap (ATC) or Equivalent
C5, C6 — 20 pF, 100 Mil Chip Cap (ATC) or Equivalent
C7 — 18 pF, 100 Mil Chip Cap (ATC) or Equivalent
C9, C10 — 270 pF, 100 Mil Chip Cap (ATC) or Equivalent
C11, C12, C16, C17 — 470 pF 100 Mil Chip Cap (ATC) or Equivalent
C13, C18 — 680 pF Feedthru
C14, C19 — 0.1 μF Erie Redcap or Equivalent
C15 — 20 μF, 50 V

L1, L2 — 0.15 μH Molded Choke With Ferrite Bead
L3, L4 — 2-1/2 Turns #20 AWG, 0.200 ID
L5, L6 — 3-1/2 Turns #18 AWG, 0.200 ID

B1 — Balun, 50 Ω Semi-Rigid Coaxial Cable 86 Mil OD, 2" L
B2 — Balun, 50 Ω Semi-Rigid Coaxial Cable 86 Mil OD, 2" L

Z1 — Microstrip Line 270 Mil L x 125 Mil W
Z2 — Microstrip Line 375 Mil L x 125 Mil W
Z3 — Microstrip Line 280 Mil L x 125 Mil W
Z4 — Microstrip Line 300 Mil L x 125 Mil W
Z5 — Microstrip Line 350 Mil L x 125 Mil W
Z6 — Microstrip Line 365 Mil L x 125 Mil W

Board Material — 0.0625" Teflon Fiberglass ϵ_r = 2.5 ± 0.05 1 oz. Cu. CLAD, Double Sided

Figure 1. 400 MHz Test Fixture

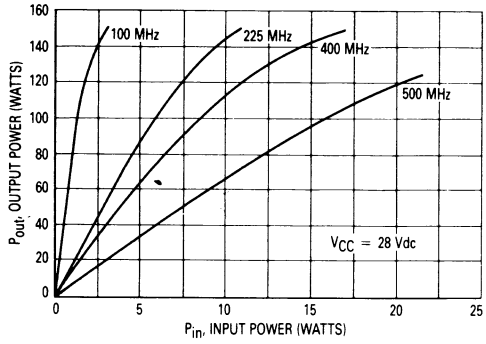


Figure 2. Output Power versus Input Power

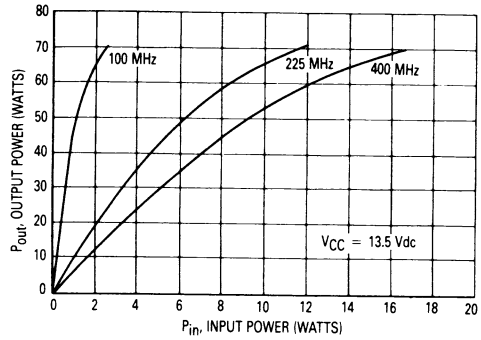


Figure 3. Output Power versus Input Power

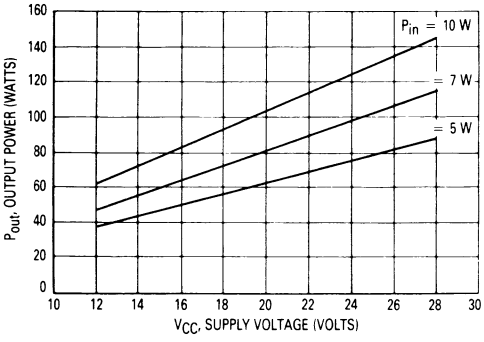


Figure 4. Output Power versus Supply Voltage — 225 MHz

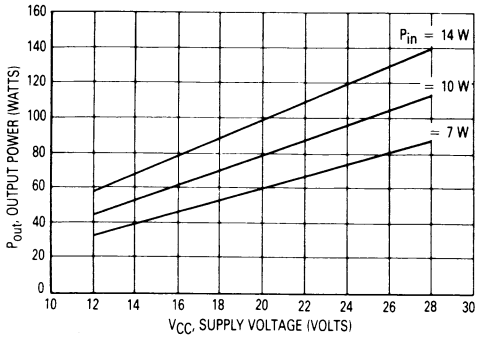
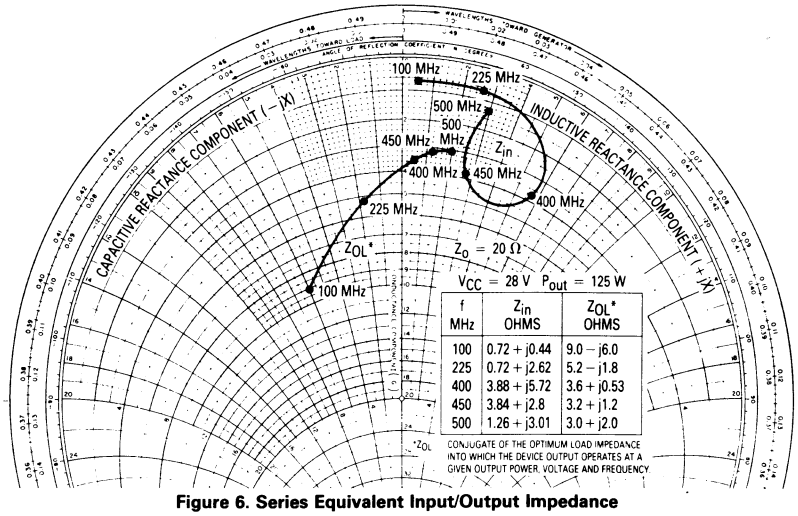
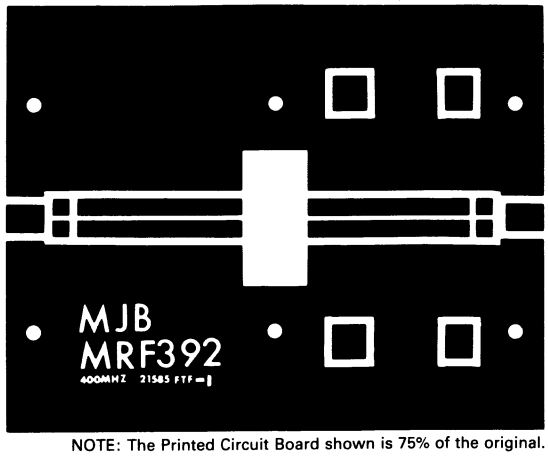


Figure 5. Output Power versus Supply Voltage — 400 MHz



f MHz	Z_{in} OHMS	Z_{OL}* OHMS
100	0.72 + j0.44	9.0 − j6.0
225	0.72 + j2.62	5.2 − j1.8
400	3.88 + j5.72	3.6 + j0.53
450	3.84 + j2.8	3.2 + j1.2
500	1.26 + j3.01	3.0 + j2.0

Figure 6. Series Equivalent Input/Output Impedance



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

Figure 7. Test Circuit Photomaster

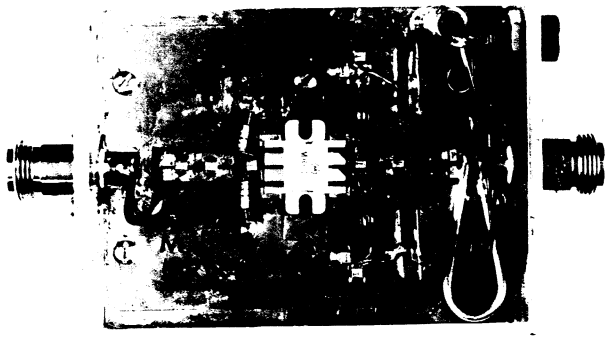
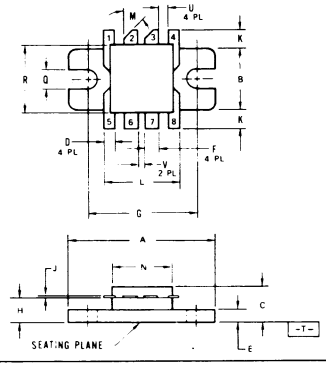


Figure 8. 400 MHz Test Circuit

OUTLINE DIMENSIONS



STYLE 1
PIN 1. EMITTER (COMMON)
2. COLLECTOR
3. COLLECTOR
4. EMITTER (COMMON)
5. EMITTER (COMMON)
6. BASE
7. BASE
8. EMITTER (COMMON)

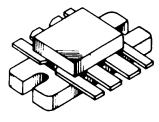
NOTES:
1. DIMENSIONS A AND B ARE DATUMS AND -T- IS A DATUM SURFACE.
2. POSITIONAL TOLERANCE FOR SLOTS: ⌖ ⌀ 0.76 (0.030) Ⓜ A Ⓜ B Ⓜ
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

CASE 744A-01

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	22.60	23.11	0.890	0.910
B	9.52	10.03	0.375	0.395
C	6.65	7.16	0.262	0.282
D	1.60	1.95	0.063	0.077
E	2.94	3.40	0.116	0.134
F	2.87	3.22	0.113	0.127
G	16.51 BSC		0.650 BSC	
H	4.01	4.36	0.158	0.172
J	0.07	0.15	0.003	0.006
K	4.34	4.90	0.171	0.193
L	12.44	12.95	0.490	0.510
M	45° NOM		45° NOM	
N	10.51	11.02	0.414	0.434
Q	3.04	3.35	0.120	0.132
R	9.90	10.41	0.390	0.410
U	1.02	1.27	0.040	0.050
V	0.64	0.89	0.025	0.035

MRF393

**100 WATTS, 30–500 MHz
CONTROLLED "Q"
BROADBAND PUSH-PULL
RF POWER TRANSISTOR
NPN SILICON**



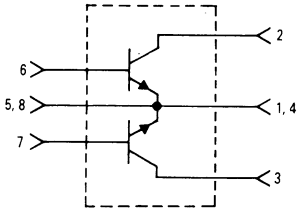
CASE 744A-01

The RF Line

NPN Silicon Push-Pull RF Power Transistor

. . . designed primarily for wideband large-signal output and driver amplifier stages in the 30–500 MHz frequency range.

- Specified 28 Volt, 500 MHz Characteristics —
  Output Power = 100 W
  Typical Gain = 9.5 dB (Class AB); 8.5 dB (Class C)
  Efficiency = 55% (Typ)
- Built-In Input Impedance Matching Networks for Broadband Operation
- Push-Pull Configuration Reduces Even Numbered Harmonics
- Gold Metallization System for High Reliability
- 100% Tested for Load Mismatch



The MRF393 is two transistors in a single package with separate base and collector leads and emitters common. This arrangement provides the designer with a space saving device capable of operation in a push-pull configuration.

3

PUSH-PULL TRANSISTORS

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	30	Vdc
Collector-Base Voltage	V_{CBO}	60	Vdc
Emitter-Base Voltage	V_{EBO}	4	Vdc
Collector Current — Continuous	I_C	16	Adc
Total Device Dissipation @ T_C = 25°C (1) Derate above 25°C	P_D	270 1.54	Watts W/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C
Junction Temperature	T_J	200	°C

THERMAL CHARACTERISTICS

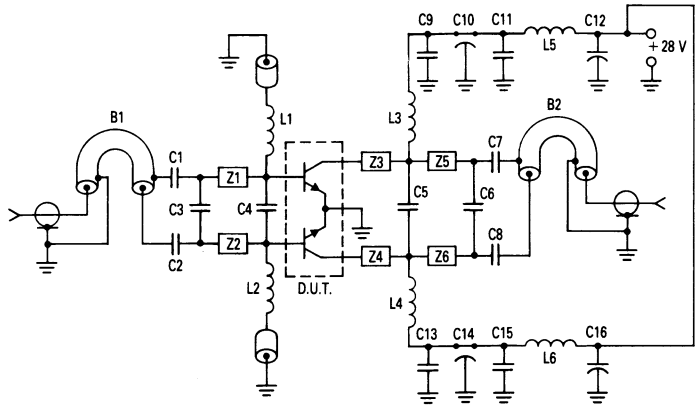
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.65	°C/W

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

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS (NOTE 1)					
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, I_B = 0)	$V_{(BR)CEO}$	30	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	60	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 5 mAdc, I_C = 0)	$V_{(BR)EBO}$	4	—	—	Vdc
Collector Cutoff Current (V_{CB} = 30 Vdc, I_E = 0)	I_{CBO}	—	—	5	mAdc
ON CHARACTERISTICS (NOTE 1)					
DC Current Gain (I_C = 1 Adc, V_{CE} = 5 Vdc)	h_{FE}	20	—	100	—
DYNAMIC CHARACTERISTICS (NOTE 1)					
Output Capacitance (V_{CB} = 28 Vdc, I_E = 0, f = 1 MHz)	C_{ob}	—	75	115	pF
FUNCTIONAL TEST (NOTE 2 — See Figure 1)					
Common-Emitter Amplifier Power Gain (V_{CC} = 28 Vdc, P_{out} = 100 W, f = 500 MHz)	G_{pe}	7.5	8.5	—	dB
Collector Efficiency (V_{CC} = 28 Vdc, P_{out} = 100 W, f = 500 MHz)	η	50	55	—	%
Load Mismatch (V_{CC} = 28 Vdc, P_{out} = 100 W, f = 500 MHz VSWR = 30:1, all phase angles)	ψ	No Degradation in Output Power			

NOTES:
1. Each transistor chip measured separately.
2. Both transistor chips operating in push-pull amplifier.



C1, C2, C7, C8 — 240 pF 100 mil Chip Cap
C3 — 15 pF 100 mil Chip Cap
C4 — 24 pF 100 mil Chip Cap
C5 — 33 pF 100 mil Chip Cap
C6 — 12 pF 100 mil Chip Cap
C9, C13 — 1000 pF 100 mil Chip Cap
C10, C14 — 680 pF Feedthru Cap
C11, C15 — 0.1 μF Ceramic Disc Cap
C12, C16 — 50 μF 50 V

L1–L2 — 0.15 μH Molded Choke with Ferrite Bead
L3–L4 — 2-1/2 Turns #20 AWG 0.200" ID
L5–L6 — 3-1/2 Turns #18 AWG 0.200" ID

B1, B2 — Balun 50 Ω Semi Rigid Coax, 86 mil OD, 2" Long

Z1, Z2 — 850 mil Long x 125 mil W. Microstrip
Z3, Z4 — 200 mil Long x 125 mil W. Microstrip
Z5, Z6 — 800 mil Long x 125 mil W. Microstrip

Board Material — 0.0325" Teflon-Fiberglass, ϵ_r = 2.56, 1 oz. Copper Clad both sides.

Figure 1. 500 MHz Test Fixture

OUTPUT POWER versus INPUT POWER
CLASS C

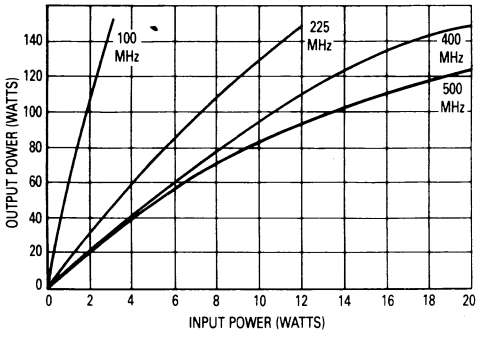


Figure 2. V_{CC} = 28 V

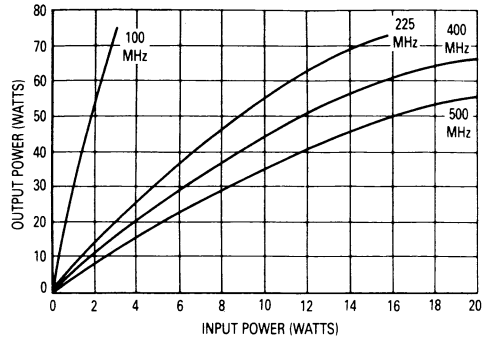


Figure 3. V_{CC} = 13.5 V

OUTPUT POWER versus SUPPLY VOLTAGE
CLASS C

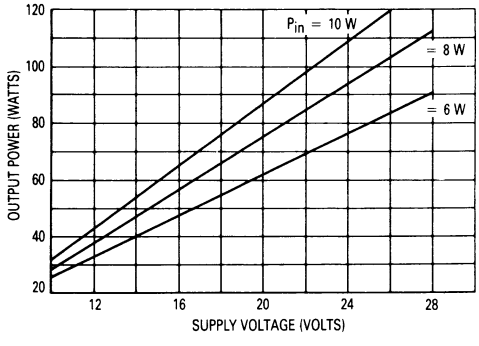


Figure 4. f = 225 MHz

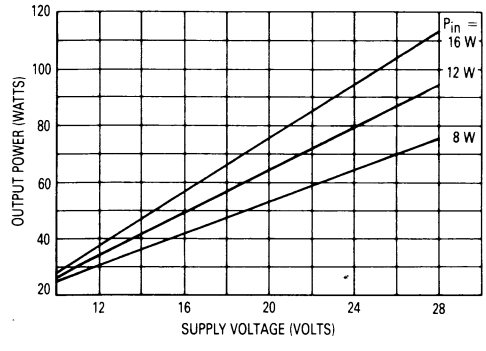
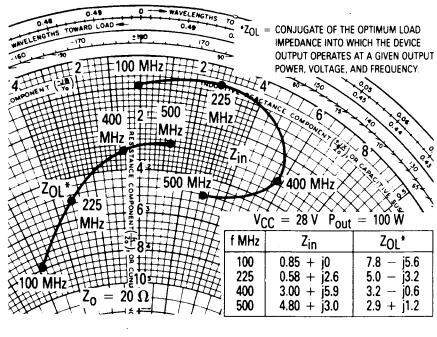


Figure 5. f = 500 MHz



f MHz	Z_{in}	Z_{OL}*
100	0.85 + j0	7.8 − j5.6
225	0.58 + j2.6	5.0 − j3.2
400	3.00 + j5.9	3.2 − j0.6
500	4.80 + j3.0	2.9 + j1.2

Figure 6. Series Equivalent Input/Output Impedance

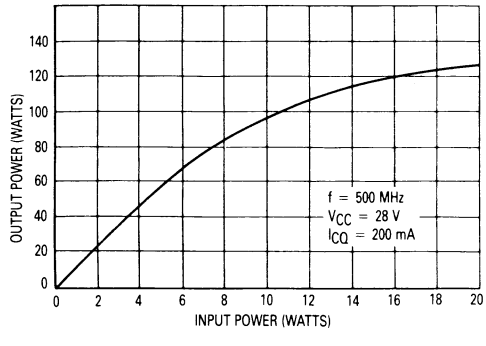
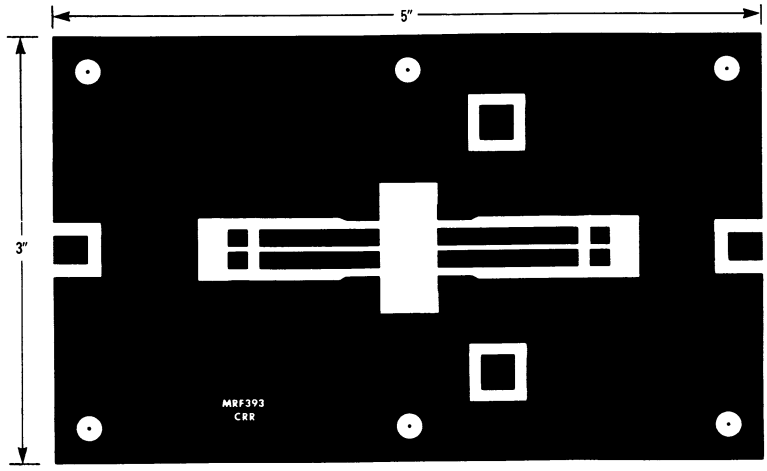


Figure 7. Class AB Output Power versus Input Power



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

Figure 8. Test Circuit Photomaster

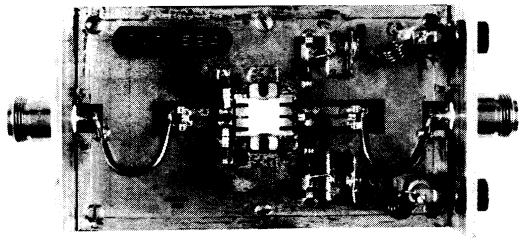
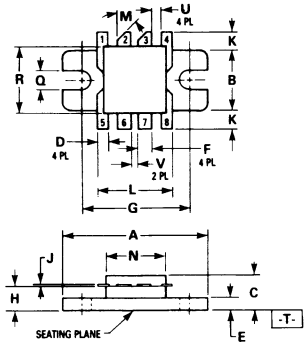


Figure 9. 500 MHz Test Circuit

OUTLINE DIMENSIONS



STYLE 1:
PIN 1. EMITTER
2. COLLECTOR
3. COLLECTOR
4. EMITTER
5. EMITTER
6. BASE
7. BASE
8. EMITTER

NOTES:
1. DIMENSIONS A AND B ARE DATUMS AND T IS A DATUM SURFACE.
2. POSITIONAL TOLERANCE FOR SLOTS:
   ⌖ ⌀0.76 (0.030) Ⓜ A Ⓜ B Ⓜ
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

CASE 744A-01

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	22.60	23.11	0.890	0.910
B	9.52	10.03	0.375	0.395
C	6.65	7.16	0.262	0.282
D	1.60	1.95	0.063	0.077
E	2.94	3.40	0.116	0.134
F	2.87	3.22	0.113	0.127
G	16.51 BSC		0.650 BSC	
H	4.01	4.36	0.158	0.172
J	0.07	0.15	0.003	0.006
K	4.34	4.90	0.171	0.193
L	12.44	12.95	0.490	0.510
M	45° NOM		45° NOM	
N	10.51	11.02	0.414	0.434
Q	3.04	3.35	0.120	0.132
R	9.90	10.41	0.390	0.410
U	1.02	1.27	0.040	0.050
V	0.64	0.89	0.025	0.035

MRF401

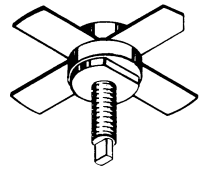
The RF Line

25 W PEP – 30 MHz
RF POWER
TRANSISTOR
NPN SILICON

NPN SILICON RF POWER TRANSISTORS

. . . designed primarily for applications as a high-power linear amplifier from 2.0 to 75 MHz.

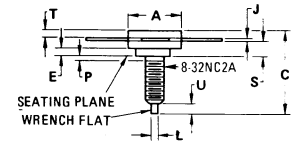
- Specified 28 Volt, 30 MHz Characteristics –
  Output Power = 25 W (PEP)
  Minimum Gain = 13 dB
  Efficiency = 40%
- Intermodulation Distortion at 25 W (PEP)
  IMD = -32 dB (Max)
- Isothermal-Resistor Design Results in Rugged Device

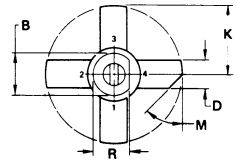


MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	30	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector Current – Continuous	I_C	3.3	Adc
Total Device Dissipation @ T_C = 25°C(1) Derate above 25°C	P_D	50 0.286	Watts W/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

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





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

DIM	MILLIMETERS MIN	MAX	INCHES 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

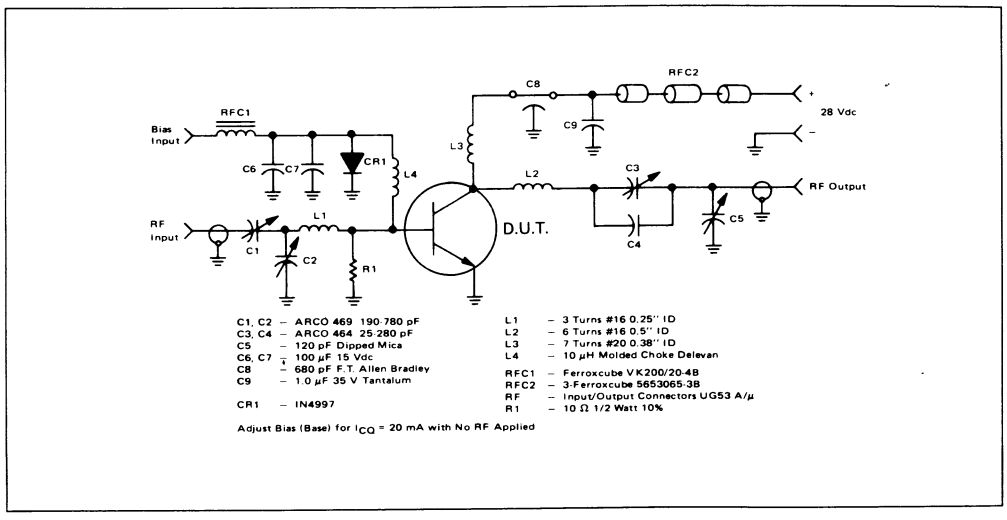
Case 145A-09

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, I_B = 0)	$V_{(BR)CEO}$	30	–	–	Vdc
Collector-Emitter Breakdown Voltage (I_C = 10 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	60	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 1.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	10	20	–	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 30 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	65	85	pF
FUNCTIONAL TEST (Figure 1)					
Common-Emitter Amplifier Power Gain (P_{out} = 25 Watts PEP, I_C (max) = 1.12 Adc, V_{CC} = 28 Vdc, f = 30 MHz)	G_{PE}	13	–	–	dB
Collector Efficienty (P_{out} = 25 Watts PEP, I_C (max) = 1.12 Adc, V_{CC} = 28 Vdc, f = 30 MHz)	η	40	–	–	%
Intermodulation Distortion (P_{out} = 25 Watts PEP, I_C = 1.12 Adc, V_{CC} = 28 Vdc, f_1 = 30 MHz, f_2 = 30.001 MHz)	IMD	–	–	-32	dB

3

FIGURE 1 – 30 MHz LINEAR TEST CIRCUIT



C1, C2 – ARCO 469 190-780 pF
C3, C4 – ARCO 464 25-280 pF
C5 – 120 pF Dipped Mica
C6, C7 – 100 µF 15 Vdc
C8 – 680 pF F.T. Allen Bradley
C9 – 1.0 µF 35 V Tantalum

CR1 – IN4997

L1 – 3 Turns #16 0.25" ID
L2 – 6 Turns #16 0.5" ID
L3 – 7 Turns #20 0.38" ID
L4 – 10 µH Molded Choke Delevan

RFC1 – Ferroxcube VK200/20-4B
RFC2 – 3-Ferroxcube 5653065-3B
RF – Input/Output Connectors UG53 A/µ
R1 – 10 Ω 1/2 Watt 10%

Adjust Bias (Base) for I_{CQ} = 20 mA with No RF Applied

FIGURE 2 – PARALLEL EQUIVALENT INPUT RESISTANCE versus FREQUENCY

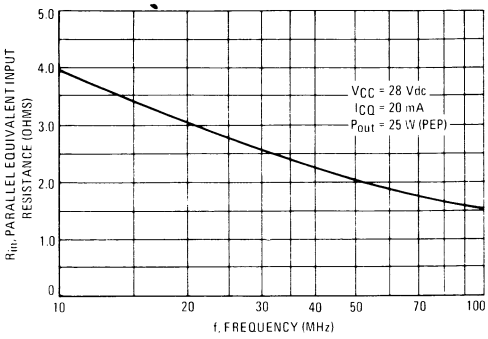


FIGURE 3 – PARALLEL EQUIVALENT INPUT CAPACITANCE versus FREQUENCY

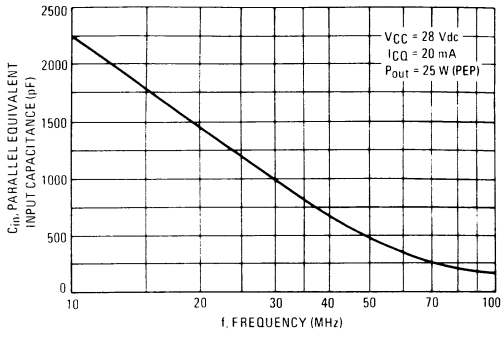


FIGURE 4 – PARALLEL EQUIVALENT OUTPUT CAPACITANCE versus FREQUENCY

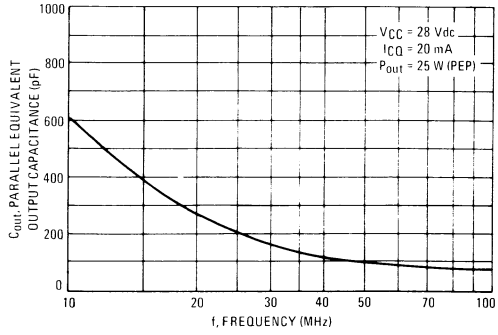


FIGURE 5 – POWER GAIN versus FREQUENCY

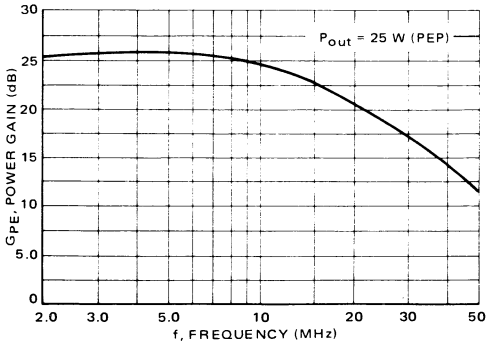
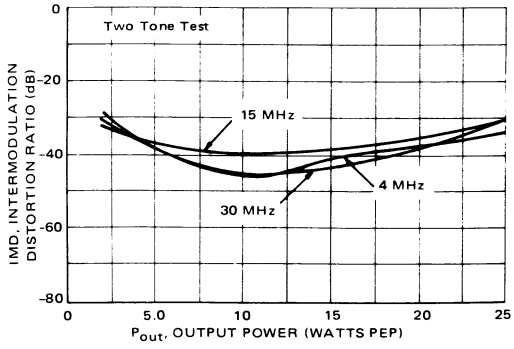


FIGURE 6 – IMD versus POWER OUTPUT



MRF406

The RF Line

20 W(PEP) – 30 MHz

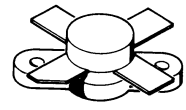
RF POWER TRANSISTOR

NPN SILICON

NPN SILICON RF POWER TRANSISTOR

. . . designed primarily for application as a power linear amplifier from 2.0 to 30 MHz.

- Specified 12.5 Volt, 30 MHz Characteristics –
  Output Power = 20 W(PEP)
  Minimum Gain = 12 dB
  Efficiency = 45%
- Intermodulation Distortion @ 20 W(PEP) –
  IMD = -30 dB (Min)
- 100% Tested for Load Mismatch at all Phase Angles with 30:1 VSWR

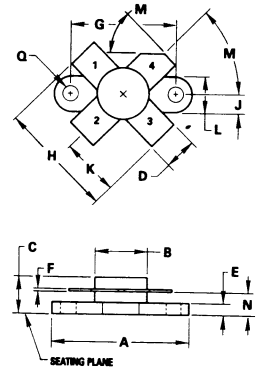


MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	20	Vdc
Collector-Base Voltage	V_{CBO}	40	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector Current — Continuous	I_C	4.0	Adc
Withstand Current (t = 5.0 s)	—	12	Adc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	80 0.46	Watts W/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C
Junction Temperature	T_J	200	°C

THERMAL CHARACTERISTICS

Characteristics	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.2	°C/W



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

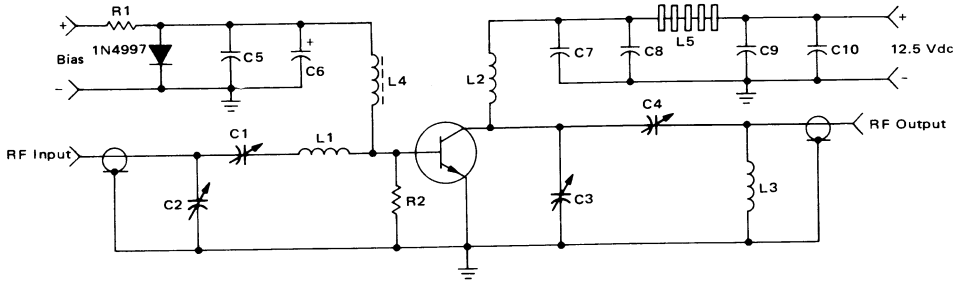
DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	24.38	25.15	0.960	0.990
B	9.40	9.91	0.370	0.390
C	5.82	7.14	0.229	0.281
D	5.46	5.97	0.215	0.235
E	2.16	2.67	0.085	0.105
F	0.10	0.15	0.004	0.006
G	18.29	18.54	0.720	0.730
H	20.07	20.57	0.790	0.810
K	10.03	10.29	0.395	0.405
L	6.22	6.48	0.245	0.255
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

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, I_B = 0)	$V_{(BR)CEO}$	20	–	–	Vdc
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	40	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 50 mAdc, I_E = 0)	$V_{(BR)CBO}$	40	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 1.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CE} = 12.5 Vdc, V_{BE} = 0)	I_{CES}	–	–	5.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 1.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	10	35	–	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 12.5 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	150	200	pF
FUNCTIONAL TESTS (Figure 1)					
Common-Emitter Amplifier Power Gain (V_{CC} = 12.5 Vdc, P_{out} = 20 W(PEP), $I_{C(max)}$ = 1.75 Adc, I_{CQ} = 25 mAdc, f = 30, 30.001 MHz)	G_{PE}	12	15	–	dB
Power Output (V_{CE} = 12.5 Vdc, f = 30 MHz)	P_{out}	20	–	–	Watts(PEP)
Collector Efficiency (V_{CC} = 12.5 Vdc, P_{out} = 20 W(PEP), $I_{C(max)}$ = 1.75 Adc, I_{CQ} = 25 mAdc, f = 30, 30.001 MHz)	η	45	–	–	%
Intermodulation Distortion (V_{CE} = 12.5 Vdc, P_{out} = 20 W(PEP), $I_{C(max)}$ = 1.75 Adc, I_{CQ} = 25 Adc, f = 30, 30.001 MHz)	IMD	−30	−35	–	dB
Load Mismatch (V_{CC} = 12.5 Vdc, P_{out} = 20 W(PEP), I_C = 1.75 Adc, I_{CQ} = 25 mAdc, f = 30, 30.001 MHz)	–	> 30:1 All Phase Angles			–

FIGURE 1 – 30 MHz TEST CIRCUIT SCHEMATIC



C1, C2, C4	ARCO 466	L1	0.15 µH, Molded Choke
C3	ARCO 469	L2	15 Turns of #20 AWG Enameled Wire, 1/4" I.D., Close Wound
C5, C8, C9	0.1 µF Disc Ceramic	L3	4 Turns of #18 AWG Wire, 5/16" I.D., 3/8" Long.
C6	1000 µF, 3 V Electrolytic	L4	10 µH, Molded Choke
C7	1000 pF, UNELCO	L5	5 Ferrite Beads, FERROXCUBE #56-590-65/3B
C10	100 µF, 15 V Electrolytic		
R1	100 Ohm, 25 W, Wire Wound		
R2	10 Ohm, ½ W, Carbon		

FIGURE 2 – OUTPUT POWER versus INPUT POWER

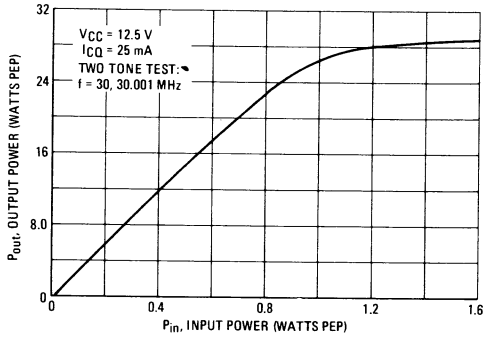


FIGURE 3 – OUTPUT POWER versus SUPPLY VOLTAGE

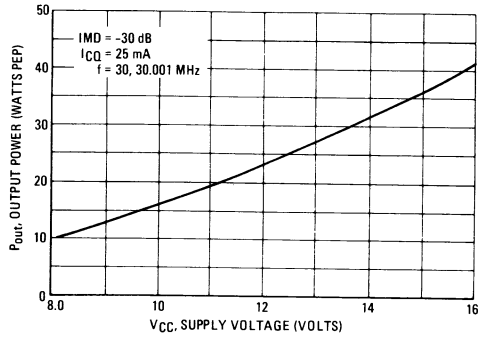


FIGURE 4 – POWER GAIN versus FREQUENCY

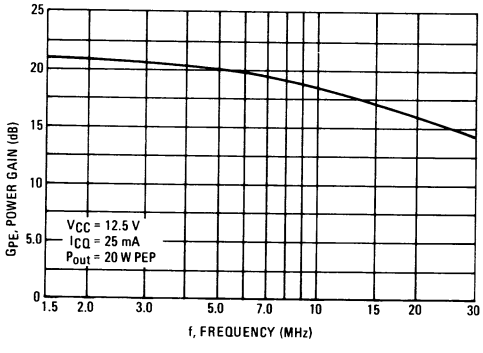


FIGURE 5 – INTERMODULATION DISTORTION versus OUTPUT POWER

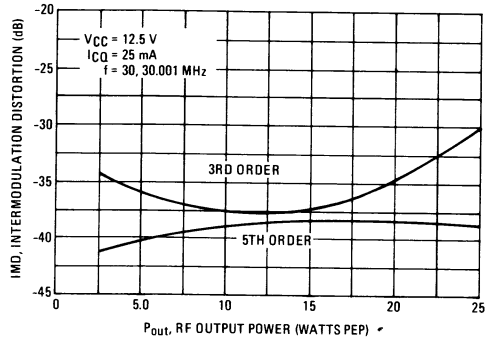
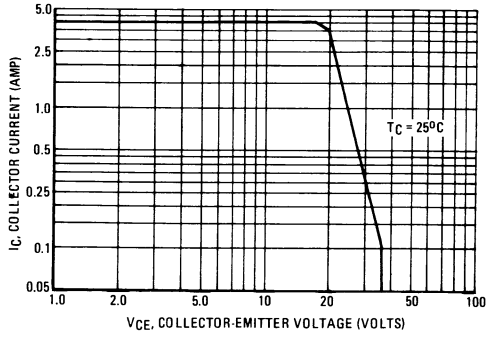


FIGURE 6 – DC SAFE OPERATING AREA



3

FIGURE 7 – SERIES EQUIVALENT IMPEDANCE

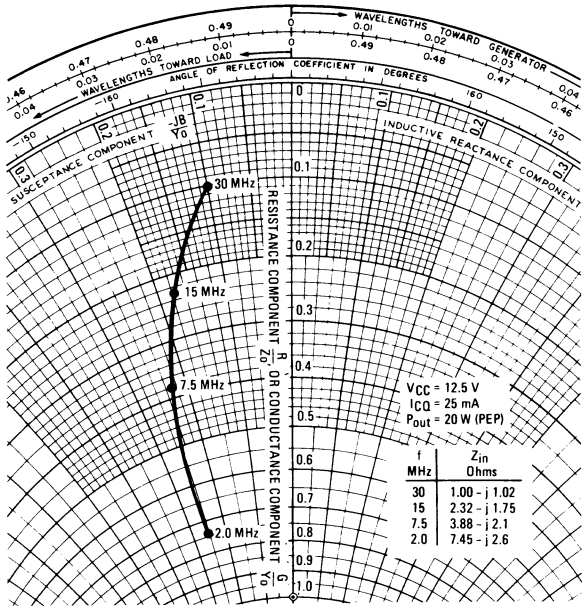


FIGURE 8 – PARALLEL EQUIVALENT OUTPUT CAPACITANCE versus FREQUENCY

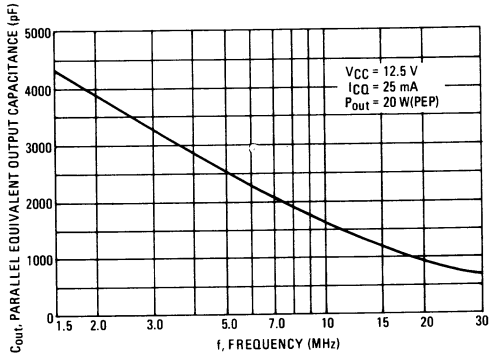


FIGURE 9 – PARALLEL EQUIVALENT OUTPUT RESISTANCE versus FREQUENCY