MRF604

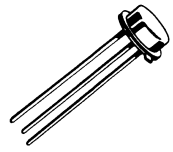
The RF Line

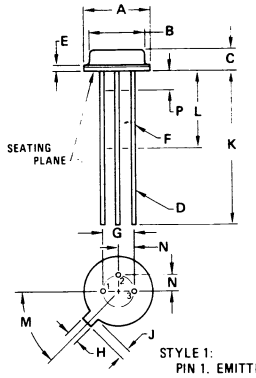
1.0 W – 175 MHz
RF POWER
TRANSISTOR
NPN SILICON

NPN SILICON RF POWER TRANSISTOR

. . . designed for 12.5 Volt VHF large-signal amplifier applications in industrial equipment with restricted available space.

- Specified 12.5 Volt, 175 MHz Characteristics –
  Output Power = 1.0 Watt
  Minimum Gain = 10 dB
  Efficiency = 50%





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

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}	2.0	Vdc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	2.0 11.0	Watts mW/°C
Storage Temperature Range	T_{stg}	−65 to +200	°C

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	5.31	5.84	0.209	0.230
B	4.52	4.95	0.178	0.195
C	1.65	2.16	0.065	0.085
D	0.406	0.533	0.016	0.021
E	–	1.02	–	0.040
F	0.305	0.483	0.012	0.019
G	2.54 BSC		0.100 BSC	
H	0.914	1.17	0.036	0.046
J	0.711	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

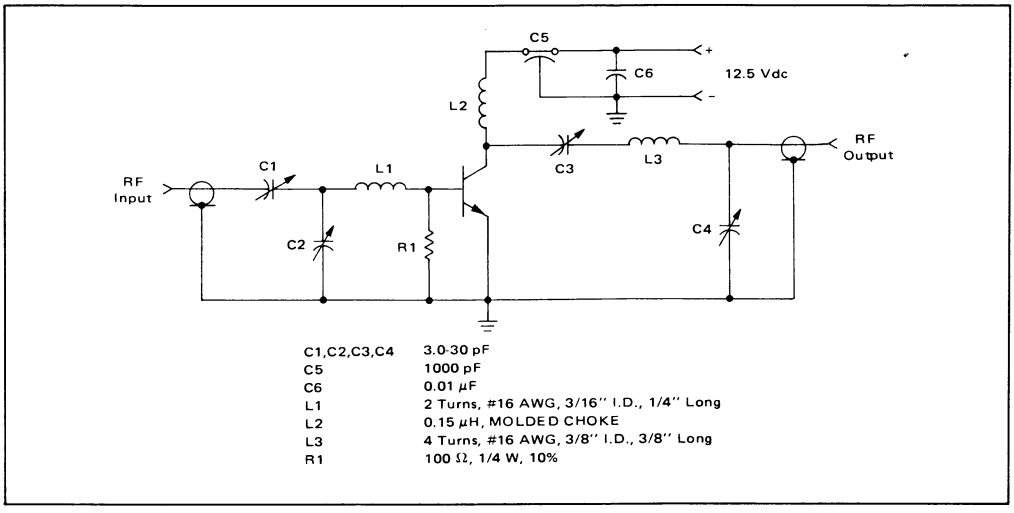
CASE 26-03
TO-46

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-Base Breakdown Voltage (I_C = 100 μAdc, I_E = 0)	$V_{(BR)CBO}$	40	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 100 μAdc, I_C = 0)	$V_{(BR)EBO}$	3.5	–	–	Vdc
Collector Cutoff Current (V_{CE} = 12 Vdc, I_B = 0)	I_{CEO}	–	–	1.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 50 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	20	80	200	–
DYNAMIC CHARACTERISTICS					
Current-Gain – Bandwidth Product (I_C = 50 mAdc, V_{CE} = 10 Vdc, f = 200 MHz)	f_T	800	–	–	MHz
Output Capacitance (V_{CB} = 12.5 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	–	3.5	pF
FUNCTIONAL TESTS (Figure 1)					
Common-Emitter Amplifier Power Gain (V_{CC} = 12.5 Vdc, P_{out} = 1.0 W, f = 175 MHz)	G_{PE}	10	–	–	dB
Collector Efficiency (V_{CC} = 12.5 Vdc, P_{out} = 1.0 W, f = 175 MHz)	η	50	–	–	%
Series Equivalent Input Impedance (V_{CC} = 12.5 Vdc, P_{out} = 1.0 W, f = 175 MHz)	Z_{in}	–	7.5-j 14	–	Ohms
Series Equivalent Output Impedance (V_{CC} = 12.5 Vdc, P_{out} = 1.0 W, f = 175 MHz)	Z_{out}	–	47-j 60	–	Ohms

3

FIGURE 1 – 175 MHz TEST CIRCUIT SCHEMATIC



C1,C2,C3,C4	3.0-30 pF
C5	1000 pF
C6	0.01 μF
L1	2 Turns, #16 AWG, 3/16" I.D., 1/4" Long
L2	0.15 μH, MOLDED CHOKE
L3	4 Turns, #16 AWG, 3/8" I.D., 3/8" Long
R1	100 Ω, 1/4 W, 10%

FIGURE 2 – OUTPUT POWER versus INPUT POWER

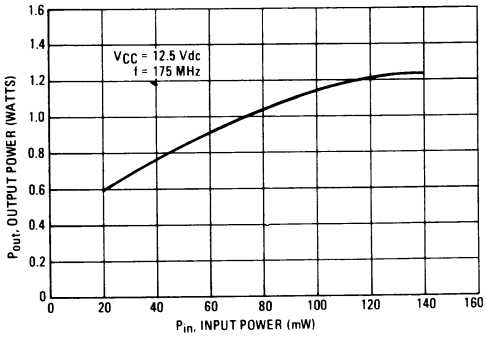


FIGURE 3 – CURRENT-GAIN BANDWIDTH PRODUCT

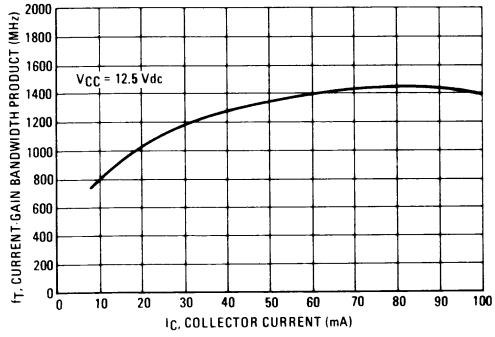
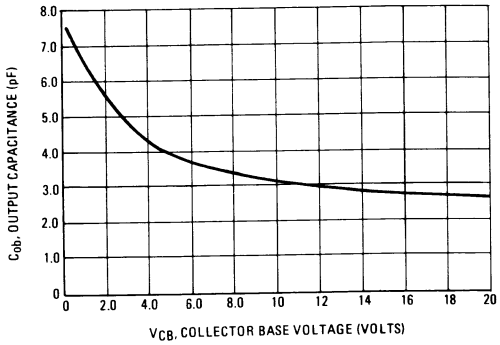


FIGURE 4 – OUTPUT CAPACITANCE versus COLLECTOR BASE VOLTAGE



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MRF607

The RF Line

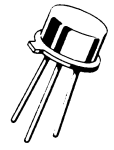
1.75 W – 175 MHz

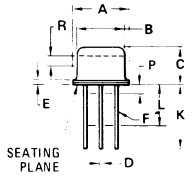
RF POWER
TRANSISTOR
NPN SILICON

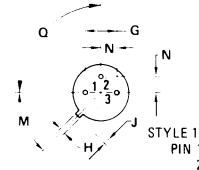
NPN SILICON RF POWER TRANSISTOR

. . . designed for amplifier, frequency multiplier, or oscillator applications in military, mobile, marine and citizens band equipment. Suitable for use as output driver or pre-driver stages in VHF and UHF equipment.

- Specified 12.5 Volt, 175 MHz Characteristics –
  Output Power = 1.75 Watts
  Minimum Gain = 11.5 dB
  Efficiency = 50%
- Characterized through 225 MHz







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

DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	8.89	9.40	0.350	0.370
B	8.00	8.51	0.315	0.335
C	6.10	6.60	0.240	0.260
D	0.406	0.533	0.016	0.021
E	0.229	3.18	0.009	0.125
F	0.406	0.483	0.016	0.019
G	4.83	5.33	0.190	0.210
H	0.711	0.864	0.028	0.034
J	0.737	1.02	0.029	0.040
K	12.70	–	0.500	–
L	6.35	–	0.250	–
M	45° NOM		45° NOM	
P	–	1.27	–	0.050
Q	90° NOM		90° NOM	
R	2.54	–	0.100	–

CASE 79-02
TO-39
All JEDEC notes and dimensions apply.

MAXIMUM RATINGS

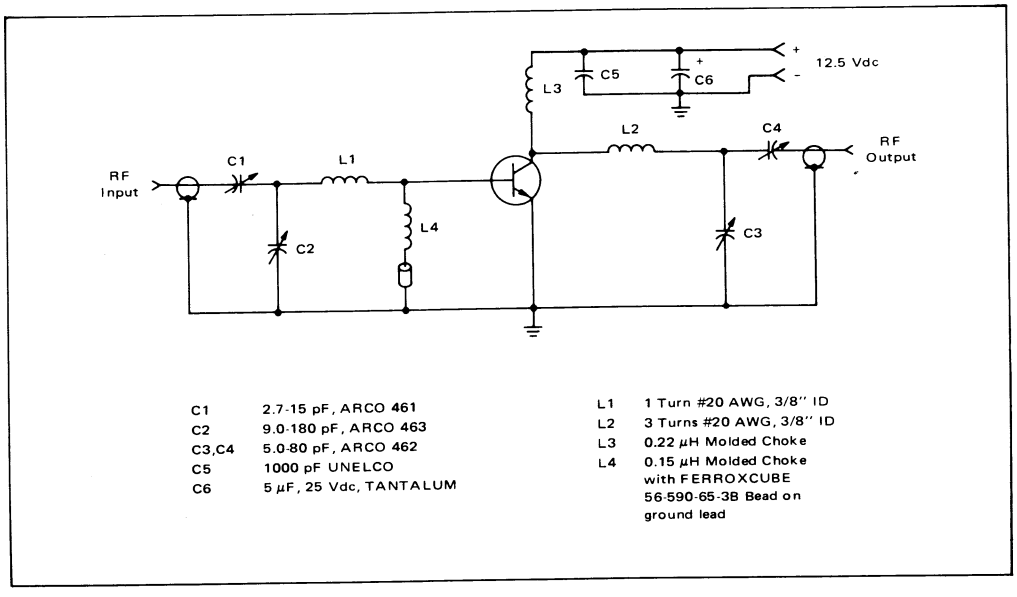
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	16	Vdc
Collector-Base Voltage	V_{CBO}	36	Vdc
Emitter-Base Voltage	V_{EBO}	3.5	Vdc
Collector Current – Continuous	I_C	0.33	Adc
Total Device Dissipation @ T_C = 75°C (1) Derate above 75°C	P_D	3.5 28	Watts mW/°C
Storage Temperature Range	T_{stg}	-65 to +200	°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.

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

Characteristic	Symbol	Min	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 = 0.5 mAdc, I_C = 0)	$V_{(BR)EBO}$	3.5	–	Vdc
Collector Cutoff Current (V_{CE} = 10 Vdc, I_B = 0)	I_{CEO}	–	0.3	mAdc
ON CHARACTERISTICS				
DC Current Gain (I_C = 50 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	20	150	–
DYNAMIC CHARACTERISTICS				
Output Capacitance (V_{CB} = 12 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	15	pF
FUNCTIONAL TEST (Figure 1)				
Common-Emitter Amplifier Power Gain (P_{out} = 1.75 W, V_{CC} = 12.5 Vdc, f = 175 MHz)	G_{PE}	11.5	–	dB
Collector Efficiency (P_{out} = 1.75 W, V_{CC} = 12.5 Vdc, f = 175 MHz)	η	50	–	%

FIGURE 1 – 175 MHz TEST CIRCUIT SCHEMATIC



C1	2.7-15 pF, ARCO 461	L1	1 Turn #20 AWG, 3/8" ID
C2	9.0-180 pF, ARCO 463	L2	3 Turns #20 AWG, 3/8" ID
C3,C4	5.0-80 pF, ARCO 462	L3	0.22 μH Molded Choke
C5	1000 pF UNELCO	L4	0.15 μH Molded Choke with FERROXCUBE 56-590-65-3B Bead on ground lead
C6	5 μF, 25 Vdc, TANTALUM		

TYPICAL PERFORMANCE DATA

FIGURE 2 – OUTPUT POWER versus FREQUENCY

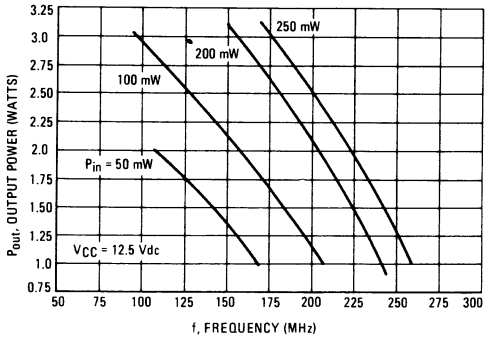


FIGURE 3 – OUTPUT POWER versus INPUT POWER

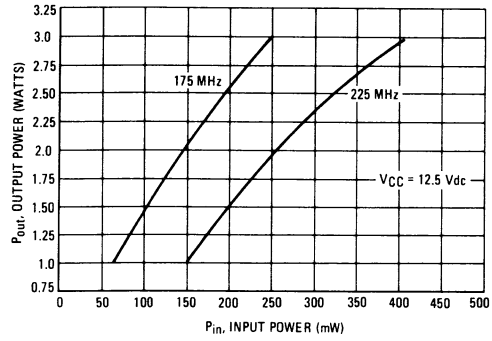


FIGURE 4 – OUTPUT POWER versus SUPPLY VOLTAGE

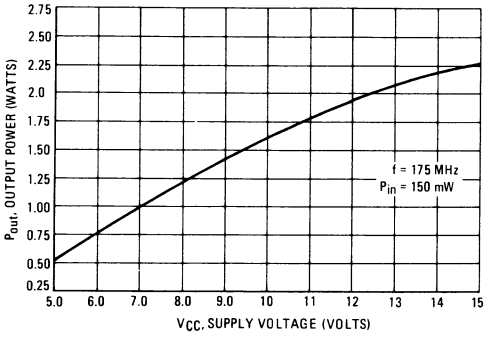
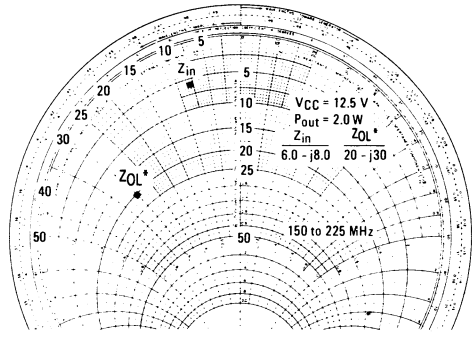


FIGURE 5 – SERIES EQUIVALENT IMPEDANCE PARAMETERS



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

3

MRF627

The RF Line

0.5 W - 470 MHz

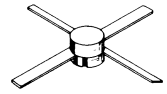
HIGH FREQUENCY TRANSISTORS

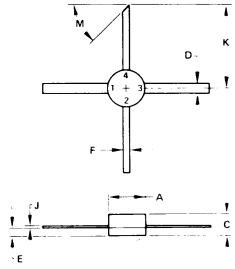
NPN SILICON

NPN SILICON HIGH FREQUENCY TRANSISTORS

. . . designed for 12.5 Volt UHF large-signal amplifier applications in industrial and commercial FM equipment operating in the 407 to 512 MHz range. Ideally suited for requirements that specify optimum performance in a limited space.

- Specified 12.5 Volt, 470 MHz Characteristics —
  Output Power = 0.5 Watts
  Minimum Gain = 10 dB
  Efficiency = 60%





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

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	20	Vdc
Collector-Base Voltage	V_{CBO}	30	Vdc
Emitter-Base Voltage	V_{EBO}	3.5	Vdc
Collector-Current - Continuous	I_C	150	mAdc
Total Device Dissipation @ $T_C = 25^oC$ Derate Above 25^oC	P_D	2.5 35	Watts $mW/^oC$
Storage Temperature Range	T_{stg}	−65 to +150	^oC

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	28.5	$^oC/W$

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	5.08	5.59	0.200	0.220
C	2.41	3.30	0.095	0.130
D	1.40	1.65	0.055	0.065
E	1.02	1.27	0.040	0.050
F	0.64	0.89	0.025	0.035
J	0.08	0.18	0.003	0.007
K	11.05	–	0.435	
M	45° NOM		45° NOM	

Case 305A-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, $I_B \geq 0$)	$V_{(BR)CEO}$	20	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 0.1 mAdc, I_E = 0)	$V_{(BR)CBO}$	30	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 0.1 mAdc, I_C = 0)	$V_{(BR)EBO}$	3.5	–	–	Vdc
Collector Cutoff Current (V_{CE} = 12 Vdc, I_B = 0)	I_{CEO}	–	–	1.0	mAdc
Emitter Cutoff Current (V_{BE} = 3.5 Vdc, I_C = 0)	I_{EBO}	–	–	1.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 50 mAdc, V_{CE} = 10 Vdc)	h_{FE}	15	–	150	–
DYNAMIC CHARACTERISTICS					
Current-Gain–Bandwidth Product	f_T				GHz
(I_C = 50 mAdc, V_{CE} = 12.5 Vdc, f = 200 MHz)		–	2.5	–	
(I_C = 100 mAdc, V_{CE} = 12.5 Vdc, f = 200 MHz)		–	2.7	–	
(I_C = 150 mAdc, V_{CE} = 12.5 Vdc, f = 200 MHz)		–	2.6	–	
Output Capacitance (V_{CB} = 12.5 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	3.0	3.5	pF
Input Capacitance (V_{BE} = 1.0 Vdc, I_C = 0, f = 1.0 MHz)	C_{ib}	–	8.8	–	pF
FUNCTIONAL TESTS					
Common-Emitter Amplifier Power Gain (V_{CC} = 12.5 Vdc, P_{out} = 0.5 W, f = 470 MHz)	G_{PE}	10	12	–	dB
Collector Efficiency (V_{CC} = 12.5 Vdc, P_{out} = 0.5 W, f = 470 MHz)	η	–	60	–	%
Series Equivalent Input Impedance (V_{CC} = 12.5 Vdc, P_{out} = 0.5 W, f = 470 MHz)	Z_{in}	–	6.0-j4.0	–	Ohms
Series Equivalent Output Impedance (V_{CC} = 12.5 Vdc, P_{out} = 0.5 W, f = 470 MHz)	Z_{out}	–	45-j28	–	Ohms

FIGURE 1 – OUTPUT POWER versus INPUT POWER

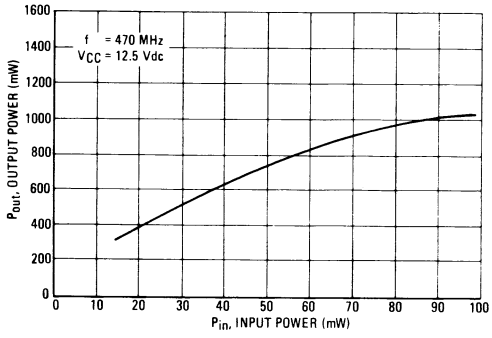


FIGURE 2 – OUTPUT CAPACITANCE versus COLLECTOR BASE VOLTAGE

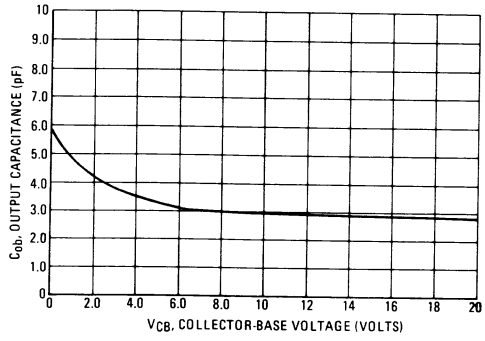


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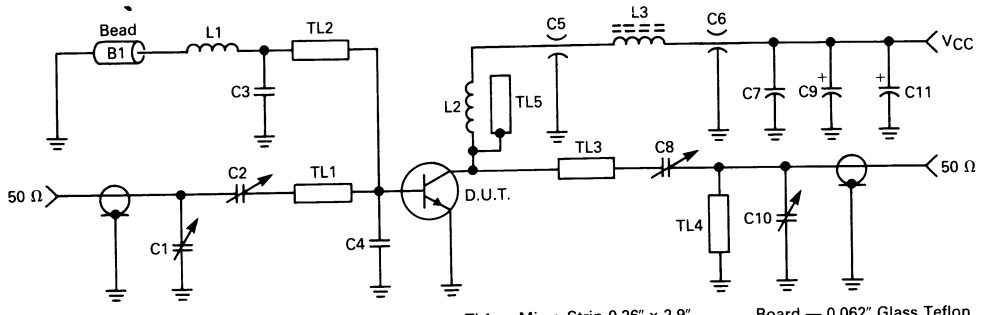
FIGURE 3 — 470 MHz TEST CIRCUIT SCHEMATIC



B1 — Ferroxcube Bead — 56-590-65-3B
C1, C2, C8, C10 — Johanson Trimmer, JMC #5501
C3 — 100 pF Unelco 350 Vdc J101
C4 — 15 pF Unelco
C5, C6 — 680 pF Allen Bradley, Feed-Thru
C7 — 0.1 μF Monolithic
C9 — 1 μF Tantalum Sprague ±10% 35 Vdc
C11 — 30 μF Electrolytic 25 Vdc

TL1 — Micro Strip 0.26″ x 2.9″
TL2 — Micro Strip 0.055″ x 3.9″
TL3 — Micro Strip 0.26″ x 2.9″
TL4 — Micro Strip 0.50″ x 1.2″
TL5 — Micro Strip 0.055″ x 2.9″
L1 — #18 AWG Wire 0.750″ Long
L2 — 2 Turns #18 AWG ID ≈ 0.2″
L3 — VK200 20/4B

Board — 0.062″ Glass Teflon
2 oz. Cu. CLAD
ϵ_r = 2.55

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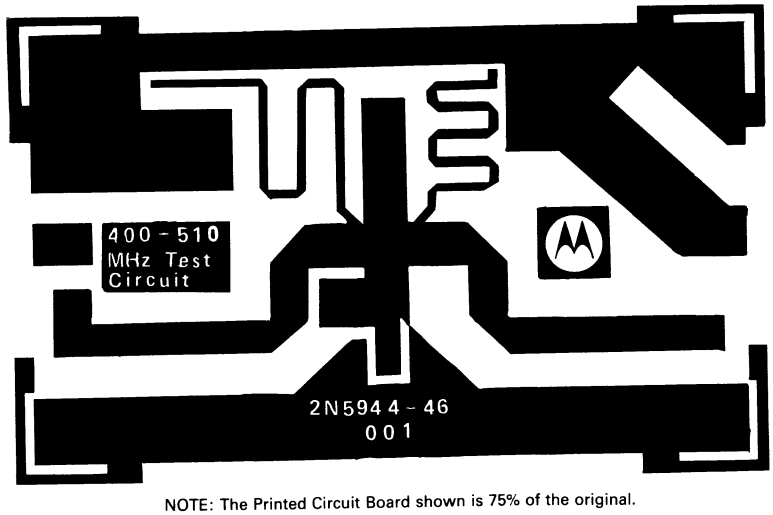
FIGURE 4 – 470 MHz TEST CIRCUIT LAYOUT



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

FIGURE 5 – TYPICAL S_{11} and S_{22} versus FREQUENCY

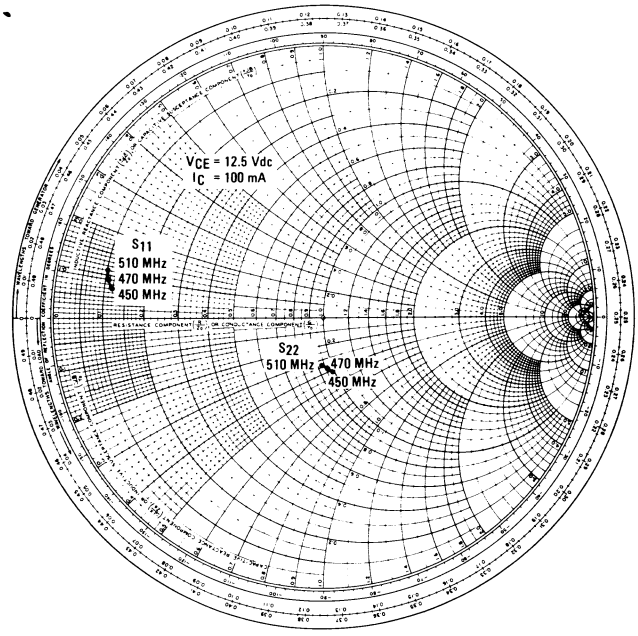


FIGURE 6 – TYPICAL S_{12} versus FREQUENCY

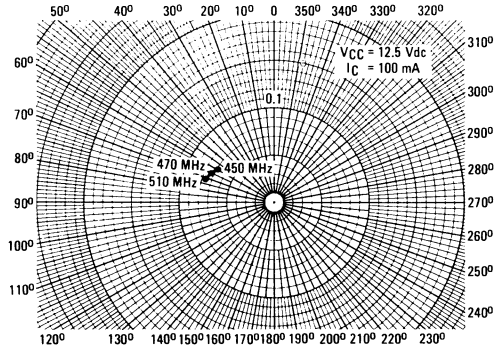
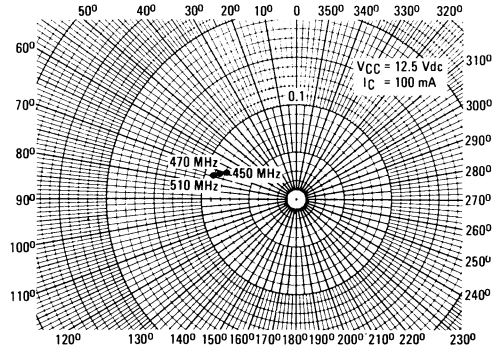


FIGURE 7 – TYPICAL S_{21} versus FREQUENCY



MRF630

The RF Line

NPN SILICON RF POWER TRANSISTOR

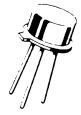
. . . designed for 12.5 Volt UHF large-signal, amplifier applications in industrial and commercial FM equipment operating to 512 MHz.

- Specified 12.5 Volt, 470 MHz Characteristics
  Output Power = 3.0 Watts
  Minimum Gain = 9.5 dB
  Efficiency = 55%
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Grounded Emitter TO-39 Package for High Gain and Excellent Heat Dissipation
- Replaces Medium-Power Stud Mounted Devices
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration

3.0 W 470 MHz

RF POWER TRANSISTOR

NPN SILICON



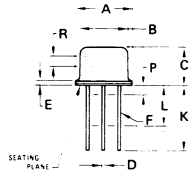
3

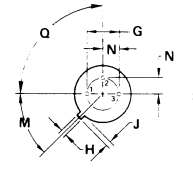
MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	16	Vdc
Collector-Base Voltage	V_{CES}	36	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector Current — Continuous	I_C	1.0	Adc
Total Device Dissipation @ T_C = 25°C Derate Above 25°C	P_D	8.75 50	Watts mW/°C
Storage Temperature Range	T_{stg}	-65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	20	°C/W





STYLE 5:
PIN 1. COLLECTOR
2. BASE
3. EMITTER

NOTES:
1. ALL RULES AND NOTES ASSOCIATED WITH TO-39 OUTLINE SHALL APPLY.

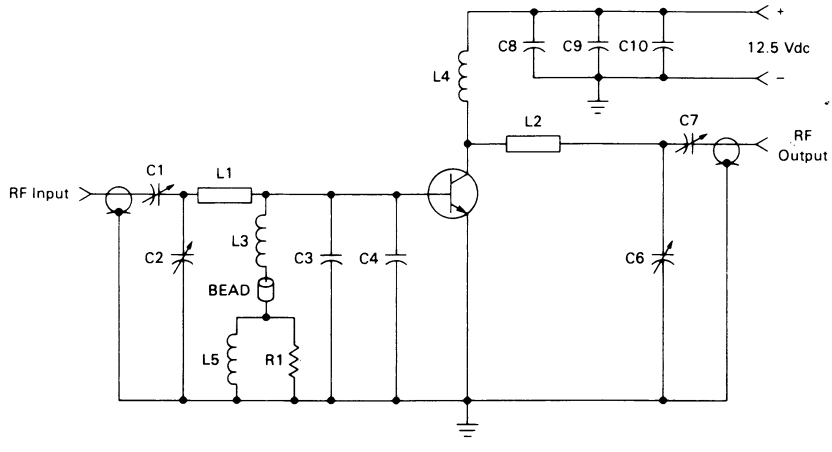
DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	9.02	9.30	0.355	0.366
B	8.00	8.51	0.315	0.335
C	4.19	4.57	0.165	0.180
D	0.43	0.53	0.017	0.021
E	0.43	0.89	0.017	0.035
F	0.41	0.48	0.016	0.019
G	4.83	5.33	0.190	0.210
H	0.71	0.86	0.028	0.034
J	0.74	1.02	0.029	0.040
K	12.70	–	0.500	–
M	45° NOM		45° NOM	
N	2.54 TYP		0.100 TYP	
Q	90° NOM		90° NOM	

CASE 79-03

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)	$V_{(BR)CEO}$	16	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	36	—	—	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, T_C = 25°C)	I_{CES}	—	—	1.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 100 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	20	60	—	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 12.5 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	—	8.0	12	pF
FUNCTIONAL TEST					
Common-Emitter Amplifier Power Gain (Fig. 1) (V_{CC} = 12.5 Vdc, P_{out} = 3.0 W, f = 470 MHz)	G_{PE}	9.5	10.8	—	dB
Collector Efficiency (Fig. 1) (V_{CC} = 12.5 Vdc, P_{out} = 3.0 W, f = 470 MHz)	η	—	55	—	%

FIGURE 1 — 470 MHz TEST CIRCUIT SCHEMATIC



C1, C7 — 1.5 - 20 pF Johanson
C2, C6 — 1 - 10 pF Johanson
C3, C4 — 27 pF Mini-Unelco
C8 — 250 pF Unelco
C9 — 0.047 μF Erie Disc Cap 10 V
C10 — 1.0 μF Electrolytic

L1, L2 — Copper Strap, 1" Length × 0.225 Width × 0.005" Thickness
L3 — 0.33 μH Molded Choke
L4 — 0.12 μH Molded Choke
L5 — 1.2 μH Molded Choke
R1 — 10 Ω, 1/4 W

FIGURE 2 — OUTPUT POWER versus INPUT POWER

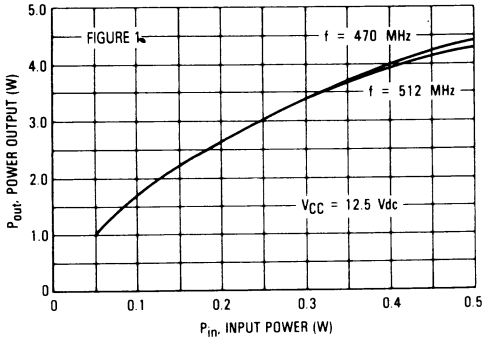


FIGURE 3 — OUTPUT POWER versus FREQUENCY

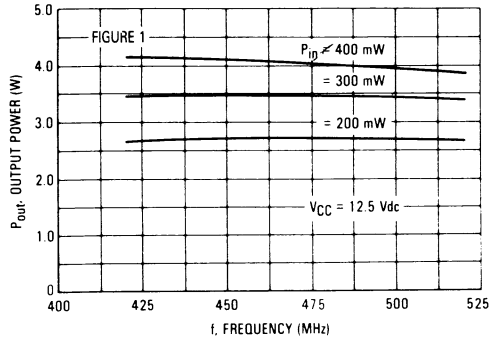


FIGURE 4 — POWER OUT versus SUPPLY VOLTAGE

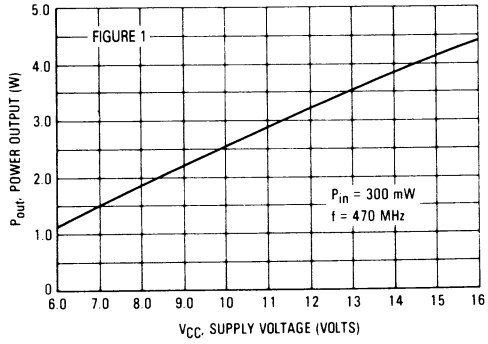
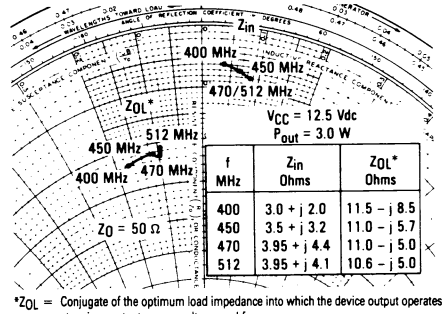


FIGURE 5 — SERIES EQUIVALENT IMPEDANCE



f MHz	Zin Ohms	ZOL* Ohms
400	3.0 + j 2.0	11.5 – j 8.5
450	3.5 + j 3.2	11.0 – j 5.7
470	3.95 + j 4.4	11.0 – j 5.0
512	3.95 + j 4.1	10.6 – j 5.0

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

FIGURE 6 — OUTPUT POWER versus FREQUENCY, BROADBAND CIRCUIT

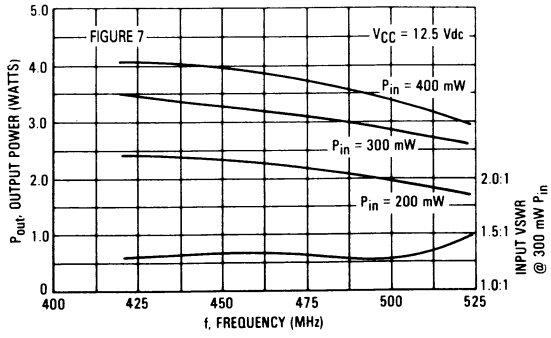
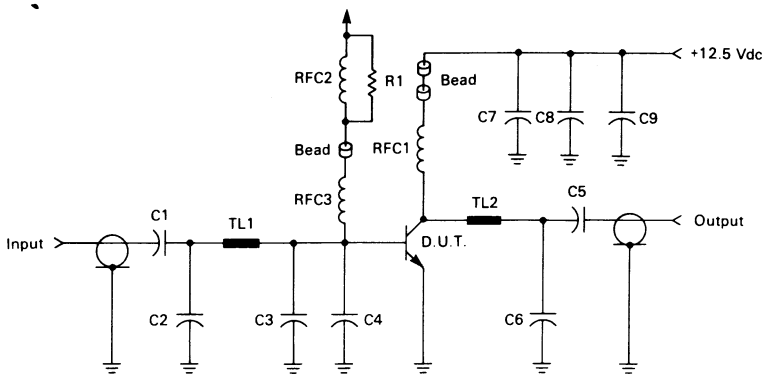


FIGURE 7 — MRF630 BROADBAND CIRCUIT
420-520 MHz



C1, C5 — 43 pF Mini-Unelco
C2 — 10 pF Mini-Unelco
C3 — 18 pF Mini-Unelco
C4 — 27 pF Mini-Unelco
C6 — 6.8 pF Mini-Unelco
C7 — 220 pF Ceramic Chip
C8 — 0.1 mF
C9 — 1.0 mF Tantalum

RFC1 — 0.47 μH Molded Choke
RFC2 — 1.0 μH Molded Choke
RFC3 — 0.3 μH Molded Choke
R1 — 12 Ω/1/4 W
TL1 — Transmission Line 0.166" × 1.85" (WXL)
TL2 — Transmission Line 0.166" × 1.77" (WXL)
Board Material — 2 oz. 0.0625" TFG

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FIGURE 8 — BROADBAND CIRCUIT