

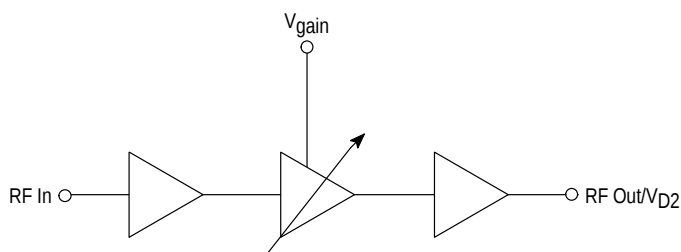
**MOTOROLA**

# 900 MHz GaAs Low Noise Amplifier with Gain Control

Designed primarily for use in 900 MHz wireless communication systems such as GSM, AMPS, and Industrial, Scientific, and Medical (ISM) band applications. The MRFIC0930 is a two-stage low noise amplifier with an integrated step attenuator and is packaged in a low-cost SO-8 package. The MRFIC0930DM is packaged in the smaller Micro-8 package. The attenuator is controlled by a  $V_{\text{gain}}$  Pin. The LNA can be turned off during transmit mode to save current by using the Rx Enable Pin. The amplifier can be matched to optimize gain or noise figure with simple off-chip input matching.

- Usable Frequency Range = 800 to 1000 MHz
- 19 dB Typ Gain
- Gain Attenuation = 18 dB (Typ)
- 1.7 dB Typ Noise Figure
- Simple Off-chip Matching for Maximum Gain/Noise Figure Flexibility
- High Reverse Isolation = 41 dB (Typ)
- Low Power Consumption = 24 mW (Typ)
- Single Bias Supply = 2.7 to 4.5 V
- Low Standby Current = 20  $\mu\text{A}$  (Typ)
- Low Cost Surface Mount Plastic Package

**Simplified Block Diagram**

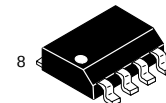


This device contains 12 active transistors.

## MRFIC0930

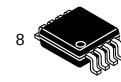
### 900 MHz GaAs LOW NOISE AMPLIFIER WITH GAIN CONTROL

#### SEMICONDUCTOR TECHNICAL DATA



(Scale 2:1)

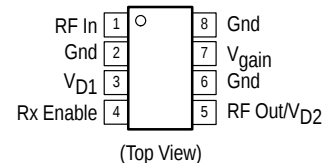
PLASTIC PACKAGE  
CASE 751  
(SO-8, Tape & Reel Only)



(Scale 2:1)

**DM SUFFIX**  
PLASTIC PACKAGE  
CASE 846A  
(Micro-8, Tape & Reel Only)

#### PIN CONNECTIONS



#### ORDERING INFORMATION

| Device        | Operating Temp Range              | Package                  |
|---------------|-----------------------------------|--------------------------|
| MRFIC0930R2   | $T_A = -30$ to $70^\circ\text{C}$ | SO-8*<br>Tape & Reel     |
| MRFIC0930DMR2 |                                   | Micro-8**<br>Tape & Reel |

\*2,500 Units per 16 mm, 13 inch reel.  
\*\*2,500 Units per 12 mm, 13 inch reel.

## MAXIMUM RATINGS (T<sub>A</sub> = 25°C, unless otherwise noted)

| Rating                        | Symbol                            | Value      | Unit |
|-------------------------------|-----------------------------------|------------|------|
| Supply Voltage                | V <sub>D1</sub> , V <sub>D2</sub> | 5.5        | Vdc  |
| RF Input Power                | P <sub>RF</sub>                   | 3          | dBm  |
| Gain Control Voltage          | V <sub>gain</sub>                 | 5.5        | Vdc  |
| Enable Voltage                | RX Enable                         | 5.5        | Vdc  |
| Storage Temperature Range     | T <sub>stg</sub>                  | –65 to 150 | °C   |
| Operating Ambient Temperature | T <sub>A</sub>                    | –30 to 70  | °C   |

**NOTES:** 1. Meets Human Body Model (HBM) ≤750 V and Machine Model (MM) ≤100 V.  
2. ESD data available upon request.

## RECOMMENDED OPERATING RANGES

| Parameter                     | Symbol                            | Min | Typ | Max                               | Unit |
|-------------------------------|-----------------------------------|-----|-----|-----------------------------------|------|
| RF Frequency                  | f <sub>RF</sub>                   | 800 | –   | 1000                              | MHz  |
| Supply Voltage                | V <sub>D1</sub> , V <sub>D2</sub> | 2.7 | –   | 4.5                               | Vdc  |
| V <sub>gain</sub> , High Gain | V <sub>gain</sub>                 | –   | 3.0 | –                                 | Vdc  |
| V <sub>gain</sub> , Low Gain  | V <sub>gain</sub>                 | –   | 0   | –                                 | Vdc  |
| Rx Enable Voltage, On         | Rx Enable                         | 2.7 | –   | V <sub>D1</sub> , V <sub>D2</sub> | Vdc  |
| Rx Enable Voltage, Off        | Rx Enable                         | 0   | –   | 0.2                               | Vdc  |

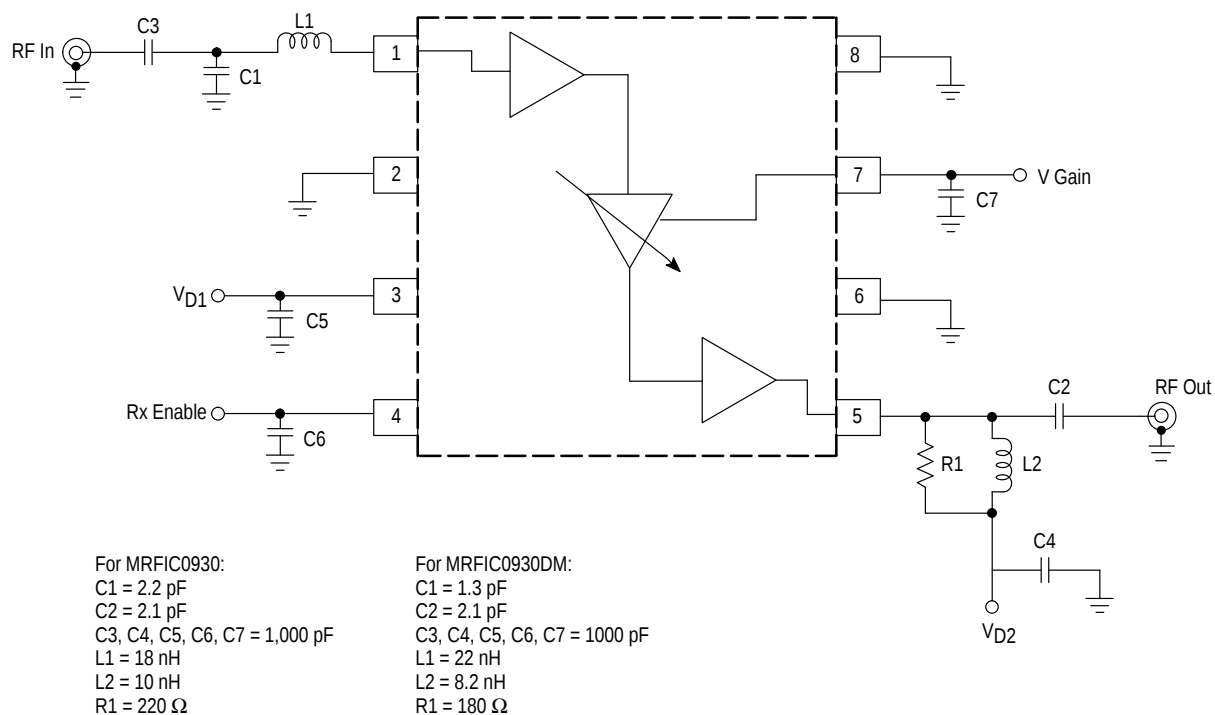
**NOTE:** To bias, apply V<sub>D1</sub> and V<sub>D2</sub> before Rx Enable.

**ELECTRICAL CHARACTERISTICS** (V<sub>D1</sub>, V<sub>D2</sub> = 2.8 V, T<sub>A</sub> = 25°C, RF = 940 MHz, Rx Enable = 2.8 V, V<sub>Gain</sub> = 2.8 V, RF In = –30 dBm, unless otherwise noted. Tested in Circuit Shown in Figure 1.)

| Characteristic                                                      | Symbol           | Min        | Typ      | Max        | Unit |
|---------------------------------------------------------------------|------------------|------------|----------|------------|------|
| RF Gain<br>MRFIC0930<br>MRFIC0930DM                                 | S <sub>21</sub>  | 17<br>17.5 | 19<br>19 | 21<br>21.5 | dB   |
| RF Gain (V <sub>gain</sub> = 0 V)                                   | S <sub>21</sub>  | –          | 0.8      | 4.0        | dB   |
| SSB Noise Figure [Note]                                             | NF               | –          | 1.7      | 3.0        | dB   |
| SSB Noise Figure (V <sub>gain</sub> = 0 V) [Note]                   | NF               | –          | 10.4     | –          | dB   |
| RF Input 3rd Order Intercept Point [Note]                           | IIP3             | –12        | –9.0     | –          | dBm  |
| RF Input 3rd Order Intercept Point (V <sub>gain</sub> = 0 V) [Note] | IIP3             | –7.0       | –5.7     | –          | dBm  |
| Input 1.0 dB Gain Compression [Note]                                | P <sub>1dB</sub> | –21.5      | –20.8    | –          | dBm  |
| Input 1.0 dB Gain Compression (V <sub>gain</sub> = 0 V) [Note]      | P <sub>1dB</sub> | –16        | –11      | –          | dBm  |
| Reverse Isolation (S <sub>12</sub> )                                | S <sub>12</sub>  | –          | 41       | –          | dB   |
| Input Return Loss                                                   | S <sub>11</sub>  | –          | 15       | –          | dB   |
| Input Return Loss (V <sub>gain</sub> = 0 V)                         | S <sub>11</sub>  | –          | 15       | –          | dB   |
| Output Return Loss                                                  | S <sub>22</sub>  | –          | 15       | –          | dB   |
| Output Return Loss (V <sub>gain</sub> = 0 V)                        | S <sub>22</sub>  | –          | 12       | –          | dB   |
| Supply Current Rx Mode                                              | I <sub>D</sub>   | –          | 8.5      | 12         | mA   |
| Supply Current Standby Mode (Rx Enable = 0 V)                       | I <sub>D</sub>   | –          | 20       | 200        | μA   |

**NOTE:** Guaranteed by design.

**Figure 1. 900 MHz Test Circuit**



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## TYPICAL CHARACTERISTICS (For SO-8 Packaged MRFIC0930)

Figure 2. Reverse Isolation versus Frequency

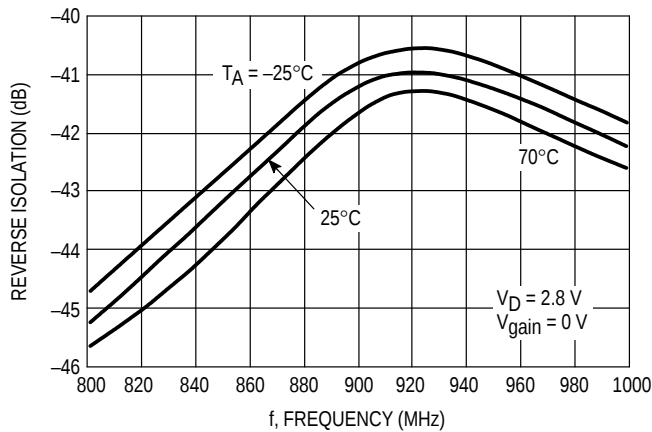


Figure 3. Reverse Isolation versus Frequency

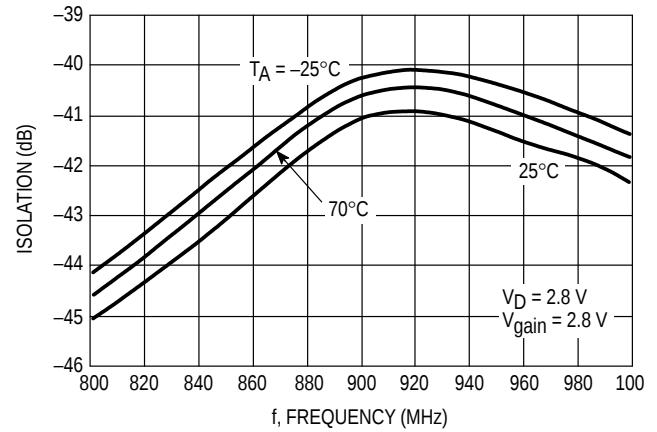


Figure 4. Gain versus Frequency

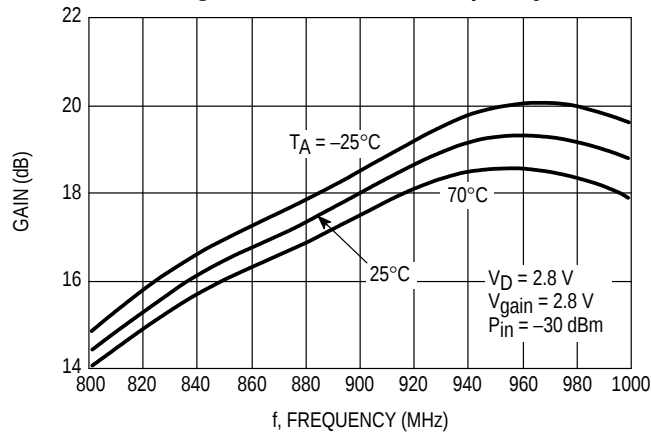


Figure 5. Gain Attenuation versus Frequency

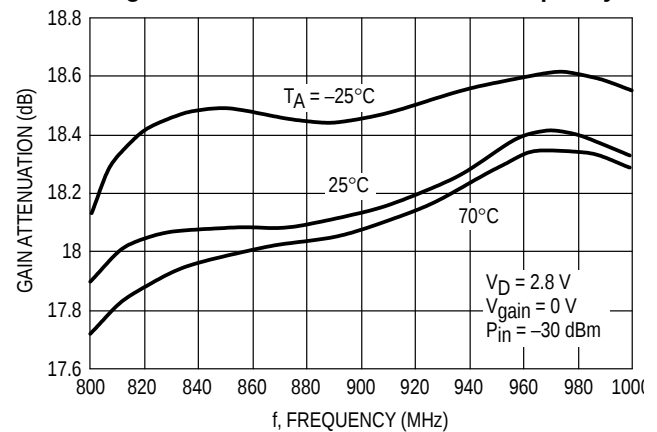


Figure 6. Gain versus Frequency

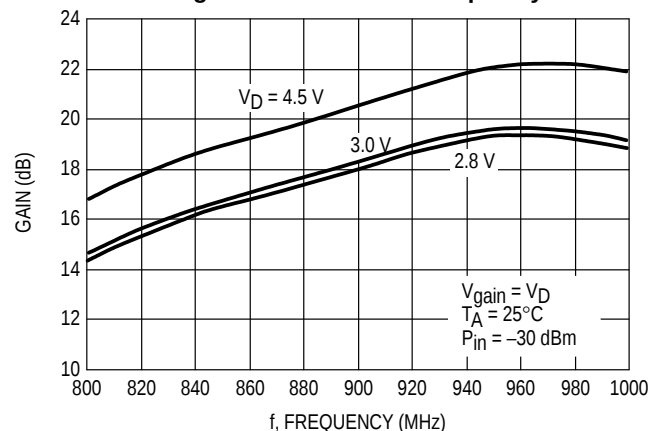
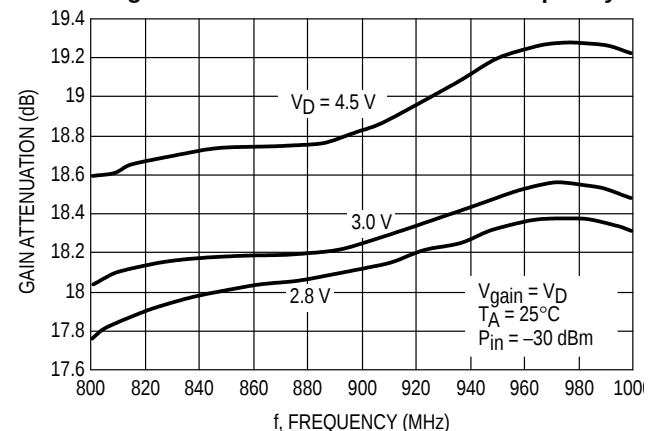


Figure 7. Gain Attenuation versus Frequency



# Freescale Semiconductor, Inc.

## TYPICAL CHARACTERISTICS

(For SO-8 Packaged MRFIC0930)

Figure 8. Input Power versus Output Power

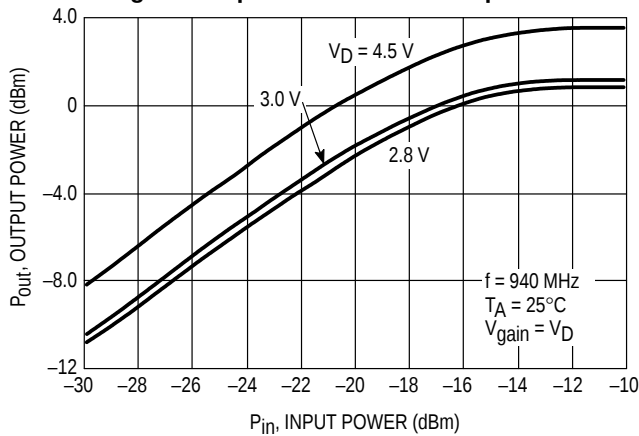


Figure 9. Input Power versus Output Power

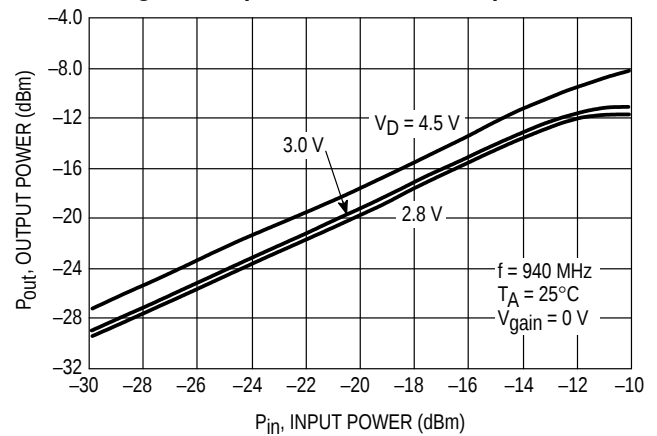


Figure 10. Input Power versus Output Power

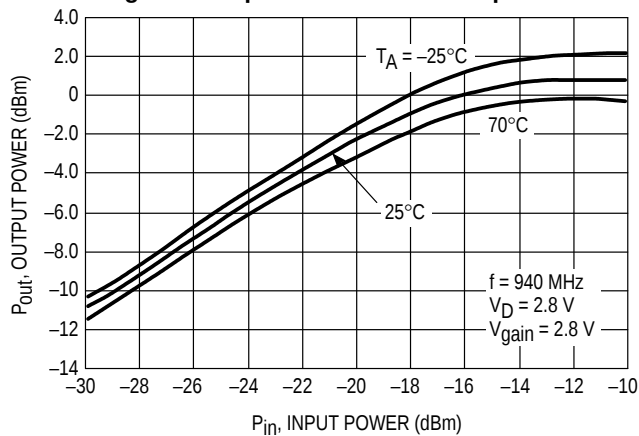


Figure 11. Input Power versus Output Power

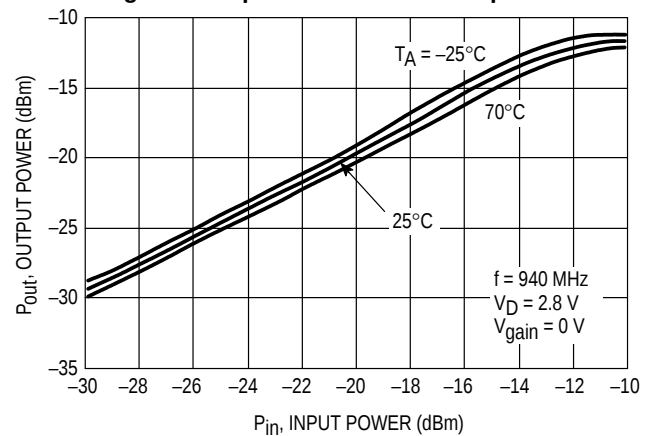


Figure 12. Noise Figure versus Frequency

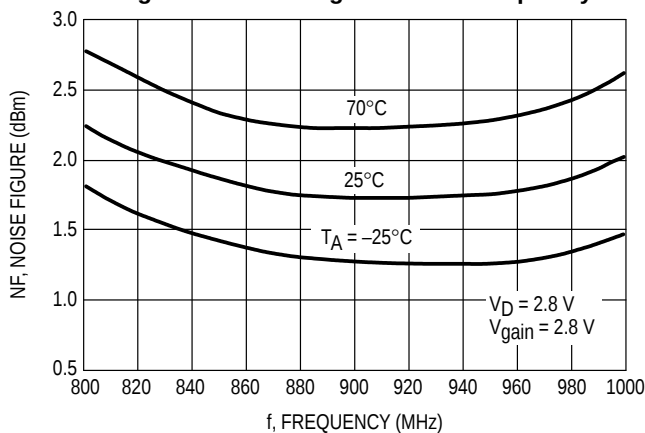
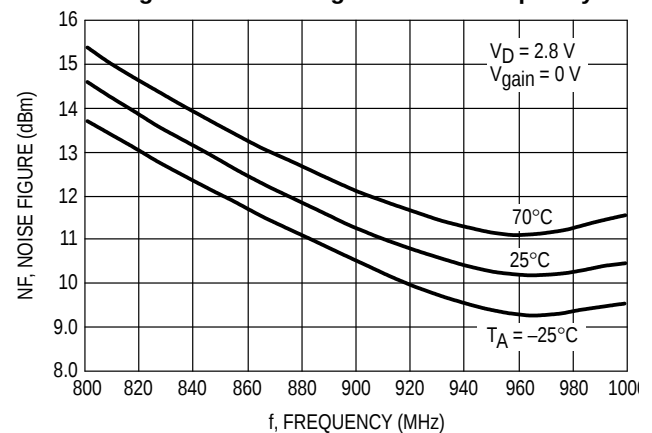


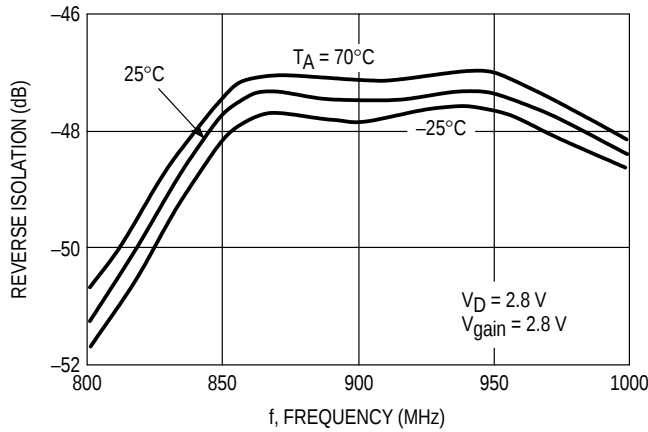
Figure 13. Noise Figure versus Frequency



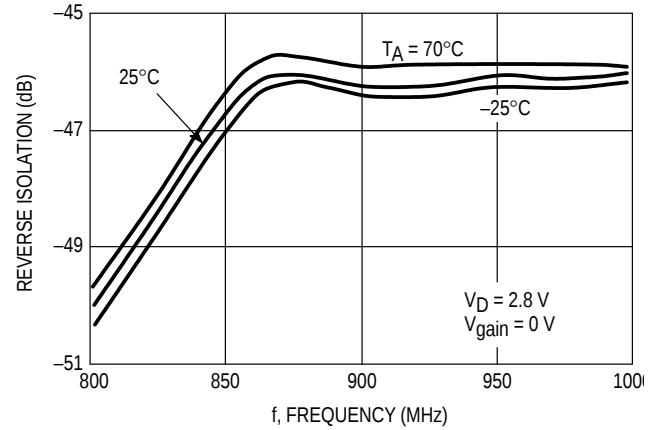
# Freescale Semiconductor, Inc.

## TYPICAL CHARACTERISTICS (For Micro-8 Packaged MRFIC0930DM)

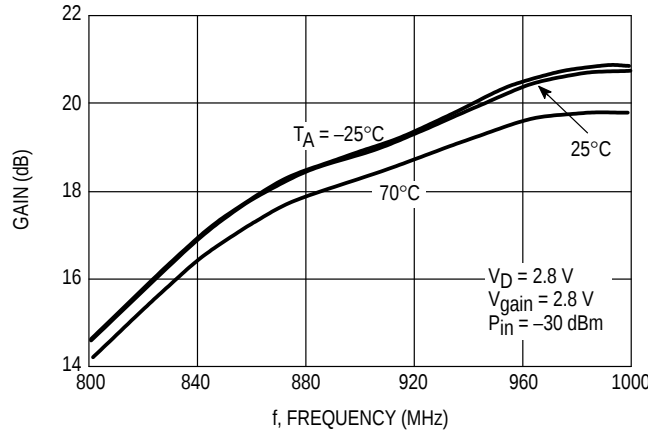
**Figure 14. Reverse Isolation versus Frequency**



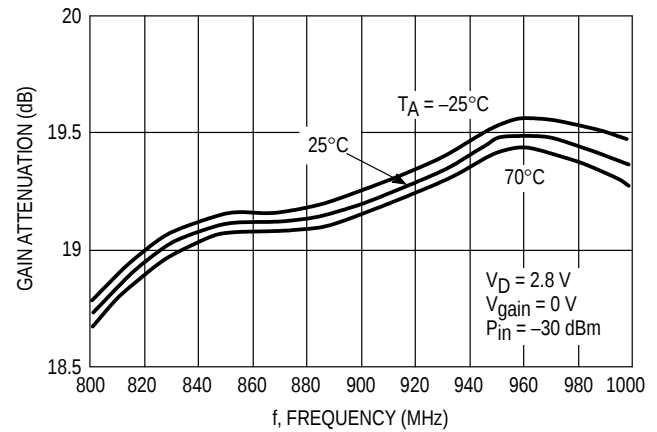
**Figure 15. Reverse Isolation versus Frequency**



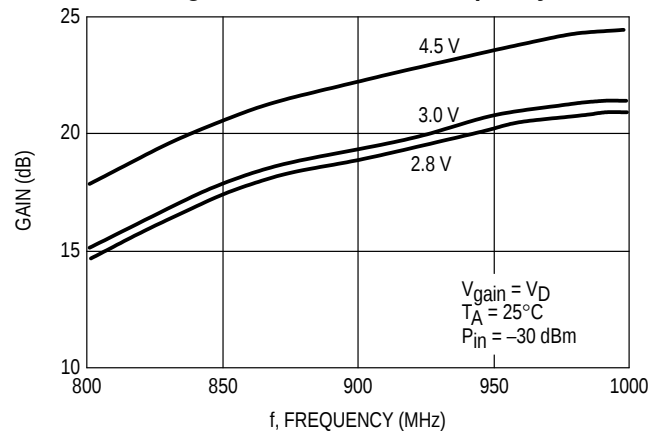
**Figure 16. Gain versus Frequency**



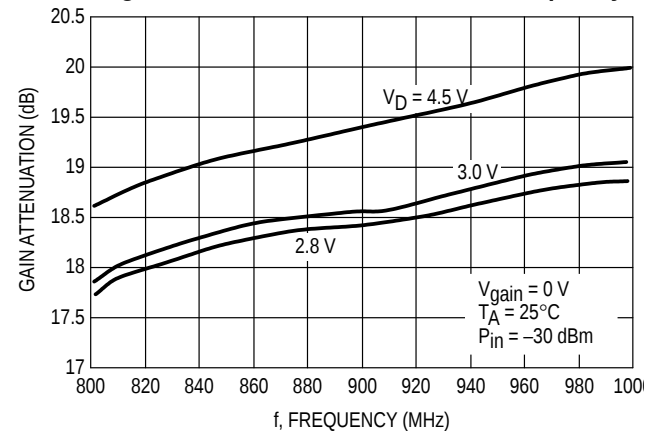
**Figure 17. Gain Attenuation versus Frequency**



**Figure 18. Gain versus Frequency**



**Figure 19. Gain Attenuation versus Frequency**



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## TYPICAL CHARACTERISTICS (For Micro-8 Packaged MRFIC0930DM)

Figure 20. Input Power versus Output Power

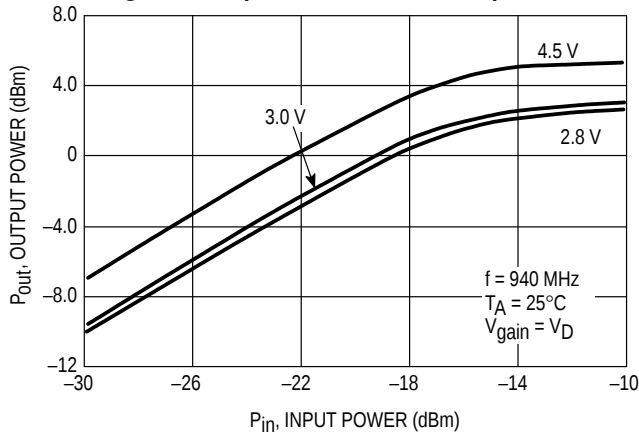


Figure 21. Input Power versus Output Power

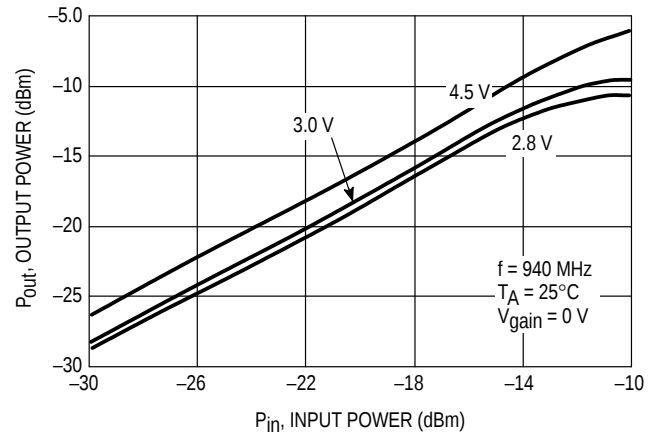


Figure 22. Input Power versus Output Power

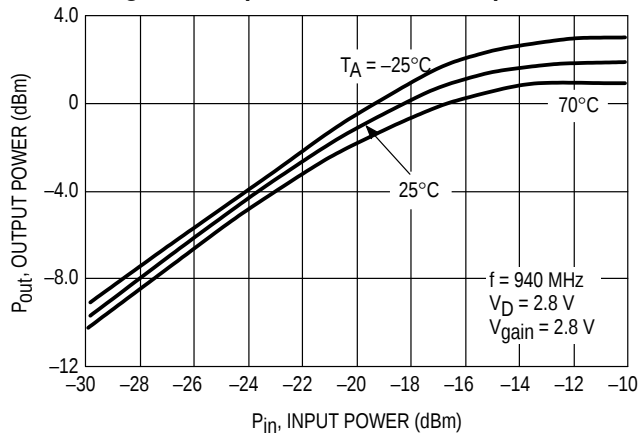


Figure 23. Input Power versus Output Power

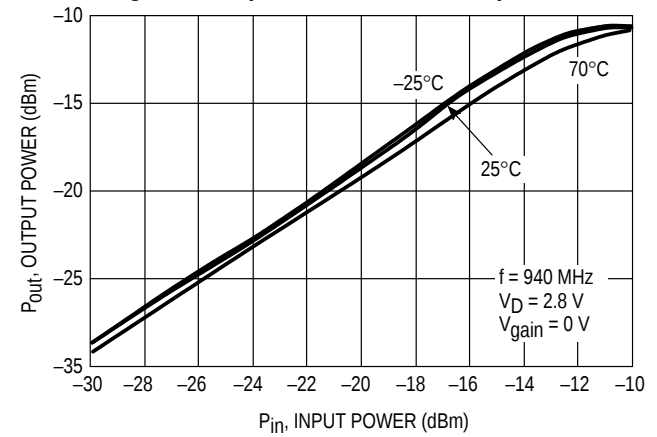


Figure 24. Noise Figure versus Frequency

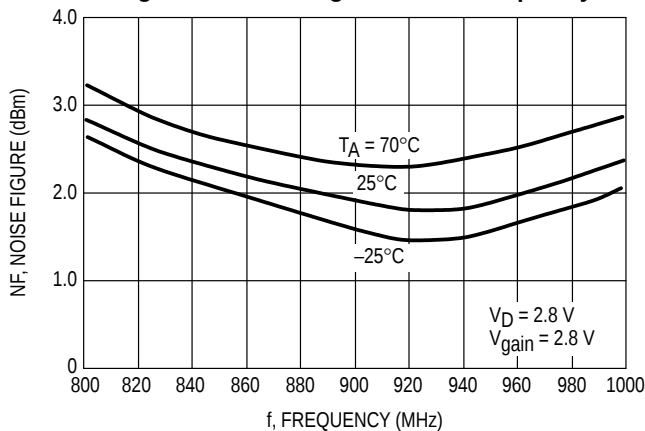
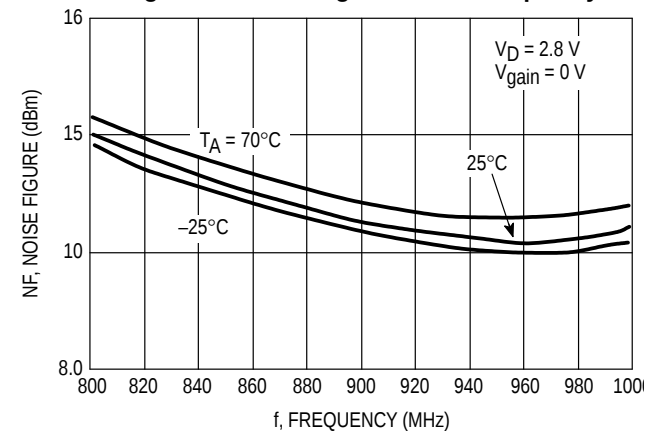
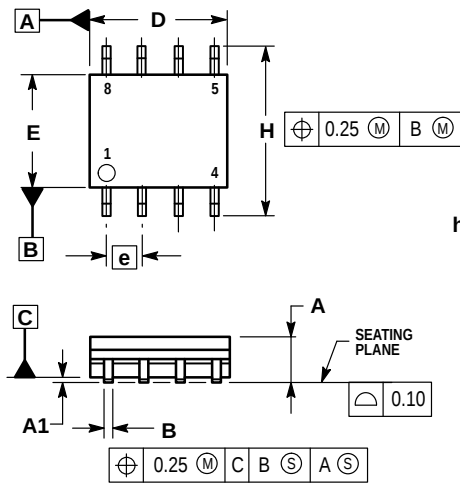


Figure 25. Noise Figure versus Frequency



## OUTLINE DIMENSIONS

### PLASTIC PACKAGE CASE 751-06 (SO-8) ISSUE T

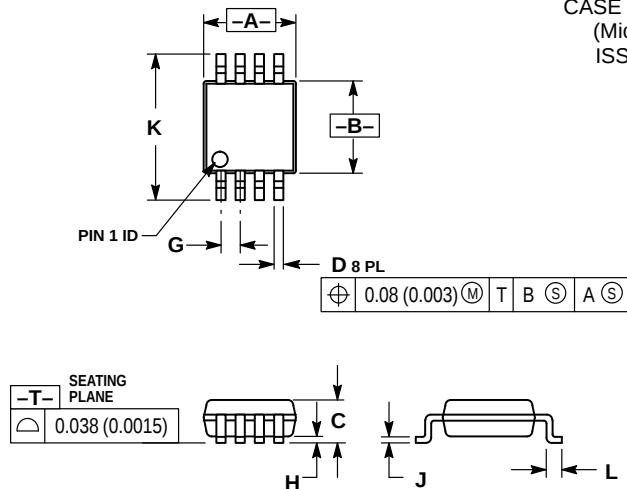


#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. DIMENSIONS ARE IN MILLIMETER.
3. DIMENSION D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR 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   | 0.19        | 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°   |

### PLASTIC PACKAGE CASE 846A-02 (Micro-8) ISSUE D



#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 2.90        | 3.10 | 0.114     | 0.122 |
| B   | 2.90        | 3.10 | 0.114     | 0.122 |
| C   | —           | 1.10 | —         | 0.043 |
| D   | 0.25        | 0.40 | 0.010     | 0.016 |
| G   | 0.65 BSC    |      | 0.026 BSC |       |
| H   | 0.05        | 0.15 | 0.002     | 0.006 |
| J   | 0.13        | 0.23 | 0.005     | 0.009 |
| K   | 4.75        | 5.05 | 0.187     | 0.199 |
| L   | 0.40        | 0.70 | 0.016     | 0.028 |

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