

# The RF Line

## NPN Silicon

## RF Power Transistors

Designed for 12.5 Vdc UHF large-signal, amplifier applications in industrial and commercial FM equipment operating to 512 MHz.

- Guaranteed 12.5 Volt, 512 MHz Characteristics
  - Output Power = 5.0 Watts
  - Minimum Gain = 10 dB
  - Efficiency = 65% (Typ)
- Typical Performance at 512 MHz, 12.5 V, 5.0 W Output = 6.0 dB
- Series Equivalent Large-Signal Characterization
- Gold Metallized, Emitter Ballasted for Long Life and Reliability
- Capable of 30:1 VSWR Load Mismatch at 15.5 V Supply Voltage
- Circuit board photomaster available upon request by contacting RF Tactical Marketing in Phoenix, AZ.

### MAXIMUM RATINGS

| Rating                                                                                 | Symbol    | Value       | Unit                          |
|----------------------------------------------------------------------------------------|-----------|-------------|-------------------------------|
| Collector-Emitter Voltage                                                              | $V_{CEO}$ | 16          | Vdc                           |
| Collector-Base Voltage                                                                 | $V_{CBO}$ | 36          | Vdc                           |
| Emitter-Base Voltage                                                                   | $V_{EBO}$ | 4.0         | Vdc                           |
| Collector Current — Continuous                                                         | $I_C$     | 2.0         | Adc                           |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$     | 25<br>143   | Watts<br>mW/ $^\circ\text{C}$ |
| Storage Temperature Range                                                              | $T_{stg}$ | -65 to +150 | $^\circ\text{C}$              |
| Operating Junction Temperature                                                         | $T_J$     | 200         | $^\circ\text{C}$              |

### THERMAL CHARACTERISTICS

| Characteristic                       | Symbol          | Max | Unit               |
|--------------------------------------|-----------------|-----|--------------------|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 7.0 | $^\circ\text{C/W}$ |

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                                                                  |               |     |   |     |      |
|----------------------------------------------------------------------------------|---------------|-----|---|-----|------|
| Collector-Emitter Breakdown Voltage<br>( $I_C = 25\text{ mAdc}$ , $I_B = 0$ )    | $V_{(BR)CEO}$ | 16  | — | —   | Vdc  |
| Collector-Emitter Breakdown Voltage<br>( $I_C = 25\text{ mAdc}$ , $V_{BE} = 0$ ) | $V_{(BR)CES}$ | 36  | — | —   | Vdc  |
| Collector-Base Breakdown Voltage<br>( $I_C = 25\text{ mAdc}$ , $I_E = 0$ )       | $V_{(BR)CBO}$ | 36  | — | —   | Vdc  |
| Emitter-Base Breakdown Voltage<br>( $I_E = 5.0\text{ mAdc}$ , $I_C = 0$ )        | $V_{(BR)EBO}$ | 4.0 | — | —   | Vdc  |
| Collector Cutoff Current<br>( $V_{CE} = 15\text{ Vdc}$ , $V_{BE} = 0$ )          | $I_{CES}$     | —   | — | 1.0 | mAdc |

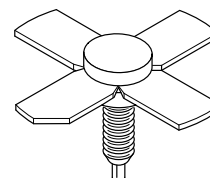
### ON CHARACTERISTICS

|                                                                            |          |    |   |     |   |
|----------------------------------------------------------------------------|----------|----|---|-----|---|
| DC Current Gain<br>( $I_C = 200\text{ mAdc}$ , $V_{CE} = 5.0\text{ Vdc}$ ) | $h_{FE}$ | 10 | — | 150 | — |
|----------------------------------------------------------------------------|----------|----|---|-----|---|

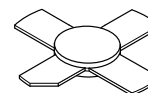
(continued)

**MRF652**  
**MRF652S**

5.0 W, 512 MHz  
RF POWER  
TRANSISTORS  
NPN SILICON



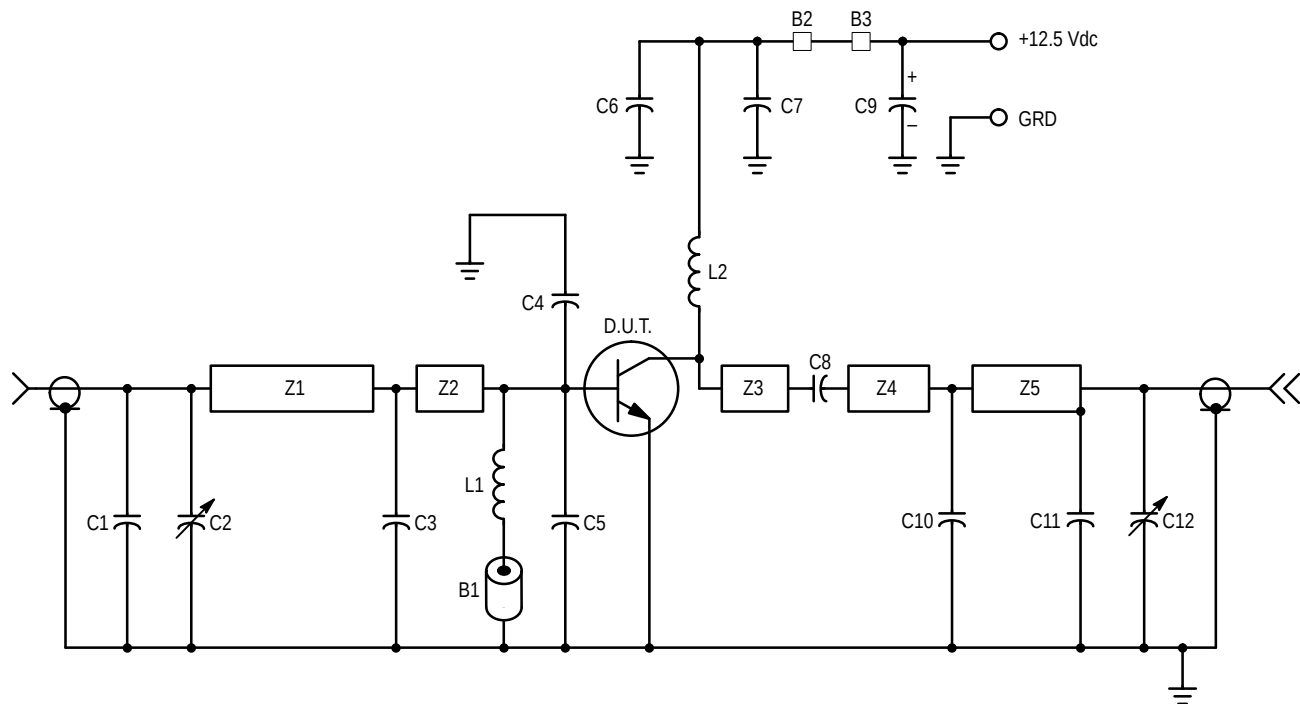
CASE 244-04, STYLE 1  
MRF652



CASE 249-06, STYLE 1  
MRF652S

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

| Characteristic                                                                                                                         | Symbol   | Min                            | Typ       | Max    | Unit |
|----------------------------------------------------------------------------------------------------------------------------------------|----------|--------------------------------|-----------|--------|------|
| <b>DYNAMIC CHARACTERISTICS</b>                                                                                                         |          |                                |           |        |      |
| Output Capacitance ( $V_{CB} = 15\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )                                                     | $C_{ob}$ | —                              | 9.5       | 15     | pF   |
| <b>FUNCTIONAL TESTS</b>                                                                                                                |          |                                |           |        |      |
| Common-Emitter Amplifier Power Gain<br>( $V_{CC} = 12.5\text{ Vdc}$ , $P_{out} = 5.0\text{ W}$ )                                       | $G_{pe}$ | 10<br>—                        | 11<br>6.0 | —<br>— | dB   |
| Collector Efficiency<br>( $V_{CC} = 12.5\text{ Vdc}$ , $P_{out} = 5.0\text{ W}$ , $f = 512\text{ MHz}$ )                               | $\eta$   | 60                             | 65        | —      | %    |
| Load Mismatch<br>( $V_{CC} = 15.5\text{ Vdc}$ , $P_{in} = 500\text{ mW}$ , $f = 512\text{ MHz}$ ,<br>VSWR = 30:1, At All Phase Angles) | $\psi$   | No Degradation in Output Power |           |        |      |



B1, B2, B3 — Ferrite Bead  
 C1 — 7.0 pF Unelco Mica  
 C2 — 1.0–6.0 pF Johanson Variable 5201  
 C3 — 15 pF Unelco Mica  
 C4 — 43 pF Mini-Underwood Mica  
 C5 — 56 pF Mini-Underwood Mica  
 C6 — 1000 pF Unelco Mica  
 C7 — 0.1  $\mu\text{F}$  Ceramic

C8 — 68 pF Mini-Underwood Mica  
 C9 — 1.0  $\mu\text{F}$  Electrolytic 25 V  
 C10, C11 — 5.0 pF Unelco Mica  
 C12 — 1.0–10 pF Johanson Variable 5501  
 L1, L2 — 6 Turns, 20 AWG Wire 0.125" ID  
 Z1, Z2 — 25 Ohm  $\mu\text{Stripline}$   
 Z3, Z4, Z5 — 50 Ohm  $\mu\text{Stripline}$   
 Board — 0.032" Glass-Teflon

**Figure 1. 440–512 MHz Broadband Test Circuit**

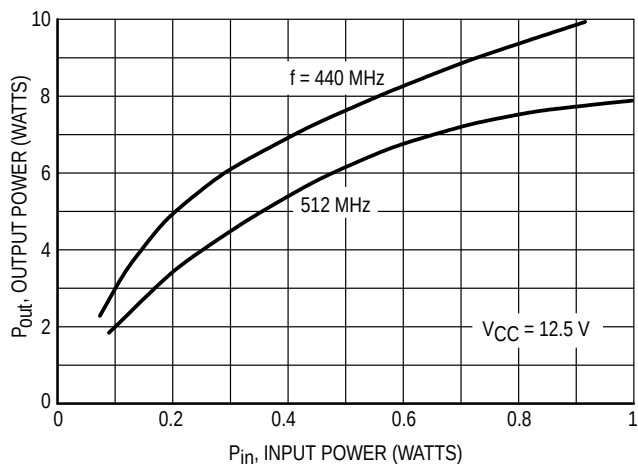


Figure 2. Output Power versus Input Power

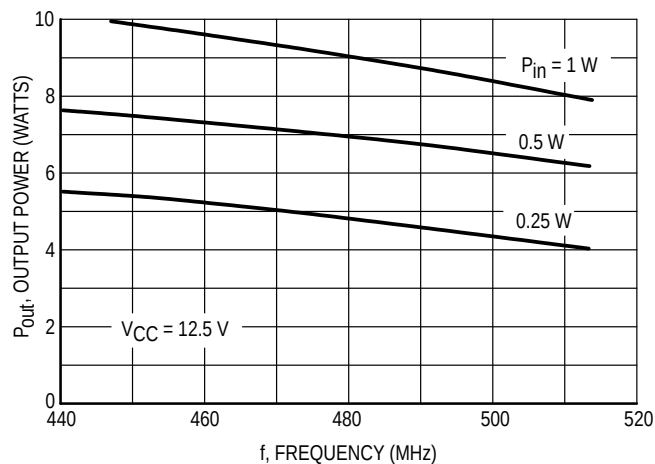


Figure 3. Output Power versus Frequency

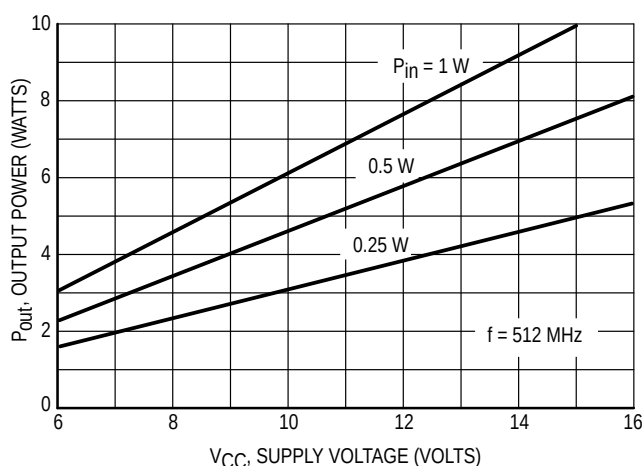


Figure 4. Output Power versus Supply Voltage

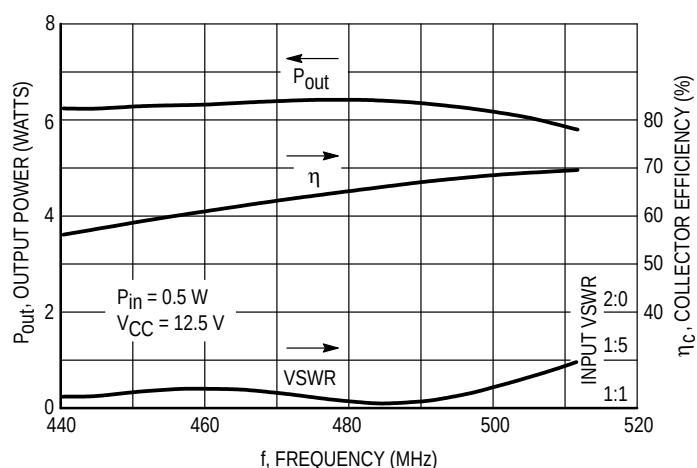
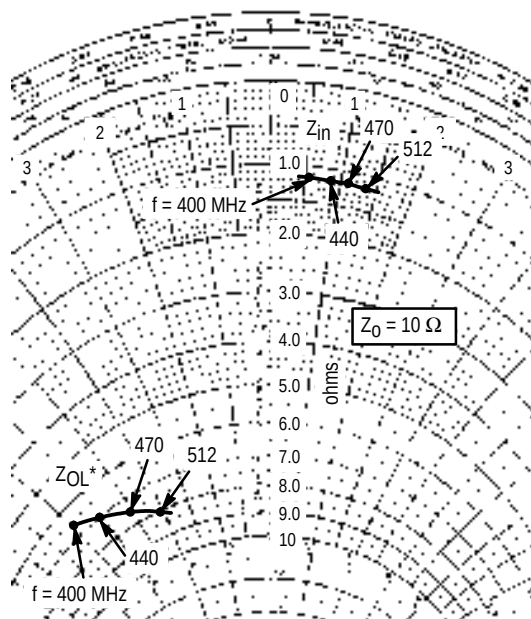


Figure 5. Typical Broadband Circuit Performance



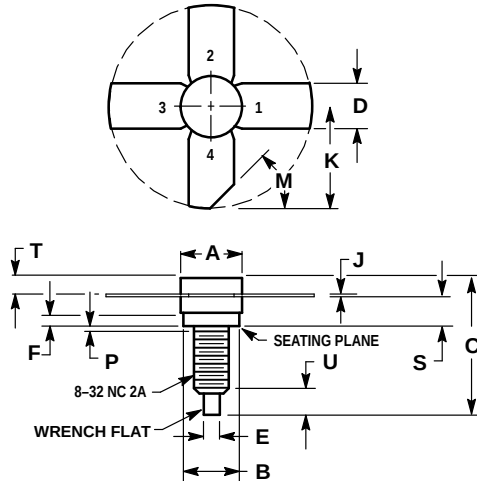
$V_{CC} = 12.5 \text{ Vdc}$   
 $P_{out} = 5.0 \text{ W}$

| f<br>MHz | $Z_{in}$<br>Ohms | $Z_{OL}^*$<br>Ohms |
|----------|------------------|--------------------|
| 400      | $1.18 + j0.54$   | $6.7 - j6.9$       |
| 440      | $1.19 + j0.88$   | $7.05 - j6.1$      |
| 470      | $1.19 + j1.11$   | $7.6 - j5.1$       |
| 512      | $1.19 + j1.35$   | $8.1 - j4.1$       |

$Z_{OL}^*$  = Conjugate of the optimum load impedance into which the device output operates at a given output power, voltage and frequency.

Figure 6. Series Equivalent Input/Output Impedance

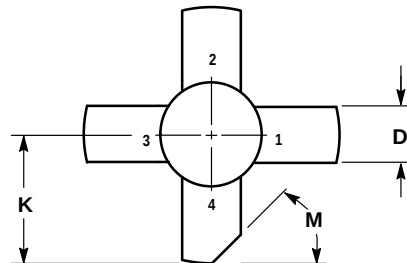
## PACKAGE DIMENSIONS



| DIM | MILLIMETERS |       | INCHES  |       |
|-----|-------------|-------|---------|-------|
|     | MIN         | MAX   | MIN     | MAX   |
| A   | 7.06        | 7.26  | 0.278   | 0.286 |
| B   | 6.20        | 6.50  | 0.244   | 0.256 |
| C   | 14.99       | 16.51 | 0.590   | 0.650 |
| D   | 5.46        | 5.96  | 0.215   | 0.235 |
| E   | 1.40        | 1.65  | 0.055   | 0.065 |
| G   | 1.52        | —     | 0.060   | —     |
| J   | 0.08        | 0.17  | 0.003   | 0.007 |
| K   | 11.05       | —     | 0.435   | —     |
| M   | 45° NOM     |       | 45° NOM |       |
| P   | —           | 1.27  | —       | 0.050 |
| S   | 3.00        | 3.25  | 0.118   | 0.128 |
| T   | 1.40        | 1.77  | 0.055   | 0.070 |
| U   | 2.92        | 3.68  | 0.115   | 0.145 |

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

**CASE 244-04  
ISSUE J  
MRF652**



NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.  
3. SEATING PLANE = GROUND AND IS CONNECTED TO PIN 1 AND 3.

| DIM | INCHES  |       | MILLIMETERS |      |
|-----|---------|-------|-------------|------|
|     | MIN     | MAX   | MIN         | MAX  |
| A   | 0.271   | 0.286 | 6.88        | 7.26 |
| C   | 0.112   | 0.136 | 2.84        | 3.45 |
| D   | 0.215   | 0.235 | 5.46        | 5.97 |
| H   | 0.055   | 0.065 | 1.40        | 1.65 |
| J   | 0.003   | 0.007 | 0.08        | 0.18 |
| K   | 0.435   | —     | 11.05       | —    |
| M   | 45° REF |       | 45° REF     |      |

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

**CASE 249-06  
ISSUE H  
MRF652S**

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MRF652/D

