

## Cascadable Silicon Bipolar MMIC Amplifier

# Technical Data

#### **MSA-0170**

#### Features

- Cascadable 50  $\Omega$  Gain Block
- **3 dB Bandwidth:** DC to 1.3 GHz
- High Gain: 18.5 dB Typical at 0.5 GHz
- Unconditionally Stable (k>1)
- Hermetic Gold-ceramic Microstrip Package

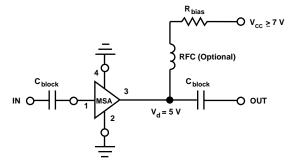
#### Description

The MSA-0170 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  $\Omega$  gain block. Typical applications include narrow and broad 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-0170 Absolute Maximum Ratings

| Parameter                          | Absolute Maximum <sup>[1]</sup> |
|------------------------------------|---------------------------------|
| Device Current                     | 40 mA                           |
| Power Dissipation <sup>[2,3]</sup> | 200 mW                          |
| RF Input Power                     | +13dBm                          |
| Junction Temperature               | 200°C                           |
| Storage Temperature                | −65 to 200°C                    |

Thermal Resistance<sup>[2,4]</sup>:

 $\theta_{\rm jc} = 125$ °C/W

#### Notes:

- 1. Permanent damage may occur if any of these limits are exceeded.
- 2.  $T_{CASE} = 25^{\circ}C.$
- 3. Derate at 8 mW/°C for  $T_C > 175$ °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.

| Symbol            | Parameters and Test Conditions:        | Units                  | Min.  | Тур. | Max.  |     |
|-------------------|--|------------------------|-------|------|-------|-----|
| GP                | Power Gain $( S_{21} ^2)$              | $f = 0.1 \mathrm{GHz}$ | dB    | 18.0 | 19.0  |     |
| $\Delta G_P$      | Gain Flatness                          | f=0.1to0.7GHz          | dB    |      | ±0.6  |     |
| f <sub>3 dB</sub> | 3 dB Bandwidth                         |                        | GHz   |      | 1.3   |     |
| VSWR              | Input VSWR                             | f = 0.1  to  3.0  GHz  |       |      | 1.3:1 |     |
|                   | Output VSWR                            | f = 0.1  to  3.0  GHz  |       |      | 1.3:1 |     |
| NF                | $50 \Omega$ Noise Figure               | f = 0.5 GHz            | dB    |      | 5.5   |     |
| P <sub>1 dB</sub> | Output Power at 1 dB Gain Compression  | f = 0.5 GHz            | dBm   |      | 1.5   |     |
| IP <sub>3</sub>   | Third Order Intercept Point            | f = 0.5 GHz            | dBm   |      | 14.0  |     |
| tD                | Group Delay                            | f = 0.5 GHz            | psec  |      | 150   |     |
| Vd                | Device Voltage                         |                        | V     | 4.5  | 5.0   | 5.5 |
| dV/dT             | Device Voltage Temperature Coefficient |                        | mV/°C |      | -9.0  |     |

### MSA-0170 Electrical Specifications<sup>[1]</sup>, $T_A = 25^{\circ}C$

Note:

1. The recommended operating current range for this device is 13 to 25 mA. Typical performance as a function of current is on the following page.

| Freq. | S <sub>11</sub> |      | $S_{21}$ |      | S <sub>12</sub> |       |      | $\mathbf{S}_{22}$ |     |      |
|-------|-----------------|------|----------|------|-----------------|-------|------|-------------------|-----|------|
| GHz   | Mag             | Ang  | dB       | Mag  | Ang             | dB    | Mag  | Ang               | Mag | Ang  |
| 0.1   | .08             | 171  | 19.0     | 8.88 | 173             | -22.7 | .073 | 2                 | .10 | -13  |
| 0.2   | .07             | 161  | 18.9     | 8.77 | 167             | -22.5 | .075 | 6                 | .11 | -27  |
| 0.3   | .07             | 152  | 18.7     | 8.64 | 160             | -22.3 | .077 | 8                 | .10 | -39  |
| 0.4   | .06             | 143  | 18.5     | 8.45 | 153             | -22.4 | .076 | 11                | .11 | -49  |
| 0.5   | .05             | 133  | 18.3     | 8.23 | 147             | -22.0 | .079 | 13                | .11 | -59  |
| 0.6   | .04             | 115  | 18.0     | 7.98 | 141             | -21.8 | .081 | 17                | .12 | -67  |
| 0.8   | .03             | 79   | 17.5     | 7.46 | 130             | -21.2 | .087 | 20                | .12 | -83  |
| 1.0   | .04             | -14  | 16.8     | 6.90 | 119             | -20.2 | .098 | 23                | .12 | -96  |
| 1.5   | .08             | -52  | 15.0     | 5.64 | 96              | -19.0 | .112 | 26                | .10 | -116 |
| 2.0   | .12             | -87  | 13.2     | 4.58 | 78              | -17.7 | .131 | 24                | .08 | -134 |
| 2.5   | .15             | -112 | 11.7     | 3.85 | 67              | -16.7 | .147 | 25                | .07 | -135 |
| 3.0   | .19             | -132 | 10.3     | 3.27 | 54              | -16.1 | .156 | 22                | .07 | -129 |
| 3.5   | .24             | -148 | 8.9      | 2.80 | 41              | -15.4 | .170 | 18                | .09 | -117 |
| 4.0   | .26             | -159 | 7.7      | 2.43 | 29              | -15.0 | .177 | 13                | .13 | -106 |
| 4.5   | .27             | -170 | 6.6      | 2.14 | 18              | -14.7 | .184 | 8                 | .17 | -105 |
| 5.0   | .27             | 175  | 5.7      | 1.92 | 8               | -14.3 | .192 | 5                 | .20 | -106 |

MSA-0170 Typical Scattering Parameters (Z $_{0}$  = 50  $\Omega,$   $T_{A}$  = 25°C,  $I_{d}$  = 17 mA)

A model for this device is available in the DEVICE MODELS section.

### MSA-0170 Typical Performance, $T_A = 25^{\circ}C$

(unless otherwise noted)

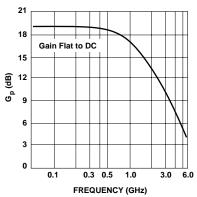


Figure 1. Typical Power Gain vs. Frequency,  $T_A = 25^{\circ}C$ ,  $I_d = 17$  mA.

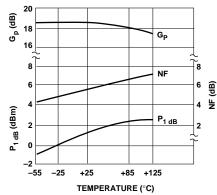


Figure 4. Output Power at 1 dB Gain Compression, NF and Power Gain vs. CaseTemperature, f = 0.5 GHz,  $I_d = 17$  mA.

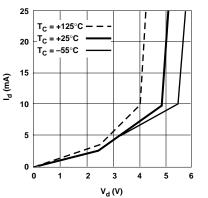


Figure 2. Device Current vs. Voltage.

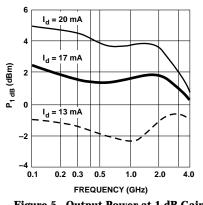


Figure 5. Output Power at 1 dB Gain Compression vs. Frequency.

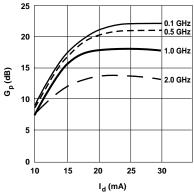


Figure 3. Power Gain vs. Current.

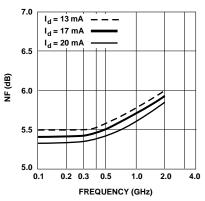


Figure 6. Noise Figure vs. Frequency.



