

MRW2000 Series

5.2 TO 9 dB
1–2.3 GHz
1 TO 20 WATTS
MICROWAVE
POWER TRANSISTORS

The RF Line
Microwave Power Transistors

... designed primarily for large-signal output and driver amplifier stages in the 1 to 2.3 GHz frequency range.


- Designed for Class B or C, Common Base Power Amplifiers
- Specified 28 Volt, 2 GHz Characteristics:
 - Output Power — 1 to 20 Watts
 - Power Gain — 5.2 to 9 dB, Min
 - Collector Efficiency — 40%, Min
- Hermetic Package Suitable for Military/Space Applications
- Gold Metallization for Improved Reliability
- Diffused Ballast Resistors
- Formerly Named TRW2000 Series

MAXIMUM RATINGS

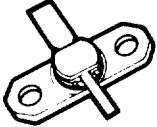
Rating	Symbol	2001,F	2003,F	2005,F	2010,F	2015,F	2020,F	Unit
Collector-Base Voltage	V _{CES}	50						Vdc
Emitter-Base Voltage	V _{EBO}	3.5						Vdc
Collector Current — Continuous	I _C	0.25	0.5	1	2	3	4	Adc
Operating Junction Temperature	T _J	200						°C
Storage Temperature Range	T _{stg}	65 to -200						°C

THERMAL CHARACTERISTICS

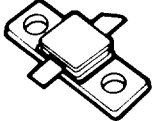
Characteristic	Symbol	Max						Unit
Thermal Resistance, RF, Junction to Case	R _{θJC}	25	15	8.5	6	3.5	3	°C/W




CASE 328F-01, STYLE 1 (GP-13)
MRW2001, 2003, 2005, 2010



CASE 328E-01, STYLE 1 (GP-13F)
MRW2001F, 2003F, 2005F, 2010F



CASE 393-01, STYLE 1 (HLP-11)
MRW2015, 2020



CASE 393A-01, STYLE 1 (HLP-11F)
MRW2015F, 2020F

MRW2000 Series

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I _C = 10 mA, V _{BE} = 0)	V _{(BR)CES}	50	—	—	V _{dc}
(I _C = 20 mA, V _{BE} = 0)		50	—	—	
(I _C = 40 mA, V _{BE} = 0)		50	—	—	
(I _C = 80 mA, V _{BE} = 0)		50	—	—	
(I _C = 120 mA, V _{BE} = 0)		50	—	—	
(I _C = 160 mA, V _{BE} = 0)		50	—	—	
Emitter-Base Breakdown Voltage (I _E = 0.2 mA, I _C = 0)	V _{(BR)EBO}	3.5	—	—	V _{dc}
(I _E = 0.25 mA, I _C = 0)		3.5	—	—	
(I _E = 0.5 mA, I _C = 0)		3.5	—	—	
(I _E = 1 mA, I _C = 0)		3.5	—	—	
(I _E = 1.5 mA, I _C = 0)		3.5	—	—	
(I _E = 2 mA, I _C = 0)		3.5	—	—	
Collector Cutoff Current (V _{CB} = 28 V, I _E = 0)	I _{CBO}	—	—	0.5	mA _{dc}
		—	—	0.5	
		—	—	0.5	
		—	—	0.5	
		—	—	1.5	
		—	—	2	
ON CHARACTERISTICS					
DC Current Gain (I _C = 100 mA, V _{CE} = 5 V)	h _{FE}	10	—	120	—
(I _C = 100 mA, V _{CE} = 5 V)		10	—	100	
(I _C = 200 mA, V _{CE} = 5 V)		10	—	100	
(I _C = 400 mA, V _{CE} = 5 V)		10	—	100	
(I _C = 600 mA, V _{CE} = 5 V)		10	—	100	
(I _C = 800 mA, V _{CE} = 5 V)		10	—	100	
DYNAMIC CHARACTERISTICS					
Output Capacitance (V _{CB} = 28 V, I _E = 0, f = 1 MHz)	C _{ob}	—	—	4	pF
		—	—	5	
		—	—	7	
		—	—	12	
		—	—	21	
		—	—	24	

(continued)

MRW2000 Series

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

Characteristic	Symbol	Min	Typ	Max	Unit	
FUNCTIONAL TESTS						
Common-Base Amplifier Power Gain (V _{CE} = 28 V, P _{out} = 1 W, f = 2 GHz) (V _{CE} = 28 V, P _{out} = 10 W, f = 2 GHz)	MRW2001,F MRW2010,F	9 7	— —	— —	dB	
Common-Base Amplifier Power Gain (V _{CE} = 28 V, P _{out} = 3 W, f = 2 GHz) (V _{CE} = 28 V, P _{out} = 5 W, f = 2 GHz) (V _{CE} = 28 V, P _{out} = 15 W, f = 2 GHz) (V _{CE} = 28 V, P _{out} = 20 W, f = 2 GHz)	MRW2003,F MRW2005,F MRW2015,F MRW2020,F	8 8 6 5.2	— — — —	— — — —	dB	
Collector Efficiency (V _{CE} = 28 V, P _{out} = 1 W, f = 2 GHz) (V _{CE} = 28 V, P _{out} = 3 W, f = 2 GHz) (V _{CE} = 28 V, P _{out} = 5 W, f = 2 GHz) (V _{CE} = 28 V, P _{out} = 10 W, f = 2 GHz) (V _{CE} = 28 V, P _{out} = 15 W, f = 2 GHz) (V _{CE} = 28 V, P _{out} = 20 W, f = 2 GHz)	MRW2001,F MRW2003,F MRW2005,F MRW2010,F MRW2015,F MRW2020,F	40	—	—	%	
Load Mismatch (V _{CE} = 28 V, f = 2 GHz, Load VSWR = ∞:1, All Phase Angles) P _{out} = 1 W P _{out} = 3 W P _{out} = 5 W P _{out} = 10 W P _{out} = 15 W P _{out} = 20 W	MRW2001,F MRW2003,F MRW2005,F MRW2010,F MRW2015,F MRW2020,F	ψ	No Degradation in Output Power			
Saturated Output Power (V _{CE} = 28 V, f = 2.3 GHz) (V _{CE} = 28 V, f = 1.5 GHz) (V _{CE} = 28 V, f = 1 GHz) (V _{CE} = 28 V, f = 2.3 GHz) (V _{CE} = 28 V, f = 1.5 GHz) (V _{CE} = 28 V, f = 1 GHz) (V _{CE} = 28 V, f = 2.3 GHz) (V _{CE} = 28 V, f = 1.5 GHz) (V _{CE} = 28 V, f = 1 GHz) (V _{CE} = 28 V, f = 2.3 GHz) (V _{CE} = 28 V, f = 1.5 GHz) (V _{CE} = 28 V, f = 1 GHz) (V _{CE} = 28 V, f = 1.5 GHz) (V _{CE} = 28 V, f = 1 GHz) (V _{CE} = 28 V, f = 1.5 GHz) (V _{CE} = 28 V, f = 1 GHz)	MRW2001,F MRW2003,F MRW2005,F MRW2010,F MRW2015,F MRW2020,F	P _{sat1} P _{sat2} P _{sat3}	— — — — — — — — — — — — — — — —	1 1.2 1.3 3 3.7 4 5 6.5 7.5 10 13 15 22 30 30 40	— — — — — — — — — — — — — — — —	W

2

MRW2000 Series

TYPICAL CHARACTERISTICS

2

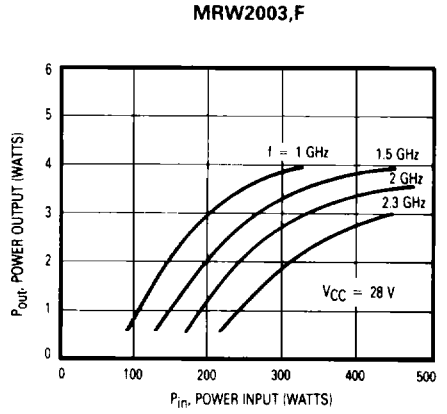
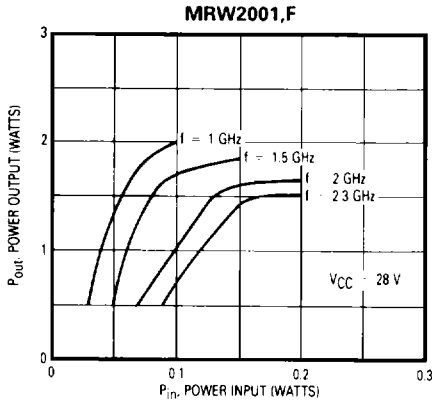


Figure 1. Output Power versus Input Power

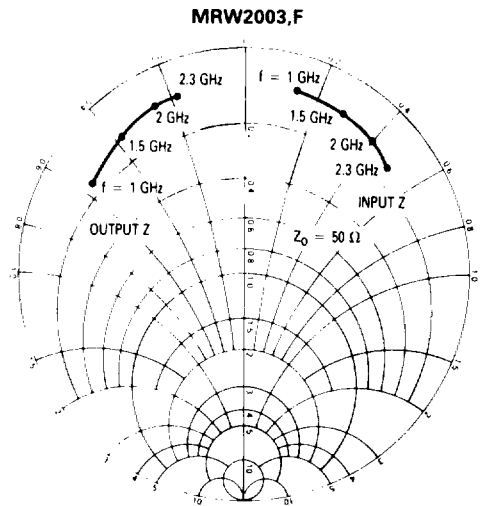
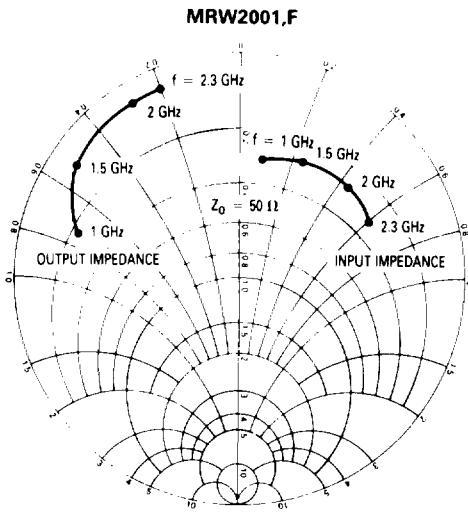


Figure 2. Series Equivalent Input/Output Impedance
 $V_{CC} = 28\text{ V}$

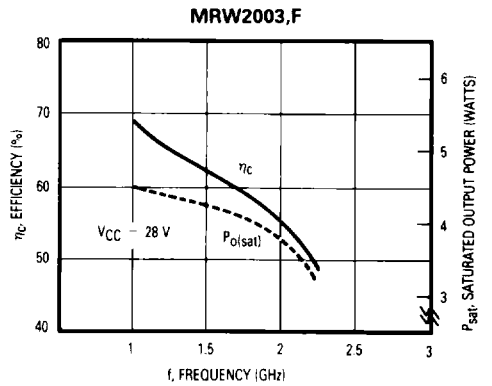
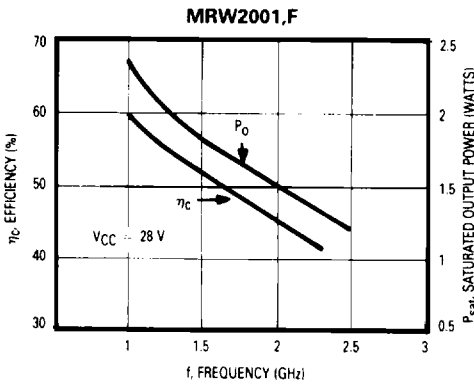


Figure 3. Power Output and Efficiency versus Frequency

MRW2000 Series

TYPICAL CHARACTERISTICS

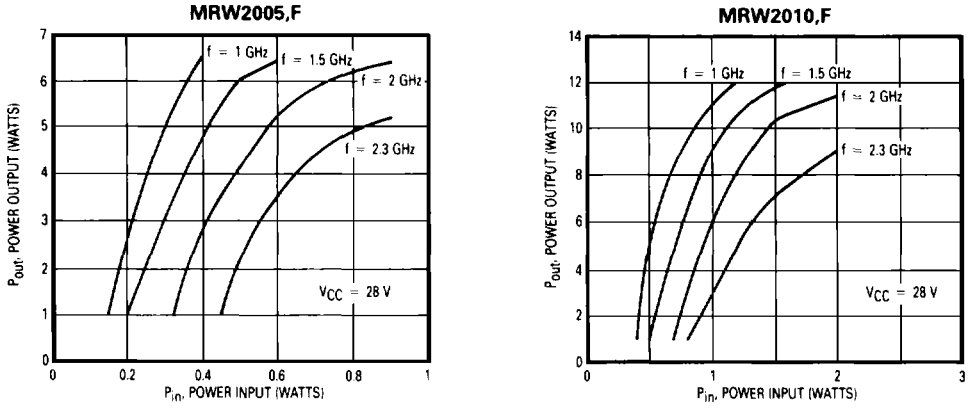


Figure 4. Output Power versus Input Power

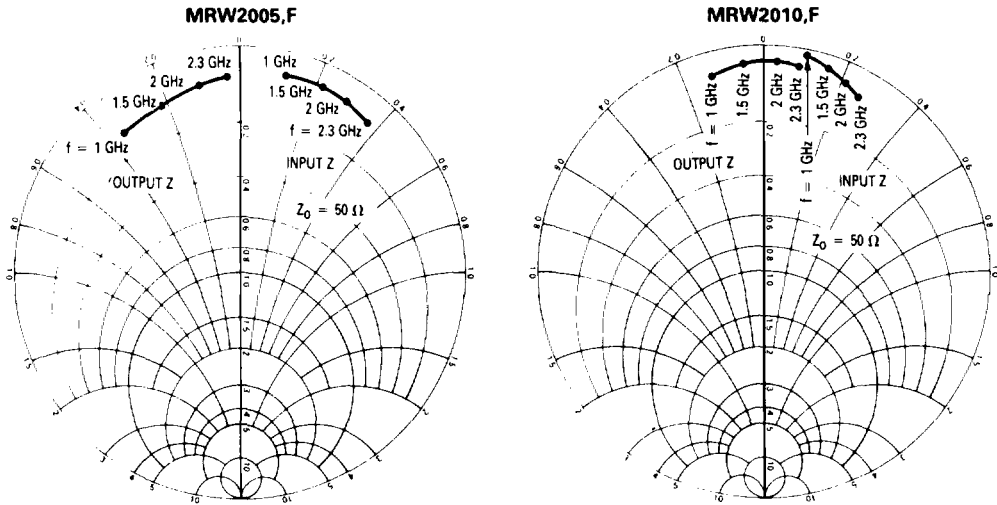


Figure 5. Series Equivalent Input/Output Impedance
VCC = 28 V

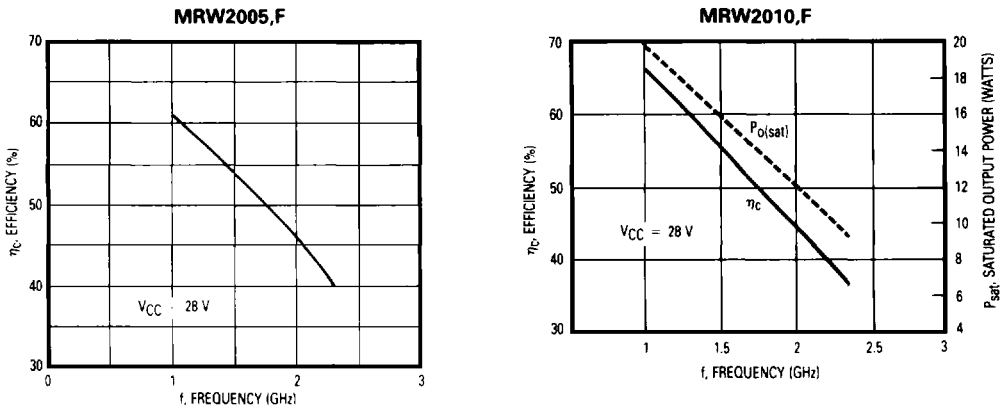


Figure 6. Power Output and Efficiency versus Frequency

MRW2000 Series

TYPICAL CHARACTERISTICS

2

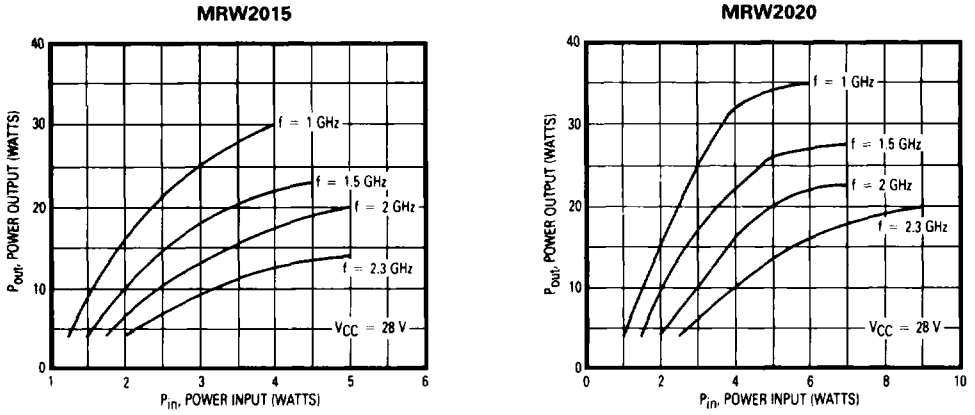


Figure 7. Output Power versus Input Power

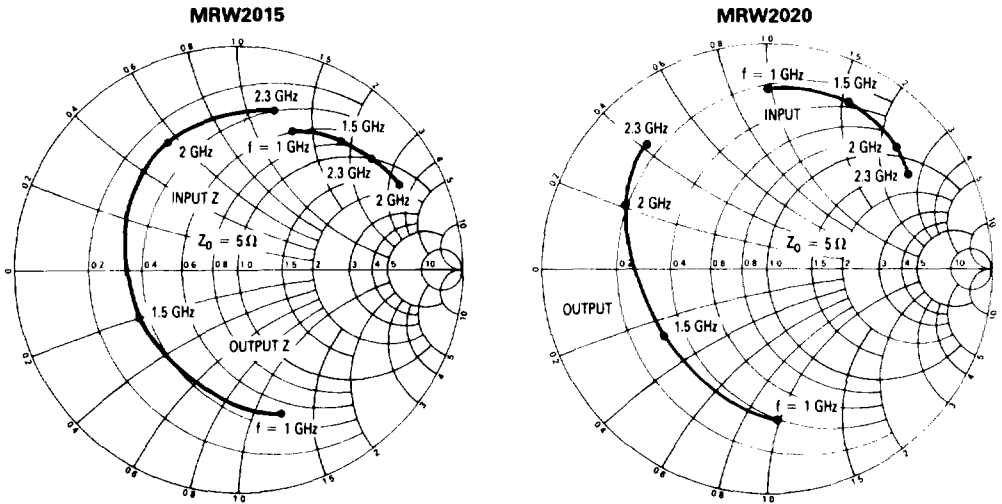


Figure 8. Series Equivalent Input/Output Impedance
VCC = 28 V

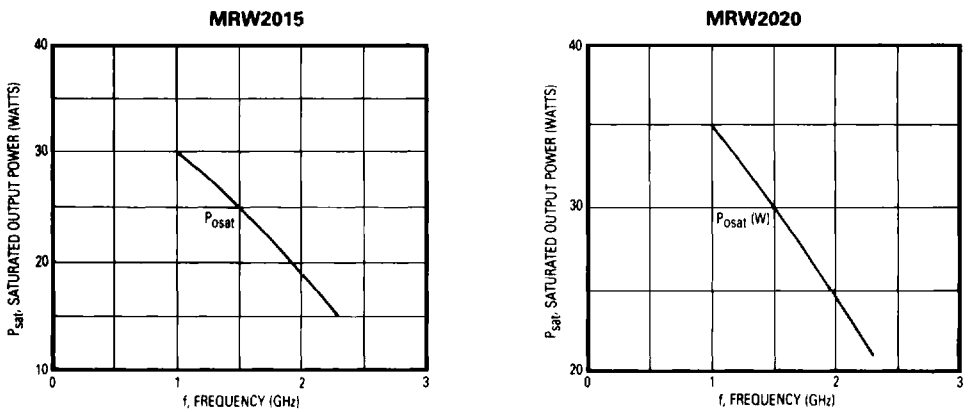


Figure 9. Power Output and Efficiency versus Frequency

MRW2000 Series

The graph shown below displays MTTF in hours x ampere² emitter current for each of the "Super 2 GHz" 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 on the graph.

Example for MRW2010

$$\begin{aligned}
 P_o &= 10 \text{ W} \\
 P_{in} &= 2 \text{ W} \\
 V_{CC} &= 28 \text{ V} \\
 \eta_c &= 40\% \\
 T_{FLANGE} &= 70^\circ\text{C} \\
 I_C = I_E &= \frac{100 \times P_o}{\eta_c \times V_{CC}} = 0.892 \\
 P_{DISS} &= P_{in} + V_{CC} \cdot I_C - P_o = 16.9 \text{ W} \\
 T_J &= T_{FLANGE} + \theta_{JC} \times P_{DISS} = 171^\circ\text{C} \\
 \text{MTTF} &= \frac{0.065 \times 10^6 \text{ Hrs} \times \text{Amp}^2}{I_C^2} = 81,692 \text{ Hrs} \\
 &= 9.32 \text{ Yrs}
 \end{aligned}$$

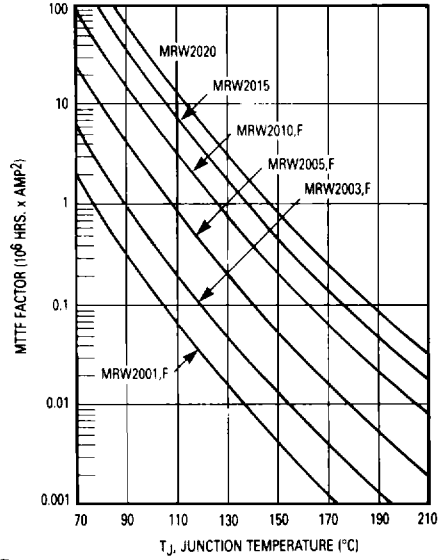


Figure 10. MTTF Factor

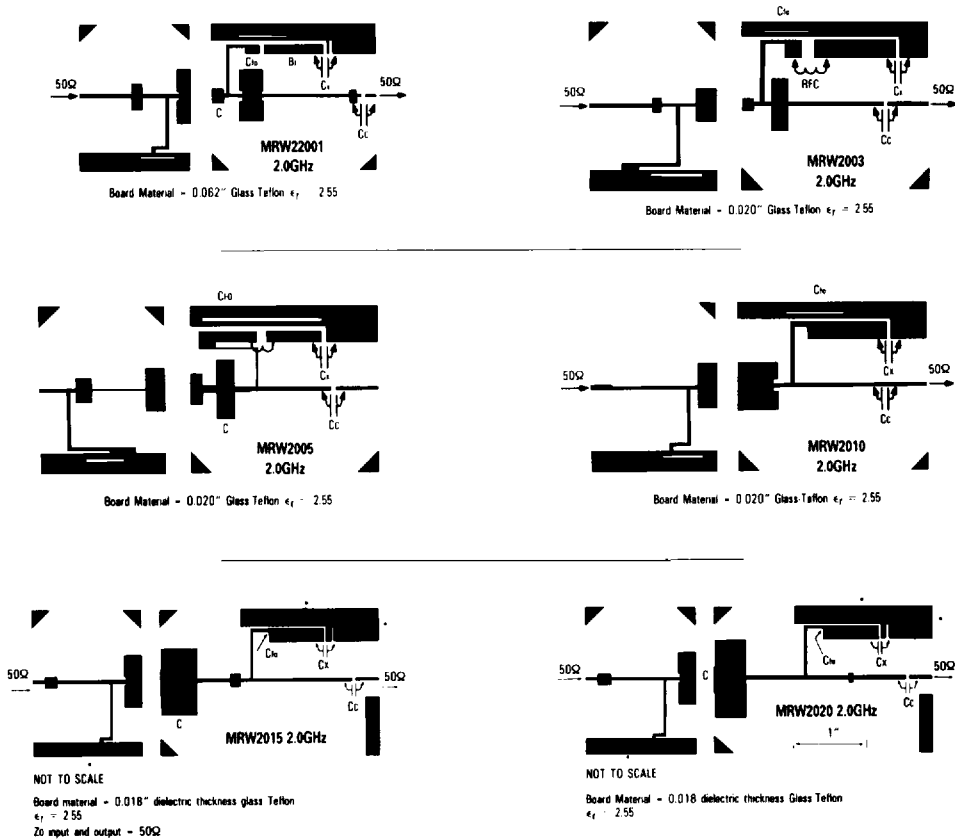


Figure 11. PC Board Layouts