

## The MRFIC Line

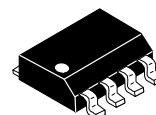
# 2.4 GHz GaAs Exciter Amplifier

The MRFIC2404 is a single-stage class A GaAs amplifier in a low-cost 8 lead plastic package designed to drive the MRFIC2403 power amplifier for use in the 2.4 to 2.5 GHz Industrial-Scientific-Medical (ISM) band. The design is optimized for 5.0 Volt operation at 2.45 GHz but is usable from 2.0 to 3.0 GHz in applications such as telemetry and Multichannel Multipoint Distribution System (MMDS) wireless cable TV systems. Performance is suitable for frequency hopping or direct sequence spread spectrum as well as single-frequency applications.

- High Output Capability = +5.0 dBm Typical
- High Gain = 17 dB Typical
- Low Current Drain = 9.0 mA Typical
- Single Supply Voltage = 5.0 Volts
- Good Noise Figure = 4.3 dB Typical
- Low-Cost, Low Profile Plastic SOIC Package
- Order MRFIC2404R2 for Tape and Reel.  
R2 Suffix = 2,500 Units per 12 mm, 13 inch Reel.
- Device Marking = M2404

## MRFIC2404

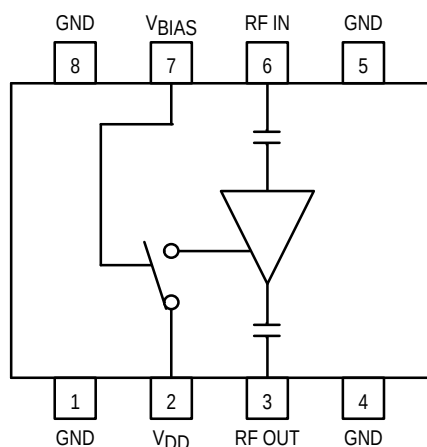
**2.4 GHz  
EXCITER AMPLIFIER  
GaAs MONOLITHIC  
INTEGRATED CIRCUIT**



**CASE 751-05  
(SO-8)**

### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

| Parameter                     | Symbol     | Value       | Unit             |
|-------------------------------|------------|-------------|------------------|
| Supply Voltage                | $V_{DD}$   | 12          | Vdc              |
| RF Input Power                | RF IN      | +10         | dBm              |
| Bias Enable Voltage           | $V_{bias}$ | 6.0         | Vdc              |
| Ambient Operating Temperature | $T_A$      | -30 to +85  | $^\circ\text{C}$ |
| Storage Temperature           | $T_{stg}$  | -65 to +125 | $^\circ\text{C}$ |



**Pin Connections and Functional Block Diagram**

## RECOMMENDED OPERATING CONDITIONS

| Parameter                 | Symbol     | Value        | Unit |
|---------------------------|------------|--------------|------|
| Supply Voltage            | $V_{DD}$   | 4.75 to 5.25 | Vdc  |
| Bias Enable Voltage – ON  | $V_{bias}$ | 0            | Vdc  |
| Bias Enable Voltage – OFF | $V_{bias}$ | 5.0          | Vdc  |
| Operating Frequency Range | $f_{OP}$   | 2000 to 3000 | MHz  |

## ELECTRICAL CHARACTERISTICS ( $V_{DD} = 5.0$ Vdc, $T_A = 25^\circ\text{C}$ , $R_F = 2.45$ GHz, $V_{bias} = 0$ Vdc)

| Characteristic                                    | Min | Typ  | Max | Unit          |
|---------------------------------------------------|-----|------|-----|---------------|
| Small Signal Gain                                 | 16  | 17   | –   | dB            |
| Power Output, 1.0 dB Compression                  | –   | +5.0 | –   | dBm           |
| Power Output ( $P_{in} = -11$ dBm)                | 4.0 | 5.0  | –   | dBm           |
| Third Order Intercept Point                       | –   | +15  | –   | dBm           |
| Noise Figure                                      | –   | 4.3  | –   | dB            |
| Reverse Isolation                                 | –   | 25   | –   | dB            |
| Turn On Time                                      | –   | 1.0  | –   | $\mu\text{s}$ |
| Supply Current                                    | –   | 9.0  | 12  | mA            |
| SLEEP Mode Supply Current ( $V_{bias} = 5.0$ Vdc) | –   | 800  | –   | $\mu\text{A}$ |

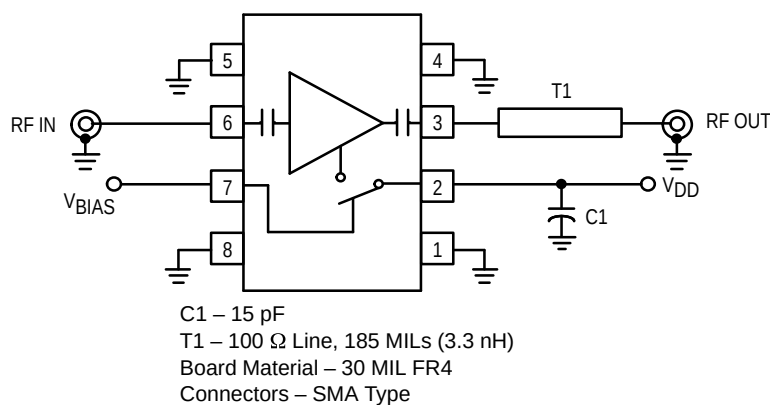


Figure 1. Applications Circuit Configuration

**Table 1. Scattering Parameters**  
(VDD = 5 V, T<sub>A</sub> = 25°C, 50 Ω System)

| f     | S <sub>11</sub> |        | S <sub>21</sub> |         | S <sub>12</sub> |         | S <sub>22</sub> |         |
|-------|-----------------|--------|-----------------|---------|-----------------|---------|-----------------|---------|
| (MHz) | S <sub>11</sub> | ∠ φ    | S <sub>21</sub> | ∠ φ     | S <sub>12</sub> | ∠ φ     | S <sub>22</sub> | ∠ φ     |
| 2000  | 0.232           | −92.34 | 6.290           | 165.97  | 0.024           | −51.08  | 0.483           | −123.13 |
| 2050  | 0.174           | −90.78 | 7.049           | 147.75  | 0.029           | −66.26  | 0.383           | −125.77 |
| 2100  | 0.122           | −76.88 | 7.563           | 127.95  | 0.032           | −78.38  | 0.281           | −124.34 |
| 2150  | 0.102           | −48.38 | 7.803           | 109.02  | 0.035           | −97.84  | 0.191           | −109.23 |
| 2200  | 0.128           | −19.45 | 8.046           | 91.04   | 0.037           | −105.62 | 0.159           | −80.33  |
| 2250  | 0.185           | −6.60  | 8.144           | 72.36   | 0.039           | −123.88 | 0.196           | −53.35  |
| 2300  | 0.244           | −5.52  | 7.977           | 55.31   | 0.038           | −135.36 | 0.273           | −42.38  |
| 2350  | 0.300           | −8.04  | 7.979           | 39.91   | 0.043           | −144.83 | 0.350           | −41.15  |
| 2400  | 0.343           | −12.42 | 8.147           | 23.40   | 0.044           | −160.94 | 0.423           | −43.39  |
| 2450  | 0.379           | −17.11 | 8.020           | 5.27    | 0.045           | −173.09 | 0.477           | −47.05  |
| 2500  | 0.403           | −21.90 | 7.550           | −10.93  | 0.041           | 173.83  | 0.522           | −50.67  |
| 2550  | 0.424           | −26.32 | 7.245           | −25.36  | 0.043           | 165.85  | 0.556           | −54.67  |
| 2600  | 0.436           | −30.95 | 6.911           | −39.88  | 0.042           | 154.14  | 0.582           | −58.35  |
| 2650  | 0.443           | −34.94 | 6.631           | −52.32  | 0.041           | 145.35  | 0.600           | −62.23  |
| 2700  | 0.447           | −39.48 | 6.566           | −65.57  | 0.044           | 135.12  | 0.610           | −65.41  |
| 2750  | 0.445           | −43.12 | 6.338           | −79.97  | 0.043           | 123.72  | 0.622           | −68.57  |
| 2800  | 0.446           | −46.68 | 6.009           | −93.15  | 0.042           | 114.52  | 0.624           | −72.06  |
| 2850  | 0.441           | −50.42 | 5.733           | −105.10 | 0.043           | 107.18  | 0.620           | −74.86  |
| 2900  | 0.439           | −53.14 | 5.565           | −116.69 | 0.041           | 98.95   | 0.617           | −77.74  |
| 2950  | 0.437           | −57.27 | 5.393           | −129.54 | 0.042           | 90.72   | 0.608           | −80.01  |
| 3000  | 0.409           | −61.28 | 4.938           | −142.70 | 0.043           | 81.68   | 0.611           | −81.12  |

## Typical Characteristics

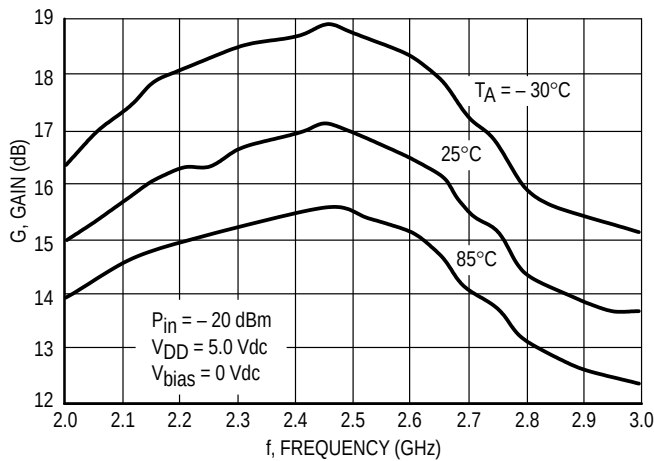


Figure 2. Gain versus Frequency

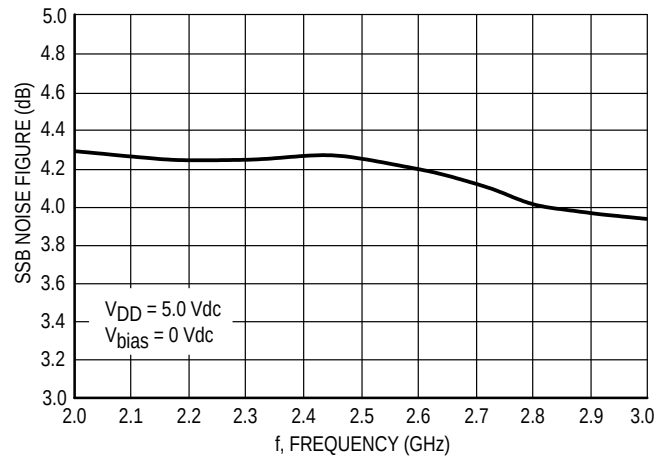


Figure 3. Noise Figure versus Frequency

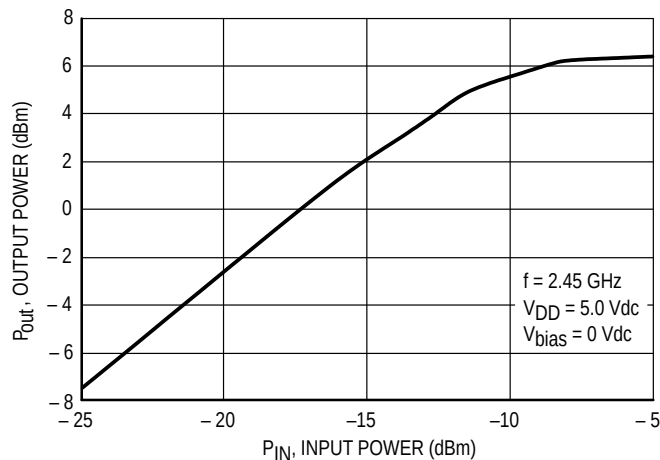


Figure 4. Output Power versus Input Power

## DESIGN AND APPLICATIONS INFORMATION

The MRFIC2404 is a single-stage GaAs amplifier designed for exciter applications such as driving the MRFIC2403 power amplifier. The 4.3 dB noise figure, 17 dB gain and +5.0 dBm power output at 1.0 dB gain compression make the MRFIC2404 suitable for high-performance receiver IF application, Multichannel Multipoint Distribution System (MMDS) applications, telemetry and other applications in the 2.0 to 3.0 GHz range.

The characterization curves show typical performance in the 2.0 to 3.0 GHz range in the circuit shown in Figure 1. This circuit was also used to derive the device impedance shown in Table 1. The amplifier input is matched to 50  $\Omega$  while the output requires about 3.3 nH series inductance for best

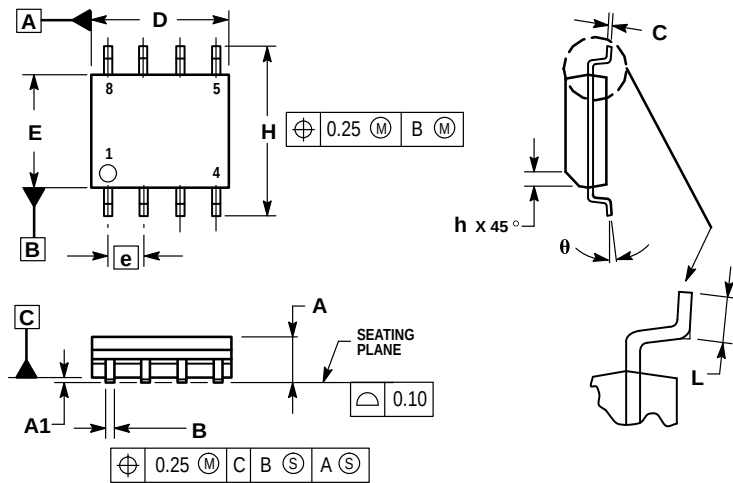
match at 2.45 GHz. The  $V_{DD}$  supply line should be bypassed as close to the chip as possible to avoid low frequency oscillations. Power supply "stiffening" and digital transient bypassing in the form of electrolytic or tantalum capacitors should be added.

The device can be put into a reduced current "sleep" mode by 5.0 Vdc to the  $V_{bias}$  pin.

## EVALUATION BOARDS

Evaluation boards are available for RF Monolithic Integrated Circuits by adding a "TF" suffix to the device type. For a complete list of currently available boards and ones in development for newly introduced product, please contact your local Motorola Distributor or Sales Office.

PACKAGE DIMENSIONS



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. DIMENSIONS ARE IN MILLIMETERS.
  3. DIMENSION D AND E DO NOT INCLUDE MOLD PROTRUSION.
  4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
  5. DIMENSION B DOES NOT INCLUDE MOLD PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | MIN         | MAX  |
| A   | 1.35        | 1.75 |
| A1  | 0.10        | 0.25 |
| B   | 0.35        | 0.49 |
| C   | 0.18        | 0.25 |
| D   | 4.80        | 5.00 |
| E   | 3.80        | 4.00 |
| e   | 1.27 BSC    |      |
| H   | 5.80        | 6.20 |
| h   | 0.25        | 0.50 |
| L   | 0.40        | 1.25 |
| θ   | 0°          | 7°   |

CASE 751-05  
ISSUE S

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