MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MRF475

The RF Line

NPN SILICON RF POWER TRANSISTOR

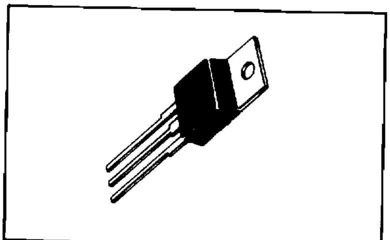
. . . designed primarily for use in single sideband linear amplifier output applications in citizens band and other communications equipment operating to 30 MHz.

- Characterized for Single Sideband and Large-Signal Amplifier Applications Utilizing Low-Level Modulation
- Specified 13.6 V, 30 MHz Characteristics —
  - Output Power = 12 W (PEP)
  - Minimum Efficiency = 40% (SSB)
  - Output Power = 12 W (CW)
  - Minimum Efficiency = 50% (CW)
  - Minimum Power Gain = 10 dB (PEP & CW)
- Common Collector Configuration

12 W (PEP) — 12 W (CW) — 30 MHz

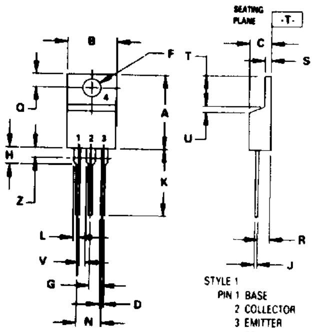
RF POWER TRANSISTOR

NPN SILICON



MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	18	Vdc
Collector-Base Voltage	V_{CBO}	48	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector Current — Continuous	I_C	4.0	Adc
Total Device Dissipation @ $T_C = 50°C$ Derate above 50°C	P_D	10 0.1	Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +150	°C

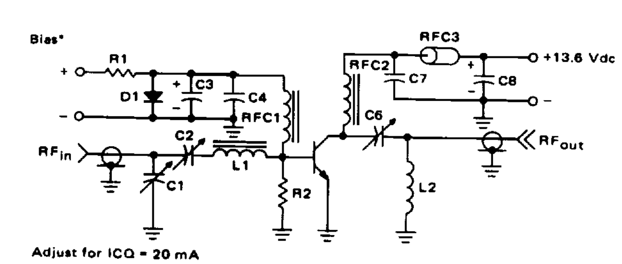


NOTES
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982
2. CONTROLLING DIMENSION: INCH
3. DIM Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	14.48	15.75	0.570	0.620
B	9.66	10.28	0.380	0.405
C	4.07	4.82	0.160	0.190
D	0.64	0.88	0.025	0.035
F	3.61	3.73	0.142	0.147
G	2.42	2.66	0.095	0.105
H	2.80	3.93	0.110	0.155
J	0.36	0.55	0.014	0.022
K	12.70	14.27	0.500	0.562
L	1.15	1.39	0.045	0.055
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	1.15	1.39	0.045	0.055
T	5.97	6.47	0.235	0.255
U	0.00	1.27	0.000	0.050
V	1.15	—	0.045	—
Z	—	2.04	—	0.080

CASE 221A-04
TO-220AB

FIGURE 1 — COMMON-EMITTER TEST CIRCUIT



*Adjust for ICQ = 20 mA

C1, 2, 6	— ARCO 466 Trimmer Capacitors	RFC1	— 10 μH Molded Choke
C3	— 1000 μF, 3.0 Vdc Electrolytic	RFC2	— 15 Turns #20 AWG Wire on 5.6 kΩ, 1.0 Watt Carbon Resistor
C4, 7	— 0.1 μF Disc Ceramics	RFC3	— 5 Ferroxcube, #56-590-65/3B, Beads on #18 AWG Wire
C8	— 100 μF, 15 Vdc Electrolytic	D1	— 1N4997
R1	— 10 Ω, 5.0 Watt Resistor		
R2	— 10 Ω, 1.0 Watt Resistor		
L1	— 2.2 μH Molded Choke		
L2	— 4 Turns #18 AWG Wire, 1/2" I.D., 5/16" Long		

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 20 mAdc, I_B = 0)	$V_{(BR)CEO}$	18	–	–	Vdc
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	48	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 5.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 25 Vdc, I_E = 0)	I_{CBO}	–	–	1.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 500 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	30	60	–	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 13.6 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	125	145	pF
FUNCTIONAL TESTS (SSB)					
Common-Emitter Amplifier Power Gain (V_{CC} = 13.6 Vdc, P_{out} = 12 W (PEP), f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 20 mA)	G_{PE}	10	12	–	dB
Collector Efficiency (V_{CC} = 13.6 Vdc, P_{out} = 12 W (PEP), f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 20 mA)	η	40	–	–	%
Intermodulation Distortion (1) (V_{CC} = 13.6 Vdc, P_{out} = 12 W (PEP), f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 20 mA)	IMD	—	—	-30	dB
FUNCTIONAL TESTS (CW)					
Common-Emitter Amplifier Power Gain (V_{CC} = 13.6 Vdc, P_{out} = 4.0 W, f = 30 MHz)	G_{PE}	10	12	–	dB
Collector Efficiency (V_{CC} = 13.6 Vdc, P_{out} = 4.0 W, f = 30 MHz)	η	50	–	–	%
Percentage Up-Modulation (1) (4.0 W Carrier)	–	–	100	–	%

IMPEDANCE CHARACTERISTICS

Characteristic	Conditions	Symbol	Min	Typ	Max	Unit
Series Equivalent Input	V_{CC} = 13.6 Vdc, P_o = 12 W (PEP), f = 30 MHz, I_{CQ} = 20 mA	Z_{in}	–	4.5–j2.4	–	Ohms
Series Equivalent Output		Z_{out}	–	5.1–j3.2	–	Ohms
Parallel Equivalent Input		Z_{in}	–	5.8/10.9	–	Ω/pF
Parallel Equivalent Output		Z_{out}	–	7.1/11.3	–	Ω/pF

(1) To proposed EIA method of measurement. Reference peak envelope power.

(2) Percentage Up-Modulation is measured in the test circuit (Figure 1) by setting the Carrier Power (P_c) to 4.0 Watts with V_{CC} = 13.6 Vdc and noting the power input. Then the Peak Envelope Power (PEP) is noted after doubling the original power input to simulate driver modulation.

$$\text{Percentage Up-Modulation} = \left[\left(\frac{PEP}{P_c}\right)^{\frac{1}{2}} - 1\right] \bullet 100$$

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FIGURE 2 — OUTPUT POWER versus INPUT POWER

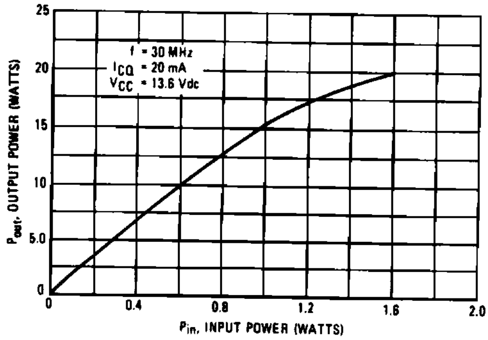


FIGURE 3 — INTERMODULATION DISTORTION versus OUTPUT POWER

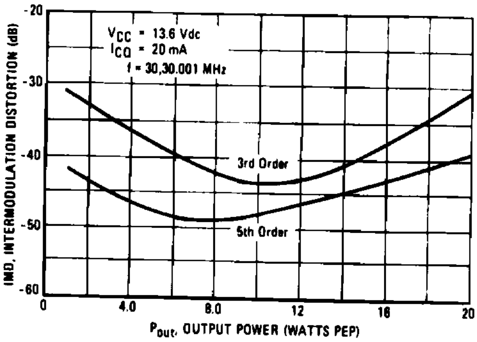


FIGURE 4 — OUTPUT POWER versus SUPPLY VOLTAGE

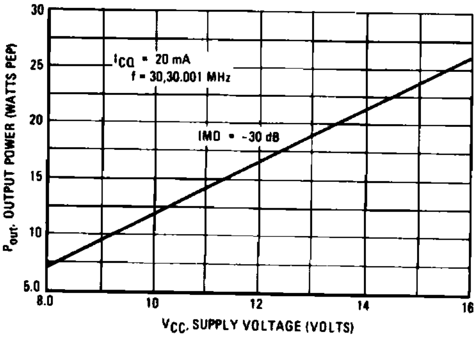


FIGURE 5 — OUTPUT CAPACITANCE versus FREQUENCY

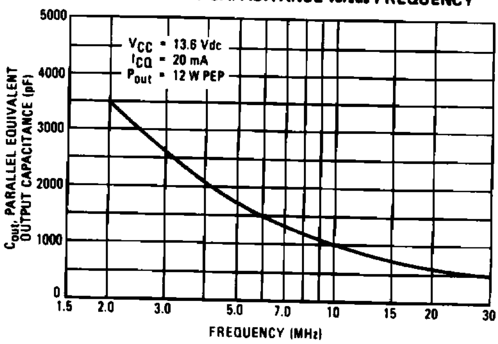


FIGURE 6 — OUTPUT RESISTANCE versus FREQUENCY

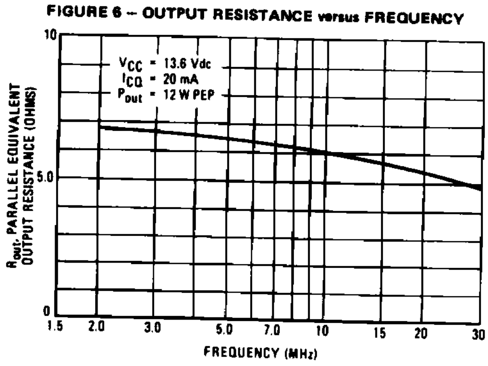


FIGURE 7 — POWER GAIN versus FREQUENCY

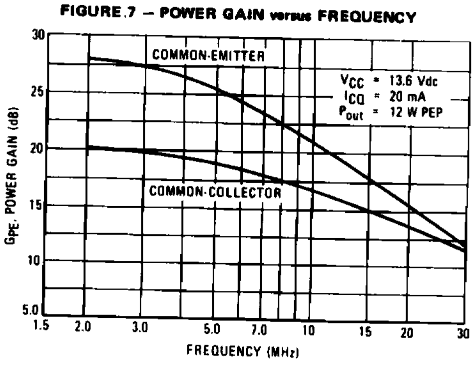
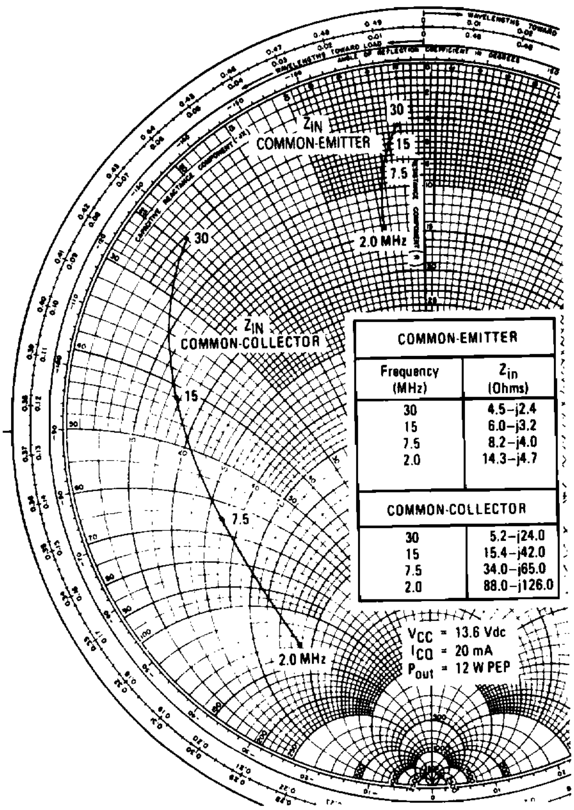


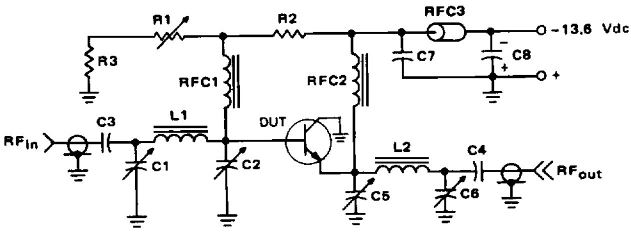
FIGURE 8 - SERIES EQUIVALENT INPUT IMPEDANCE



COMMON-EMITTER	
Frequency (MHz)	Z_{in} (Ohms)
30	4.5–j2.4
15	6.0–j3.2
7.5	8.2–j4.0
2.0	14.3–j4.7

COMMON-COLLECTOR	
30	5.2–j24.0
15	15.4–j42.0
7.5	34.0–j65.0
2.0	88.0–j126.0

FIGURE 9 – COMMON-COLLECTOR TEST CIRCUIT



C1, 5 – ARCO 466 Trimmer Capacitors
C2 – ARCO 463 Trimmer Capacitor
C3, 4, 7 – 0.1 µF Ceramic Disc
C6 – ARCO 469 Trimmer Capacitor
C8 – 100 µF 15 Vdc Electrolytic
R1 – 250 Ω, 2.0 W Potentiometer
R2 – 5.1 Ω, 1/2 W Resistor
R3 – 51 Ω, 2.0 W Resistor

L1 – 0.33 µH Molded Choke
L2 – 4 Turns #18 AWG Wire, 1/8" I.D., 5/16" Long
RFC1 – 18 µH Molded Choke
RFC2 – 15 Turns #20 AWG Wire on 100 Ω, 1.0 W Carbon Resistor
RFC3 – Ferroxcube, #56-590-65/3B, Beads on #18 AWG Wire