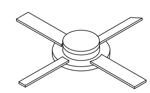
## The RF Line
# Microwave Linear Power Transistors

# MRW54001

. . . designed primarily for large–signal output and driver amplifier stages in the 1.0 to 4.0 GHz frequency range.

- Designed for Class A or AB, Common–Emitter Linear Power Amplifiers
- Specified 20 Volt, 2.0 GHz Characteristics:
  Output Power — 0.5 Watt
  Power Gain — 10 to 11 dB
- 100% Tested for Load Mismatch at All Phase Angles with ∞:1 VSWR
- Gold Metallization for Improved Reliability
- Diffused Ballast Resistors

**10 – 11 dB**
**1.0 – 4.0 GHz**
**0.5 WATT**
**MICROWAVE LINEAR**
**POWER TRANSISTORS**



**CASE 400–01, STYLE 1**
**(TW200)**

**MAXIMUM RATINGS**

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector–Emitter Voltage | $V_{CEO}$ | 22 | Vdc |
| Collector–Base Voltage | $V_{CES}$ | 50 | 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 | $R_{\theta JC}$ | 40 | °C/W |

**ELECTRICAL CHARACTERISTICS**

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Collector–Emitter Breakdown Voltage ($I_C$ = 10 mA, $I_B$ = 0) | $V_{(BR)CEO}$ | 22 | — | — | Vdc |
| Collector–Emitter Breakdown Voltage ($I_C$ = 10 mA, $V_{BE}$ = 0) | $V_{(BR)CES}$ | 50 | — | — | Vdc |
| Collector–Base Breakdown Voltage ($I_C$ = 1.0 mA, $I_E$ = 0) | $V_{(BR)CBO}$ | 45 | — | — | Vdc |
| Emitter–Base Breakdown Voltage ($I_E$ = 0.25 mA, $I_C$ = 0) | $V_{(BR)EBO}$ | 3.5 | — | — | Vdc |
| Collector Cutoff Current ($V_{CB}$ = 28 V, $I_E$ = 0) | $I_{CBO}$ | — | — | 0.25 | mAdc |
| **ON CHARACTERISTICS** | | | | | |
| DC Current Gain ($I_C$ = 100 mA, $V_{CE}$ = 5.0 V) | $h_{FE}$ | 20 | — | 120 | — |
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Output Capacitance ($V_{CB}$ = 28 V, $I_E$ = 0, f = 1.0 MHz) | $C_{ob}$ | — | — | 3.5 | pF |

(continued)

**ELECTRICAL CHARACTERISTICS — continued**

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **FUNCTIONAL TESTS** | | | | | |
| Common–Emitter Amplifier Power Gain ($V_{CE}$ = 20 V, $P_{out}$ = 0.5 W, f = 2.0 GHz, $I_E$ = 120 mA) | $G_{PE}$ | 10 | — | — | dB |
| Load Mismatch ($V_{CE}$ = 20 V, $I_E$ = 120 mA, $P_{out}$ = 0.5 W, f = 2.0 GHz, Load VSWR = ∞:1, All Phase Angles) | ψ | No Degradation in Output Power | | | |
| Cutoff Frequency ($V_{CE}$ = 20 V, $I_E$ = 120 mA) | $f_\tau$ | 4.0 | 4.5 | — | GHz |
| Gain Linearity ($V_{CE}$ = 20 V, $I_E$ = 120 mA, f = 2.0 GHz, $P_{o1}$ = 0.5 W, $P_{o2}$ = 0.5 mW) | $L_G$ | —<br>— | —<br>— | –0.2<br>+1.0 | dB |
| Intermodulation Distortion, 3rd Order ($V_{CE}$ = 20 V, $I_E$ = 120 mA, $P_o$ (PEP) = 0.5 W, Tones at 2.0 GHz and 2.005 GHz) | IMD | — | –30 | — | dB |

## TYPICAL CHARACTERISTICS

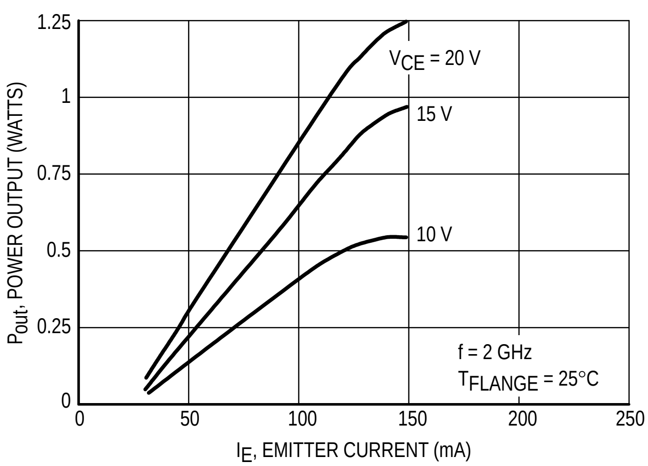



**Figure 1. 1.0 dB Compression Point versus Emitter Current**

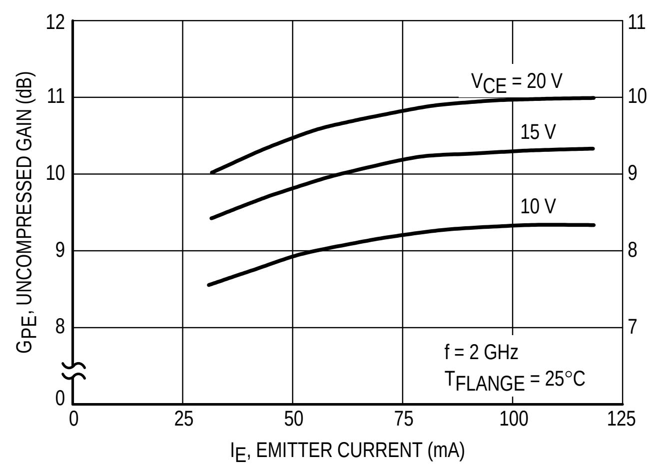



**Figure 2. Gain versus Emitter Current**

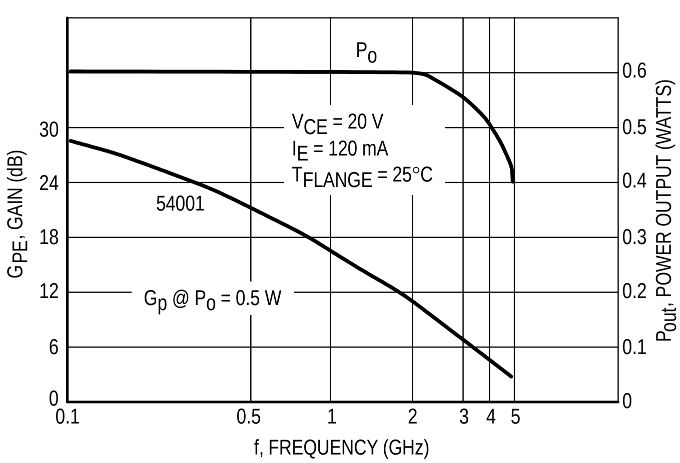



**Figure 3. Gain and 1.0 dB Compressed Power versus Frequency**

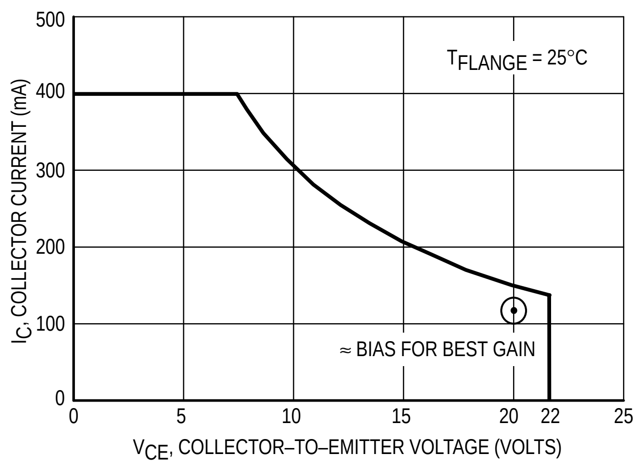



**Figure 4. DC Safe Operating Area**

| $V_{CE}$ (Volts) | $I_C$ (mA) | f (GHz) | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Mag** | ∠ φ | **Mag** | ∠ φ | **Mag** | ∠ φ | **Mag** | ∠ φ |
| 20 | 100 | 0.5 | 0.76 | –177 | 6.65 | 74 | 0.03 | 20 | 0.43 | –73 |
| | | 1.0 | 0.76 | 159 | 3.24 | 39 | 0.03 | 24 | 0.50 | –104 |
| | | 1.3 | 0.76 | 148 | 2.46 | 21 | 0.04 | 25 | 0.56 | –120 |
| | | 1.5 | 0.75 | 141 | 2.07 | 9.0 | 0.04 | 24 | 0.60 | –130 |
| | | 1.7 | 0.76 | 134 | 1.80 | –1.0 | 0.05 | 24 | 0.64 | –140 |
| | | 2.0 | 0.76 | 124 | 1.51 | –14 | 0.06 | 22 | 0.68 | –152 |
| | | 2.3 | 0.74 | 113 | 1.27 | –33 | 0.06 | 13 | 0.74 | –167 |
| | | 2.5 | 0.73 | 106 | 1.15 | –43 | 0.07 | 9.0 | 0.76 | –173 |
| | | 2.7 | 0.72 | 98 | 1.06 | –52 | 0.07 | 5.0 | 0.77 | 179 |
| | | 32 | 0.69 | 85 | 0.95 | –67 | 0.08 | –4.0 | 0.82 | 170 |
| | | 3.3 | 0.64 | 71 | 0.86 | –81 | 0.09 | –14 | 0.85 | 161 |
| | | 3.5 | 0.61 | 60 | 0.81 | –94 | 0.10 | –22 | 0.87 | 155 |
| | | 3.7 | 0.57 | 47 | 0.77 | –103 | 0.10 | –30 | 0.80 | 149 |
| | | 4.0 | 0.51 | 24 | 0.70 | –119 | 0.11 | –44 | 0.92 | 141 |

**Table 1. MRW54001 Common Emitter S–Parameters**

The graph shown below displays MTTF in hours x ampere$^2$ emitter current for each of the devices. Life tests at elevated temperatures have correlated to better than ±10% to the theoretical prediction for metal failure. Divide MTTF by $I_C{}^2$ for MTTF in a particular application.

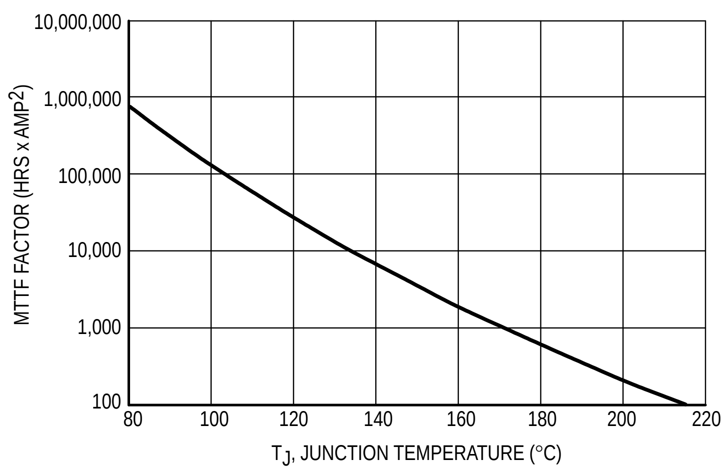
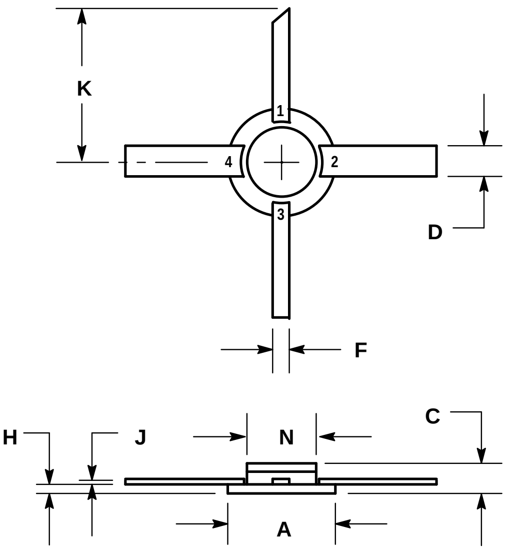



**Figure 5. MTTF Factor versus Junction Temperature**

## PACKAGE DIMENSIONS




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

| DIM | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 0.203 | 0.207 | 5.16 | 5.25 |
| C | 0.049 | 0.065 | 1.25 | 1.65 |
| D | 0.055 | 0.065 | 1.40 | 1.65 |
| F | 0.025 | 0.035 | 0.64 | 0.88 |
| H | 0.017 | 0.023 | 0.44 | 0.58 |
| J | 0.002 | 0.004 | 0.06 | 0.10 |
| K | 0.280 | 0.320 | 7.12 | 8.12 |
| N | 0.123 | 0.133 | 3.13 | 3.37 |

STYLE 1:
PIN 1. COLLECTOR
2. EMITTER
3. BASE
4. EMITTER

**CASE 400–01**
**ISSUE B**



**How to reach us:**
**USA / EUROPE / Locations Not Listed**: Motorola Literature Distribution; P.O. Box 5405, Denver, Colorado 80217. 303–675–2140 or 1–800–441–2447

**Mfax**™: RMFAX0@email.sps.mot.com – TOUCHTONE 602–244–6609
– US & Canada ONLY 1–800–774–1848

**INTERNET**: http://motorola.com/sps

**JAPAN**: Nippon Motorola Ltd.: SPD, Strategic Planning Office, 4–32–1, Nishi–Gotanda, Shinagawa–ku, Tokyo 141, Japan. 81–3–5487–8488

**ASIA / PACIFIC**: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park, 51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852–26629298

**MOTOROLA**