

# The RF Line

## NPN Silicon

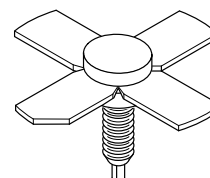
## RF Power Transistor

... designed primarily for wideband large-signal driver and predriver amplifier stages in 200–500 MHz frequency range.

- Guaranteed Performance at 400 MHz, 28 Vdc
  - Output Power = 10 Watts
  - Power Gain = 12 dB Min
  - Efficiency = 50% Min
- 100% Tested for Load Mismatch at all Phase Angles with 30:1 VSWR
- Gold Metallization System for High Reliability
- Computer-Controlled Wirebonding Gives Consistent Input Impedance

# MRF321

10 W, 400 MHz  
RF POWER  
TRANSISTOR  
NPN SILICON



CASE 244-04, STYLE 1

### MAXIMUM RATINGS

| Rating                                                                                     | Symbol    | Value       | Unit                          |
|--------------------------------------------------------------------------------------------|-----------|-------------|-------------------------------|
| Collector-Emitter Voltage                                                                  | $V_{CEO}$ | 33          | Vdc                           |
| Collector-Base Voltage                                                                     | $V_{CBO}$ | 60          | Vdc                           |
| Emitter-Base Voltage                                                                       | $V_{EBO}$ | 4.0         | Vdc                           |
| Collector Current — Continuous<br>— Peak                                                   | $I_C$     | 1.1<br>1.5  | Adc                           |
| Total Device Dissipation @ $T_A = 25^\circ\text{C}$ (1)<br>Derate above $25^\circ\text{C}$ | $P_D$     | 27<br>160   | Watts<br>mW/ $^\circ\text{C}$ |
| Storage Temperature Range                                                                  | $T_{stg}$ | -65 to +150 | $^\circ\text{C}$              |

### THERMAL CHARACTERISTICS

| Characteristic                       | Symbol          | Max | Unit               |
|--------------------------------------|-----------------|-----|--------------------|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 6.4 | $^\circ\text{C/W}$ |

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

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

### OFF CHARACTERISTICS

|                                                                                  |               |     |   |     |      |
|----------------------------------------------------------------------------------|---------------|-----|---|-----|------|
| Collector-Emitter Breakdown Voltage<br>( $I_C = 20\text{ mAdc}$ , $I_B = 0$ )    | $V_{(BR)CEO}$ | 33  | — | —   | Vdc  |
| Collector-Emitter Breakdown Voltage<br>( $I_C = 20\text{ mAdc}$ , $V_{BE} = 0$ ) | $V_{(BR)CES}$ | 60  | — | —   | Vdc  |
| Collector-Base Breakdown Voltage<br>( $I_C = 20\text{ mAdc}$ , $I_E = 0$ )       | $V_{(BR)CBO}$ | 60  | — | —   | Vdc  |
| Emitter-Base Breakdown Voltage<br>( $I_E = 2.0\text{ mAdc}$ , $I_C = 0$ )        | $V_{(BR)EBO}$ | 4.0 | — | —   | Vdc  |
| Collector Cutoff Current<br>( $V_{CB} = 30\text{ Vdc}$ , $I_E = 0$ )             | $I_{CBO}$     | —   | — | 1.0 | mAdc |

### ON CHARACTERISTICS

|                                                                          |          |    |   |    |   |
|--------------------------------------------------------------------------|----------|----|---|----|---|
| DC Current Gain<br>( $I_C = 500\text{ mA}$ , $V_{CE} = 5.0\text{ Vdc}$ ) | $h_{FE}$ | 20 | — | 80 | — |
|--------------------------------------------------------------------------|----------|----|---|----|---|

NOTE:

- This device is designed for RF operation. The total device dissipation rating applies only when the device is operated as an RF amplifier.

(continued)

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

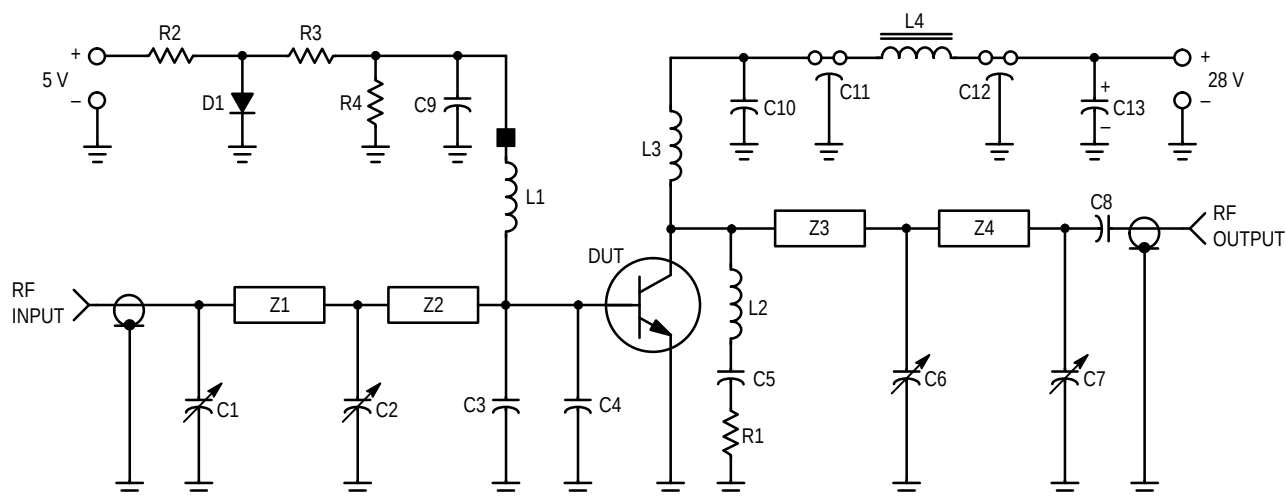
| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

## **DYNAMIC CHARACTERISTICS**

|                                                                                       |          |   |    |    |    |
|---------------------------------------------------------------------------------------|----------|---|----|----|----|
| Output Capacitance<br>( $V_{CB} = 28\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ ) | $C_{ob}$ | — | 10 | 12 | pF |
|---------------------------------------------------------------------------------------|----------|---|----|----|----|

## **FUNCTIONAL TESTS** (Figure 1)

|                                                                                                                                 |          |                                |    |   |    |
|---------------------------------------------------------------------------------------------------------------------------------|----------|--------------------------------|----|---|----|
| Common-Emitter Amplifier Power Gain<br>( $V_{CC} = 28\text{ Vdc}$ , $P_{out} = 10\text{ W}$ , $f = 400\text{ MHz}$ )            | $G_{PE}$ | 12                             | 13 | — | dB |
| Collector Efficiency<br>( $V_{CC} = 28\text{ Vdc}$ , $P_{out} = 10\text{ W}$ , $f = 400\text{ MHz}$ )                           | $\eta$   | 50                             | 60 | — | %  |
| Load Mismatch<br>( $V_{CC} = 28\text{ Vdc}$ , $P_{out} = 10\text{ W}$ , $f = 400\text{ MHz}$ ,<br>VSWR = 30:1 all phase angles) | $\psi$   | No Degradation in Output Power |    |   |    |



C1, C2, C3 — 1.0–20 pF Johanson Trimmer (JMC 5501)  
 C3, C4 — 47 pF ATC Chip Capacitor  
 C5, C10 — 0.1  $\mu\text{F}$  Erie Redcap  
 C7 — 0.5–10 pF Johanson Trimmer (JMC 5201)  
 C8 — 0.018  $\mu\text{F}$  Vitramon Chip Capacitor  
 C9 — 200 pF UNELCO Capacitor  
 C11, C12 — 680 pF Feedthru  
 C13 — 1.0  $\mu\text{F}$ , 50 Volt Tantalum Capacitor  
 D1 — 1N4001  
 L1 — 0.33  $\mu\text{H}$  Molded Choke with Ferroxcube Bead  
 (Ferroxcube 56–590–65/4B) on Ground End of Coil  
 L2 — 4 Turns #20 Enamel, 1/8" ID

L3 — 6 Turns #20 Enamel, 1/4" ID  
 L4 — Ferroxcube VK200–19/4B  
 R1 — 5.1  $\Omega$ , 1/4 Watt  
 R2 — 120  $\Omega$ , 1.0 Watt  
 R3 — 20  $\Omega$ , 1/2 Watt  
 R4 — 47  $\Omega$ , 1/2 Watt  
 Z1 — Microstrip 0.1" W x 1.35" L  
 Z2 — Microstrip 0.1" W x 0.55" L  
 Z3 — Microstrip 0.1" W x 0.8" L  
 Z4 — Microstrip 0.1" W x 1.75" L  
 Board — Glass Teflon,  $\epsilon_R = 2.56$ ,  $t = 0.062$ "  
 Input/Output Connectors — Type N

**Figure 1. 400 MHz Test Circuit Schematic**

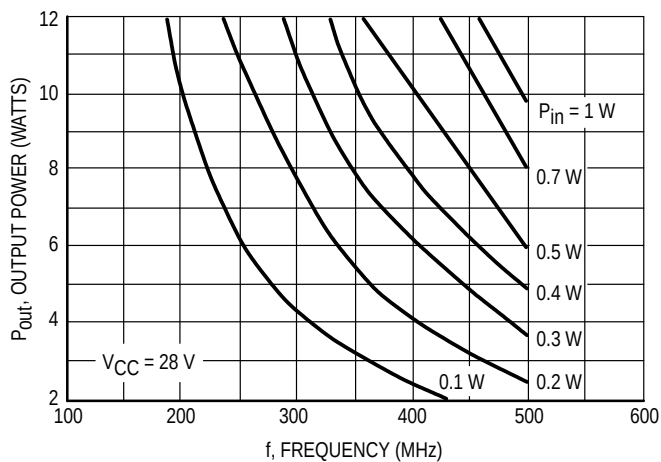


Figure 2. Output Power versus Frequency

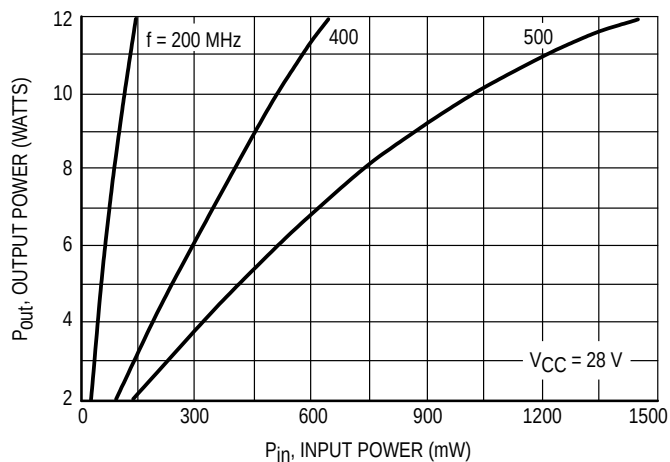


Figure 3. Output Power versus Input Power

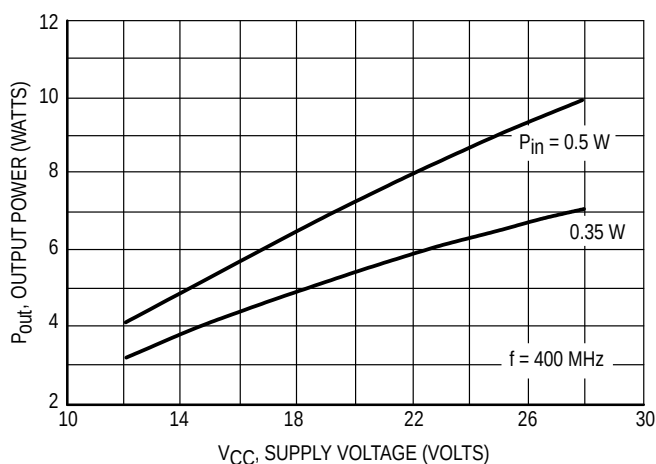


Figure 4. Output Power versus Supply Voltage

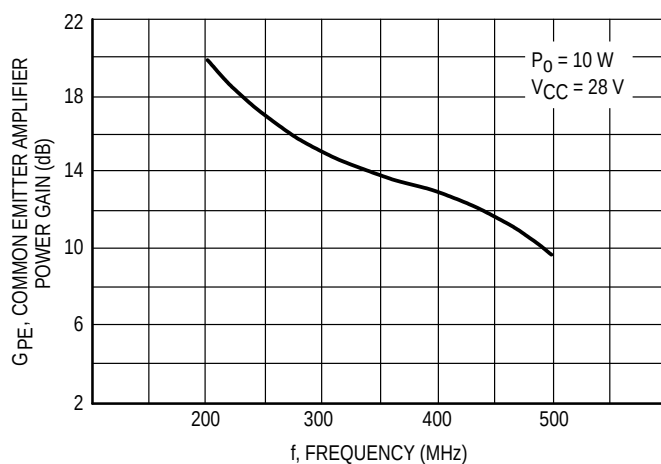
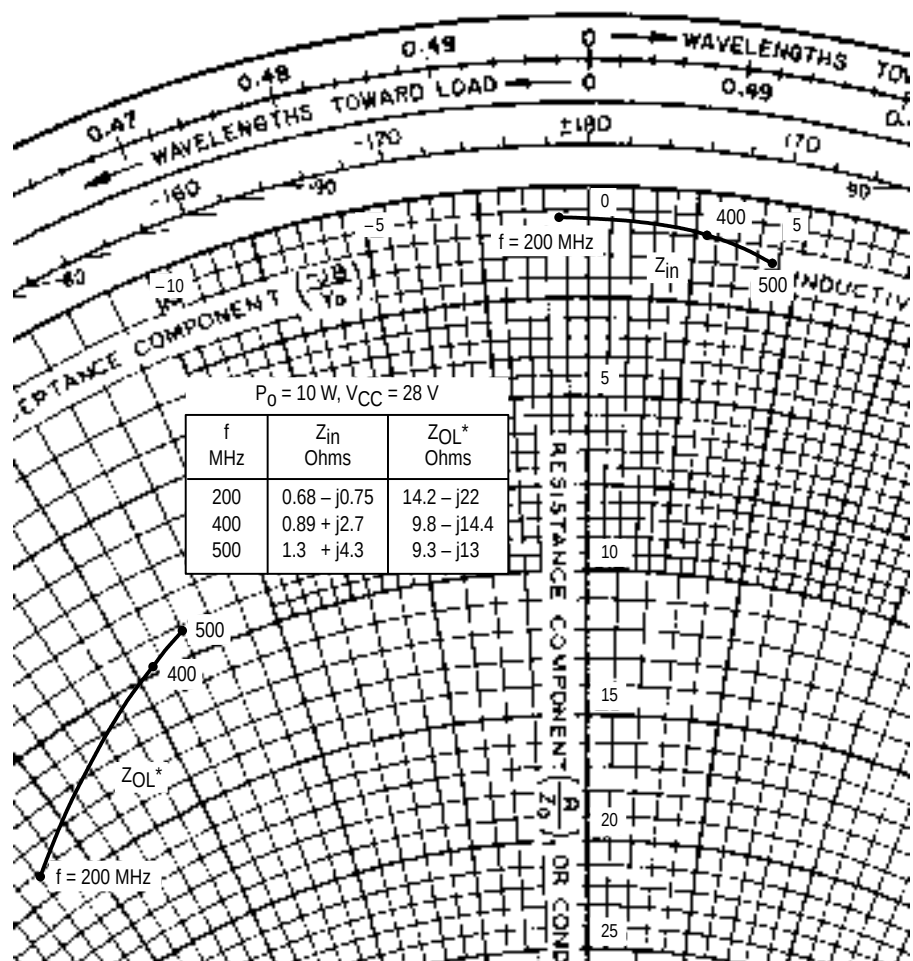


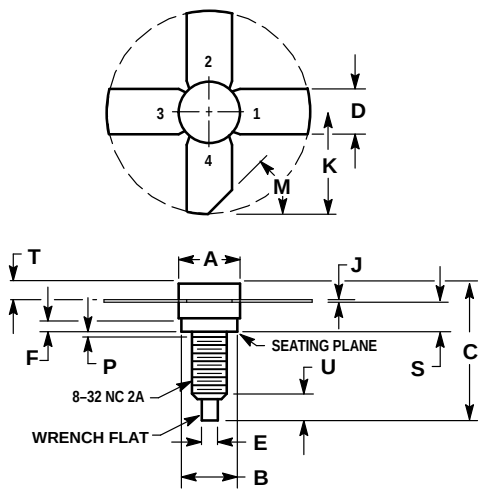
Figure 5. Power Gain versus Frequency



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

Figure 6. Series Equivalent 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

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