

6367254 MOTOROLA SC (XSTRS/R F)

89D 78971 D

T-33-15

**MOTOROLA  
SEMICONDUCTOR  
TECHNICAL DATA**

**MRF412**

**The RF Line**

**NPN SILICON RF POWER TRANSISTOR**

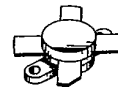
... designed primarily for applications as a high-power amplifier from 2.0 to 30 MHz, in single sideband mobile, marine and base station equipment where superior ruggedness is required.

- 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 <sub>CEO</sub>	18	Vdc
Collector-Base Voltage	V <sub>CBO</sub>	36	Vdc
Emitter-Base Voltage	V <sub>EBO</sub>	4.0	Vdc
Collector-Current — Continuous	I <sub>C</sub>	20	Adc
Total Device Dissipation @ T <sub>C</sub> = 25°C (1) Derate above 25°C	P <sub>D</sub>	250 1.43	Watts mW/°C
Storage Temperature Range	T <sub>stg</sub>	-65 to +150	°C

**THERMAL CHARACTERISTICS**

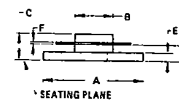
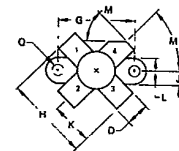
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	R <sub>θJC</sub>	0.7	°C/W

- (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.

**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<sub>FE</sub> at the data sheet conditions and color coding the device to predetermined h<sub>FE</sub> ranges within the normal h<sub>FE</sub> 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.



STYLE 1  
PIN 1 EMITTER  
2 BASE  
3 EMITTER  
4 COLLECTOR

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	24.38	25.15	0.960	0.990
B	5.40	5.93	0.213	0.233
C	5.87	7.14	0.231	0.281
D	5.48	5.97	0.215	0.235
E	7.15	7.67	0.281	0.303
F	2.15	2.15	0.084	0.084
G	18.28	18.54	0.719	0.730
H	20.07	20.57	0.790	0.810
I	10.29	10.29	0.405	0.405
J	6.27	6.48	0.248	0.255
K	4.05	4.05	0.160	0.160
L	4.81	4.93	0.190	0.193
M	2.87	3.30	0.113	0.130

CASE 211-11

6367254 MOTOROLA SC (XSTRS/R F)

89D 78972 DT-33-15

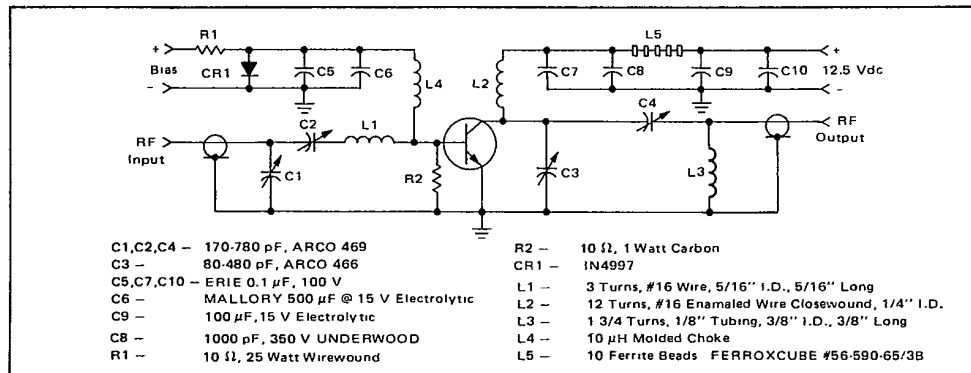
## MRF412

ELECTRICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Collector-Emitter Breakdown Voltage ( $I_C = 100 \text{ mAdc}$ , $I_B = 0$ )	$V_{(BR)CEO}$	18	—	—	Vdc
Collector-Emitter Breakdown Voltage ( $I_C = 50 \text{ mAdc}$ , $V_{BE} = 0$ )	$V_{(BR)CES}$	36	—	—	Vdc
Emitter-Base Breakdown Voltage ( $I_E = 10 \text{ mAdc}$ , $I_C = 0$ )	$V_{(BR)EBO}$	4.0	—	—	Vdc
Collector Cutoff Current ( $V_{CE} = 13.6 \text{ Vdc}$ , $V_{BE} = 0$ )	$I_{CES}$	—	—	20	mAdc
<b>ON CHARACTERISTICS</b>					
DC Current Gain ( $I_C = 5.0 \text{ Adc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )	$h_{FE}$	10	—	150	—
<b>DYNAMIC CHARACTERISTICS</b>					
Output Capacitance ( $V_{CB} = 15 \text{ Vdc}$ , $I_E = 0$ , $f = 1.0 \text{ MHz}$ )	$C_{ob}$	—	—	450	pF
<b>FUNCTIONAL TESTS (SSB)</b>					
Common-Emitter Amplifier Power Gain ( $V_{CC} = 13.6 \text{ Vdc}$ , $P_{out} = 70 \text{ W (PEP)}$ , $f_1 = 30 \text{ MHz}$ , $f_2 = 30.001 \text{ MHz}$ , $I_{CQ} = 100 \text{ mA}$ )	$G_{PE}$	13	16	—	dB
Collector Efficiency ( $V_{CC} = 13.6 \text{ Vdc}$ , $P_{out} = 70 \text{ W (PEP)}$ , $f_1 = 30 \text{ MHz}$ , $f_2 = 30.001 \text{ MHz}$ , $I_{CQ} = 100 \text{ mA}$ )	$\eta$	40	—	—	%
Intermodulation Distortion (1) (PEP) ( $V_{CC} = 13.6 \text{ Vdc}$ , $P_{out} = 70 \text{ W (PEP)}$ , $f_1 = 30 \text{ MHz}$ , $f_2 = 30.001 \text{ MHz}$ , $I_{CQ} = 100 \text{ mA}$ )	$IMD(d_3)$	—	-33	-28	dB
Load Mismatch ( $V_{CC} = 15.5 \text{ Vdc}$ , $P_{in} = 7.0 \text{ W (CW)}$ , $f = 30 \text{ MHz}$ , $V_{SWR} = 30:1$ All Angles)	$\psi$	No Degradation in Output Power			

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

FIGURE 1 — 30-MHz TEST CIRCUIT



MRF412

FIGURE 2 - OUTPUT POWER versus INPUT POWER

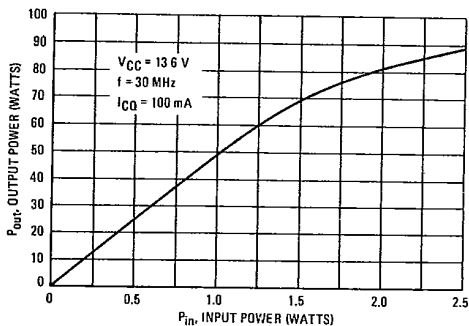


FIGURE 3 - POWER GAIN versus FREQUENCY

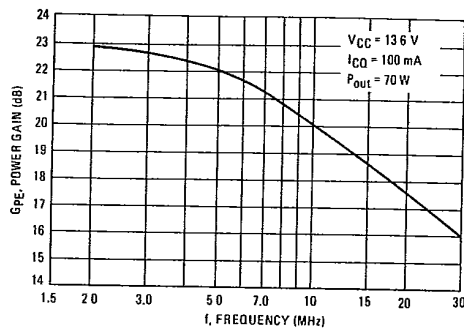


FIGURE 4 - OUTPUT POWER versus SUPPLY VOLTAGE

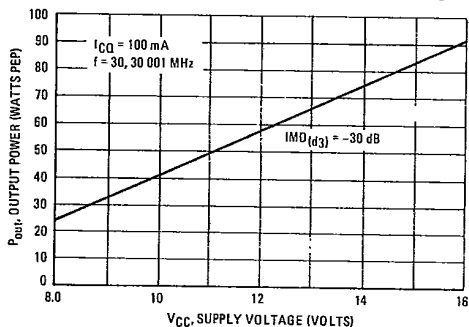


FIGURE 5 - INTERMODULATION DISTORTION versus OUTPUT POWER

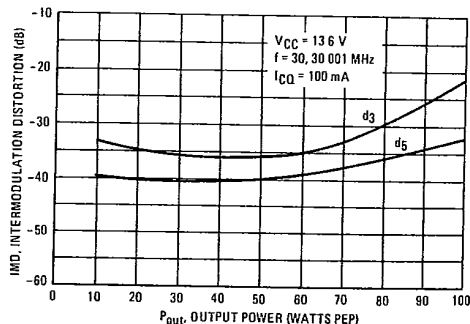


FIGURE 6 - OUTPUT CAPACITANCE versus FREQUENCY

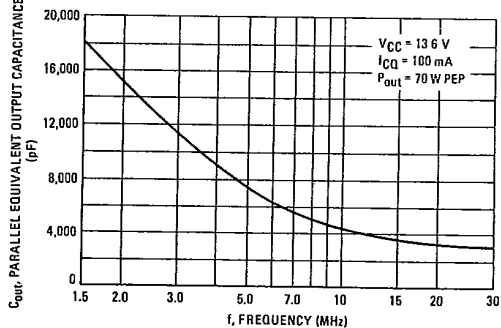
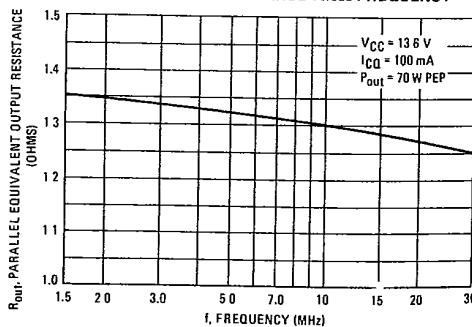


FIGURE 7 - OUTPUT RESISTANCE versus FREQUENCY



3

MRF412

FIGURE 8 -- SAFE OPERATING AREA

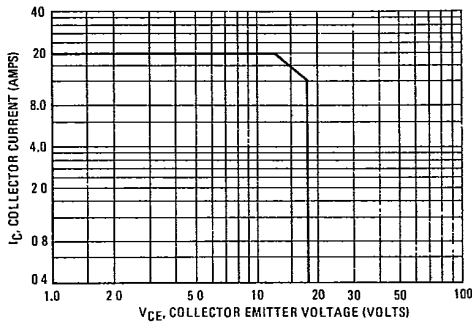
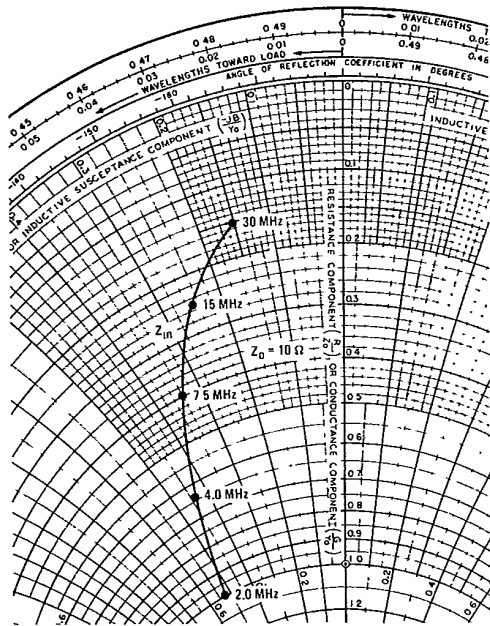


FIGURE 9 -- SERIES INPUT IMPEDANCE



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

f MHz	Z <sub>in</sub> 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

3