MRF492
MRF492A

The RF Line

70 W 50 MHz

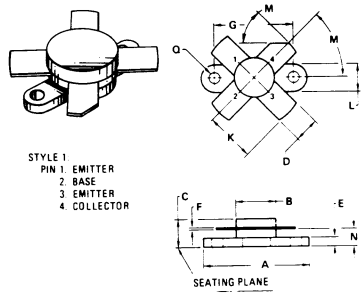
RF POWER TRANSISTOR

NPN SILICON

NPN SILICON RF POWER TRANSISTOR

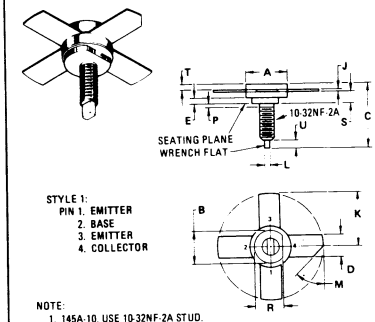
. . . designed for 12.5 volt low band VHF large-signal power amplifier applications in commercial and industrial FM equipment.

- Specified 12.5 V, 50 MHz Characteristics —
  Output Power = 70 W
  Minimum Gain = 11 dB
  Efficiency = 50%
- Load Mismatch Capability at High Line and RF Overdrive



DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	24.64	24.89	0.970	0.980
B	11.81	12.95	0.465	0.510
C	5.82	6.98	0.229	0.275
D	5.46	5.97	0.216	0.235
E	2.13	2.79	0.084	0.110
F	0.08	0.18	0.003	0.007
G	18.29	18.54	0.720	0.730
K	11.05	–	0.435	–
L	6.22	6.48	0.246	0.255
M	45° NOM		45° NOM	
N	3.66	4.52	0.144	0.178
Q	2.92	3.30	0.115	0.130

MRF492 CASE 211-11



DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	12.45	12.95	0.490	0.510
B	10.54	10.80	0.415	0.425
C	19.68	22.73	0.775	0.895
D	5.46	5.97	0.215	0.235
E	1.83	–	0.072	–
J	0.08	0.18	0.003	0.007
K	12.45	–	0.490	–
L	1.65	1.90	0.065	0.075
M	45° NOM		45° NOM	
P	–	1.27	–	0.050
R	9.73	10.06	0.383	0.396
S	3.84	4.50	0.151	0.177
T	2.11	2.54	0.083	0.100
U	2.49	3.35	0.098	0.132

MRF492A CASE 145A-10

3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	18	Vdc
Collector-Base Voltage	V_{CBO}	36	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector-Current — Continuous	I_C	20	Adc
Total Device Dissipation @ T_C = 25°C (1) Derate above 25°C	P_D	250 1.43	Watts W/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	$R_{\theta JC}$	0.7	°C/W

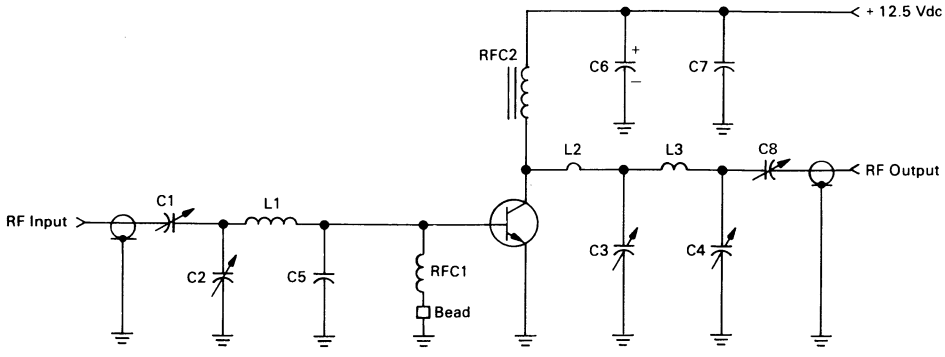
(1) These devices are designed for RF operation. The total device dissipation rating applies only when the devices are operated as RF amplifiers.
(2) Thermal Resistance is determined under specified RF operating conditions by infrared measurement techniques.

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, I_B = 0)	$V_{(BR)CEO}$	18	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	36	—	—	Vdc
Emitter-Base Breakdown Voltage I_E = 10 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	—	—	Vdc
Collector Cutoff Current (V_{CE} = 13.6 Vdc, V_{BE} = 0)	I_{CES}	—	—	20	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 5.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	10	—	150	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 15 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	—	275	450	pF
FUNCTIONAL TESTS					
Common-Emitter Amplifier Power Gain (V_{CC} = 12.5 Vdc, P_{out} = 70 W, f = 50 MHz)	G_{PE}	11	13	—	dB
Collector Efficiency (V_{CC} = 12.5 Vdc, P_{out} = 70 W, f = 50 MHz)	η	50	—	—	%

3

FIGURE 1 — 50 MHz TEST CIRCUIT



C1, C8 — 9.0–180 pF, Arco 463
C2, C3, C4 — 80–480 pF, Arco 466
C5 — 1000 pF, 350 V, Unelco
C6 — 10 μF, 25 Vdc
C7 — 0.01 μF, Ceramic
RFC1 — 10 μH Molded Choke

RFC2 — 12 Turns, #16 AWG, Enameled Wire Closewound on a 2 W Carbon Resistor
L1 — 2 Turns, #18 AWG Enameled Wire, 0.4" ID, 0.15" Long
L2 — Loop, #12 AWG Wire, 0.6" High, 0.4" Wide
L3 — 2 Turns, #12 AWG Wire, ID 0.4", 0.25" Long
Bead — Ferrite Bead Ferroxcube #56-590-65/3B

FIGURE 2 — OUTPUT POWER versus INPUT POWER

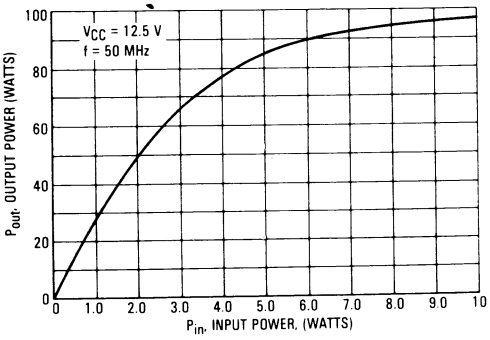


FIGURE 3 — POWER GAIN versus FREQUENCY

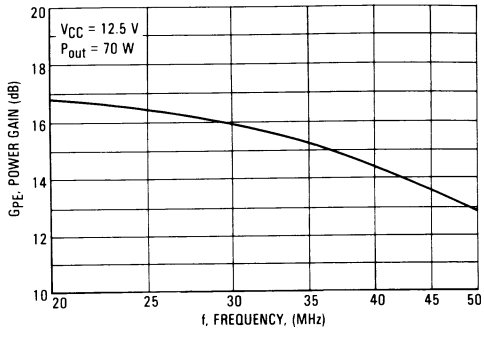


FIGURE 4 — OUTPUT POWER versus SUPPLY VOLTAGE

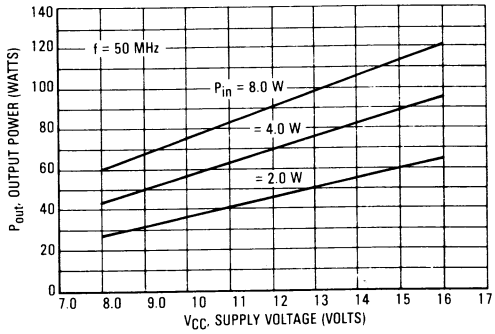


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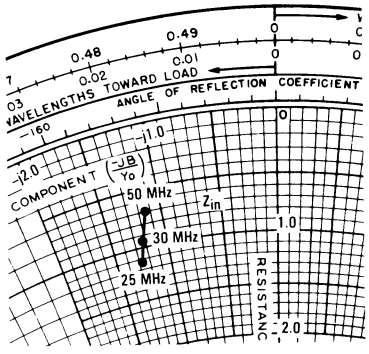
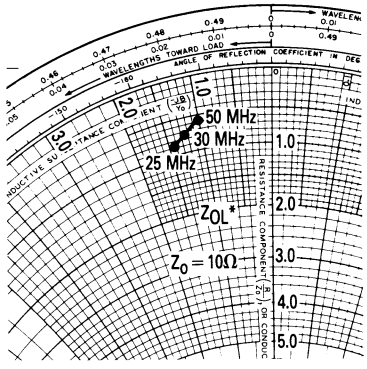
FIGURE 5 — SERIES EQUIVALENT INPUT/OUTPUT IMPEDANCES



V_{CC} = 12.5 V, P_{out} = 70 W

f MHz	Z_{in} Ohms	Z_{OL}^* Ohms
50	0.7 – j1.17	0.58 – j1.0
30	0.93 – j1.24	0.76 – j1.3
25	1.12 – j1.28	0.85 – j1.46

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



MRF497

The RF Line

40 W 50 MHz

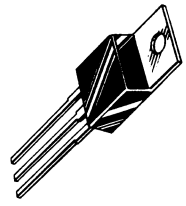
RF POWER TRANSISTOR

NPN SILICON

NPN SILICON RF POWER TRANSISTOR

. . . designed for 12.5-volt VHF large-signal power amplifier applications in commercial and industrial equipment, operating in the 25 to 50 MHz frequency range.

- Low-Cost, Common-Emitter TO-220 Package
- Specified 12.5 V, 50 MHz Performance —
  Output Power = 40 Watts
  Power Gain = 10 dB Min
  Efficiency = 60% Min
- Load Mismatch Capability at Rated Voltage and RF Drive



MAXIMUM RATINGS

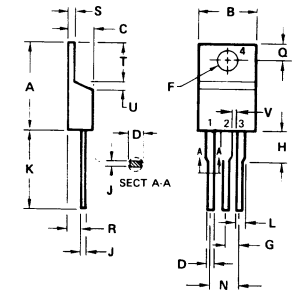
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	18	Vdc
Collector-Base Voltage	V_{CBO}	36	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector-Current — Continuous	I_C	6.0	Adc
Total Device Dissipation @ T_C = 25°C (1) Derate above 25°C	P_D	87.5 0.5	Watts mW/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	$R_{\theta JC}$	2.0	°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.



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

NOTE:
1. DIM. L & H APPLIES TO ALL LEADS.

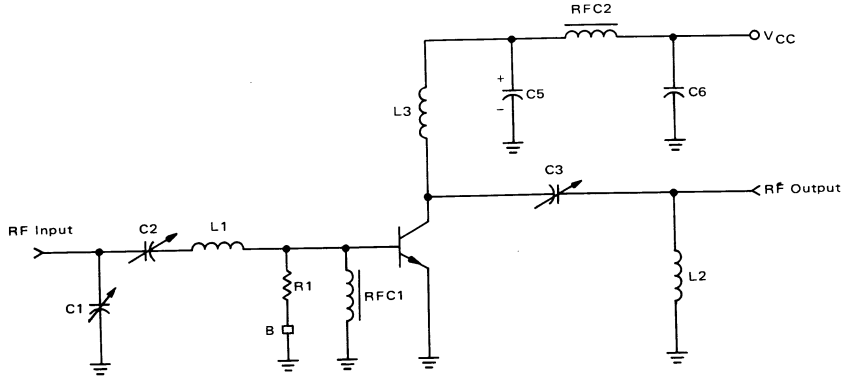
DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	15.11	15.75	0.595	0.620
B	9.65	10.29	0.380	0.405
C	4.06	4.82	0.160	0.190
D	0.64	0.89	0.025	0.035
F	3.61	3.73	0.142	0.147
G	2.41	2.67	0.095	0.105
H	2.79	3.30	0.110	0.130
J	0.36	0.56	0.014	0.022
K	12.70	14.27	0.500	0.562
L	1.14	1.27	0.045	0.050
N	4.83	5.33	0.190	0.210
Q	2.54	3.04	0.100	0.120
R	2.04	2.79	0.080	0.110
S	1.14	1.39	0.045	0.055
T	5.97	6.48	0.235	0.255
U	0.76	1.27	0.030	0.050
V	1.14	-	0.045	-

CASE 221A-02

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, I_B = 0)	$V_{(BR)CEO}$	18	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 20 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	36	—	—	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}	20	—	—	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 15 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	—	—	250	pF
FUNCTIONAL TESTS					
Common-Emitter Amplifier Power Gain (V_{CC} = 12.5 Vdc, P_{out} = 40 W, f = 50 MHz)	G_{PE}	10	11.2	—	dB
Collector Efficiency (V_{CC} = 12.5 Vdc, P_{out} = 40 W, f = 50 MHz)	η	60	—	—	%

FIGURE 1 — 50 MHz TEST CIRCUIT



C1 — Arco 469
C2, C3 — Arco 466
C5 — 100 µF, 16 Vdc Electrolytic
C6 — 0.001 µF Disc Ceramic

R1 — 10 Ω, 1.0 Watt Resistor

L1 — 3 Turns #14 AWG Wire, 1/3" ID
L2 — 1-1/2 Turns #14 AWG Wire, 1/2" ID
L3 — 14 Turns #18 AWG Wire 1/4" ID

RFC1 — RF Choke Ferroxcube VK200-20/4B
RFC2 — 3 Ferroxcube, #56-590-65/3B, Beads on #18 AWG Wire

B — Ferroxcube #56-490-65/3B

Board Material — Epoxy Fiberglass, 0.062" thick

FIGURE 2 – POWER GAIN versus FREQUENCY

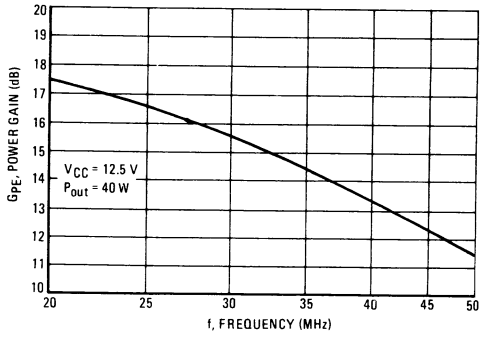


FIGURE 3 – OUTPUT POWER versus INPUT POWER

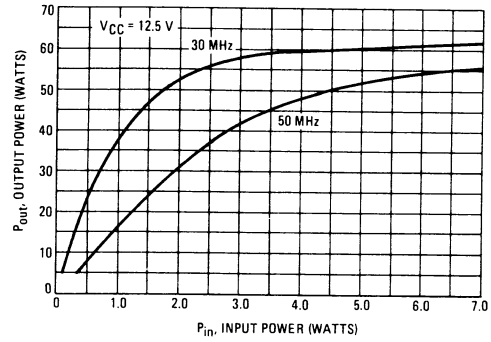


FIGURE 4 – OUTPUT POWER versus SUPPLY VOLTAGE
50 MHz

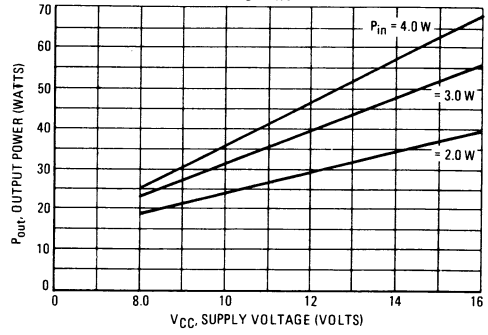


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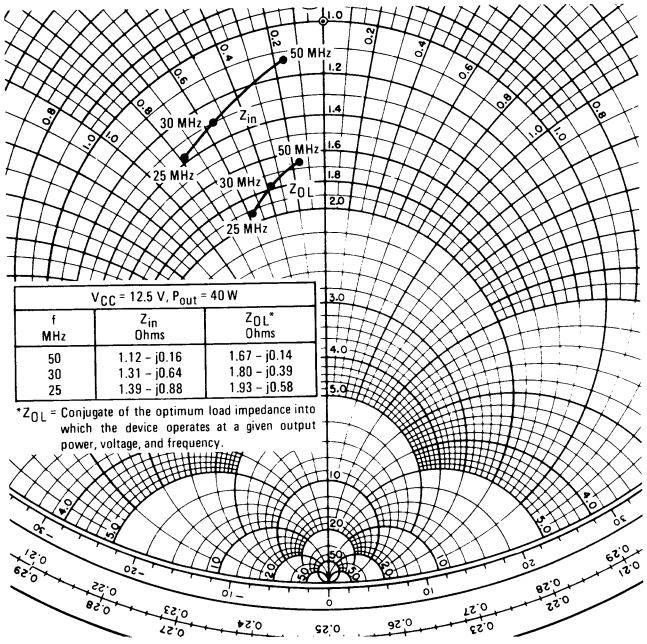
FIGURE 5 — SERIES EQUIVALENT INPUT/OUTPUT IMPEDANCES

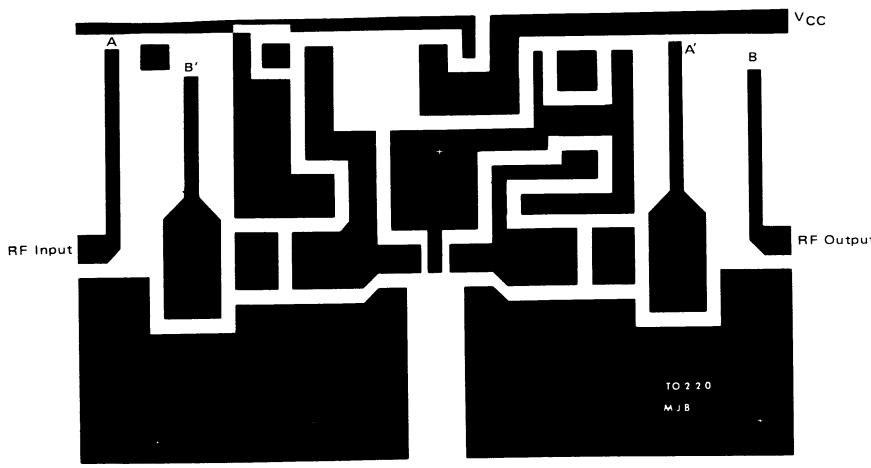


V_{CC} = 12.5 V, P_{out} = 40 W		
f MHz	Z_{in} Ohms	Z_{OL}* Ohms
50	1.12 – j0.16	1.67 – j0.14
30	1.31 – j0.64	1.80 – j0.39
25	1.39 – j0.88	1.93 – j0.58

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

3

FIGURE 6 — TEST AMPLIFIER PCB PHOTOMASTER



NOTE: Points A, A′ and B, B′ are connected via 50 Ω coaxial cable under the PCB.
The Printed Circuit Board shown is 75% of the original.

MRF501
MRF502

The RF Line

NPN SILICON HIGH-FREQUENCY TRANSISTORS

. . . designed primarily for use in high-gain, low-noise amplifier, oscillator, and mixer applications. Can also be used in UHF converter applications.

- High Current-Gain — Bandwidth Product —
  f_T = 1.2 GHz (Typ) @ I_C = 5.0 mAdc
- Low Noise Figure —
  NF = 4.0 dB (Typ) @ f = 200 MHz

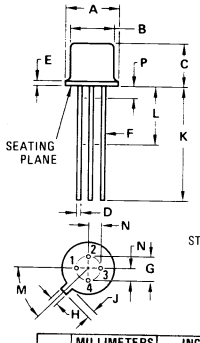
HIGH FREQUENCY TRANSISTORS

NPN SILICON

3

MAXIMUM RATINGS

Rating	Symbol	MRF501	MRF502	Unit
Collector-Emitter Voltage	V_{CEO}	15		Vdc
Collector-Base Voltage	V_{CBO}	25	35	Vdc
Emitter-Base Voltage	V_{EBO}	3.5		Vdc
Collector Current	I_C	50		mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	200 1.14		mW mW/°C
Storage Temperature Range	T_{stg}	-65 to +200		°C



DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	5.31	5.84	0.209	0.230
B	4.52	4.95	0.178	0.195
C	4.32	5.33	0.170	0.210
D	0.41	0.53	0.016	0.021
E	–	0.76	–	0.030
F	0.41	0.48	0.016	0.019
G	2.54 BSC		0.100 BSC	
H	0.91	1.17	0.036	0.046
J	0.71	1.22	0.028	0.048
K	12.70	–	0.500	–
L	6.35	–	0.250	–
M	45° BSC		45° BSC	
N	1.27 BSC		0.050 BSC	
P	–	1.27	–	0.050

ALL JEDEC dimensions and notes apply

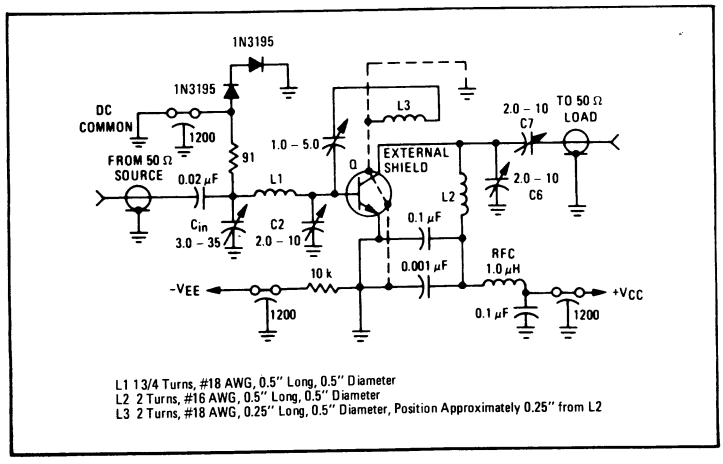
CASE 20-03
TO-72

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

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage (I_C = 3.0 mAdc, I_B = 0)		$V_{(BR)CEO}$	15	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 1.0 μAdc, I_E = 0)	MRF501 MRF502	$V_{(BR)CBO}$	25 35	– –	– –	Vdc
Emitter-Base Breakdown Voltage (I_E = 1.0 μAdc, I_C = 0)		$V_{(BR)EBO}$	3.5	–	–	Vdc
Collector Cutoff Current (V_{CB} = 1.0 Vdc, I_E = 0)	MRF501 MRF502	I_{CBO}	– –	– –	50 20	nAdc
ON CHARACTERISTICS						
DC Current Gain (I_C = 1.0 mAdc, V_{CE} = 6.0 Vdc)	MRF501 MRF502	h_{FE}	30 40	– –	250 170	–
DYNAMIC CHARACTERISTICS						
Current Gain – Bandwdith Product (I_C = 5.0 mAdc, V_{CE} = 6.0 Vdc, f = 100 MHz)	MRF501 MRF502	f_T	600 800	1000 1200	– –	MHz
Collector-Base Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 0.1 to 1.0 MHz)		C_{cb}	–	0.6	–	pF
Collector-Base Time Constant (I_E = 2.0 mAdc, V_{CB} = 6.0 Vdc, f = 31.8 MHz)		$r_b'C_c$	–	8.0	–	ps
Noise Figure (Figure 1) (I_C = 1.5 mAdc, V_{CE} = 6.0 Vdc, R_S = 50 ohms, f = 200 MHz)	MRF501 MRF502	NF	– –	4.5 4.0	– –	dB
FUNCTIONAL TEST						
Common-Emitter Amplifier Power Gain (Figure 1) (V_{CC} = 6.0 Vdc, I_C = 5.0 mAdc, f = 200 MHz)	MRF501 MRF502	G_{pe}	– –	15 17	– –	dB

3

FIGURE 1 – 200 MHz AMPLIFIER POWER GAIN AND NOISE FIGURE CIRCUIT



L1 13/4 Turns, #18 AWG, 0.5" Long, 0.5" Diameter
L2 2 Turns, #16 AWG, 0.5" Long, 0.5" Diameter
L3 2 Turns, #18 AWG, 0.25" Long, 0.5" Diameter, Position Approximately 0.25" from L2

MRF511

The RF Line

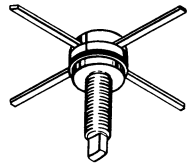
NPN SILICON HIGH FREQUENCY TRANSISTOR

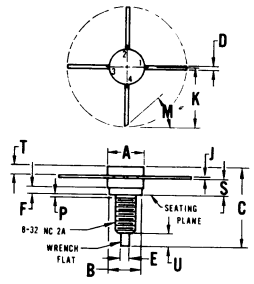
. . . designed specifically for broadband applications requiring low distortion characteristics and noise figure. Specified for use in CATV applications.

- Specified +50 dBmV Output, 80 mAdc Distortion Characteristics –
  Triple Beat = -65 dB (Max)
  Cross Modulation = -57 dB (Max)
  Second Order = -50 dB (Max)
- High Broadband Power Gain –
  G_{pe} = 10 dB (Min) @ f = 250 MHz
- Low Broadband Noise Figure –
  NF = 10 dB (Max) @ f = 200 MHz

HIGH FREQUENCY TRANSISTOR

NPN SILICON





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

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	7.06	7.26	0.278	0.286
B	6.20	6.50	0.244	0.256
C	15.24	16.51	0.600	0.650
D	0.66	0.86	0.026	0.034
E	1.40	1.65	0.055	0.065
F	1.52	–	0.060	–
J	0.10	0.15	0.004	0.006
K	11.17	–	0.440	–
M	45° NOM		45° NOM	
P	–	1.27	–	0.050
S	2.74	3.35	0.108	0.132
T	1.40	1.78	0.055	0.070
U	2.92	3.68	0.115	0.145

CASE 244A-01

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	25	Vdc
Collector-Base Voltage	V_{CBO}	35	Vdc
Emitter-Base Voltage	V_{EBO}	3.5	Vdc
Collector Current – Continuous	I_C	250	mAdc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	5.0 28.6	Watts mW/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C
Stud Torque(1)	–	6.5	In. Lb.

(1) For Repeated Assembly use 5 In. Lb.

3

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

Characteristics	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-Base Breakdown Voltage (I_C = 100 μAdc, I_E = 0)	$V_{(BR)CBO}$	35	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 100 μAdc, I_C = 0)	$V_{(BR)EBO}$	3.5	–	–	Vdc
Collector Cutoff Current (V_{CE} = 15 Vdc, I_B = 0)	I_{CEO}	–	–	100	μAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 80 mAdc, V_{CE} = 10 Vdc)	h_{FE}	25	50	200	–
Collector-Emitter Saturation Voltage (I_C = 100 mAdc, I_B = 10 mAdc)	$V_{CE(sat)}$	–	0.2	0.5	Vdc
DYNAMIC CHARACTERISTICS					
Current-Gain–Bandwidth Product (I_C = 80 mAdc, V_{CE} = 20 Vdc, f = 200 MHz)	f_T	1.5	2.1	–	GHz
Output Capacitance (V_{CB} = 20 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	3.2	4.5	pF
Noise Figure (I_C = 50 mAdc, V_{CE} = 20 Vdc, f = 200 MHz)	NF	–	7.3	10	dB
FUNCTIONAL TESTS (Figure 1)					
Common-Emitter Amplifier Power Gain (V_{CE} = 20 Vdc, I_C = 80 mAdc, f = 250 MHz)	G_{pe}	10	11	–	dB
2nd Order Intermodulation Distortion (V_{CE} = 20 Vdc, I_C = 80 mAdc, V_{out} = +50 dBmV, Chn 2 + Chn 13 = 266.5 MHz)	IMD	–	-55	-50	dB
Cross-Modulation Distortion (V_{CE} = 20 Vdc, V_{out} = +50 dBmV, I_C = 80 mAdc) Chn 13 / Chn R	12 Chn XMD / 30 Chn XMD	– / –	-59 / -46	-57 / –	dB
Triple Beat (V_{CE} = 20 Vdc, I_C = 80 mAdc, V_{out} = +50 dBmV, Chn 2 + Chn 3 + Chn E = 261.75 MHz)	TB	–	-68	-65	dB

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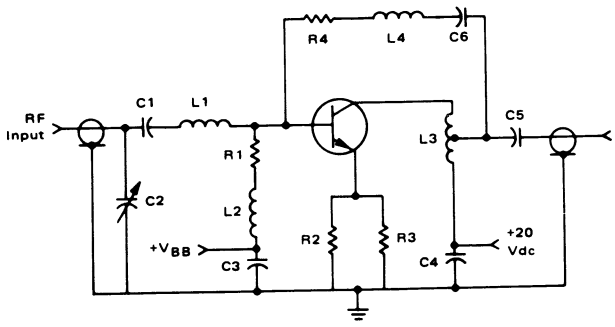
FIGURE 1 – 40 to 330 MHz BROADBAND TEST CIRCUIT SCHEMATIC



CIRCUIT PERFORMANCE	Min	Typ
Input/Output Return Loss	–	18 dB
Flatness	–	+0.3 dB
Gain	10 dB	
Bandwidth	–	40-300 MHz

C1,C3,C4,C5,C6	0.002 μF Ceramic Disc
C2	0.35-3.5 pF JOHANSON 4702
L1	2 Turns, #20 AWG, 1/8" I.D., 0.2 " Long
L2	5 μH, Ferrite Choke, MILLER
L3	18 Turns, #24 AWG Enamelled, on Ferrite Torrid Core FERROXCUBE 1041TO60-4C7
L4	5 Turns, #20 AWG, 3/16" I.D., 0.35" Long

R1	4.7 kΩ, 1/4W, 10%
R2	27 Ω, 1W, 10%
R3	27 Ω, 1W,10%
R4	300 Ω, 1/4W, 10%.

Input/Output Connectors – Type F

Z_o – 75 Ohms

FIGURE 2 – CURRENT-GAIN–BANDWIDTH PRODUCT

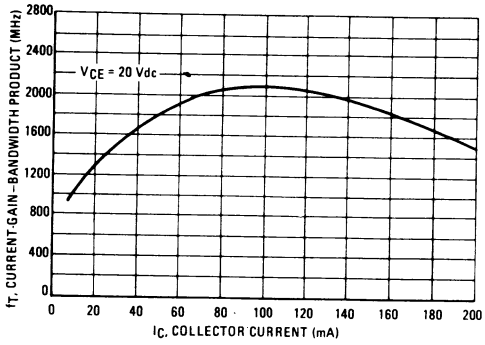


FIGURE 3 – OUTPUT CAPACITANCE

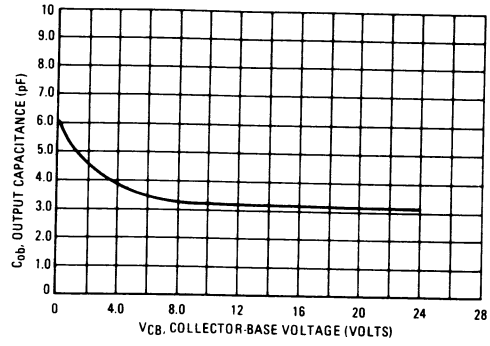


FIGURE 4 – INPUT CAPACITANCE

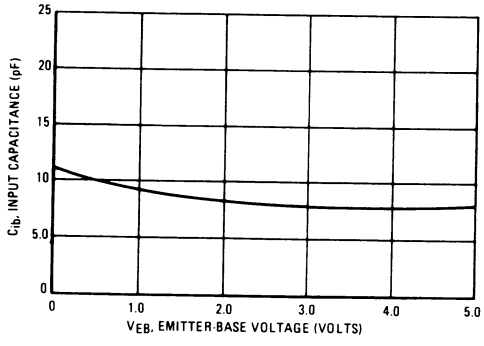


FIGURE 5 – BROADBAND NOISE FIGURE

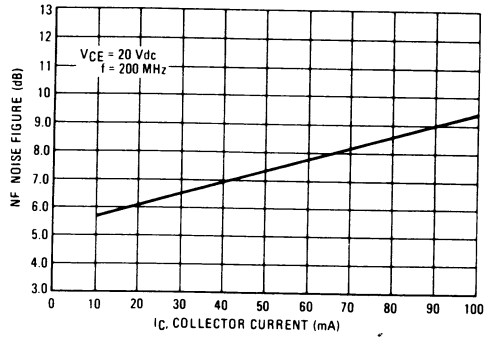


FIGURE 6 – 12 CHANNEL CROSS-MODULATION versus COLLECTOR-EMITTER VOLTAGE

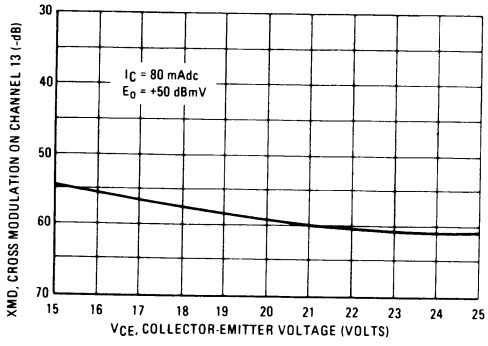


FIGURE 7 – 12 CHANNEL CROSS-MODULATION versus COLLECTOR CURRENT

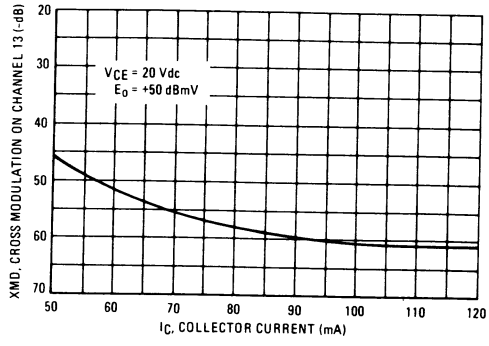


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FIGURE 8 – 30-CHANNEL CROSS-MODULATION ON CHANNEL R

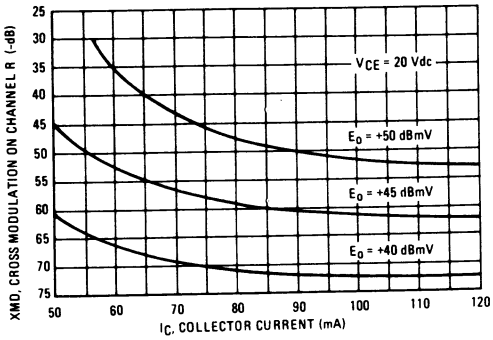

FIGURE 9 – 30 CHANNEL CROSS-MODULATION ON CHANNEL 2,13,R

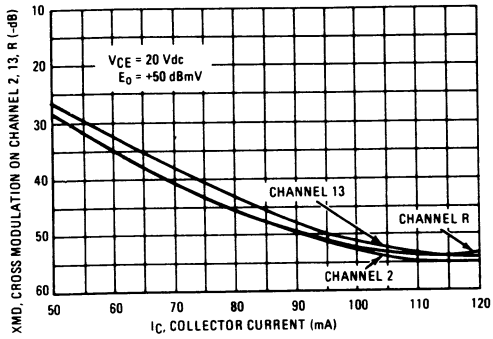

FIGURE 10 – 30-CHANNEL CROSS-MODULATION versus COLLECTOR-EMITTER VOLTAGE

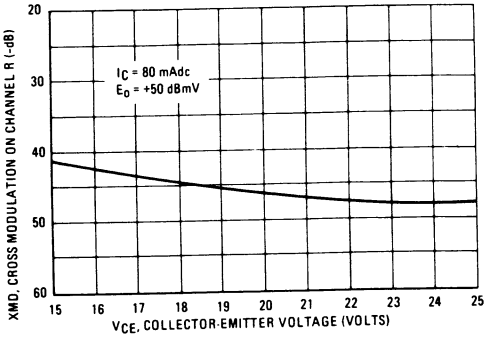

FIGURE 11 – TRIPLE BEAT versus COLLECTOR CURRENT

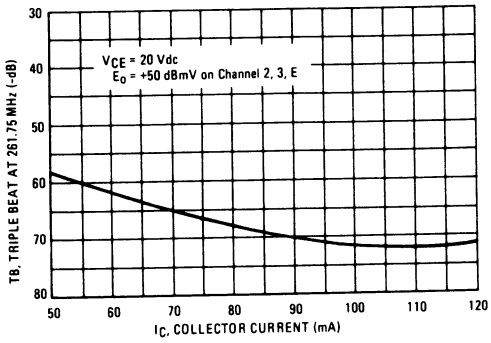

FIGURE 12 – TRIPLE BEAT versus COLLECTOR-EMITTER VOLTAGE

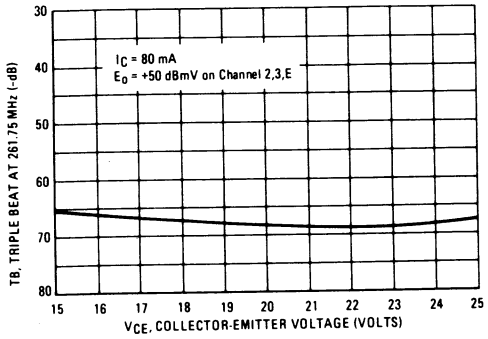

FIGURE 13 – SECOND ORDER IMD versus COLLECTOR CURRENT

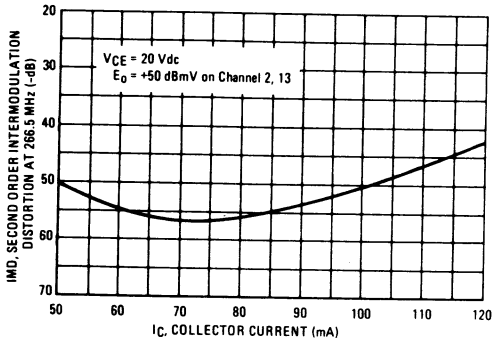

FIGURE 14 – SECOND ORDER IMD versus COLLECTOR-EMITTER VOLTAGE

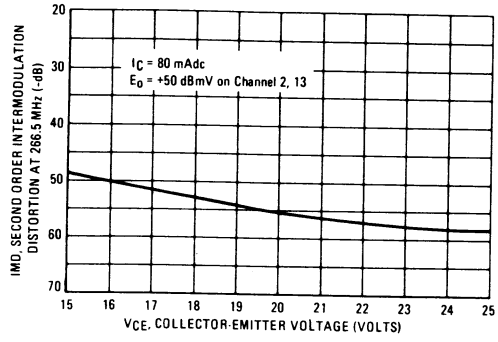

FIGURE 15 – INPUT REFLECTION COEFFICIENT (S11) AND OUTPUT REFLECTION COEFFICIENT (S22) versus FREQUENCY

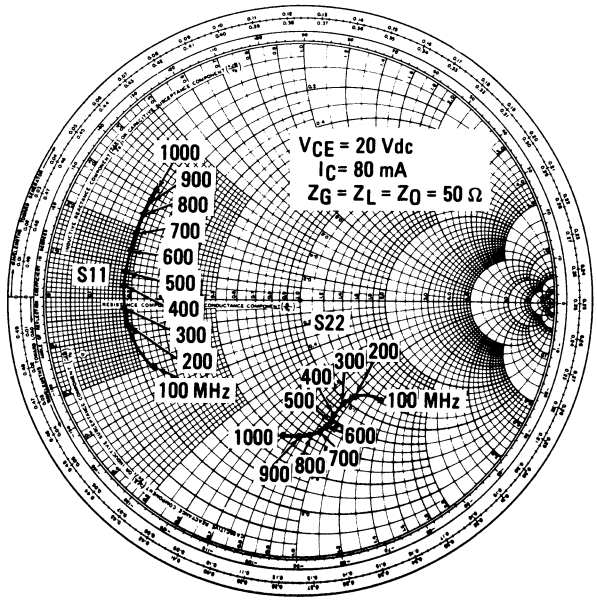

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FIGURE 16 – FORWARD TRANSMISSION COEFFICIENT (S12) versus FREQUENCY

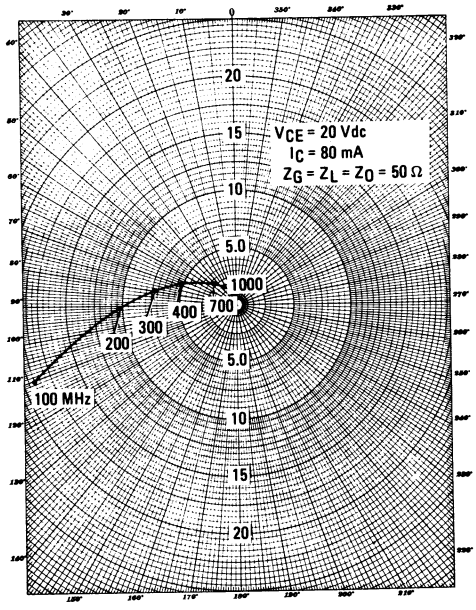
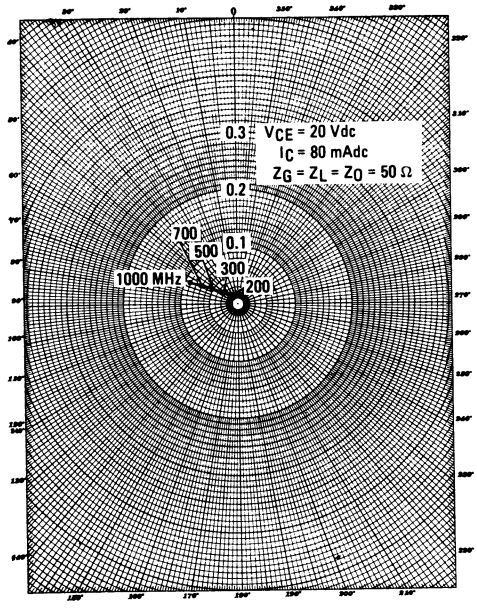


FIGURE 17 – REVERSE TRANSMISSION COEFFICIENT (S21) versus FREQUENCY



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