The RF Line

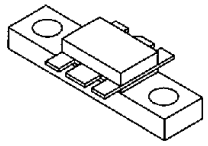
# UHF Linear Power Transistor

. . . designed for 24 Volt UHF large–signal common emitter amplifier applications in industrial and commercial FM equipment operating in the 380 to 512 MHz frequency range, i.e., cellular radio base stations.

- 380–512 MHz
- 15 W — $P_{out}$
- 24 V — $V_{CC}$
- High Gain — 11 dB Min, Class AB
- Gold Metallization for Reliability

**TP5015**

**15 W, 380–512 MHz
UHF LINEAR
POWER TRANSISTOR
NPN SILICON**



**CASE 319–07, STYLE 2
(EB)**

## MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Emitter–Base Voltage | $V_{EBO}$ | 4.0 | Vdc |
| Total Device Dissipation @ $T_C$ = 70°C<br>Derate above 70°C | $P_D$ | 18<br>0.143 | Watts<br>W/°C |
| 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 ($T_C$ = 70°C) | $R_{\theta JC}$ | 7.0 | °C/W |

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Emitter–Base Breakdown Voltage<br>($I_E$ = 5.0 mA, $I_C$ = 0) | $V_{(BR)EBO}$ | 4.0 | — | — | Vdc |
| Collector–Emitter Breakdown Voltage<br>($I_C$ = 10 mA, $R_{BE}$ = 75 Ω) | $V_{(BR)CER}$ | 40 | — | — | Vdc |
| Collector–Emitter Leakage<br>($V_{CE}$ = 26 V, $R_{BE}$ = 75 Ω) | $I_{CER}$ | — | — | 10 | mAdc |
| **ON CHARACTERISTICS** | | | | | |
| DC Current Gain<br>($I_C$ = 100 mA, $V_{CE}$ = 10 V) | $h_{FE}$ | 15 | — | 100 | — |
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Output Capacitance<br>($V_{CB}$ = 24 V, $I_E$ = 0, f = 1.0 MHz) | $C_{ob}$ | — | 16 | 25 | pF |
| **FUNCTIONAL TESTS** | | | | | |
| Common–Emitter Amplifier Power Gain<br>($V_{CE}$ = 24 V, $P_{out}$ = 15 W, f = 470 MHz, $I_Q$ = 50 mA) | $G_{PE}$ | 11 | — | — | dB |
| Collector Efficiency<br>($V_{CE}$ = 24 V, $P_{out}$ = 15 W, f = 470 MHz, $I_Q$ = 50 mA) | $\eta_c$ | 50 | 60 | — | % |

REV 6

## The RF Line

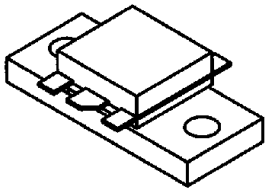
# NPN Silicon RF Power Transistor

**TP5051**

**50/60 W, 470 MHz**
**RF POWER TRANSISTOR**
**NPN SILICON**

The TP5051 is designed for 470 MHz cellular radio base stations in both analog and digital applications. It incorporates high value emitter ballast resistors, gold metallizations and offers a high degree of reliability and ruggedness.

- Specified 470 MHz Characteristics
  - Output Power — 50 Watts @ 24 Volts, 60 Watts @ 26 Volts
  - Gain — 9 dB min
  - Efficiency — 60% min
  - Class AB or C Operation
- Circuit board photomaster available upon request by contacting RF Tactical Marketing in Phoenix, AZ.



**CASE 333A–02, STYLE 2**

### MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector–Emitter Voltage | $V_{CER}$ | 40 | Vdc |
| Collector–Base Voltage | $V_{CBO}$ | 48 | Vdc |
| Emitter–Base Voltage | $V_{EBO}$ | 4 | Vdc |
| Collector–Current — Continuous | $I_C$ | 10 | Adc |
| Total Device Dissipation @ $T_C$ = 25°C<br>Derate above 25°C | $P_D$ | 145<br>0.8 | Watts<br>W/°C |
| Storage Temperature Range | $T_{stg}$ | – 65 to +150 | °C |
| Operating Junction Temperature | $T_J$ | 200 | °C |

### THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Case at 70°C Case (1) | $R_{\theta JC}$ | 1.2 | °C/W |

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

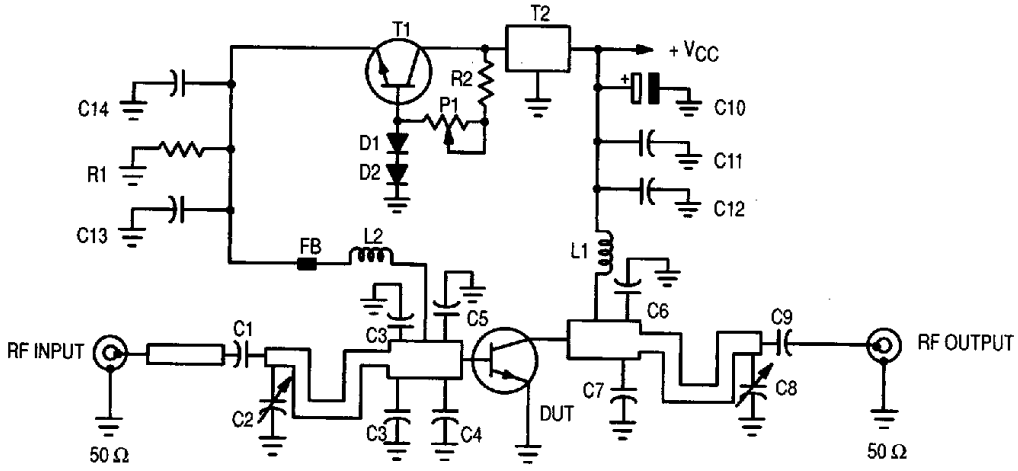
| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Collector–Emitter Breakdown Voltage<br>($I_C$ = 60 mA, $R_{BE}$ = 75 Ω) | $V_{(BR)CER}$ | 40 | — | — | Vdc |
| Emitter–Base Breakdown Voltage<br>($I_E$ = 15 mAdc) | $V_{(BR)EBO}$ | 4 | — | — | Vdc |
| Collector–Base Breakdown Voltage<br>($I_C$ = 50 mAdc) | $V_{(BR)CBO}$ | 48 | — | — | Vdc |
| Collector–Emitter Leakage<br>($V_{CE}$ = 26 V, $R_{BE}$ = 75 Ω) | $I_{CER}$ | — | — | 15 | mA |
| **ON CHARACTERISTICS** | | | | | |
| DC Current Gain<br>($I_C$ = 1 Adc, $V_{CE}$ = 10 Vdc) | $h_{FE}$ | 15 | — | 80 | — |

(continued)

NOTE:
1. Thermal resistance is determined under specified RF operating condition.

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Output Capacitance ($V_{CB}$ = 26 V, $I_E$ = 0, f = 1 MHz ) | $C_{ob}$ | — | 60 | — | pF |
| **FUNCTIONAL TESTS** | | | | | |
| Common–Emitter Amplifier Power Gain ($V_{CC}$ = 24 V, $P_{out}$ = 50 W, $I_{CQ}$ = 150 mA, f = 470 MHz) | $G_{p1}$ | 9 | 10 | — | dB |
| Collector Efficiency ($V_{CC}$ = 24 V, $P_{out}$ = 50 W, f = 470 MHz) | $\eta 1$ | 60 | 65 | — | % |
| Load Mismatch ($V_{CC}$ = 24 V, $P_{out}$ = 50 W, $I_{CQ}$ = 150 mA Load VSWR = 5:1, all phase angles at frequency of test) | $\psi 1$ | No Degradation in Output Power | | | |
| Overdrive ($V_{CC}$ = 24 V, $P_{in}$ = 12 W, f = 470 MHz) | OD | No Degradation in Output Power | | | |
| Power Saturation ($V_{CC}$ = 24 V, f = 470 MHz) | $P_{sat}$ | 65 | — | — | W |
| Common–Emitter Amplifier Power Gain ($V_{CC}$ = 26 V, $P_{out}$ = 60 W, $I_{CQ}$ = 150 mA, f = 470 MHz) | $G_{p2}$ | 9 | 10 | — | dB |
| Collector Efficiency ($V_{CC}$ = 26 V, $P_{out}$ = 60 W, f = 470 MHz) | $\eta 2$ | 60 | 65 | — | % |
| Load Mismatch ($V_{CC}$ = 26 V, $P_{out}$ = 60 W, $I_{CQ}$ = 150 mA Load VSWR = 5:1, all phase angles at frequency of test) | $\psi 2$ | No Degradation in Output Power | | | |

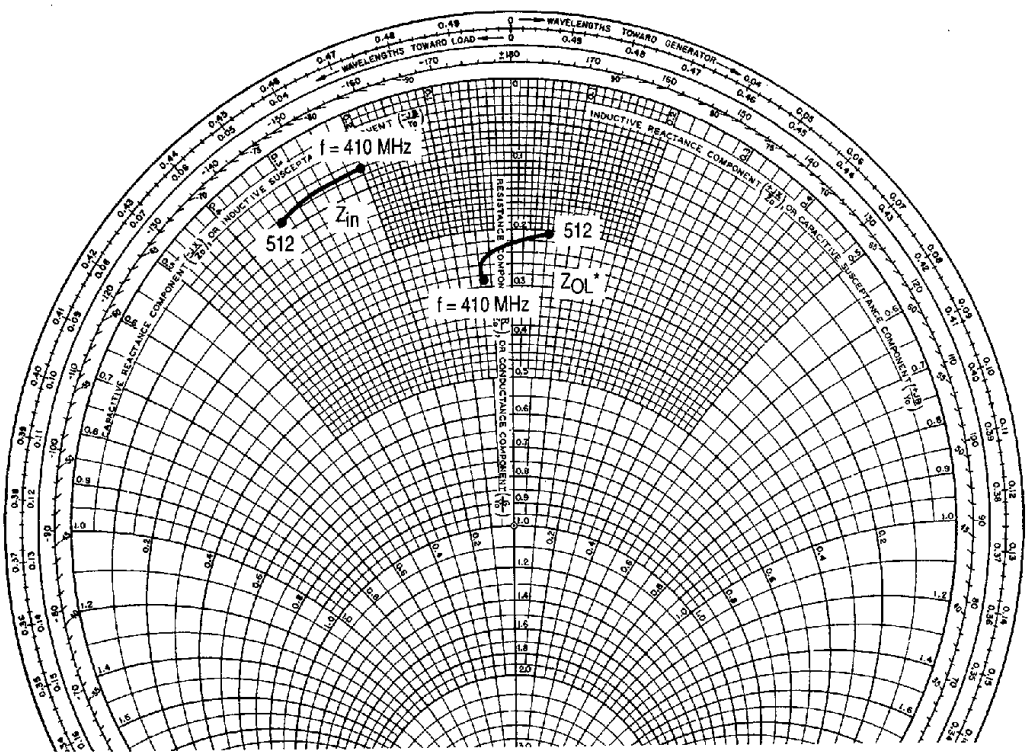



EPOXY GLASS 1/16 INCH $\epsilon r$ = 4.5

**Components List**

| | |
|---|---|
| C1,C9, | 330 pF, 5%, Chip Capacitor 0805 |
| C2,C8 | AIRTRONIC Trimmer Capacitor 5400 |
| C3 | 10 pF, ATC Chip Capacitor |
| C3′ | 12 pF, ATC Chip Capacitor |
| C4,C5 | 22 pF, ATC Chip Capacitor |
| C6 | 15 pF, ATC Chip Capacitor |
| C7 | 18 pF, ATC Chip Capacitor |
| C10 | 47 µF, 63 V, Electrolytic Capacitor |
| C11,C14 | 15 nF, Chip Capacitor 0805 |
| C12,C13 | 330 pF, 5%, Chip Capacitor 0805 |
| D1,D2 | Diode, 1N4148 |
| FB | Ferrite Board |
| L1,L2 | 6 Turns, #18 AWG ϕ 4 mm Choke |
| P1 | 1 kΩ, Trimmer |
| R1 | 56 Ω, 5%, Chip Resistor 1205 |
| R2 | 470 Ω, 5%, Chip Resistor 0805 |
| T1 | SMD Transistor, MJD31C or Similiar |
| T2 | Voltage Regulator 7805 |

**Figure 1. 470 MHz Electrical Schematic**




$P_{out}$ = 50 W, $V_{CE}$ = 24 V

| f (MHz) | $Z_{in}$ (Ω) | $Z_{OL}^*$ (Ω) |
|---|---|---|
| 512 | 1 – j3.2 | 2 – j0.7 |
| 490 | 0.97 – j2.8 | 2.2 – j0.5 |
| 470 | 0.9 – j2.7 | 2.4 + j0.13 |
| 450 | 0.85 – j2.5 | 2.6 + j0.9 |
| 410 | 0.8 – j2.1 | 3 + j0.5 |

**Figure 2. Series Equivalent Input and Output Impedances**

## TYPICAL CHARACTERISTICS

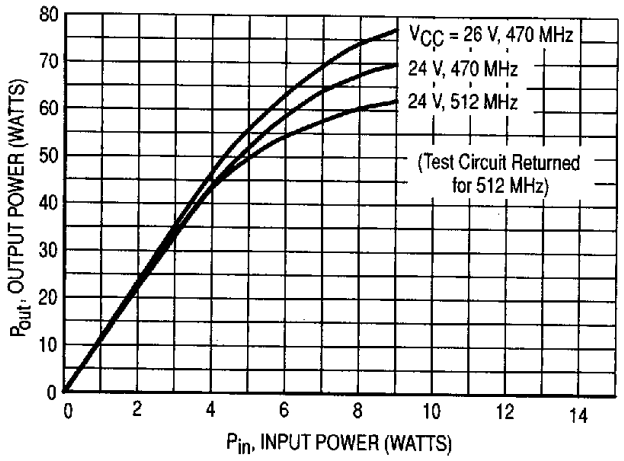



**Figure 3. Output Power versus Input Power**

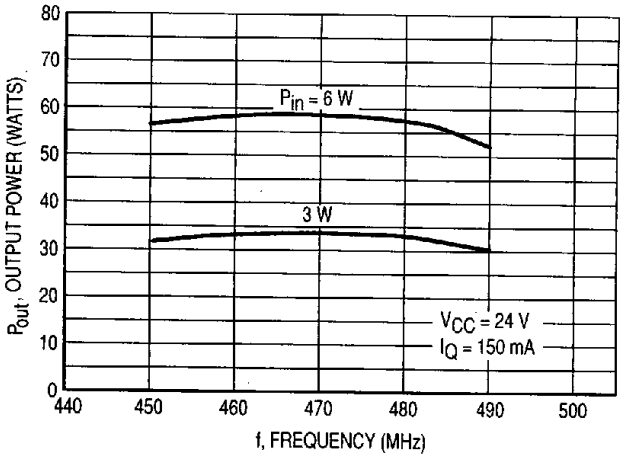



**Figure 4. Output Power versus Frequency**

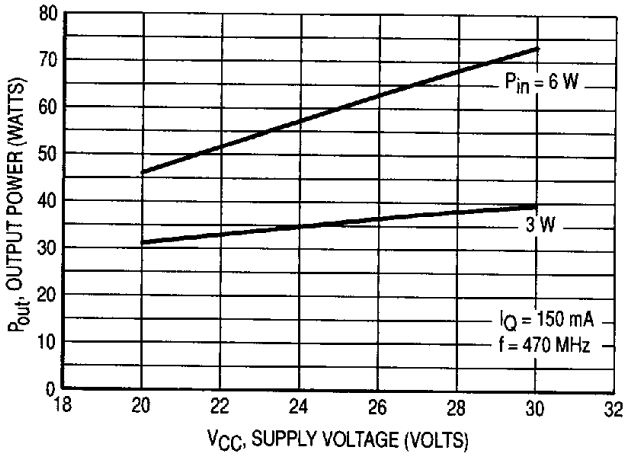



**Figure 5. Output Power versus Supply Voltage**

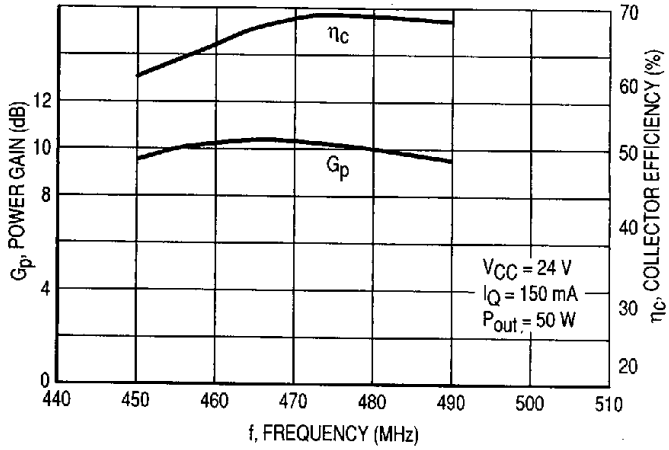
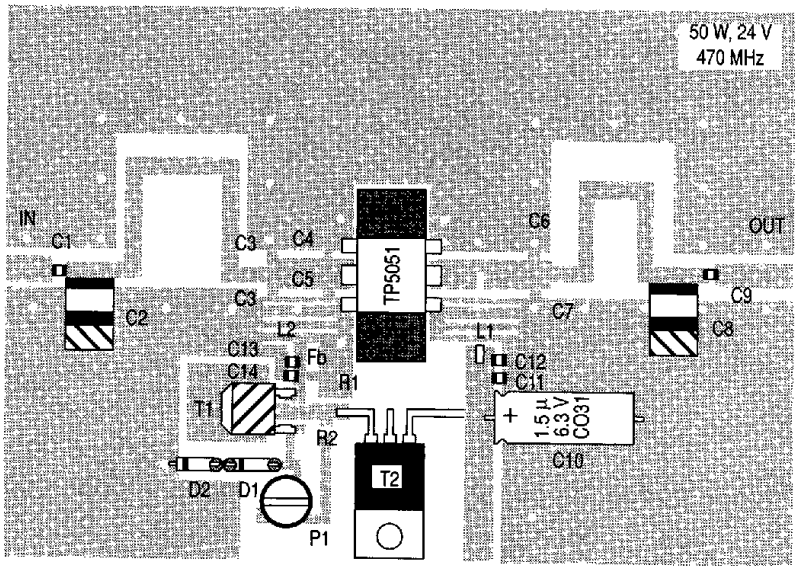



**Figure 6. Power Gain, Collector Efficiency versus Frequency**




EPOXY GLASS 1/16 INCH $\varepsilon_r$ = 4.5

**Figure 7. 470 MHz Test Circuit Components View**