MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

TRW3000 Series

2

5 TO 7 dB
1.5–3 GHz
1 TO 5 WATTS
MICROWAVE
POWER
TRANSISTORS

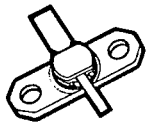
The RF Line

Microwave Power Transistors

... designed primarily for wideband, large-signal output and driver amplifier stages in the 1.5 to 3 GHz frequency range.

- Designed for Class B or C, Common Base Linear Power Amplifiers
- Specified 28 Volt, 3 GHz Characteristics:
  - Output Power — 1 to 5 Watts
  - Power Gain — 5 to 7 dB Min
  - Collector Efficiency — 30% Min
- Hermetic Package Suitable for Military/Space Applications
- Gold Metallization for Improved Reliability
- Diffused Ballast Resistors

GP-13F
CASE 328E-01, STYLE 1
TRW3001F, 3003F, 3005F



GP-13
CASE 328F-01, STYLE 2
TRW3001, 3003, 3005

MAXIMUM RATINGS

Rating	Symbol	3001,F	3003,F	3005,F	
Collector-Base Voltage	V_{CBO}	45			Vdc
Emitter-Base Voltage	V_{EBO}	3.5			Vdc
Operating Junction Temperature	T_J	200			°C
Storage Temperature Range	T_{stg}	−65 to +200			°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max			Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	35	17	8.5	°C/W

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

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage		$V_{(BR)CES}$				Vdc
(I_C = 10 mA, V_{BE} = 0)	TRW3001,F		50	—	—	
(I_C = 30 mA, V_{BE} = 0)	3003,F		50	—	—	
(I_C = 50 mA, V_{BE} = 0)	3005,F		50	—	—	
Collector-Base Breakdown Voltage		$V_{(BR)CBO}$				Vdc
(I_C = 1 mA, I_E = 0)	TRW3001,F		45	—	—	
(I_C = 3 mA, I_E = 0)	3003,F		45	—	—	
(I_C = 5 mA, I_E = 0)	3005,F		45	—	—	
Emitter-Base Breakdown Voltage		$V_{(BR)EBO}$	3.5	—	—	Vdc
(I_E = 1 mA, I_C = 0)						
Collector Cutoff Current	TRW3001,F	I_{CBO}	—	—	0.5	mAdc
(V_{CB} = 28 V, I_E = 0)	3003,F		—	—	0.75	
	3005,F		—	—	1.25	
ON CHARACTERISTICS						
DC Current Gain		h_{FE}				—
(I_C = 100 mA, V_{CE} = 5 V)	TRW3001,F		10	—	120	
(I_C = 300 mA, V_{CE} = 5 V)	3003,F		10	—	120	
(I_C = 500 mA, V_{CE} = 5 V)	3005,F		10	—	120	

(continued)

TRW3000 Series

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

Characteristic		Symbol	Min	Typ	Max	Unit
DYNAMIC CHARACTERISTICS						
Output Capacitance (V_{CB} = 28 V, I_E = 0, f = 1 MHz)	TRW3001,F	C_{ob}	—	3.5	4	pF
	3003,F		—	5.7	7	
	3005,F		—	8.4	10	
FUNCTIONAL TESTS						
Common-Base Amplifier Power Gain		G_{PB}				dB
(V_{CE} = 28 V, P_{out} = 1 W, f = 3 GHz)	TRW3001,F		7	—	—	
(V_{CE} = 28 V, P_{out} = 3 W, f = 3 GHz)	3003,F		6	—	—	
(V_{CE} = 28 V, P_{out} = 5 W, f = 3 GHz)	3005,F		5	—	—	
Collector Efficiency		η_C				%
(V_{CE} = 28 V, P_{out} = 1 W, f = 3 GHz)	TRW3001,F		30	—	—	
(V_{CE} = 28 V, P_{out} = 3 W, f = 3 GHz)	3003,F		30	—	—	
(V_{CE} = 28 V, P_{out} = 5 W, f = 3 GHz)	3005,F		30	—	—	
Load Mismatch		ψ	No Degradation in Output Power			
(V_{CE} = 28 V, P_{out} = 1 W, f = 3 GHz, P_{out} = 3 W, P_{out} = 5 W, Load VSWR = ∞:1, All Phase Angles)	TRW3001,F 3003,F 3005,F					

TRW3001,F
TYPICAL CHARACTERISTICS

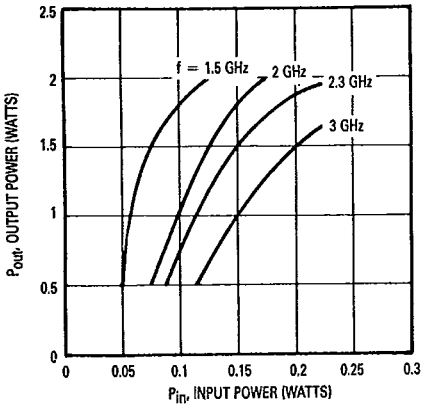


Figure 1. Output Power versus Input Power

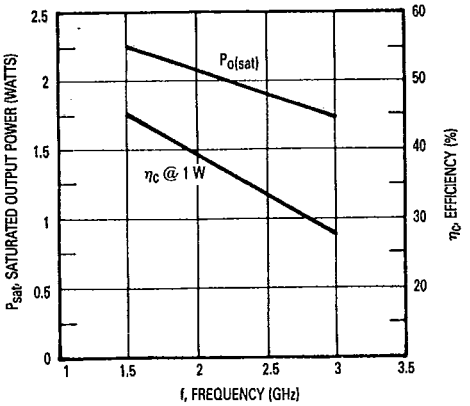


Figure 2. P_{sat} and η versus Frequency

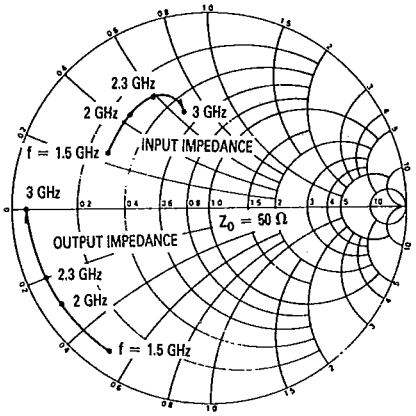
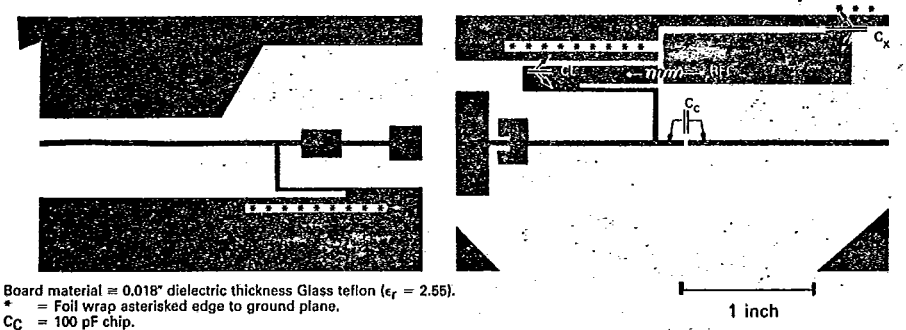


Figure 3. Series Equivalent Input/Output Impedance



Board material ≅ 0.018" dielectric thickness Glass teflon (ϵ_r = 2.55).
* = Foil wrap asterisked edge to ground plane.
C_C = 100 pF chip.
C_X = 100 pF chip capacitor and 10 μF electrolytic.
C_L = 100 pF chip capacitor. The capacitor position can be tuned.
R_{FC} = 8 turns #28 AWG, 0.010 dia.

Figure 4. PC Board Layout (Not to Scale)

TRW3003,F TYPICAL CHARACTERISTICS

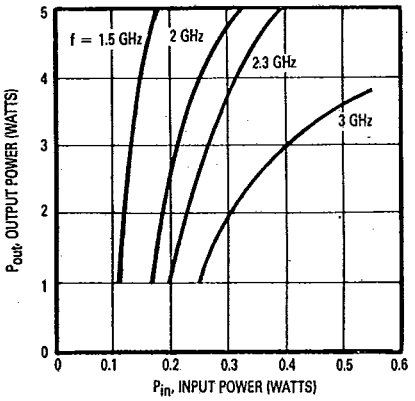


Figure 5. Output Power versus Input Power

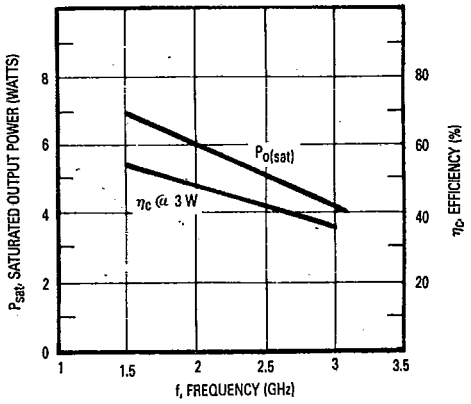


Figure 6. P_{sat} and η versus Frequency

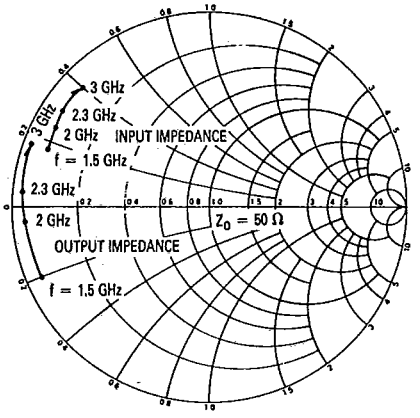
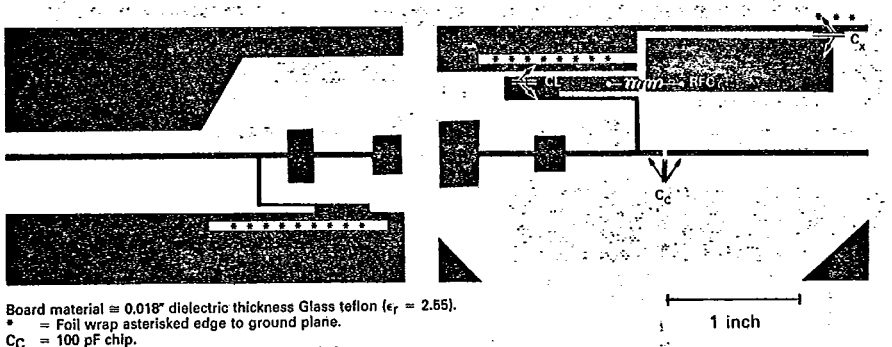


Figure 7. Series Equivalent Input/Output Impedance

T-33-01



Board material ≅ 0.018" dielectric thickness Glass teflon (ϵ_r = 2.55).
* = Foil wrap asterisked edge to ground plane.
C_C = 100 pF chip.
C_X = 100 pF chip capacitor and 10 μF electrolytic.
C_L = 100 pF chip capacitor. The capacitor position can be tuned.
R_{FC} = 8 turns #28 AWG, 0.010 dia.

Figure 8. PC Board Layout (Not to Scale)

TRW3005,F
TYPICAL CHARACTERISTICS

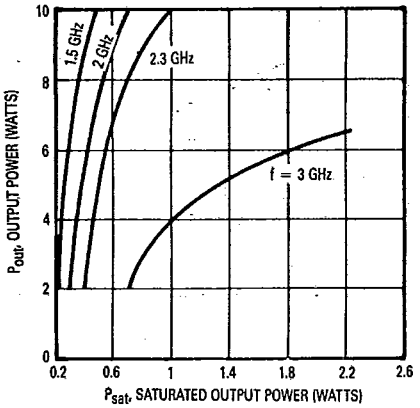


Figure 9. Output Power versus Input Power

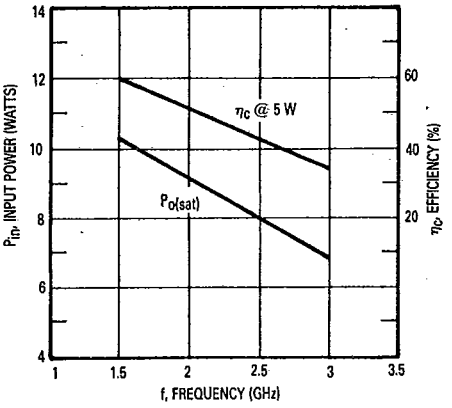


Figure 10. P_{sat} and η versus Frequency

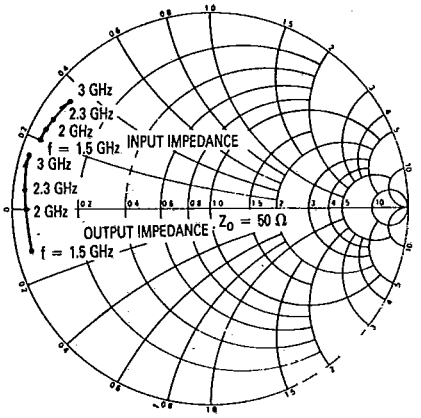
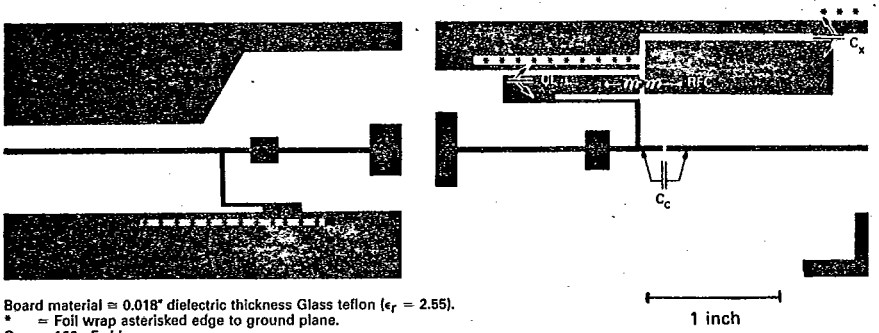


Figure 11. Series Equivalent Input/Output Impedance

T-33-01



Board material ≈ 0.018" dielectric thickness Glass teflon (ϵ_r = 2.55).
* = Foil wrap asterisked edge to ground plane.
C_C = 100 pF chip.
C_X = 100 pF chip capacitor and 10 μF electrolytic.
C_L = 100 pF chip capacitor. The capacitor position can be tuned.
R_{FC} = 8 turns #28 AWG, 0.010 dia.

Figure 12. PC Board Layout (Not to Scale)

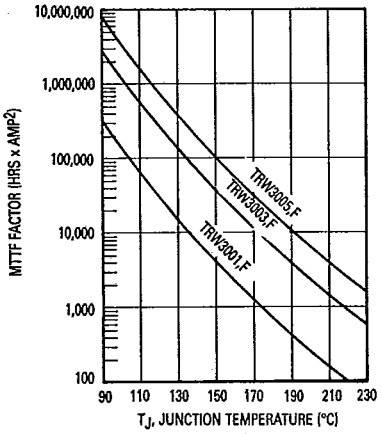


Figure 13. MTTF Factor versus Junction Temperature

MTTF Factor
(Normalized to 1 ampere² Continuous Duty)

The graph shown displays MTTF in hours x ampere² emitter current for each of the 3 GHz devices. Life tests at elevated temperatures have correlated to better than ±10% to the theoretical prediction for metal failure.
CAUTION — A calculation is required to obtain actual metal life. Sample MTTF calculations based on operating conditions are shown below.

Junction Temperature — °C

To calculate metal lifetime under any set of conditions, obtain actual data or estimate from typical performance curves. Solve for T_J (°C):

$$(1)\ T_J = \theta_{JF}\left(\frac{P_{out} \times 100}{\eta_C\ \%} + P_{in} - P_{out}\right) + T_{FLANGE}$$

Enter graph of MTF factor versus T_J. Obtain MTF factor. Calculate metal life by:

$$(2)\ \text{Metal Life in Hours} = \frac{\text{MTF Factor}}{I_C^2\ (\text{Amps})}$$