The RF Line

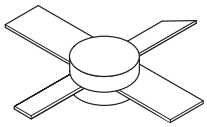
# Microwave Pulse Power Transistors

**MRF1004MB**

**4.0 W, 960–1215 MHz
MICROWAVE POWER
TRANSISTORS
NPN SILICON**

Designed for Class B and C common base amplifier applications in short and long pulse TACAN, IFF, DME, and radar transmitters.

- Guaranteed Performance @ 1090 MHz, 35 Vdc
  Output Power = 4.0 Watts Peak
  Minimum Gain = 10 dB
- 100% Tested for Load Mismatch at All Phase Angles with 10:1 VSWR
- Industry Standard Package
- Nitride Passivated
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration
- Internal Input Matching for Broadband Operation



**CASE 332A–03, STYLE 1**

**MAXIMUM RATINGS**

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector–Emitter Voltage | $V_{CEO}$ | 20 | Vdc |
| Collector–Base Voltage | $V_{CBO}$ | 50 | Vdc |
| Emitter–Base Voltage | $V_{EBO}$ | 3.5 | Vdc |
| Collector Current — Continuous | $I_C$ | 250 | mAdc |
| Total Device Dissipation @ $T_C$ = 25°C (1)<br>Derate above 25°C | $P_D$ | 7.0<br>40 | Watts<br>mW/°C |
| Storage Temperature Range | $T_{stg}$ | –65 to +150 | °C |

**THERMAL CHARACTERISTICS**

| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Case (2) | $R_{\theta JC}$ | 25 | °C/W |

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

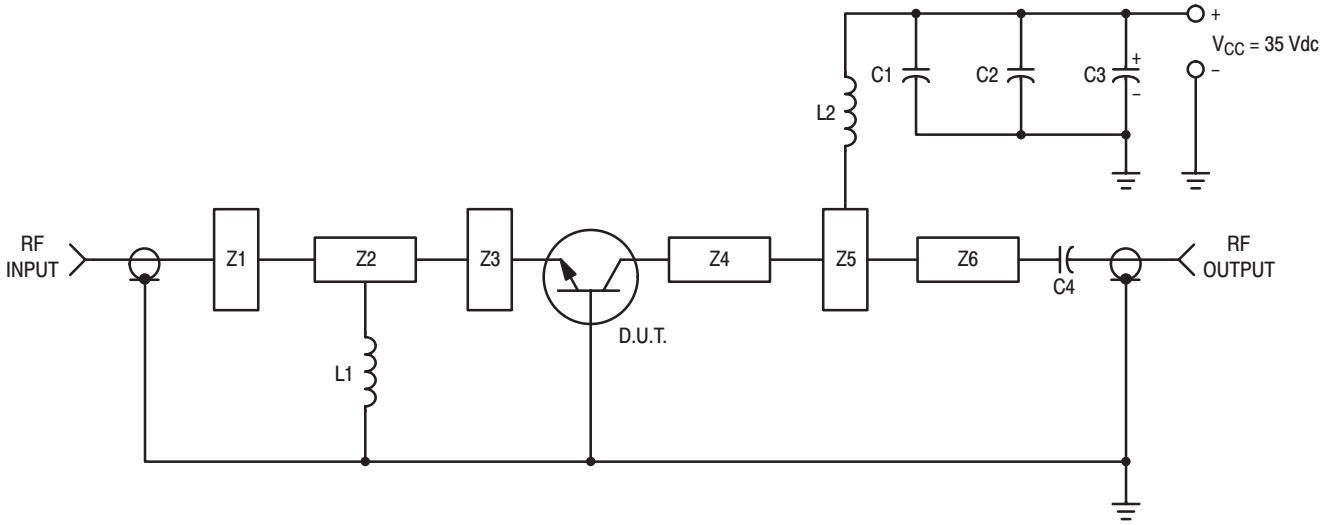
| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Collector–Emitter Breakdown Voltage ($I_C$ = 5.0 mAdc, $I_B$ = 0) | $V_{(BR)CEO}$ | 20 | — | — | Vdc |
| Collector–Emitter Breakdown Voltage ($I_C$ = 5.0 mAdc, $V_{BE}$ = 0) | $V_{(BR)CES}$ | 50 | — | — | Vdc |
| Collector–Base Breakdown Voltage ($I_C$ = 5.0 mAdc, $I_E$ = 0) | $V_{(BR)CBO}$ | 50 | — | — | Vdc |
| Emitter–Base Breakdown Voltage ($I_E$ = 1.0 mAdc, $I_C$ = 0) | $V_{(BR)EBO}$ | 3.5 | — | — | Vdc |
| Collector Cutoff Current ($V_{CB}$ = 35 Vdc, $I_E$ = 0) | $I_{CBO}$ | — | — | 0.5 | mAdc |
| **ON CHARACTERISTICS** | | | | | |
| DC Current Gain ($I_C$ = 75 mAdc, $V_{CE}$ = 5.0 Vdc) | $h_{FE}$ | 10 | — | 100 | — |

NOTES: (continued)

1. These devices are designed for RF operation. The total device dissipation rating applies only when the device is operated as RF amplifiers.
2. Thermal Resistance is determined under specified RF operating conditions by infrared measurement techniques.

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Output Capacitance ($V_{CB}$ = 35 Vdc, $I_E$ = 0, f = 1.0 MHz) | $C_{ob}$ | — | 3.3 | 5.0 | pF |
| **FUNCTIONAL TESTS** (Pulse Width = 10 μs, Duty Cycle = 1.0%) | | | | | |
| Common–Base Amplifier Power Gain ($V_{CC}$ = 35 Vdc, $P_{out}$ = 4.0 W pk, f = 1090 MHz) | $G_{PB}$ | 10 | 11 | — | dB |
| Collector Efficiency ($V_{CC}$ = 35 Vdc, $P_{out}$ = 4.0 W pk, f = 1090 MHz) | η | 40 | 45 | — | dB |
| Load Mismatch ($V_{CC}$ = 35 Vdc, $P_{out}$ = 4.0 W pk, f = 1090 MHz, VSWR = 10:1 All Phase Angles) | ψ | No Degradation in Power Output | | | |




C1 — 0.1 μF
C2, C4 — 220 pF Chip Capacitor
C3 — 20 μF, 50 V Electrolytic
L1, L2 — 3 Turns #18 AWG, 1/8″ ID
Z1–Z6 Distributed Microstrip Elements, See Photomaster
Board Material — 0.031″ Thick Glass Teflon

**Figure 1. 1090 MHz Test Circuit**

## TYPICAL CHARACTERISTICS

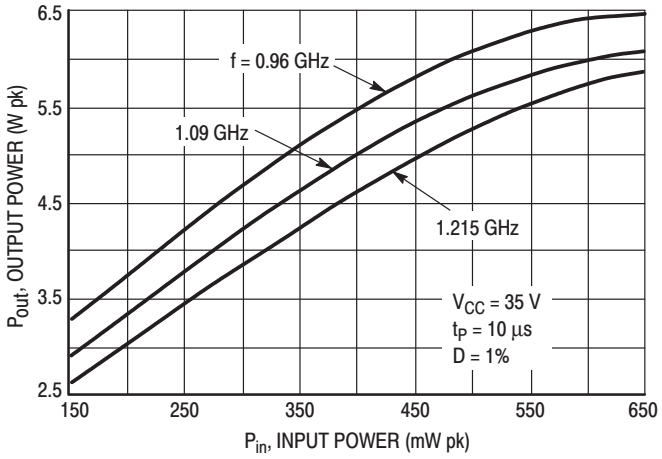



**Figure 2. Output Power versus Input Power**

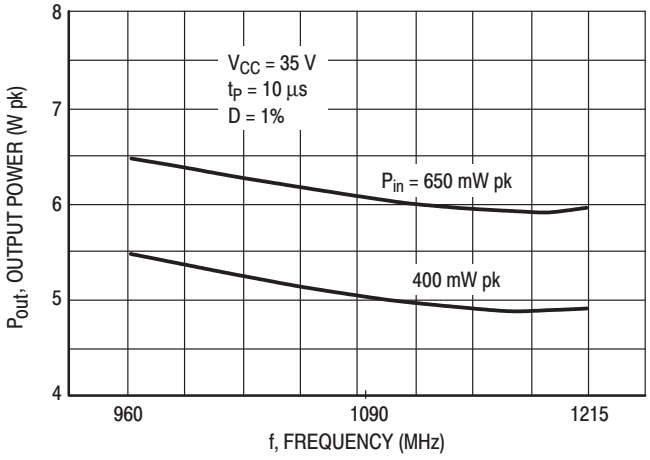



**Figure 3. Output Power versus Frequency**

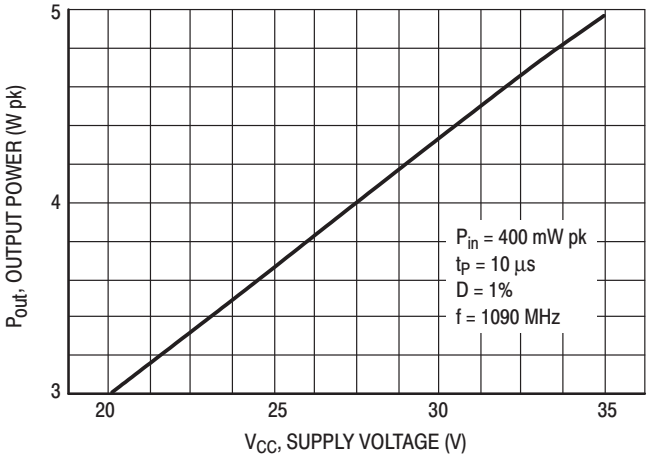



**Figure 4. Output Power versus Supply Voltage**

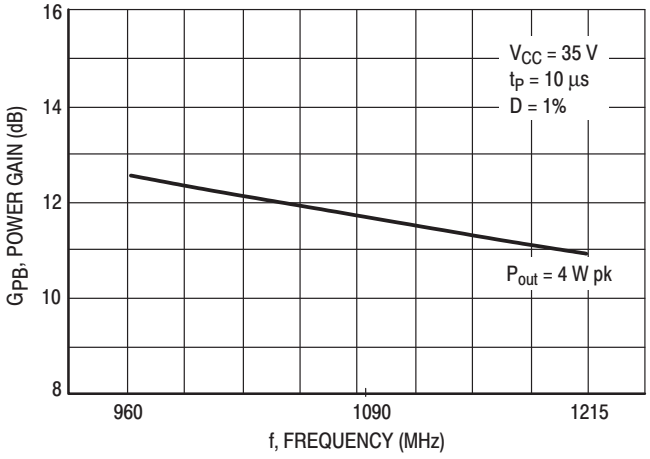
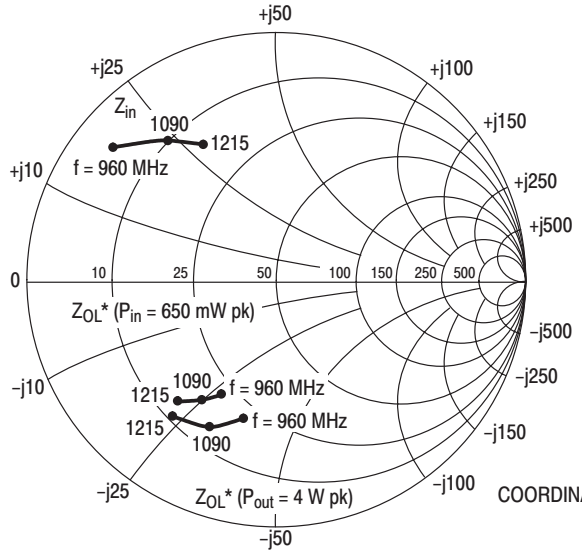



**Figure 5. Power Gain versus Frequency**




| f MHz | $Z_{in}$ Ohms | $Z_{OL}$* ($P_{in}$ = 400 mW pk) Ohms | $Z_{OL}$* ($P_{out}$ = 4.0 W pk) Ohms |
|---|---|---|---|
| 960 | 5.0 + j17.5 | 23.5 – j26 | 22.5 – j36 |
| 1090 | 10 + j23 | 18.5 – j25 | 15 – j32.5 |
| 1215 | 16 + j29.5 | 15.5 – j23.5 | 11 – j23 |

$Z_{OL}$* = 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**

## TYPICAL CHARACTERISTICS

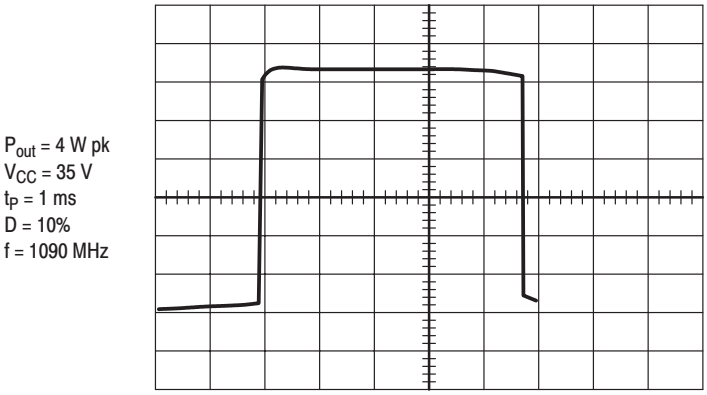
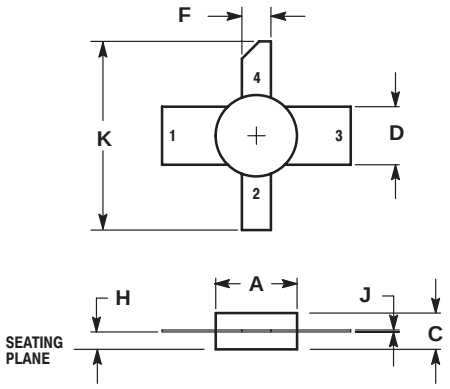



**Figure 7. Typical Long Pulse Performance**

## PACKAGE DIMENSIONS




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

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.270 | 0.290 | 6.86 | 7.36 |
| C | 0.115 | 0.135 | 2.93 | 3.42 |
| D | 0.195 | 0.205 | 4.96 | 5.20 |
| F | 0.095 | 0.105 | 2.42 | 2.66 |
| H | 0.050 | 0.070 | 1.27 | 1.77 |
| J | 0.003 | 0.007 | 0.08 | 0.17 |
| K | 0.600 | --- | 15.24 | --- |

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

**CASE 332A–03**
**ISSUE D**

*Specifications subject to change without notice.*


- **North America:** Tel. (800) 366-2266, Fax (800) 618-8883
- **Asia/Pacific:** Tel.+81-44-844-8296, Fax +81-44-844-8298
- **Europe:** Tel. +44 (1344) 869 595, Fax+44 (1344) 300 020


**Visit www.macom.com for additional data sheets and product information.**