MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MRF412

The RF Line

NPN SILICON RF POWER TRANSISTOR

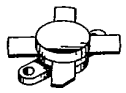
. . . designed primarily for applications as a high-power amplifier from 2.0 to 30 MHz, in single sideband mobile, marine and base station equipment where superior ruggedness is required.

- Specified 13.6 V, 30 MHz Characteristics —
  Output Power = 70 W PEP or CW
  Minimum Gain = 13 dB
  Efficiency = 40%
  Intermodulation Distortion d_3 = -33 dB Typ
- Guaranteed Ruggedness @ 3.0 dB Overdrive and 15.5 V Supply

70 W (PEP) — 30 MHz

RF POWER TRANSISTOR

NPN SILICON



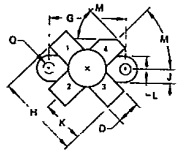
MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	18	Vdc
Collector-Base Voltage	V_{CBO}	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 mW/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

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



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	18.28	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 211-11

MATCHING PROCEDURE

In the push-pull circuit configuration it is preferred that the transistors are used as matched pairs to obtain optimum performance.

The matching procedure used by Motorola consists of measuring h_{FE} at the data sheet conditions and color coding the device to predetermined h_{FE} ranges within the normal h_{FE} limits. A color dot is added to the marking on top of the cap. Any two devices with the same color dot can be paired together to form a matched set of units.

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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}	—	—	450	pF
FUNCTIONAL TESTS (SSB)					
Common-Emitter Amplifier Power Gain (V_{CC} = 13.6 Vdc, P_{out} = 70 W (PEP), f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 100 mA)	G_{PE}	13	16	—	dB
Collector Efficiency (V_{CC} = 13.6 Vdc, P_{out} = 70 W (PEP), f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 100 mA)	η	40	—	—	%
Intermodulation Distortion (1) (PEP) (V_{CC} = 13.6 Vdc, P_{out} = 70 W (PEP), f1 = 30 MHz, f2 = 30.001 MHz, I_{CQ} = 100 mA)	$IMD_{(d3)}$	—	-33	-28	dB
Load Mismatch (V_{CC} = 15.5 Vdc, P_{in} = 7.0 W (CW), f = 30 MHz, VSWR = 30:1 All Angles)	ψ	No Degradation in Output Power			

(1) To MIL-STD-1311 Version A, Test Method 2204B, Two Tone, Reference Each Tone.

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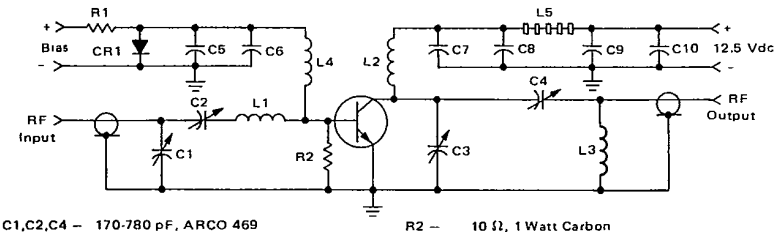
FIGURE 1 — 30-MHz TEST CIRCUIT



C1,C2,C4 — 170-780 pF, ARCO 469
C3 — 80-480 pF, ARCO 466
C5,C7,C10 — ERIE 0.1 μF, 100 V
C6 — MALLORY 500 μF @ 15 V Electrolytic
C9 — 100 μF, 15 V Electrolytic
C8 — 1000 pF, 350 V UNDERWOOD
R1 — 10 Ω, 25 Watt Wirewound
R2 — 10 Ω, 1 Watt Carbon
CR1 — IN4997
L1 — 3 Turns, #16 Wire, 5/16" I.D., 5/16" Long
L2 — 12 Turns, #16 Enamaled Wire Closewound, 1/4" I.D.
L3 — 1 3/4 Turns, 1/8" Tubing, 3/8" I.D., 3/8" Long
L4 — 10 μH Molded Choke
L5 — 10 Ferrite Beads FERROXCUBE #56-590-65/3B

FIGURE 2 – OUTPUT POWER versus INPUT POWER

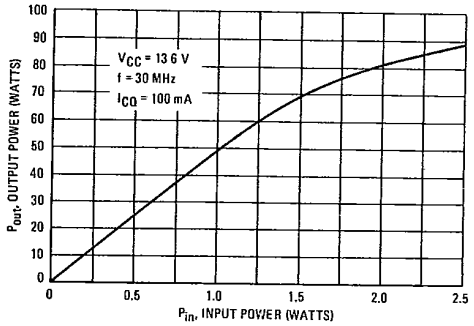


FIGURE 3 – POWER GAIN versus FREQUENCY

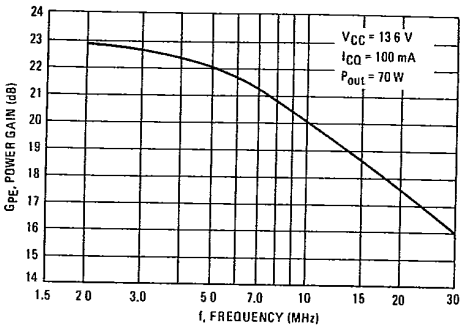


FIGURE 4 – OUTPUT POWER versus SUPPLY VOLTAGE

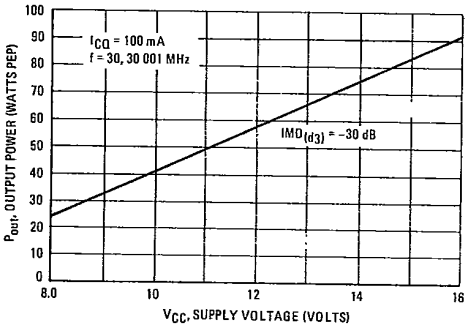


FIGURE 5 – INTERMODULATION DISTORTION versus OUTPUT POWER

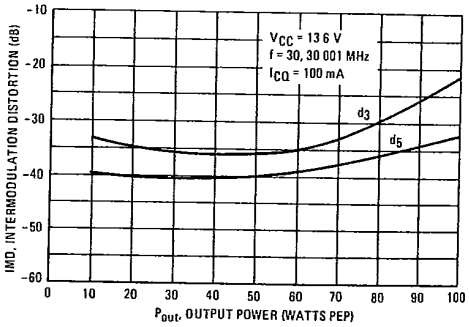


FIGURE 6 – OUTPUT CAPACITANCE versus FREQUENCY

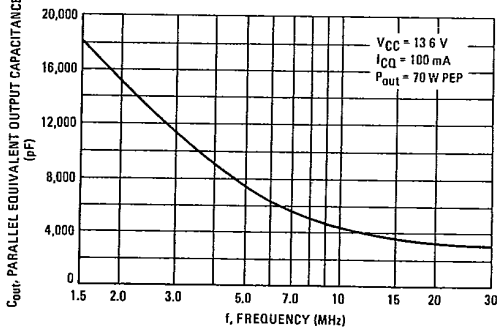


FIGURE 7 – OUTPUT RESISTANCE versus FREQUENCY

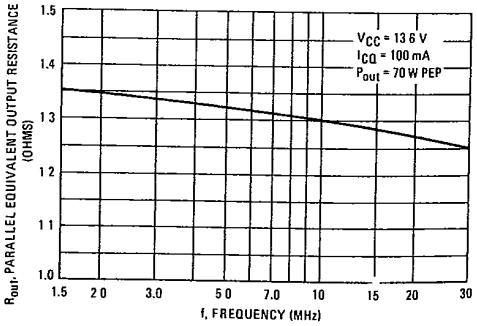


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FIGURE 8 – SAFE OPERATING AREA

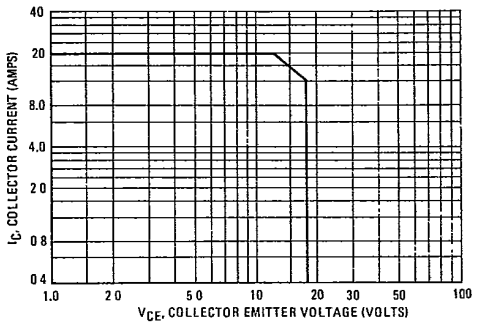
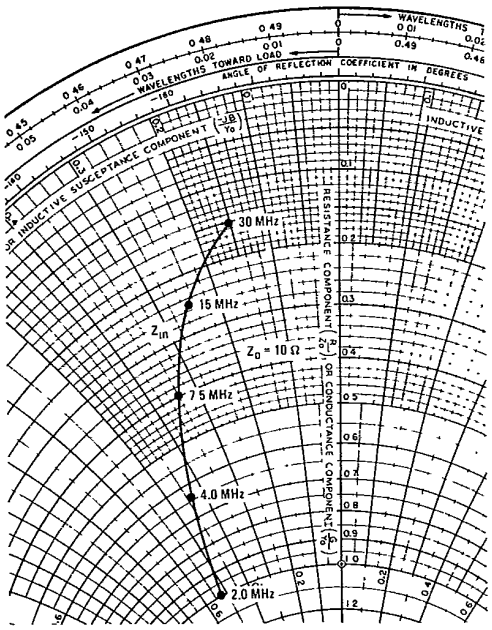


FIGURE 9 – SERIES INPUT IMPEDANCE



V_{CC} = 13.6 V
I_{CQ} = 100 mA
P_{out} = 70 W PEP

f MHz	Z_{in} Ohms
30	1.5 – j1.5
15	2.4 – j2.6
7.5	4.0 – j3.4
4.0	6.3 – j4.6
2.0	9.9 – j5.3

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