# Cascadable Silicon Bipolar MMIC Amplifier

## Technical Data

**MSA-0870**

### Features

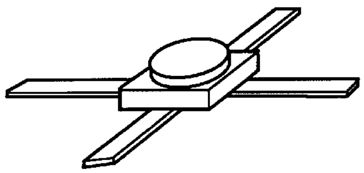
- **Usable Gain to 6.0 GHz**
- **High Gain:**
  32.5 dB Typical at 0.1 GHz
  23.5 dB Typical at 1.0 GHz
- **Low Noise Figure:**
  3.0 dB Typical at 1.0 GHz
- **Hermetic Gold-ceramic Microstrip Package**

### Description

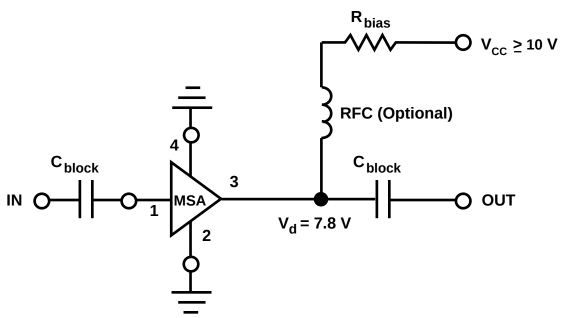
The MSA-0870 is a high performance silicon bipolar Monolithic Microwave Integrated Circuit (MMIC) housed in a hermetic, high reliability package. This MMIC is designed for use as a general purpose 50 Ω gain block above 0.5 GHz and can be used as a high gain transistor below this frequency. Typical applications include narrow and moderate band IF and RF amplifiers in industrial and military applications.

The MSA-series is fabricated using HP's 10 GHz $f_T$, 25 GHz $f_{MAX}$, silicon bipolar MMIC process which uses nitride self-alignment, ion implantation, and gold metallization to achieve excellent performance, uniformity and reliability. The use of an external bias resistor for temperature and current stability also allows bias flexibility.

### 70 mil Package



### Typical Biasing Configuration



## MSA-0870 Absolute Maximum Ratings

| Parameter | Absolute Maximum[1] |
|---|---|
| Device Current | 80 mA |
| Power Dissipation[2,3] | 750 mW |
| RF Input Power | +13 dBm |
| Junction Temperature | 200°C |
| Storage Temperature | –65°C to 200°C |

| Thermal Resistance[2,4]: |
|---|
| $\theta_{jc}$ = 150°C/W |

**Notes:**

1. Permanent damage may occur if any of these limits are exceeded.
2. $T_{CASE}$ = 25°C.
3. Derate at 6.7 mW/°C for $T_C$ > 88°C.
4. The small spot size of this technique results in a higher, though more accurate determination of $\theta_{jc}$ than do alternate methods. See MEASUREMENTS section "Thermal Resistance" for more information.

## Electrical Specifications[1], $T_A$ = 25°C

| Symbol | Parameters and Test Conditions: $I_d$ = 36 mA, $Z_O$ = 50 Ω | | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|---|
| $G_P$ | Power Gain ($\|S_{21}\|^2$) | f = 0.1 GHz<br>f = 1.0 GHz<br>f = 4.0 GHz | dB | <br>22.0<br> | 32.5<br>23.5<br>11.0 | <br>25.0<br>12.0 |
| VSWR | Input VSWR | f = 1.0 to 3.0 GHz | | | 2.0:1 | |
| | Output VSWR | f = 1.0 to 3.0 GHz | | | 1.9:1 | |
| NF | 50 Ω Noise Figure | f = 1.0 GHz | dB | | 3.0 | |
| $P_{1\,dB}$ | Output Power at 1 dB Gain Compression | f = 1.0 GHz | dBm | | 12.5 | |
| $IP_3$ | Third Order Intercept Point | f = 1.0 GHz | dBm | | 27.0 | |
| $t_D$ | Group Delay | f = 1.0 GHz | psec | | 125 | |
| $V_d$ | Device Voltage | | V | 7.0 | 7.8 | 8.4 |
| dV/dT | Device Voltage Temperature Coefficient | | mV/°C | | –17.0 | |

**Note:**

1. The recommended operating current range for this device is 20 to 40 mA. Typical performance as a function of current is on the following page.

## MSA-0870 Typical Scattering Parameters[1] ($Z_O$ = 50 Ω, $T_A$ = 25°C, $I_d$ = 36 mA)

| Freq. GHz | $S_{11}$ | | $S_{21}$ | | | $S_{12}$ | | | $S_{22}$ | | k |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mag | Ang | dB | Mag | Ang | dB | Mag | Ang | Mag | Ang | |
| 0.1 | .65 | –19 | 32.5 | 42.04 | 161 | –36.3 | .015 | 40 | .64 | –22 | 0.78 |
| 0.2 | .60 | –35 | 31.5 | 37.54 | 145 | –33.7 | .021 | 47 | .58 | –43 | 0.66 |
| 0.4 | .48 | –60 | 29.1 | 28.49 | 122 | –30.5 | .030 | 51 | .47 | –74 | 0.64 |
| 0.6 | .40 | –76 | 26.8 | 21.90 | 108 | –28.0 | .040 | 50 | .38 | –97 | 0.72 |
| 0.8 | .35 | –88 | 24.9 | 17.48 | 97 | –26.2 | .049 | 50 | .33 | –113 | 0.78 |
| 1.0 | .32 | –102 | 23.4 | 14.85 | 87 | –24.9 | .057 | 51 | .28 | –128 | 0.83 |
| 1.5 | .29 | –118 | 20.1 | 10.14 | 70 | –23.0 | .071 | 47 | .22 | –151 | 0.91 |
| 2.0 | .30 | –133 | 17.6 | 7.55 | 56 | –21.9 | .081 | 45 | .16 | –167 | 0.98 |
| 2.5 | .31 | –139 | 15.6 | 6.01 | 49 | –20.0 | .100 | 46 | .12 | –172 | 1.02 |
| 3.0 | .32 | –149 | 13.8 | 4.87 | 39 | –19.5 | .106 | 41 | .07 | –170 | 1.11 |
| 3.5 | .34 | –159 | 12.2 | 4.09 | 28 | –18.4 | .121 | 35 | .07 | –143 | 1.12 |
| 4.0 | .34 | –168 | 10.8 | 3.48 | 17 | –17.7 | .131 | 31 | .12 | –112 | 1.16 |
| 5.0 | .33 | 161 | 8.4 | 2.63 | –3 | –16.6 | .147 | 21 | .19 | –103 | 1.26 |
| 6.0 | .39 | 128 | 6.2 | 2.04 | –22 | –16.2 | .155 | 10 | .21 | –115 | 1.36 |

**Note:**
1. A model for this device is available in the DEVICE MODELS section.

## Typical Performance, $T_A$ = 25°C

(unless otherwise noted)

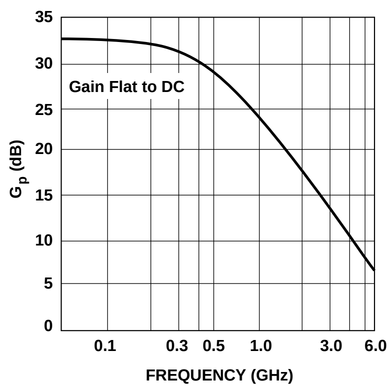



**Figure 1. Typical Power Gain vs. Frequency, $I_d$ = 36 mA.**

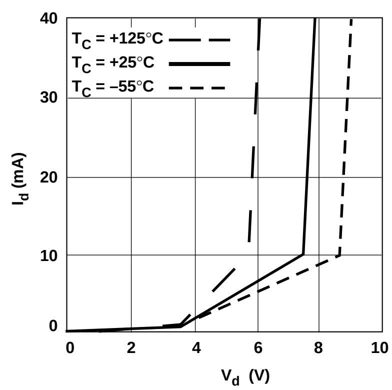



**Figure 2. Device Current vs. Voltage.**

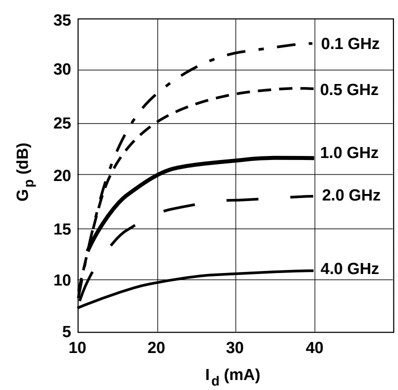



**Figure 3. Power Gain vs. Current.**

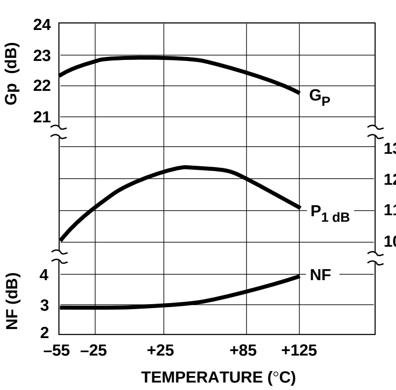



**Figure 4. Output Power at 1 dB Gain Compression, NF and Power Gain vs. Case Temperature, f = 1.0 GHz, $I_d$ = 36 mA.**

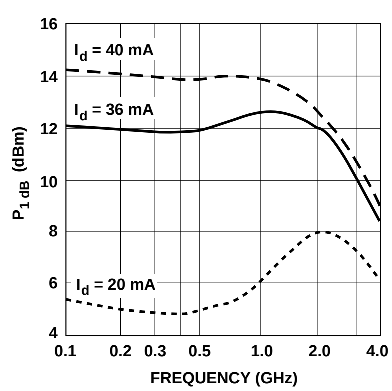



**Figure 5. Output Power at 1 dB Gain Compression vs. Frequency.**

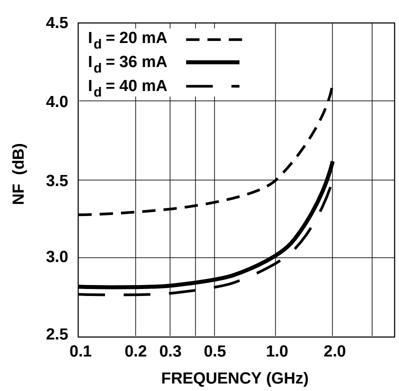
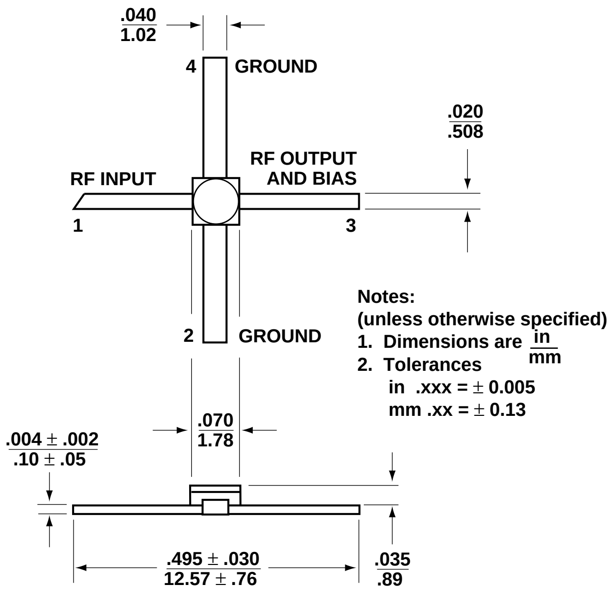



**Figure 6. Noise Figure vs. Frequency.**

## 70 mil Package Dimensions




For technical assistance or the location of your nearest Hewlett-Packard sales office, distributor or representative call:

**Americas/Canada:** 1-800-235-0312 or 408-654-8675

**Far East/Australasia:** Call your local HP sales office.

**Japan:** (81 3) 3335-8152

**Europe:** Call your local HP sales office.

Data subject to change.


Obsoletes 5965-9544E
Printed in U.S.A. 5968-0528E (6/98)