

# The RF Line

## NPN Silicon

### RF Low Power Transistor

Designed primarily for wideband large signal predriver stages in the VHF frequency range.

- Specified @ 12.5 V, 175 MHz Characteristics
  - Output Power = 1.5 W
  - Minimum Gain = 11.5 dB
  - Efficiency 60% (Typ)
- Cost Effective PowerMacro Package
- Electroless Tin Plated Leads for Improved Solderability
- Circuit board photomaster available upon request by contacting RF Tactical Marketing in Phoenix, AZ.

**MRF553**

**1.5 W, 175 MHz  
RF LOW POWER  
TRANSISTOR  
NPN SILICON**



**CASE 317D-02, STYLE 2**

#### 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                                                                | $I_C$     | 500         | mAdc                          |
| Total Device Dissipation @ $T_C = 75^\circ\text{C}$ (1, 2)<br>Derate above $75^\circ\text{C}$ | $P_D$     | 3.0<br>40   | Watts<br>mW/ $^\circ\text{C}$ |
| Storage Temperature Range                                                                     | $T_{stg}$ | -55 to +150 | $^\circ\text{C}$              |

#### THERMAL CHARACTERISTICS

| Characteristic                      | Symbol          | Max | Unit               |
|-------------------------------------|-----------------|-----|--------------------|
| Thermal Resistance Junction to Case | $R_{\theta JC}$ | 25  | $^\circ\text{C/W}$ |

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

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

#### OFF CHARACTERISTICS

|                                                                                            |               |     |   |     |      |
|--------------------------------------------------------------------------------------------|---------------|-----|---|-----|------|
| Collector-Emitter Breakdown Voltage<br>( $I_C = 10$ mAdc, $I_B = 0$ )                      | $V_{(BR)CEO}$ | 16  | — | —   | Vdc  |
| Collector-Emitter Breakdown Voltage<br>( $I_C = 5.0$ mAdc, $V_{BE} = 0$ )                  | $V_{(BR)CES}$ | 36  | — | —   | Vdc  |
| Collector-Base Breakdown Voltage<br>( $I_C = 5.0$ mAdc, $I_E = 0$ )                        | $V_{(BR)CBO}$ | 36  | — | —   | Vdc  |
| Emitter-Base Breakdown Voltage<br>( $I_E = 1.0$ mAdc, $I_C = 0$ )                          | $V_{(BR)EBO}$ | 4.0 | — | —   | Vdc  |
| Collector Cutoff Current<br>( $V_{CE} = 15$ Vdc, $V_{BE} = 0$ , $T_C = 25^\circ\text{C}$ ) | $I_{CES}$     | —   | — | 5.0 | mAdc |

#### ON CHARACTERISTICS

|                                                            |          |    |   |     |   |
|------------------------------------------------------------|----------|----|---|-----|---|
| DC Current Gain<br>( $I_C = 250$ mAdc, $V_{CE} = 5.0$ Vdc) | $h_{FE}$ | 30 | — | 200 | — |
|------------------------------------------------------------|----------|----|---|-----|---|

#### NOTES:

(continued)

- $T_C$ , Case temperature measured on collector lead immediately adjacent to body of package.
- The MRF553 PowerMacro must be properly mounted for reliable operation. AN938, "Mounting Techniques in PowerMacro Transistor," discusses methods of mounting and heatsinking.

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

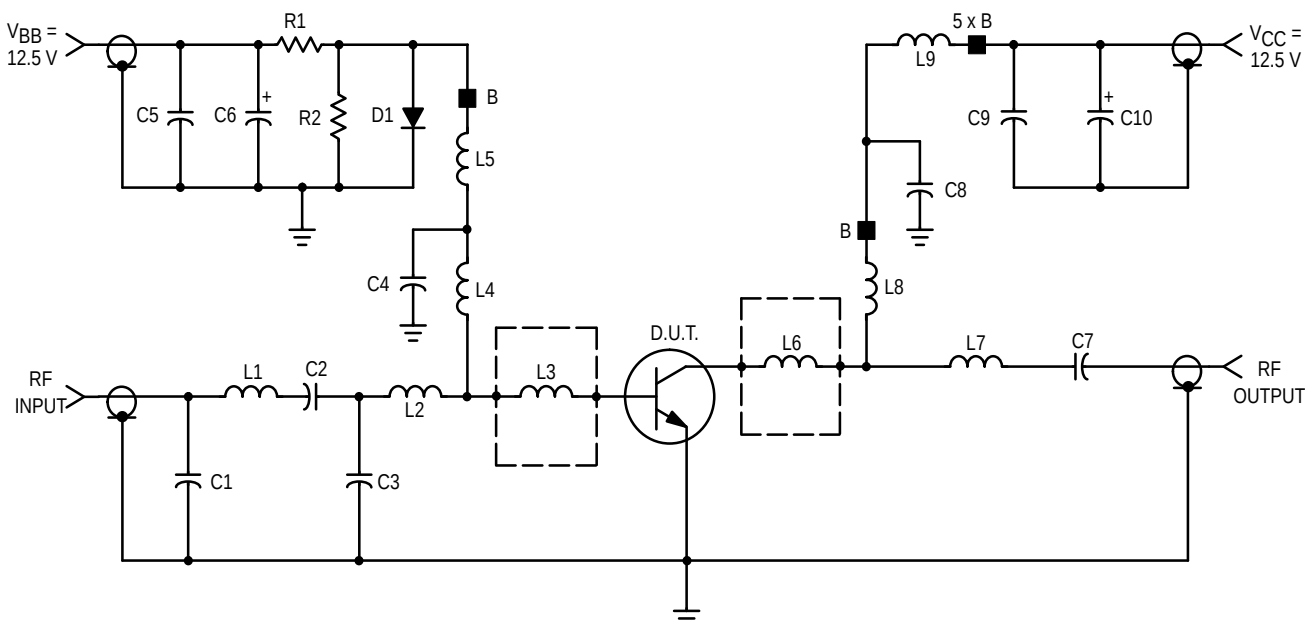
| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

## **DYNAMIC CHARACTERISTICS**

|                                                                                       |          |   |    |    |    |
|---------------------------------------------------------------------------------------|----------|---|----|----|----|
| Output Capacitance<br>( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ ) | $C_{ob}$ | — | 12 | 20 | pF |
|---------------------------------------------------------------------------------------|----------|---|----|----|----|

## **FUNCTIONAL TESTS**

|                                                                                                                                                |              |          |                                |    |   |    |
|------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------|--------------------------------|----|---|----|
| Common-Emitter Amplifier Power Gain<br>( $V_{CC} = 12.5\text{ Vdc}$ , $P_{out} = 1.5\text{ W}$ , $f = 175\text{ MHz}$ )                        | Figures 1, 2 | $G_{pe}$ | 11.5                           | 13 | — | dB |
| Collector Efficiency<br>( $V_{CC} = 12.5\text{ Vdc}$ , $P_{out} = 1.5\text{ W}$ , $f = 175\text{ MHz}$ )                                       | Figures 1, 2 | $\eta$   | 50                             | 60 | — | %  |
| Load Mismatch Stress<br>( $V_{CC} = 12.5\text{ Vdc}$ , $P_{out} = 1.5\text{ W}$ , $f = 175\text{ MHz}$ ,<br>$VSWR \geq 10:1$ All Phase Angles) |              | $\psi$   | No Degradation in Output Power |    |   | —  |



C1 — 36 pF Mini Underwood  
 C2 — 47 pF Mini Underwood  
 C3 — 91 pF Mini Underwood  
 C4 — 68 pF Mini Underwood  
 C5, C9 — 1.0  $\mu\text{F}$  Erie Red Cap Capacitor  
 C6, C10 — 0.1  $\mu\text{F}$ , 35 V Tantalum  
 C7 — 470 pF Chip Capacitor  
 C8 — 2200 pF Chip Capacitor  
 R1 — 4.7 k $\Omega$ , 1/4 W  
 R2 — 100  $\Omega$ , 1/4 W  
 D1 — 1N4148 Diode

L1 — 3 Turns, #18 AWG, 0.210" ID, 3/16" Length  
 L2, L4, L7 — 0.62", #18 AWG Wire Bent into "V"  
 L3, L6 — 60 x 125 x 250 Mils Copper Pad on 27 Mils Thick Alumina Substrate  
 L5 — 12  $\mu\text{H}$  Molded Choke  
 L8 — 7 Turns, #18 AWG, 0.170" ID, 7/16" Length  
 L9 — 1.0", #18 AWG Wire with 5 Ferrite Beads  
 B — Ferrite Bead  
 Board Material — Glass Teflon,  $\epsilon_r = 2.56$ ,  $t = 0.0625"$

**Figure 1. 140–175 MHz Broadband Circuit Schematic**

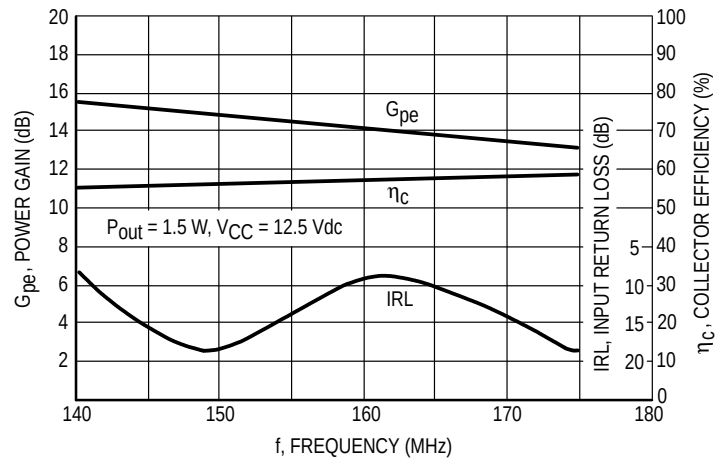


Figure 2. Typical Performance in Broadband Circuit

| f<br>Frequency<br>MHz | $Z_{in}$<br>Ohms                 |          |          |                                   |          |          | $Z_{OL}^*$<br>Ohms                |           |          |                                    |            |            |
|-----------------------|----------------------------------|----------|----------|-----------------------------------|----------|----------|-----------------------------------|-----------|----------|------------------------------------|------------|------------|
|                       | $V_{CC} = 7.5 \text{ V}; P_{in}$ |          |          | $V_{CC} = 12.5 \text{ V}; P_{in}$ |          |          | $V_{CC} = 7.5 \text{ V}; P_{out}$ |           |          | $V_{CC} = 12.5 \text{ V}; P_{out}$ |            |            |
|                       | 100 mW                           | 200 mW   | 300 mW   | 50 mW                             | 100 mW   | 150 mW   | 1.0 W                             | 1.6 W     | 2.2 W    | 1.1 W                              | 2.0 W      | 2.6 W      |
| 140                   | 1.65-j3.6                        | 2.0-j2.6 | 2.3-j1.2 | 1.7-j4.1                          | 1.8-j3.1 | 1.9-j2.7 | 9.9-j11.1                         | 10.6-j5.1 | 10-j4.9  | 28.3-j21.5                         | 16-j20.5   | 16.3-j16.5 |
| 175                   | 2.5-j5.6                         | 2.3-j5.9 | 2.8-j4.0 | 2.3-j4.6                          | 2.4-j1.2 | 2.4-j5.7 | 12.1-j14.9                        | 7.2-j9.8  | 8.1-j5.4 | 30.8-j23.3                         | 11.4-j20.9 | 11.1-j14.3 |

| f<br>Frequency<br>MHz | $Z_{in}$<br>Ohms                 |          |          |                                   |          |          | $Z_{OL}^*$<br>Ohms                |         |            |                                    |           |         |
|-----------------------|----------------------------------|----------|----------|-----------------------------------|----------|----------|-----------------------------------|---------|------------|------------------------------------|-----------|---------|
|                       | $V_{CC} = 7.5 \text{ V}; P_{in}$ |          |          | $V_{CC} = 12.5 \text{ V}; P_{in}$ |          |          | $V_{CC} = 7.5 \text{ V}; P_{out}$ |         |            | $V_{CC} = 12.5 \text{ V}; P_{out}$ |           |         |
|                       | 50 mW                            | 100 mW   | 200 mW   | 25 mW                             | 50 mW    | 100 mW   | 1.25 W                            | 1.5 W   | 2.0 W      | 1.5 W                              | 2.25 W    | 3.0 W   |
| 90                    | 2.5-j9.3                         | 2.5-j6.4 | 2.5-j4.4 | 1.6-j10.7                         | 2.5-j7.1 | 2.2-j1.3 | 31.8-j9.2                         | 32-j8.9 | 30.2-j10.7 | 45.8-j7.2                          | 45.2-j3.9 | 40-j4.5 |

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

Table 1.  $Z_{in}$  and  $Z_{OL}$  versus Collector Voltage, Input Power, and Output Power

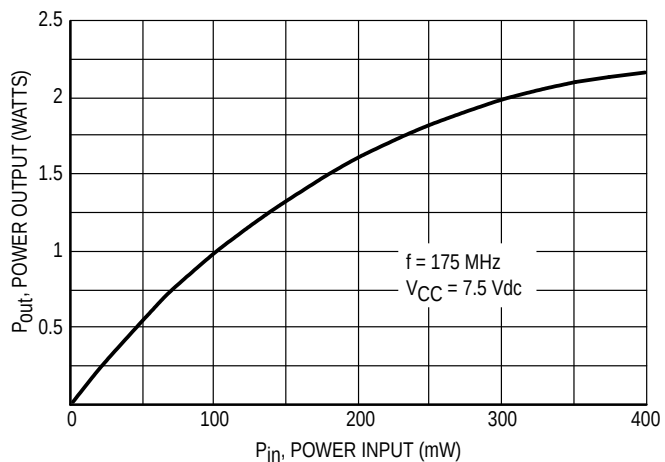


Figure 3. Power Output versus Power Input

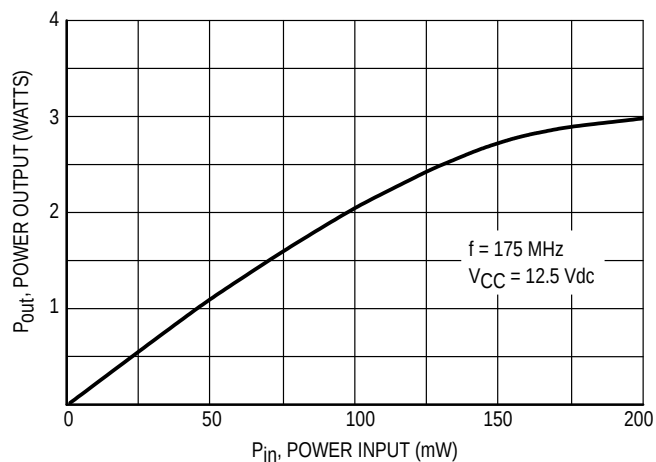


Figure 4. Power Output versus Power Input

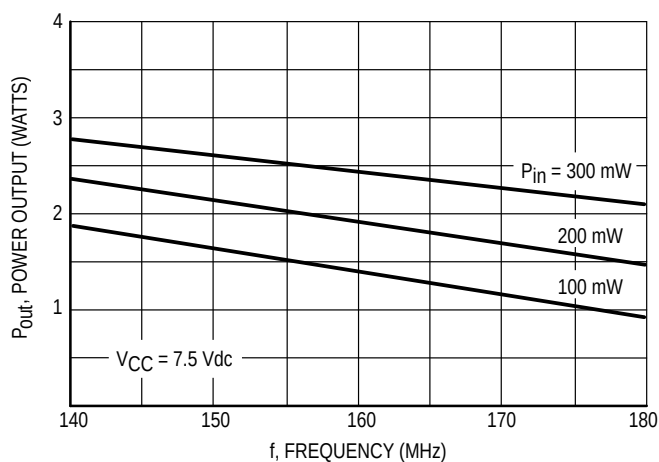


Figure 5. Power Output versus Frequency

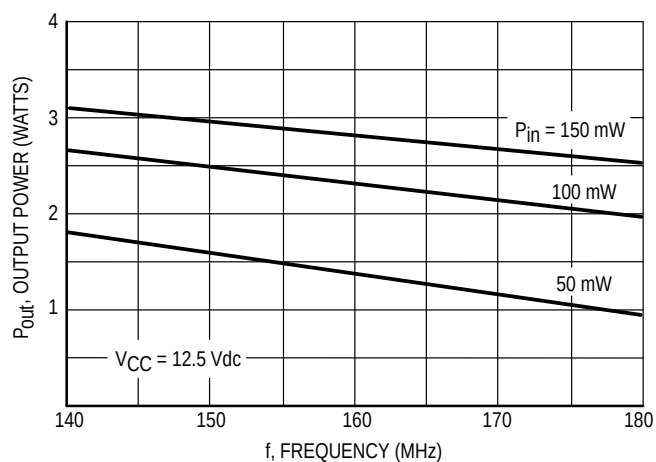


Figure 6. Power Output versus Frequency

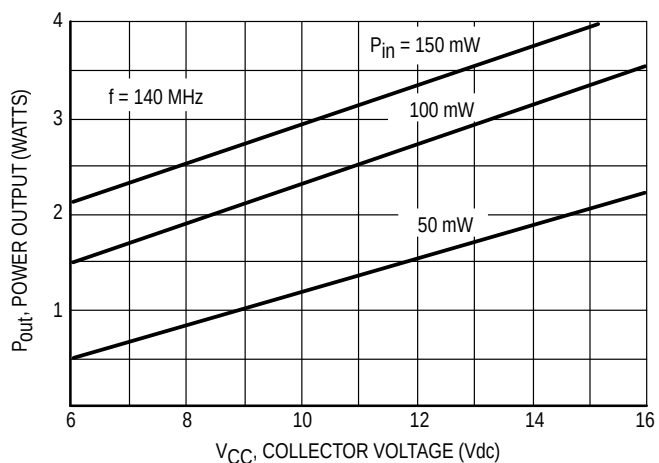


Figure 7. Power Output versus Collector Voltage

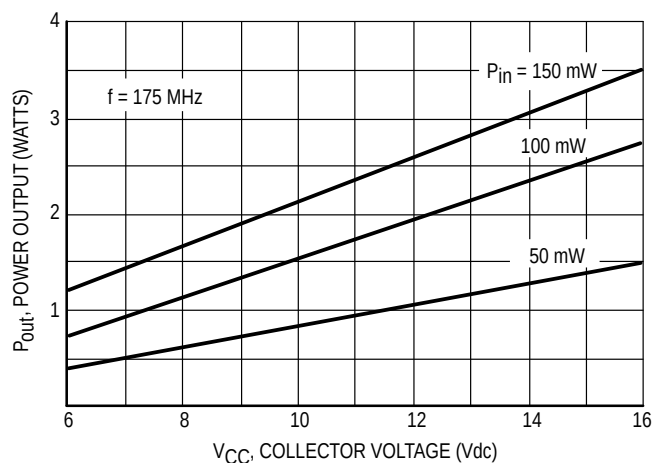
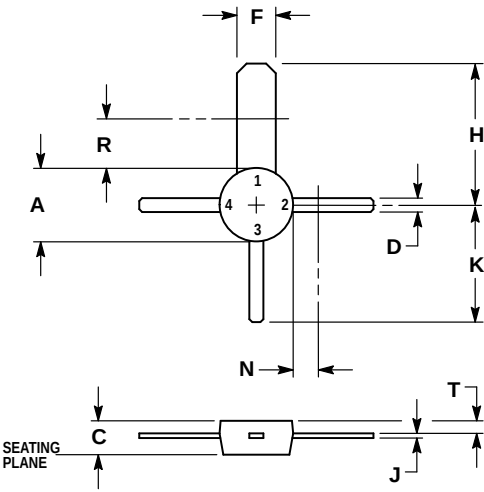


Figure 8. Power Output versus Collector Voltage

PACKAGE DIMENSIONS



- NOTES:
- 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  - 2. CONTROLLING DIMENSION: INCH.
  - 3. LEAD DIMENSIONS UNCONTROLLED WITHIN DIMENSION N AND R.

| DIM | INCHES |       | MILLIMETERS |      |
|-----|--------|-------|-------------|------|
|     | MIN    | MAX   | MIN         | MAX  |
| A   | 0.175  | 0.205 | 4.45        | 5.20 |
| C   | 0.075  | 0.100 | 1.91        | 2.54 |
| D   | 0.033  | 0.039 | 0.84        | 0.99 |
| F   | 0.097  | 0.104 | 2.46        | 2.64 |
| H   | 0.348  | 0.383 | 8.84        | 9.72 |
| J   | 0.008  | 0.012 | 0.24        | 0.30 |
| K   | 0.285  | 0.320 | 7.24        | 8.12 |
| N   | —      | 0.065 | —           | 1.65 |
| R   | —      | 0.128 | —           | 3.25 |
| T   | 0.025  | 0.040 | 0.64        | 1.01 |

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

CASE 317D-02  
ISSUE C

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