MRA1014 Series

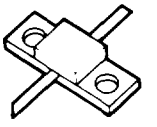
2

The RF Line
Microwave Power Transistors

7 to 8 dB
1–1.4 GHz
2 TO 35 WATTS
BROADBAND
MICROWAVE POWER
TRANSISTORS

. . . designed primarily for wideband, large-signal output and driver amplifier stages in the 1 to 1.4 GHz frequency range.

- Designed for Class C, Common Base Power Amplifiers
- Specified 28 Volt, 1.4 GHz Characteristics:
  - Output Power — 2 to 35 Watts
  - Power Gain — 7 to 8.2 dB
  - Collector Efficiency — 45 to 50%
- Built-In Matching Network for Broadband Operation
- Gold Metallization for Improved Reliability
- Diffused Ballast Resistors



CASE 394-01, STYLE 1
(MRA .25)

MAXIMUM RATINGS

Rating	Symbol	-2	-6	-12	-35	Unit
Collector-Base Voltage	V_{CES}	50				Vdc
Emitter-Base Voltage	V_{EBO}	3.5				Vdc
Collector Current — Continuous	I_C	0.5	1	2	5	Adc
Operating Junction Temperature	T_J	200				°C
Storage Temperature Range	T_{stg}	65 to +150				°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max				Unit
Thermal Resistance, RF, Junction to Case	$R_{\theta JC}$	15	8	4.5	2.5	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage		$V_{(BR)CES}$				Vdc
(I_C = 20 mA, V_{BE} = 0)	MRA1014-2		50	—	—	
(I_C = 40 mA, V_{BE} = 0)	-6		50	—	—	
(I_C = 80 mA, V_{BE} = 0)	-12		50	—	—	
(I_C = 200 mA, V_{BE} = 0)	-35		50	—	—	
Emitter-Base Breakdown Voltage		$V_{(BR)EBO}$				Vdc
(I_E = 0.25 mA, I_C = 0)	MRA1014-2		3.5	—	—	
(I_E = 0.5 mA, I_C = 0)	-6		3.5	—	—	
(I_E = 1 mA, I_C = 0)	-12		3.5	—	—	
(I_E = 2.5 mA, I_C = 0)	-35		3.5	—	—	
Collector Cutoff Current	MRA1014-2	I_{CBO}	—	—	0.5	mAdc
(V_{CB} = 28 V, I_E = 0)	-6		—	—	1	
	-12		—	—	2	
	-35		—	—	5	

(continued)

ELECTRICAL CHARACTERISTICS — continued

Characteristic		Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS						
DC Current Gain		h_{FE}				—
(I_C = 0.1 A, V_{CE} = 5 V)	MRA1014-2		10	—	100	
(I_C = 0.2 A, V_{CE} = 5 V)	-6		10	—	100	
(I_C = 0.4 A, V_{CE} = 5 V)	-12		10	—	100	
(I_C = 1 A, V_{CE} = 5 V)	-35		10	—	100	
DYNAMIC CHARACTERISTICS						
Output Capacitance	MRA1014-2	C_{ob}	—	—	4.5	pF
(V_{CB} = 28 V, I_E = 0, f = 1 MHz)	-6		—	—	8	
	-12		—	—	12	
	-35		—	—	(1)	
FUNCTIONAL TESTS						
Common-Base Amplifier Power Gain		G_{PB}				dB
(V_{CE} = 28 V, P_{out} = 2 W, f = 1.0 & 1.4 GHz)	MRA1014-2		8.2	—	—	
(V_{CE} = 28 V, P_{out} = 6 W, f = 1.0 & 1.4 GHz)	-6		7.4	—	—	
(V_{CE} = 28 V, P_{out} = 12 W, f = 1.0 & 1.4 GHz)	-12		7.8	—	—	
(V_{CE} = 28 V, P_{out} = 35 W, f = 1.0 & 1.4 GHz)	-35		7	7.5	—	
Collector Efficiency		η_C				%
(V_{CE} = 28 V, P_{out} = 2 W, f = 1.0 & 1.4 GHz)	MRA1014-2		45	—	—	
(V_{CE} = 28 V, P_{out} = 6 W, f = 1.0 & 1.4 GHz)	-6		50	—	—	
(V_{CE} = 28 V, P_{out} = 12 W, f = 1.0 & 1.4 GHz)	-12		50	—	—	
(V_{CE} = 28 V, P_{out} = 35 W, f = 1.0 & 1.4 GHz)	-35		50	55	—	

(1) Not measureable because of output matching network.

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TYPICAL CHARACTERISTICS

MRA1014-2 — 2 WATTS BROADBAND

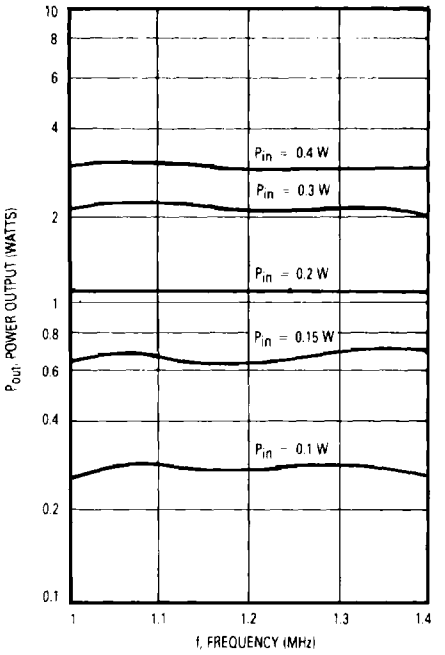


Figure 1. Power Output versus Frequency

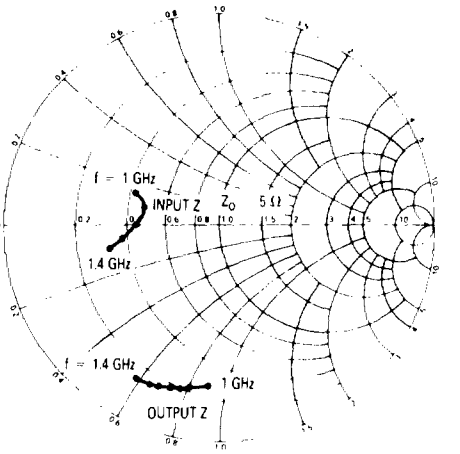


Figure 2. Series Equivalent Input/Output Impedance
V_{CC} = 28 V

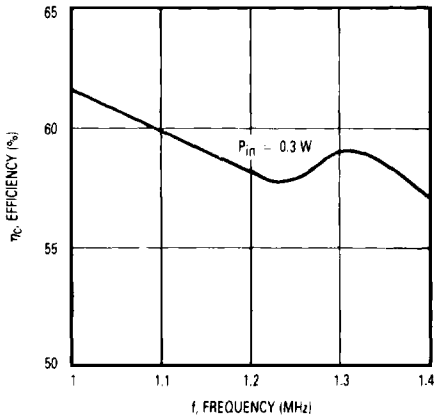


Figure 3. Efficiency versus Frequency

TYPICAL CHARACTERISTICS

MRA1014-6 — 6 WATTS BROADBAND

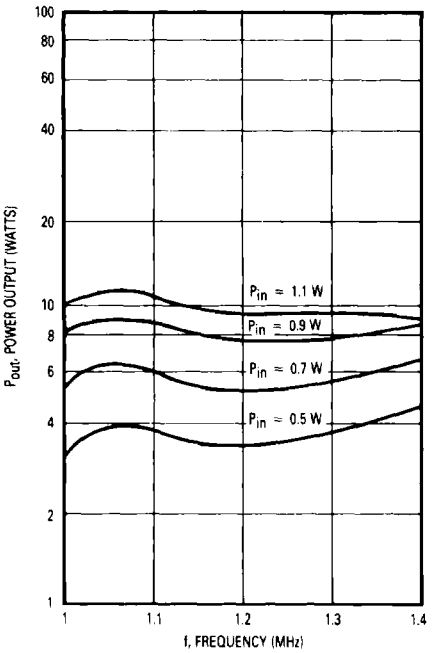


Figure 4. Power Output versus Frequency

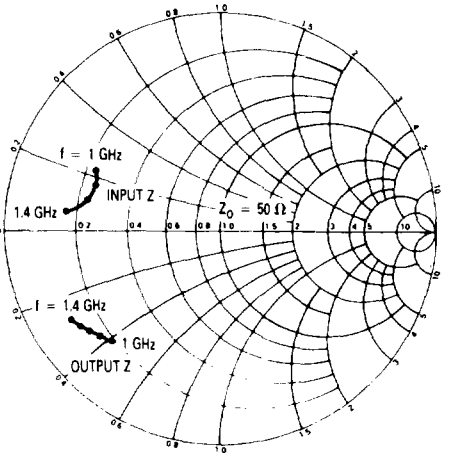


Figure 5. Series Equivalent Input/Output Impedance
V_{CC} = 28 V

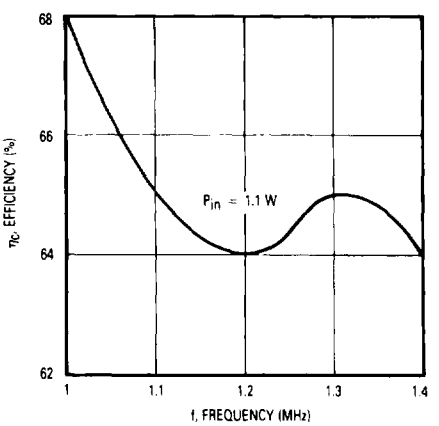


Figure 6. Efficiency versus Frequency

2

TYPICAL CHARACTERISTICS

MRA1014-12 — 12 WATTS BROADBAND

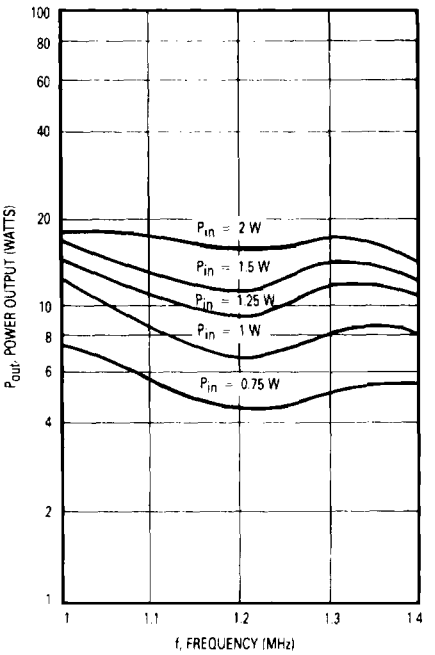


Figure 7. Power Output versus Frequency

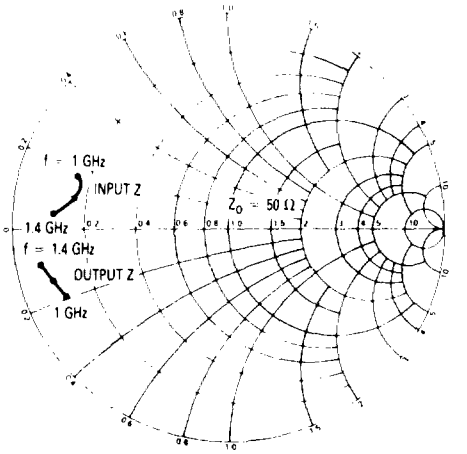


Figure 8. Series Equivalent Input/Output Impedance
V_{CC} = 28 V

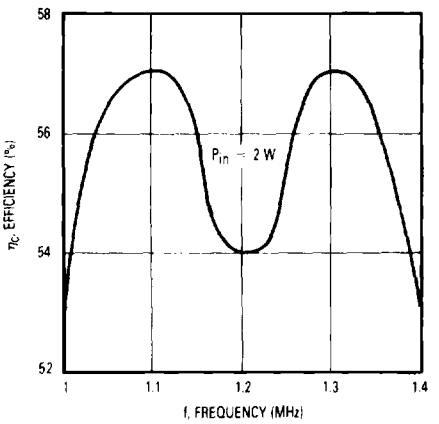


Figure 9. Efficiency versus Frequency

TYPICAL CHARACTERISTICS

MRA1014-35 — 35 WATTS BROADBAND

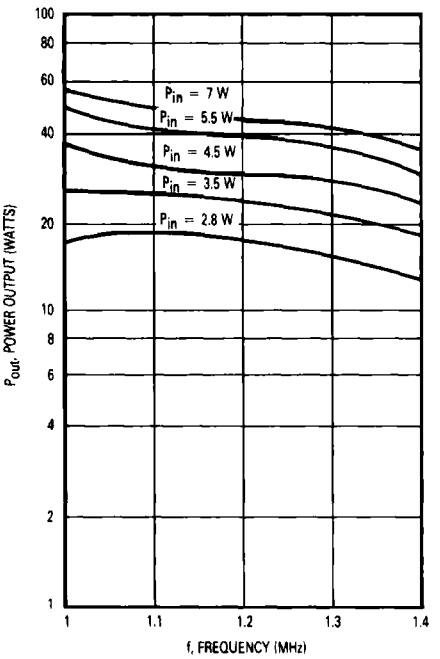


Figure 10. Power Output versus Frequency

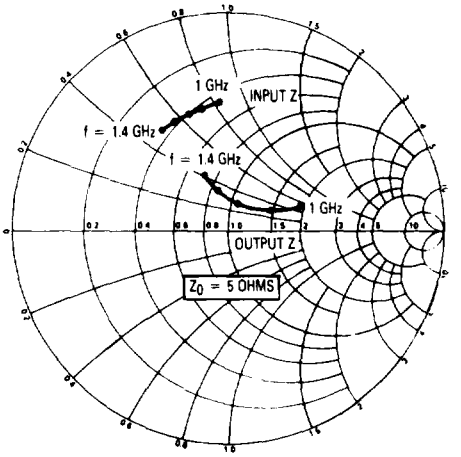


Figure 11. Series Equivalent Input/Output Impedance
V_{CC} = 28 V

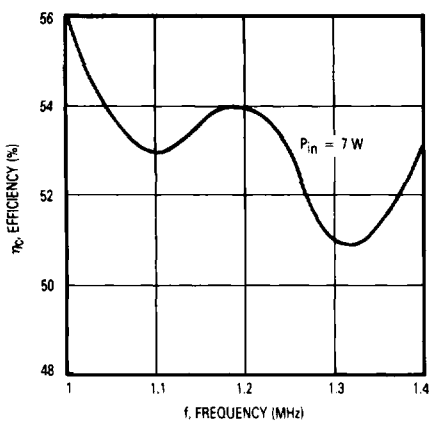
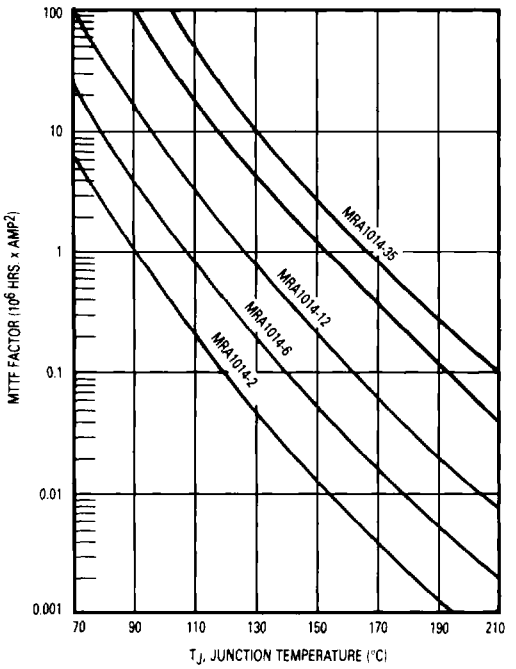


Figure 12. Efficiency versus Frequency

The graph shown below displays MTTF in hours x ampere^2 emitter current for each of the devices. Life tests at elevated temperatures have correlated to better than ±10% to the theoretical prediction for metal failure. Sample MTTF calculations based on operating conditions are included below.



Example of MTTF for MRA1014-12 Conditions

P_O = 12 W
P_{in} = 2 W
V_{CC} = 28 V
η = 50
T_{FLANGE} = 70°C

$$I_C = I_E = \frac{100 \times P_O}{\eta_C \times V_{CC}} = 0.857 \text{ A}$$

$P_{DISS} = P_{in} + V_{CC} \cdot I_C \quad P_D = 13.99$ W
$T_{JUNC} = T_{FLANGE} + \theta_{JF} \times P_{DISS} = 132.9$°C

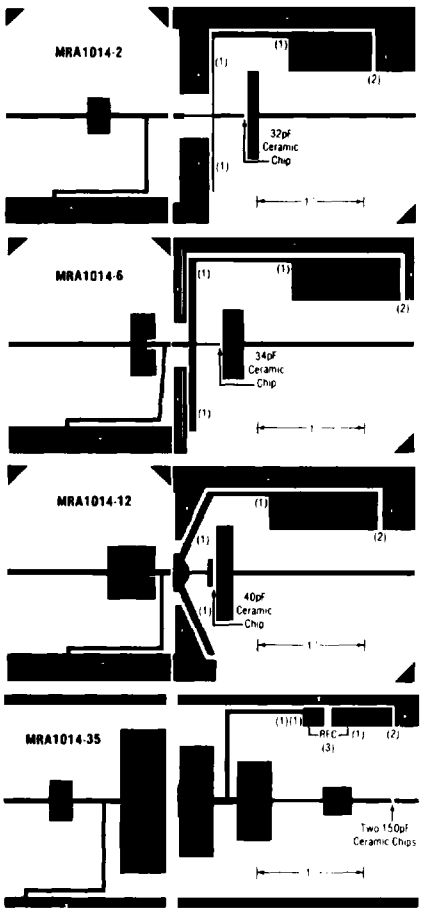
$$MTTF = \frac{0.7 \times 10^6 \text{ Hrs. Amp}^2}{I_C^2} \quad 953{,}095 \text{ Hrs}$$

MTTF = 108.8 Yrs

Figure 13. MTTF Factor (Normalized to 1 Ampere^2 Continuous Duty)

TEST CIRCUIT BOARDS FOR MRA1014 SERIES

NOTE: Scale is not 1:1



*For wrap or plate around to ground plane. Board material 0.020 inch glass teflon ε = 2.55
(1) Bypass capacitor to ground (150pF chip)
(2) Use B+ bypass of 0.01 and 1μF capacitors at this point
(3) 10 turns #20 enamel close wound on 0.040 mandrel

Figure 14. Test Circuit Boards (Not to Scale)