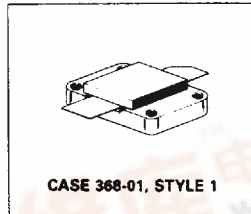


MOTOROLA SEMICONDUCTOR TECHNICAL DATA

**The RF Line
NPN Silicon
RF Power Transistor**



**600 WATTS (LINEAR)
30 MHz
RF POWER TRANSISTOR
NPN SILICON**



... designed primarily for high-voltage applications as a high-power linear amplifier from 2 to 30 MHz. Ideal for marine and base station equipment.

- Specified 50 Volt, 30 MHz Characteristics
Output Power = 600 W
Minimum Gain = 10 dB
Efficiency = 40%
- Intermodulation Distortion @ 600 W(PEP) — IMD = -30 dB
- Diffused Emitter Resistors for Superior Ruggedness
- Low Thermal Resistance

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V _{CEO}	50	Vdc
Collector-Base Voltage	V _{CB0}	110	Vdc
Emitter-Base Voltage	V _{EBO}	4	Vdc
Collector Current — Continuous	I _C	60	Adc
Operating Junction Temperature	T _J	200	°C
Total Device Dissipation @ T _C = 25°C Derate Above 25°C	P _D	875 5	Watts W/°C
Storage Temperature Range	T _{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _{θJC}	0.20	°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 = 500 mAdc, I _B = 0)	V _{(BR)CEO}	50	—	—	Vdc
Collector-Emitter Breakdown Voltage (I _C = 200 mAdc, V _{BE} = 0)	V _{(BR)CES}	110	—	—	Vdc
Emitter-Base Breakdown Voltage (I _E = 20 mAdc, I _C = 0)	V _{(BR)EBO}	4	—	—	Vdc

ON CHARACTERISTICS

DC Current Gain (I _C = 20 Adc, V _{CE} = 10 Vdc)	h _{FE}	10	30	80	—
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(continued)

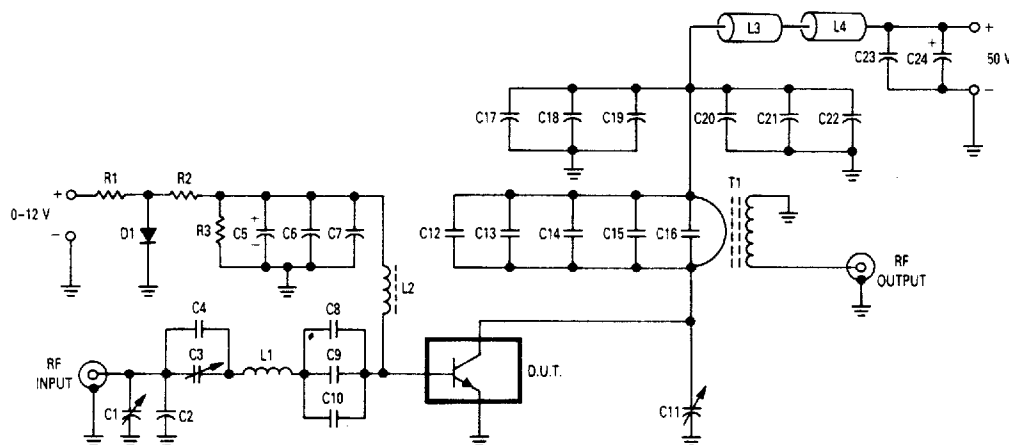


ELECTRICAL CHARACTERISTICS — continued ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
DYNAMIC CHARACTERISTICS					
Output Capacitance ($V_{CB} = 50 \text{ Vdc}$, $I_E = 0$, $f = 1 \text{ MHz}$)	C_{ob}	—	900	1200	pF
FUNCTIONAL TEST					
Common-Emitter Amplifier Power Gain ($V_{CC} = 50 \text{ Vdc}$, $P_{out} = 600 \text{ W (CW)}$, $f = 30 \text{ MHz}$, $I_{CQ} = 600 \text{ mA}$)	G_{PE}	10	13	—	dB
Collector Efficiency ($V_{CC} = 50 \text{ Vdc}$, $P_{out} = 600 \text{ W}$, $f = 30 \text{ MHz}$, $I_{CQ} = 600 \text{ mA}$)	(PEP)	—	40	—	%
	(CW)	—	60	—	%
Intermodulation Distortion (1) ($V_{CE} = 50 \text{ Vdc}$, $P_{out} = 600 \text{ W (PEP)}$, $I_{CQ} = 600 \text{ mA}$, $f = 30 \text{ MHz}$)	IMD	—	-30	—	dB

(1) To Mil Std 1311 Version A, Test Method 2204B, Two Tone, Reference Each Tone.

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C1, C3, C11 — Arco 469 or equivalent
 C2 — 820 pF
 C4 — 330 pF
 C5 — 1000 $\mu\text{F}/3 \text{ V}$ Electrolytic
 C6, C8, C9, C10, C17, C18, C19 — 0.1 μF
 C7, C22, C23 — 0.47 μF , RMC Type 2225C or equivalent
 C12, C13, C14 — 470 pF
 C15 — 1000 pF
 C16 — Two Unencapsulated 1000 pF Mica in Series
 C20, C21 — 0.039 μF
 C24 — 10 $\mu\text{F}/100 \text{ V}$ Electrolytic
 D1 — 1N4997 or equivalent
 R1 — 10 Ohms/10 W
 R2 — 0.1 Ohm/1/2 W
 R3 — 2.7 Ohms/2 W

L1 — 2 Turns #14 AWG, 1/2" ID, 1/2" Long
 L2 — Ohmite Z-235 or equivalent
 L3, L4 — Ferrite Beads, Fair-Rite Products Corp. #2673000801 or equivalent
 T1 — RF Transformer, 1:25 Impedance Ratio. See Motorola Application Note AN749, Figure 4 for details. Ferrite Material: 2 Each, Fair-Rite Product Corp. #2667540001 or equivalent
 All capacitors ATC type 100/200 chips or equivalent, unless otherwise noted.

Figure 1. 30 MHz Test Circuit Schematic

TYPICAL CHARACTERISTICS
MOTOROLA SC (XSTRS/R F) T-33-15

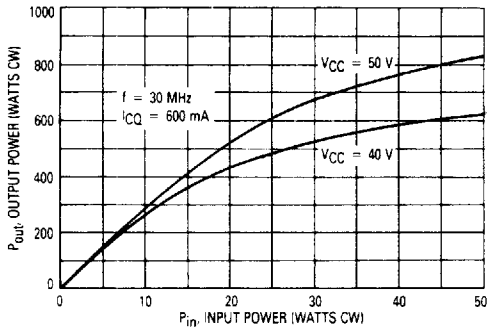


Figure 2. Output Power versus Input Power

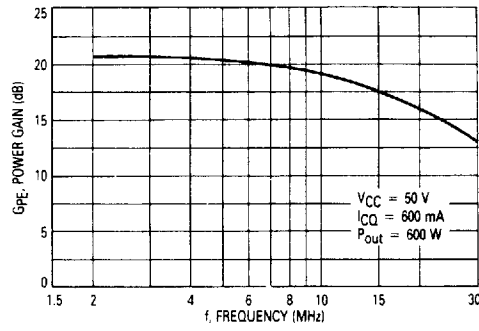


Figure 3. Power Gain versus Frequency

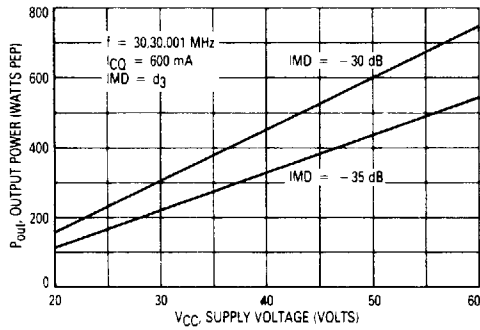


Figure 4. Output Power versus Supply Voltage

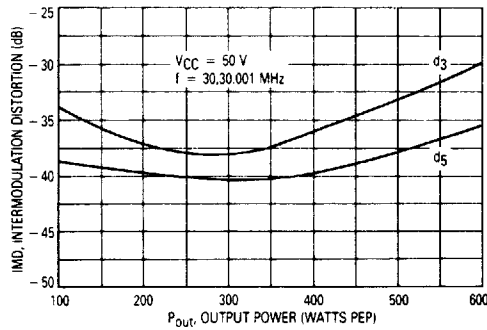


Figure 5. IMD versus Output Power

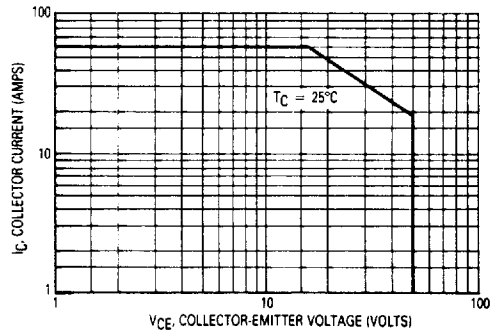


Figure 6. DC Safe Operating Area

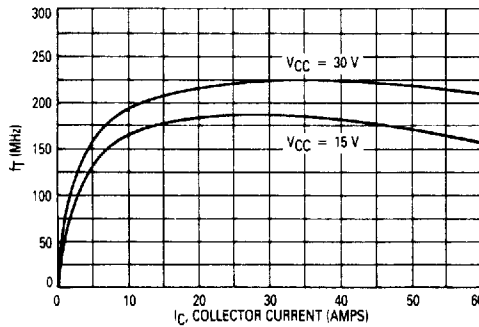


Figure 7. f_T versus Collector Current

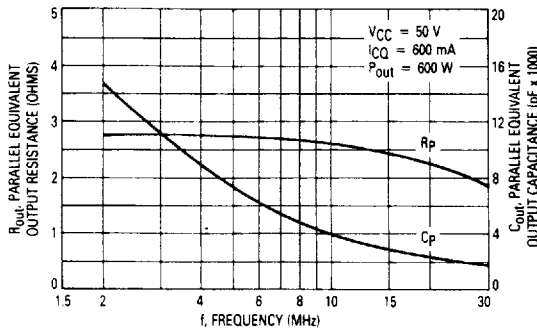


Figure 8. Output Resistance and Capacitance versus Frequency

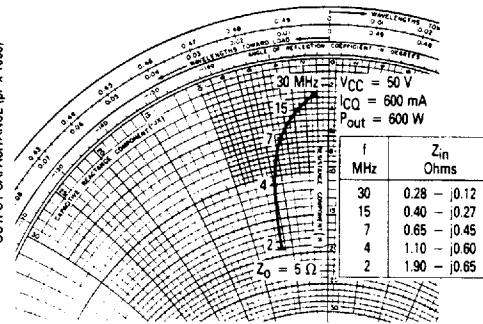


Figure 9. Series Equivalent Input Impedance

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MOUNTING OF HIGH POWER RF POWER TRANSISTORS

The package of this device is designed for conduction cooling. It is extremely important to minimize the thermal resistance between the device flange and the heat dissipator.

Since the device mounting flange is made of soft copper, it may be deformed during various stages of handling or during transportation. It is recommended that the user makes a final inspection on this before the device installation. ±0.0005" is considered sufficient for the flange bottom.

The same applies to the heat dissipator in the device mounting area. If copper heatsink is not used, a copper head spreader is strongly recommended between the device mounting surfaces and the main heatsink. It should be at least 1/4" thick and extend at least one inch from the flange edges. A thin layer of thermal compound in all interfaces is, of course, essential. The recommended torque on the 4-40 mounting screws should be in the area of 4-5 lbs.-inch, and spring type lock washers along with flat washers are recommended.

For die temperature calculations, the Δ temperature from a corner mounting screw area to the bottom center

of the flange is approximately 5°C and 10°C under normal operating conditions (dissipation 150 W and 300 W respectively).

The main heat dissipator must be sufficiently large and have low R_θ for moderate air velocity, unless liquid cooling is employed.

CIRCUIT CONSIDERATIONS

At high power levels (500 W and up), the circuit layout becomes critical due to the low impedance levels and high RF currents associated with the output matching. Some of the components, such as capacitors and inductors must also withstand these currents. The component losses are directly proportional to the operating frequency. The manufacturers specifications on capacitor ratings should be consulted on these aspects prior to design.

Push-pull circuits are less critical in general, since the ground referenced RF loops are practically eliminated, and the impedance levels are higher for a given power output. High power broadband transformers are also easier to design than comparable LC matching networks.