

# 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**

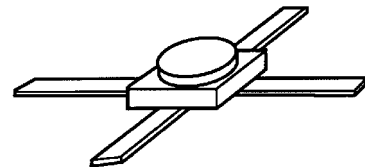
### Description

The MSA-0170 is a high performance silicon bipolar Monolithic Microwave Integrated Circuit (MMIC) housed in a hermetic high reliability package. This MMIC is

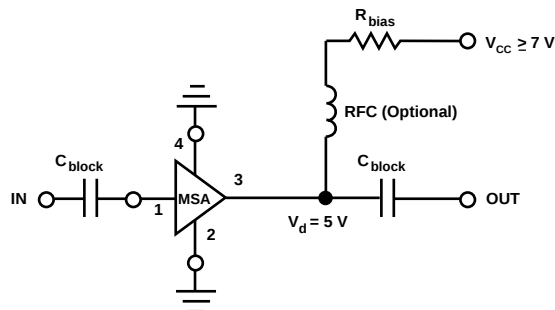
designed for use as a general purpose 50  $\Omega$  gain block. Typical applications include narrow and broad band IF and RF amplifiers in industrial and military applications.

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                     | +13 dBm                         |
| Junction Temperature               | 200°C                           |
| Storage Temperature                | –65 to 200°C                    |

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

$$\theta_{jc} = 125^{\circ}\text{C/W}$$

**Notes:**

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

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

| Symbol             | Parameters and Test Conditions: $I_d = 17 \text{ mA}$ , $Z_o = 50 \Omega$ | Units | Min. | Typ.      | Max. |
|--------------------|---------------------------------------------------------------------------|-------|------|-----------|------|
| $G_P$              | Power Gain ( $ S_{21} ^2$ ) $f = 0.1 \text{ GHz}$                         | dB    | 18.0 | 19.0      |      |
| $\Delta G_P$       | Gain Flatness $f = 0.1 \text{ to } 0.7 \text{ GHz}$                       | dB    |      | $\pm 0.6$ |      |
| $f_{3 \text{ dB}}$ | 3 dB Bandwidth                                                            | GHz   |      | 1.3       |      |
| VSWR               | Input VSWR $f = 0.1 \text{ to } 3.0 \text{ GHz}$                          |       |      | 1.3:1     |      |
|                    | Output VSWR $f = 0.1 \text{ to } 3.0 \text{ GHz}$                         |       |      | 1.3:1     |      |
| NF                 | 50 $\Omega$ Noise Figure $f = 0.5 \text{ GHz}$                            | dB    |      | 5.5       |      |
| $P_{1 \text{ dB}}$ | Output Power at 1 dB Gain Compression $f = 0.5 \text{ GHz}$               | dBm   |      | 1.5       |      |
| $IP_3$             | Third Order Intercept Point $f = 0.5 \text{ GHz}$                         | dBm   |      | 14.0      |      |
| $t_D$              | Group Delay $f = 0.5 \text{ GHz}$                                         | psec  |      | 150       |      |
| $V_d$              | Device Voltage                                                            | V     | 4.5  | 5.0       | 5.5  |
| $dV/dT$            | Device Voltage Temperature Coefficient                                    | mV/°C |      | –9.0      |      |

**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.

### MSA-0170 Typical Scattering Parameters ( $Z_0 = 50 \Omega$ , $T_A = 25^\circ\text{C}$ , $I_d = 17 \text{ mA}$ )

| Freq.<br>GHz | S <sub>11</sub> |      | S <sub>21</sub> |      |     | S <sub>12</sub> |      |     | S <sub>22</sub> |      |
|--------------|-----------------|------|-----------------|------|-----|-----------------|------|-----|-----------------|------|
|              | 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 |

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

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

(unless otherwise noted)

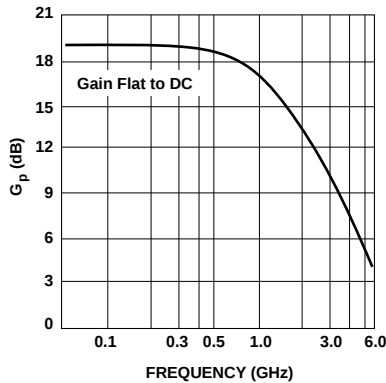


Figure 1. Typical Power Gain vs. Frequency,  $T_A = 25^\circ\text{C}$ ,  $I_d = 17 \text{ mA}$ .

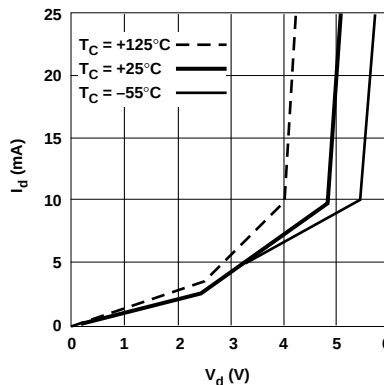


Figure 2. Device Current vs. Voltage.

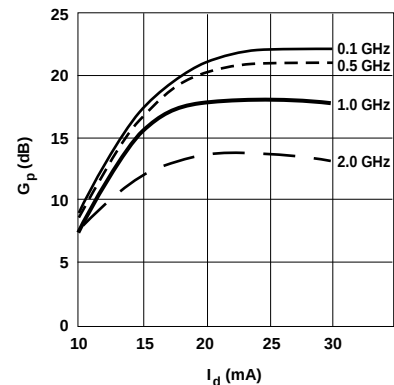


Figure 3. Power Gain vs. Current.

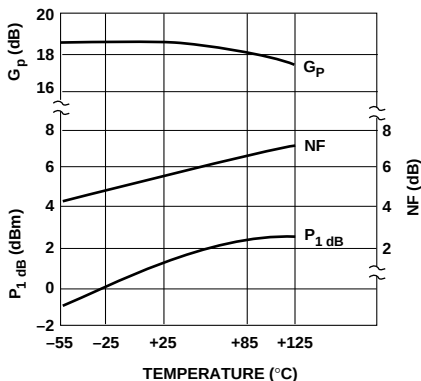


Figure 4. Output Power at 1 dB Gain Compression, NF and Power Gain vs. Case Temperature,  $f = 0.5 \text{ GHz}$ ,  $I_d = 17 \text{ mA}$ .

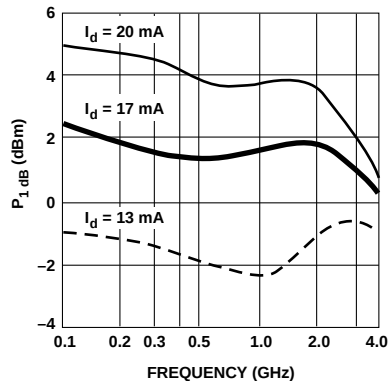


Figure 5. Output Power at 1 dB Gain Compression vs. Frequency.

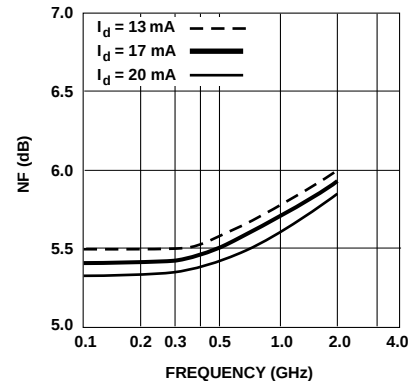
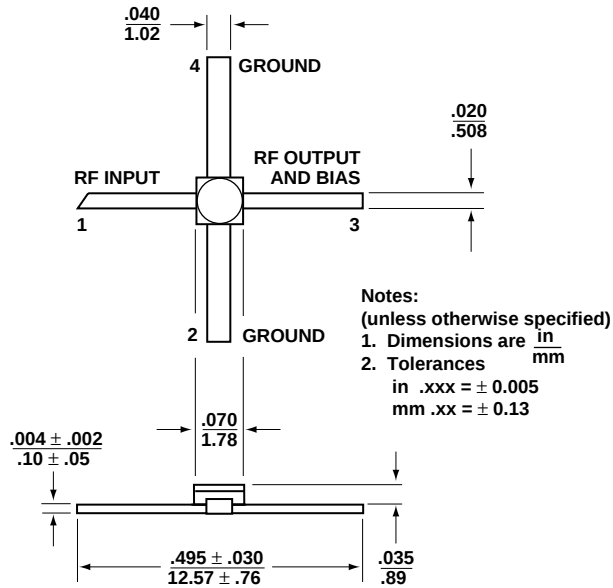


Figure 6. Noise Figure vs. Frequency.

## 70 mil Package Dimensions



[www.hp.com/go/rf](http://www.hp.com/go/rf)

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