

MOTOROLA
SEMICONDUCTOR
 TECHNICAL DATA

TRW3000
Series

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

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

MAXIMUM RATINGS

Rating	Symbol	3001,F	3003,F	3005,F	Unit
Collector-Base Voltage	V _{CB0}		45		V _{dc}
Emitter-Base Voltage	V _{EB0}		3.5		V _{dc}
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 _{θJC}	35	17	8.5	°C/W

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

Characteristic	Symbol	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Collector-Emitter Breakdown Voltage (I _C = 10 mA, V _{BE} = 0) (I _C = 30 mA, V _{BE} = 0) (I _C = 50 mA, V _{BE} = 0)	TRW3001,F 3003,F 3005,F	V _{(BR)CES}	50 50 50	— — —	— — —	V _{dc}
Collector-Base Breakdown Voltage (I _C = 1 mA, I _E = 0) (I _C = 3 mA, I _E = 0) (I _C = 5 mA, I _E = 0)	TRW3001,F 3003,F 3005,F	V _{(BR)CBO}	45 45 45	— — —	— — —	V _{dc}
Emitter-Base Breakdown Voltage (I _E = 1 mA, I _C = 0)		V _{(BR)EBO}	3.5	—	—	V _{dc}
Collector Cutoff Current (V _{CB} = 28 V, I _E = 0)	TRW3001,F 3003,F 3005,F	I _{CBO}	— — —	— — —	0.5 0.75 1.25	mAdc

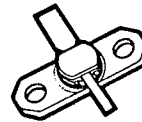
ON CHARACTERISTICS

DC Current Gain (I _C = 100 mA, V _{CE} = 5 V) (I _C = 300 mA, V _{CE} = 5 V) (I _C = 500 mA, V _{CE} = 5 V)	TRW3001,F 3003,F 3005,F	h _{FE}	10 10 10	— — —	120 120 120	—
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(continued)



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



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

TRW3000 Series

T-33-01

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	—	3.5	4	pF
	3003,F	—	5.7	7	
	3005,F	—	8.4	10	
FUNCTIONAL TESTS					
Common-Base Amplifier Power Gain (V _{CE} = 28 V, P _{out} = 1 W, f = 3 GHz) (V _{CE} = 28 V, P _{out} = 3 W, f = 3 GHz) (V _{CE} = 28 V, P _{out} = 5 W, f = 3 GHz)	TRW3001,F	GpB	7	—	dB
	3003,F		6	—	
	3005,F		5	—	
Collector Efficiency (V _{CE} = 28 V, P _{out} = 1 W, f = 3 GHz) (V _{CE} = 28 V, P _{out} = 3 W, f = 3 GHz) (V _{CE} = 28 V, P _{out} = 5 W, f = 3 GHz)	TRW3001,F	η _c	30	—	%
	3003,F		30	—	
	3005,F		30	—	
Load Mismatch (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	ψ	No Degradation in Output Power		

TRW3001,F
TYPICAL CHARACTERISTICS

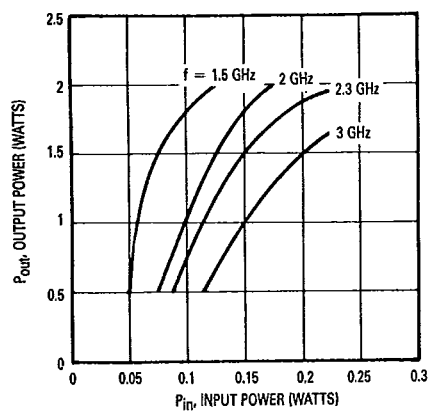


Figure 1. Output Power versus Input Power

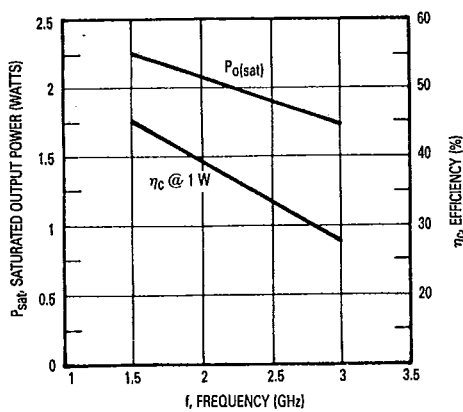


Figure 2. P_{sat} and η_c versus Frequency

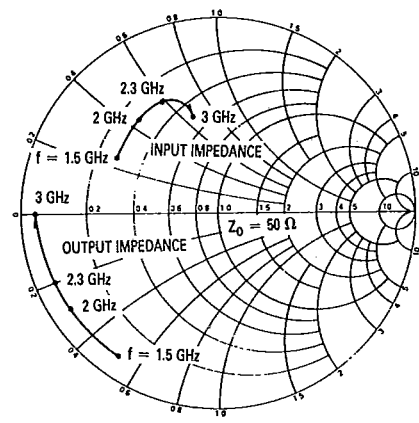
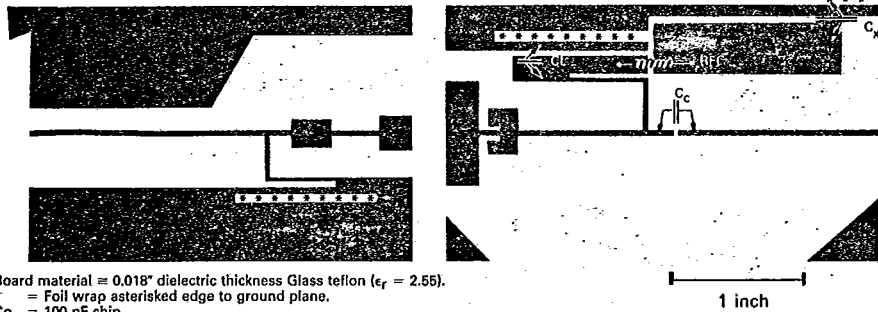


Figure 3. Series Equivalent Input/Output Impedance

T-33-01



Board material = 0.018" dielectric thickness Glass teflon ($\epsilon_r = 2.55$).
 * = Foil wrap asterisked edge to ground plane.
 Cc = 100 pF chip.
 Cx = 100 pF chip capacitor and 10 μ F electrolytic.
 Cl = 100 pF chip capacitor. The capacitor position can be tuned.
 RFC = 8 turns #28 AWG, 0.010 dia.

Figure 4. PC Board Layout
 (Not to Scale)

TRW3003,F
 TYPICAL CHARACTERISTICS

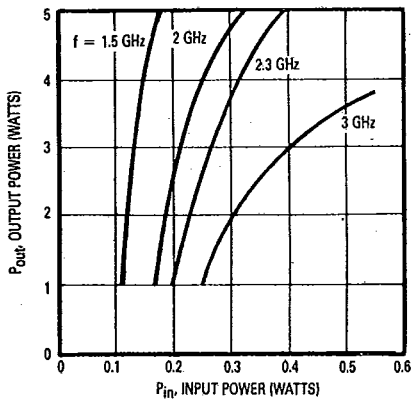


Figure 5. Output Power versus Input Power

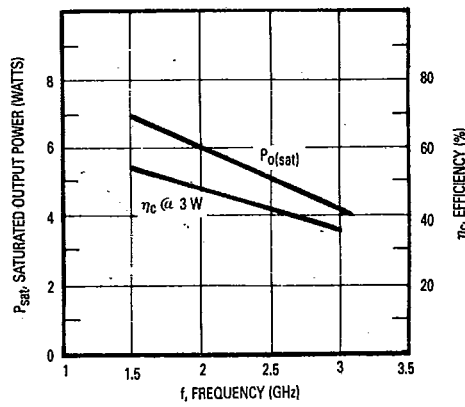


Figure 6. P_{sat} and η versus Frequency

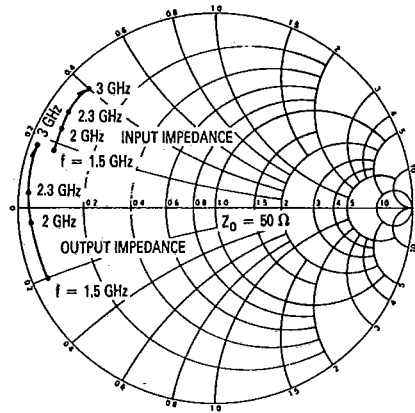
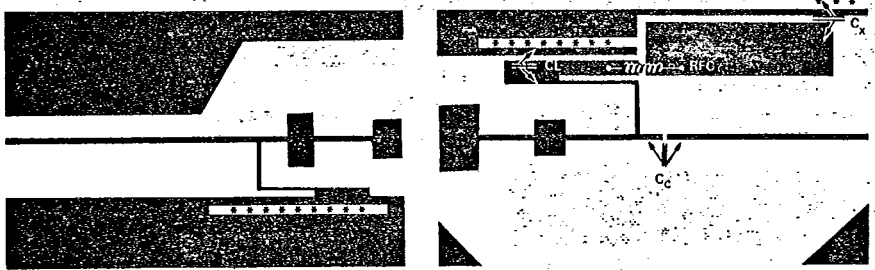


Figure 7. Series Equivalent Input/Output Impedance

T-33-01



Board material = 0.018" dielectric thickness Glass teflon ($\epsilon_r = 2.65$).
 * = Foil wrap asterisk edge to ground plane.
 C_C = 100 pF chip.
 C_X = 100 pF chip capacitor and 10 μ F 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

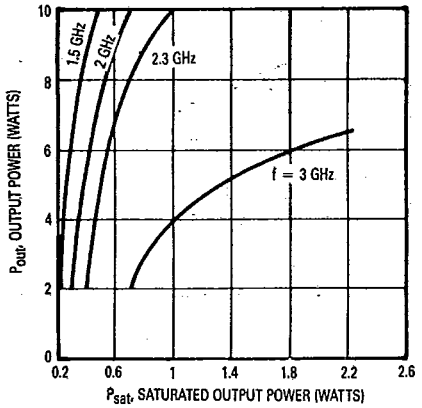


Figure 9. Output Power versus Input Power

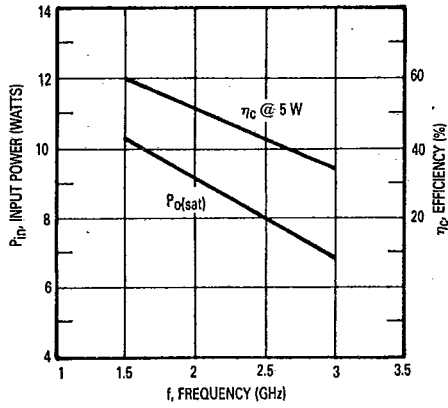


Figure 10. P_{sat} and η versus Frequency

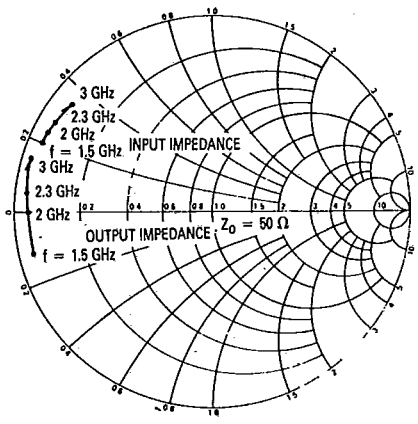
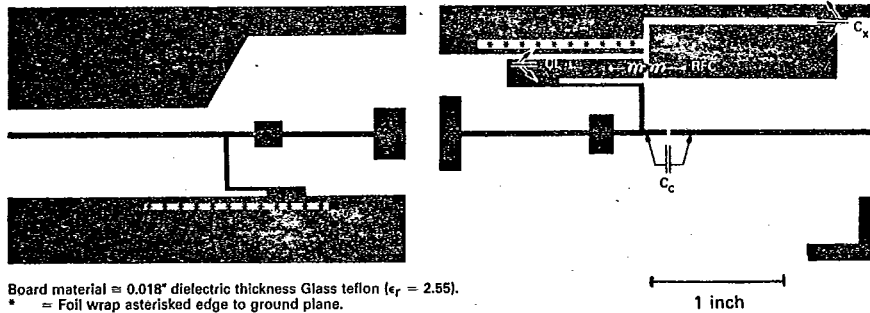


Figure 11. Series Equivalent Input/Output Impedance

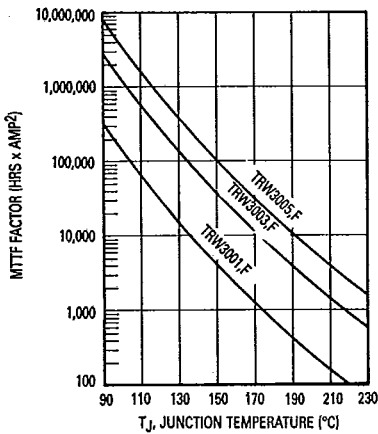
T-33-01



Board material = 0.018" dielectric thickness Glass teflon ($\epsilon_r = 2.55$).
 * = Foil wrap asterisked edge to ground plane.
 Cc = 100 pF chip.
 Cx = 100 pF chip capacitor and 10 μ F electrolytic.
 CL = 100 pF chip capacitor. The capacitor position can be tuned.
 RfC = 8 turns #28 AWG, 0.010 dia.

Figure 12. PC Board Layout
 (Not to Scale)

2



MTTF Factor
 (Normalized to 1 ampere² Continuous Duty)
 The graph shown displays MTF in hours x ampere² emitter current for each of the 3 GHz devices. Life tests at elevated temperatures have correlated to better than $\pm 10\%$ to the theoretical prediction for metal failure. **CAUTION** — A calculation is required to obtain actual metal life. Sample MTF 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:

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

Figure 13. MTF Factor versus Junction Temperature