

# MSA-0786

## Cascadable Silicon Bipolar MMIC Amplifier



### Data Sheet

#### Description

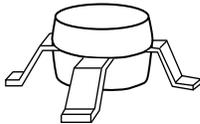
The MSA-0786 is a high performance silicon bipolar Monolithic Microwave Integrated Circuit (MMIC) housed in a low cost, surface mount plastic package. This MMIC is designed for use as a general purpose 50Ω gain block. Applications include narrow and broad band IF and RF amplifiers in commercial and industrial applications.

The MSA-series is fabricated using Avago'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.

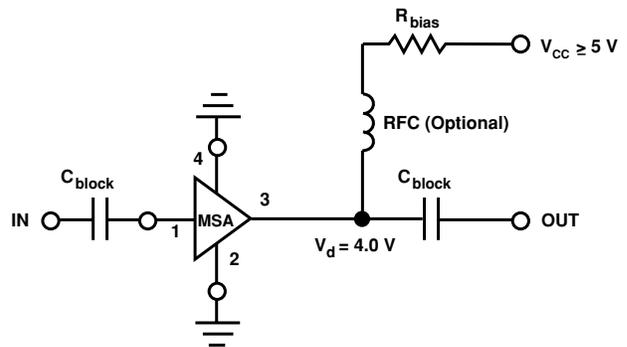
#### Features

- Cascadable 50Ω Gain Block
- Low Operating Voltage:  
4.0 V Typical  $V_d$
- 3 dB Bandwidth:  
DC to 2.0 GHz
- 12.5 dB Typical Gain at 1.0 GHz
- Unconditionally Stable ( $k > 1$ )
- Surface Mount Plastic Package
- Tape-and-Reel Packaging Option Available
- Lead-free Option Available

#### 86 Plastic Package



#### Typical Biasing Configuration



### MSA-0786 Absolute Maximum Ratings

| Parameter                          | Absolute Maximum <sup>[1]</sup> |
|------------------------------------|---------------------------------|
| Device Current                     | 60 mA                           |
| Power Dissipation <sup>[2,3]</sup> | 275 mW                          |
| RF Input Power                     | +13 dBm                         |
| Junction Temperature               | 150°C                           |
| Storage Temperature                | -65 to 150°C                    |

#### Thermal Resistance<sup>[2]:</sup>

$$\theta_{jc} = 120^{\circ}\text{C/W}$$

#### Notes:

1. Permanent damage may occur if any of these limits are exceeded.
2.  $T_{\text{CASE}} = 25^{\circ}\text{C}$ .
3. Derate at  $8.3 \text{ mW/}^{\circ}\text{C}$  for  $T_{\text{C}} > 117^{\circ}\text{C}$ .

### Electrical Specifications<sup>[1]</sup>, $T_{\text{A}} = 25^{\circ}\text{C}$

| Symbol                | Parameters and Test Conditions: $I_{\text{d}} = 22 \text{ mA}$ , $Z_{\text{o}} = 50 \Omega$ | Units                  | Min. | Typ.         | Max. |
|-----------------------|---|------------------------|------|--------------|------|
| $G_{\text{P}}$        | Power Gain ( $ S_{21} ^2$ )<br>$f = 0.1 \text{ GHz}$<br>$f = 1.0 \text{ GHz}$               | dB                     | 10.5 | 13.5<br>12.5 |      |
| $\Delta G_{\text{P}}$ | Gain Flatness<br>$f = 0.1 \text{ to } 1.3 \text{ GHz}$                                      | dB                     |      | $\pm 0.7$    |      |
| $f_{3 \text{ dB}}$    | 3 dB Bandwidth  | GHz                    |      | 2.0          |      |
| VSWR                  | Input VSWR<br>$f = 0.1 \text{ to } 2.5 \text{ GHz}$   |                        |      | 1.7:1        |      |
|                       | Output VSWR<br>$f = 0.1 \text{ to } 2.5 \text{ GHz}$  |                        |      | 1.7:1        |      |
| NF                    | 50 $\Omega$ Noise Figure<br>$f = 1.0 \text{ GHz}$   | dB                     |      | 5.0          |      |
| $P_{1 \text{ dB}}$    | Output Power at 1 dB Gain Compression<br>$f = 1.0 \text{ GHz}$                              | dBm                    |      | 5.5          |      |
| $\text{IP}_3$         | Third Order Intercept Point<br>$f = 1.0 \text{ GHz}$  | dBm                    |      | 19.0         |      |
| $t_{\text{D}}$        | Group Delay<br>$f = 1.0 \text{ GHz}$  | psec                   |      | 150          |      |
| $V_{\text{d}}$        | Device Voltage  | V                      | 3.2  | 4.0          | 4.8  |
| $dV/dT$               | Device Voltage Temperature Coefficient  | mV/ $^{\circ}\text{C}$ |      | -7.0         |      |

#### Note:

1. The recommended operating current range for this device is 15 to 40 mA. Typical performance as a function of current is on the following page.

### Ordering Information

| Part Numbers  | No. of Devices | Comments |
|---------------|----------------|----------|
| MSA-0786-BLK  | 100            | Bulk     |
| MSA-0786-BLKG | 100            | Bulk     |
| MSA-0786-TR1  | 1000           | 7" Reel  |
| MSA-0786-TR1G | 1000           | 7" Reel  |

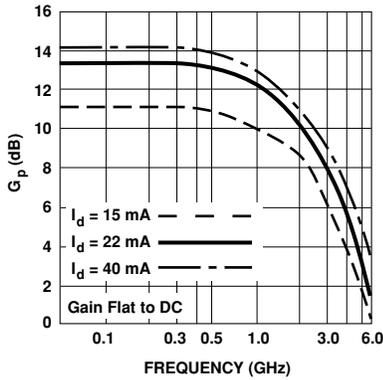
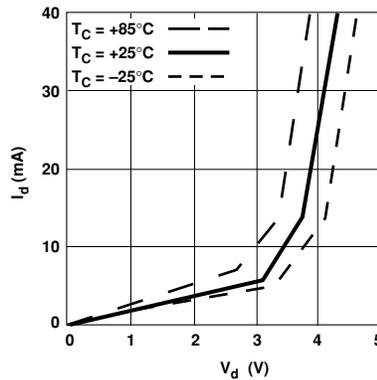
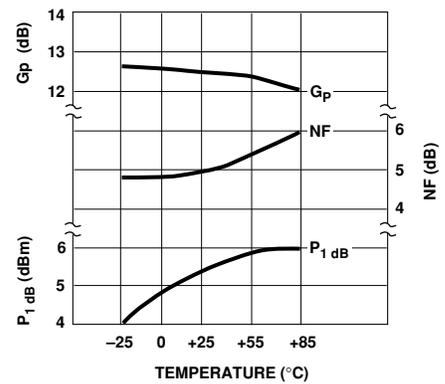
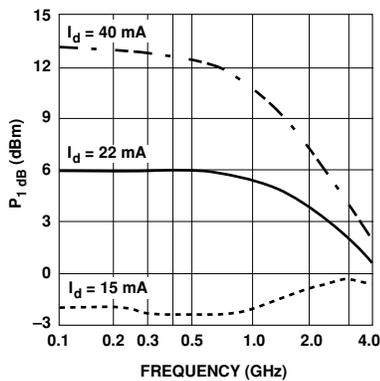
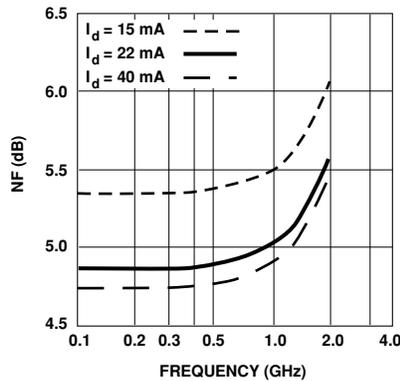
**Note:** Order part number with a "G" suffix if lead-free option is desired.

**MSA-0786 Typical Scattering Parameters ( $Z_0 = 50 \Omega$ ,  $T_A = 25^\circ\text{C}$ ,  $I_d = 22 \text{ mA}$ )**

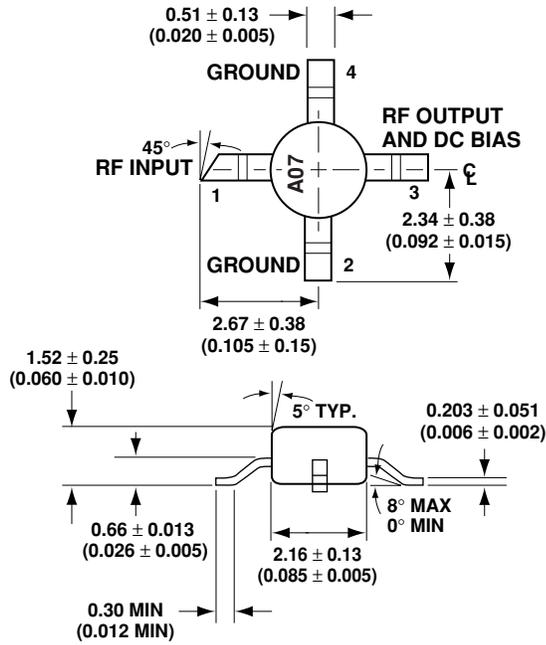
| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |      |     | $S_{12}$ |      |     | $S_{22}$ |      |
|--------------|----------|------|----------|------|-----|----------|------|-----|----------|------|
|              | Mag      | Ang  | dB       | Mag  | Ang | dB       | Mag  | Ang | Mag      | Ang  |
| 0.1          | .05      | 175  | 13.5     | 4.74 | 174 | -18.7    | .116 | 1   | .14      | -12  |
| 0.2          | .05      | 174  | 13.4     | 4.71 | 169 | -18.7    | .117 | 3   | .14      | -22  |
| 0.4          | .04      | 167  | 13.3     | 4.64 | 158 | -18.4    | .120 | 4   | .15      | -44  |
| 0.6          | .04      | 175  | 13.1     | 4.52 | 148 | -18.3    | .122 | 7   | .16      | -65  |
| 0.8          | .05      | -156 | 12.9     | 4.39 | 138 | -18.0    | .126 | 8   | .17      | -84  |
| 1.0          | .06      | -134 | 12.6     | 4.25 | 127 | -17.5    | .134 | 10  | .18      | -102 |
| 1.5          | .08      | -142 | 11.6     | 3.79 | 103 | -16.6    | .148 | 9   | .21      | -139 |
| 2.0          | .15      | -159 | 10.5     | 3.34 | 80  | -15.7    | .164 | 7   | .23      | -164 |
| 2.5          | .25      | -176 | 9.2      | 2.89 | 63  | -15.1    | .176 | 5   | .24      | 174  |
| 3.0          | .33      | 166  | 7.8      | 2.45 | 44  | -14.7    | .185 | 1   | .24      | 159  |
| 3.5          | .41      | 150  | 6.5      | 2.11 | 27  | -14.9    | .179 | -5  | .24      | 149  |
| 4.0          | .49      | 137  | 5.2      | 1.82 | 12  | -15.1    | .177 | -9  | .23      | 145  |
| 5.0          | .60      | 116  | 3.0      | 1.41 | -14 | -15.4    | .169 | -14 | .26      | 145  |

**Typical Performance,  $T_A = 25^\circ\text{C}$** 

(unless otherwise noted)


**Figure 1. Typical Power Gain vs. Frequency.**

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

**Figure 3. Output Power at 1 dB Gain Compression, NF and Power Gain vs. Case Temperature,  $f = 1.0 \text{ GHz}$ ,  $I_d = 22 \text{ mA}$ .**

**Figure 4. Output Power at 1 dB Gain Compression vs. Frequency.**

**Figure 5. Noise Figure vs. Frequency.**

## 86 Plastic Package Dimensions



DIMENSIONS ARE IN MILLIMETERS (INCHES)

For product information and a complete list of distributors, please go to our web site:  
[www.avagotech.com](http://www.avagotech.com)

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 Obsoletes 5968-4716E  
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