

MRF646

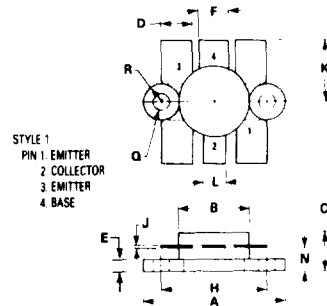
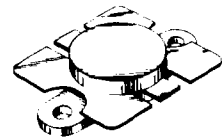
The RF Line

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 = 45 Watts
 Minimum Gain = 4.8 dB
 Efficiency = 55%
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Built-In Matching Network for Broadband Operation
- Tested for Load Mismatch Stress at all Phase Angles with 20:1 VSWR @ 16-Volt High Line and 50% Overdrive.

45 W – 470 MHz
CONTROLLED Q
RF POWER
TRANSISTOR
NPN SILICON



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

NOTE:
 FLANGE IS ISOLATED IN ALL STYLES

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	24.38	25.14	0.960	0.990
B	12.45	12.95	0.490	0.510
C	5.97	7.62	0.235	0.300
D	5.33	5.58	0.210	0.220
E	2.16	3.04	0.085	0.120
F	5.08	5.33	0.200	0.210
H	18.29	18.54	0.720	0.730
J	0.10	0.15	0.004	0.006
K	10.29	11.17	0.405	0.440
L	3.81	4.06	0.150	0.160
M	3.81	4.31	0.150	0.170
Q	2.92	3.30	0.115	0.130
R	3.05	3.30	0.120	0.130
U	11.94	12.57	0.470	0.495

CASE 316-01

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	9.0	Adc
Total Device Dissipation @ T _C = 25°C Derate above 25°C	P _D	117 0.67	Watts W/°C
Storage Temperature Range	T _{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

Thermal Resistance, Junction to Case	R _{θJC}	1.5	°C/W
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ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted.)

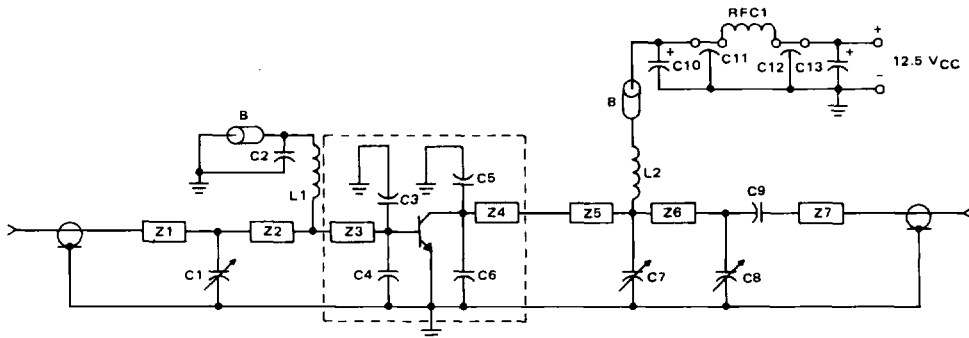
Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage ($I_C = 20 \text{ mA dc}, I_B = 0$)	$V_{(BR)CEO}$	16	—	—	Vdc
Collector-Emitter Breakdown Voltage ($I_C = 20 \text{ mA dc}, V_{BE} = 0$)	$V_{(BR)CES}$	36	—	—	Vdc
Emitter-Base Breakdown Voltage ($I_E = 5.0 \text{ mA dc}, I_C = 0$)	$V_{(BR)EBO}$	4.0	—	—	Vdc
Collector Cutoff Current ($V_{CE} = 15 \text{ Vdc}, V_{BE} = 0, T_C = 25^\circ\text{C}$)	I_{CES}	—	—	10	mA dc
ON CHARACTERISTICS					
DC Current Gain ($I_C = 4.0 \text{ A dc}, V_{CE} = 5.0 \text{ Vdc}$)	h_{FE}	20	70	150	—
DYNAMIC CHARACTERISTICS					
Output Capacitance ($V_{CB} = 12.5 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz}$)	C_{ob}	—	90	125	pF
FUNCTIONAL TESTS					
Common-Emitter Amplifier Power Gain ($V_{CC} = 12.5 \text{ Vdc}, P_{out} = 45 \text{ W}, I_C(\text{Max}) = 5.8 \text{ A dc}, f = 470 \text{ MHz}$)	G_{pe}	4.8	5.4	—	dB
Input Power ($V_{CC} = 12.5 \text{ Vdc}, P_{out} = 45 \text{ W}, f = 470 \text{ MHz}$)	P_{in}	—	13	15	Watts
Collector Efficiency ($V_{CC} = 12.5 \text{ Vdc}, P_{out} = 45 \text{ W}, I_C(\text{Max}) = 5.8 \text{ A dc}, f = 470 \text{ MHz}$)	η	55	60	—	%
Load Mismatch Stress ($V_{CC} = 16 \text{ Vdc}, P_{in} = \text{Note 1}, f = 470 \text{ MHz}, \text{VSWR} = 20:1,$ All Phase Angles)	ψ^*	No Degradation in Output Power			
Series Equivalent Input Impedance ($V_{CC} = 12.5 \text{ Vdc}, P_{out} = 45 \text{ W}, f = 470 \text{ MHz}$)	Z_{in}	—	$1.4 + j4.0$	—	Ohms
Series Equivalent Output Impedance ($V_{CC} = 12.5 \text{ Vdc}, P_{out} = 45 \text{ W}, f = 470 \text{ MHz}$)	Z_{OL}	—	$1.2 + j2.8$	—	Ohms

Notes:

1. $P_{in} = 150\%$ of Drive Requirement for 45 W output @ 12.5 V.

* ψ = Mismatch stress factor—the electrical criterion established to verify the device resistance to load mismatch failure. The mismatch stress test is accomplished in the standard test fixture (Figure 1) terminated in a 20:1 minimum load mismatch at all phase angles.

FIGURE 1 – TEST CIRCUIT SCHEMATIC



C1, C8 1.0–20 pF JOHANSON
 C2 100 pF UNELCO
 C3, C6 33 pF 100 mil ATC
 C4 30 pF 100 mil ATC
 C5 39 pF 100 mil ATC
 C7 1–10 pF JOHANSON
 C9 100 pF 100 mil ATC
 C10, C13 1 μF 35 V TANTALUM
 C11, C12 680 pF Feedthrough
 B Ferroxcube Bead 56 590-65 3B
 L1 5" # 22 AWG, 0.1" I.D.

L2 5" # 20 AWG, 0.1" I.D.
 RFC1 Ferroxcube VR200-20-4B
 Z1 0.525" x 0.190" Microstrip
 Z2 1.475" x 0.190" Microstrip
 Z3, Z4 (0.2 x 0.2)/0.25 Alumina
 Z5 0.190" x 0.190" Microstrip
 Z6 1.150" x 0.190" Microstrip
 Z7 0.660" x 0.190" Microstrip
 Board 62.5 mil Glass Teflon,
 $\epsilon_R = 2.55, \lambda = 0.0018$

MRF646

2

FIGURE 2 – POWER OUTPUT versus POWER INPUT

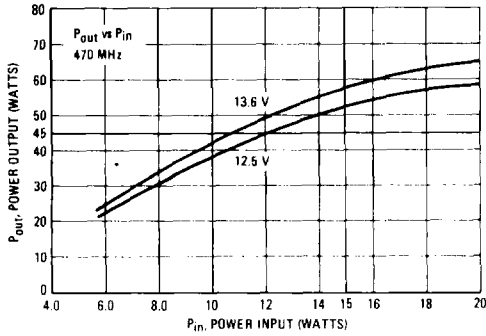


FIGURE 3 – POWER OUTPUT versus FREQUENCY

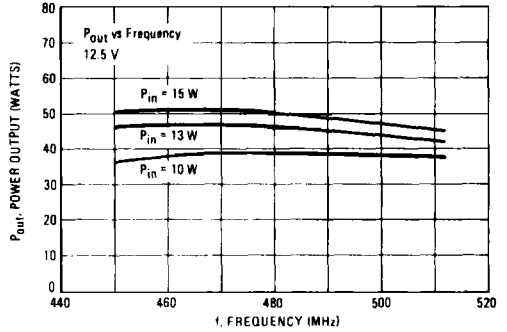


FIGURE 4 – POWER OUTPUT versus SUPPLY VOLTAGE

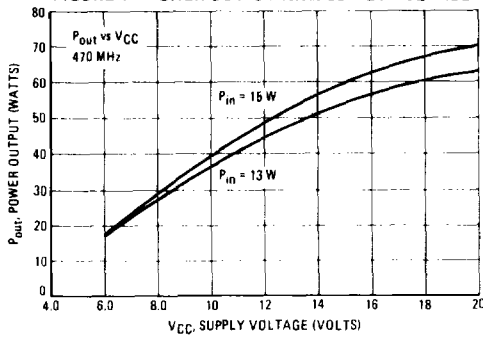


FIGURE 5 – POWER SATURATION PROFILE

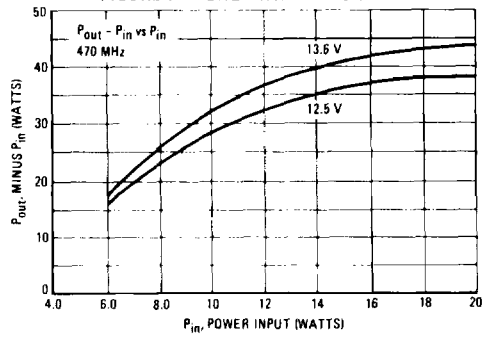
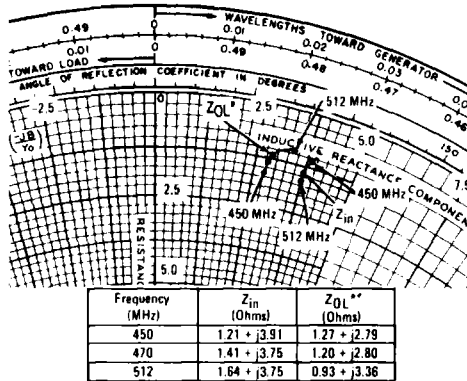


FIGURE 7 – SERIES EQUIVALENT INPUT-OUTPUT IMPEDANCE



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

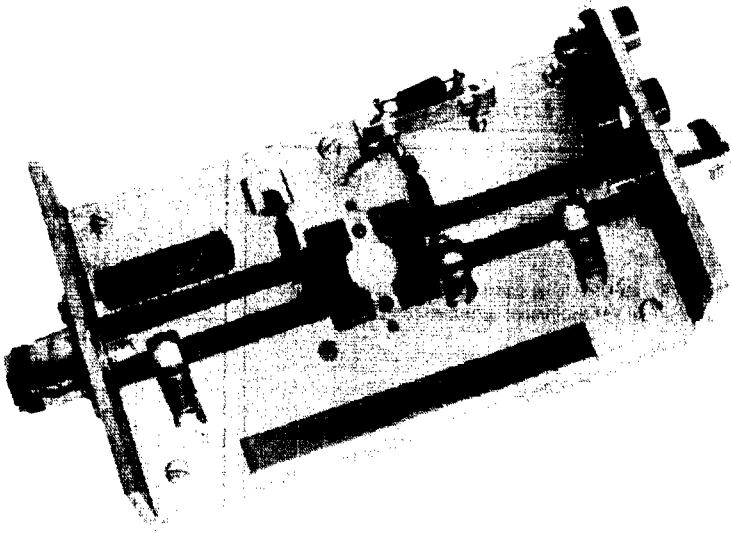
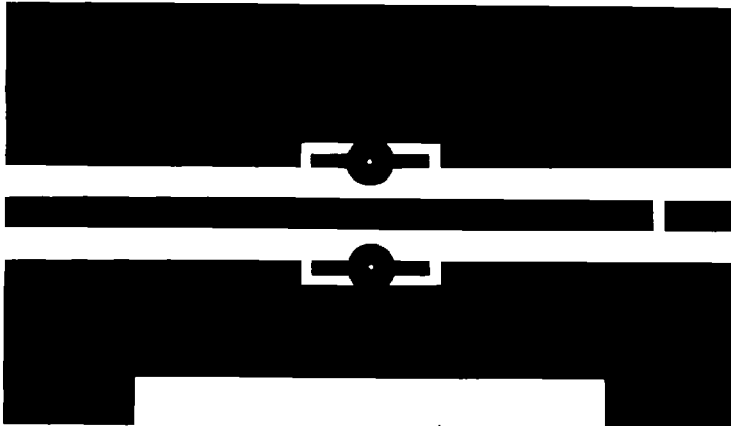


FIGURE 8 — MRF644 TEST FIXTURE



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

FIGURE 9 — PRINTED CIRCUIT BOARD