

# MSA-0986

## Cascadable Silicon Bipolar MMIC Amplifier



### Data Sheet

#### Description

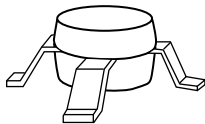
The MSA-0986 is a high performance silicon bipolar Monolithic Microwave Integrated Circuit (MMIC) housed in a low cost, surface mount plastic package. This MMIC is designed for very wide bandwidth industrial and commercial applications that require flat gain and low VSWR.

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.

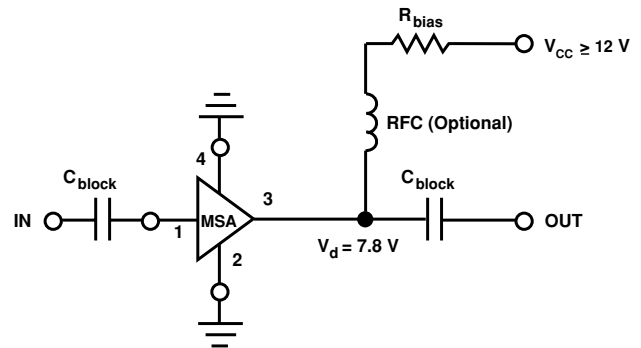
#### Features

- Broadband, Minimum Ripple Cascadable 50 $\Omega$  Gain Block
- $7.2 \pm 0.5$  dB Typical Gain Flatness from 0.1 to 3.0 GHz
- 3 dB Bandwidth: 0.1 to 5.5 GHz
- 10.5 dBm Typical  $P_{1dB}$  at 2.0 GHz
- Surface Mount Plastic Package
- Tape-and-Reel Packaging Option Available
- Lead-free Option Available

#### 86 Plastic Package



#### Typical Biasing Configuration



### MSA-0986 Absolute Maximum Ratings

| Parameter                          | Absolute Maximum <sup>[1]</sup> |
|------------------------------------|---------------------------------|
| Device Current                     | 65 mA                           |
| Power Dissipation <sup>[2,3]</sup> | 500 mW                          |
| RF Input Power                     | +13 dBm                         |
| Junction Temperature               | 150°C                           |
| Storage Temperature                | -65 to +150°C                   |

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

$$\theta_{jc} = 140^{\circ}\text{C/W}$$

#### Notes:

1. Permanent damage may occur if any of these limits are exceeded.
2.  $T_{\text{CASE}} = 25^{\circ}\text{C}$ .
3. Derate at  $7.1 \text{ mW}/^{\circ}\text{C}$  for  $T_{\text{C}} > 80^{\circ}\text{C}$ .

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

| Symbol                | Parameters and Test Conditions: $I_{\text{d}} = 35 \text{ mA}$ , $Z_{\text{o}} = 50 \Omega$ | Units                  | Min. | Typ.      | Max. |
|-----------------------|---------------------------------------------------------------------------------------------|------------------------|------|-----------|------|
| $G_{\text{P}}$        | Power Gain ( $ S_{21} ^2$ ) $f = 2.0 \text{ GHz}$                                           | dB                     | 6.0  | 7.2       |      |
| $\Delta G_{\text{P}}$ | Gain Flatness $f = 0.1 \text{ to } 3.0 \text{ GHz}$                                         | dB                     |      | $\pm 0.5$ |      |
| $f_{3 \text{ dB}}$    | 3 dB Bandwidth <sup>[2]</sup>                                                               | GHz                    |      | 5.5       |      |
| VSWR                  | Input VSWR $f = 1.0 \text{ to } 3.0 \text{ GHz}$                                            |                        |      | 1.6:1     |      |
|                       | Output VSWR $f = 1.0 \text{ to } 3.0 \text{ GHz}$                                           |                        |      | 1.8:1     |      |
| NF                    | 50 $\Omega$ Noise Figure $f = 2.0 \text{ GHz}$                                              | dB                     |      | 6.2       |      |
| $P_{1 \text{ dB}}$    | Output Power at 1 dB Gain Compression $f = 2.0 \text{ GHz}$                                 | dBm                    |      | 10.5      |      |
| $\text{IP}_3$         | Third Order Intercept Point $f = 2.0 \text{ GHz}$                                           | dBm                    |      | 23.0      |      |
| $t_{\text{D}}$        | Group Delay $f = 2.0 \text{ GHz}$                                                           | psec                   |      | 95        |      |
| $V_{\text{d}}$        | Device Voltage                                                                              | V                      | 6.2  | 7.8       | 9.4  |
| $dV/dT$               | Device Voltage Temperature Coefficient                                                      | mV/ $^{\circ}\text{C}$ |      | -16.0     |      |

#### Notes:

1. The recommended operating current range for this device is 25 to 45 mA. Typical performance as a function of current is on the following page.
2. Referenced from 0.1 GHz gain ( $G_{\text{P}}$ ).

### Ordering Information

| Part Numbers  | No. of Devices | Comments |
|---------------|----------------|----------|
| MSA-0986-BLK  | 100            | Bulk     |
| MSA-0986-BLKG | 100            | Bulk     |
| MSA-0986-TR1  | 1000           | 7" Reel  |
| MSA-0986-TR1G | 1000           | 7" Reel  |
| MSA-0986-TR2  | 4000           | 13" Reel |
| MSA-0986-TR2G | 4000           | 13" Reel |

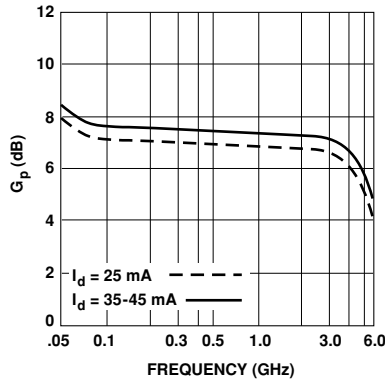
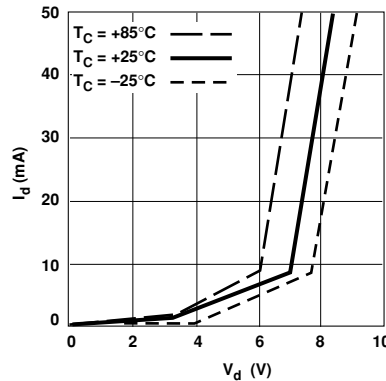
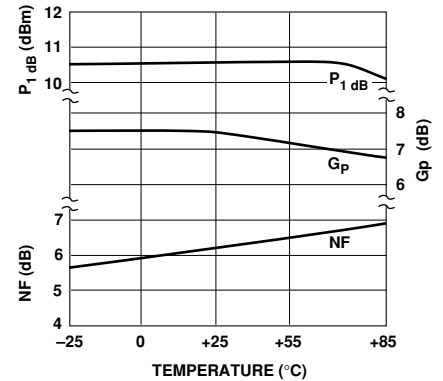
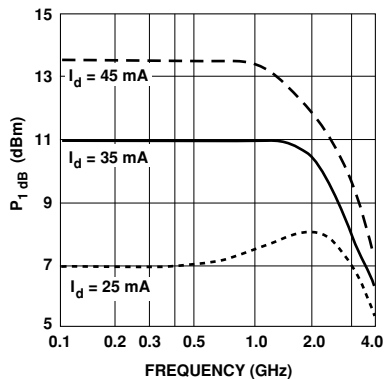
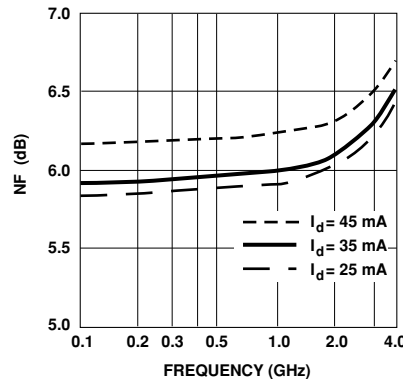
**Note:** Order part number with a "G" suffix if lead-free option is desired.

**MSA-0986 Typical Scattering Parameters ( $Z_0 = 50 \Omega$ ,  $T_A = 25^\circ\text{C}$ ,  $I_d = 35 \text{ mA}$ )**

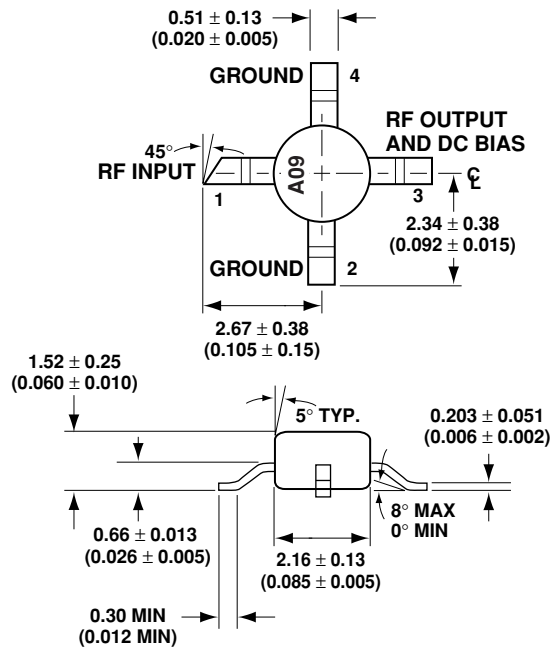
| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |      |     | $S_{12}$ |      |     | $S_{22}$ |      | k    |
|--------------|----------|------|----------|------|-----|----------|------|-----|----------|------|------|
|              | Mag      | Ang  | dB       | Mag  | Ang | dB       | Mag  | Ang | Mag      | Ang  |      |
| 0.02         | .36      | -105 | 11.4     | 3.72 | 145 | -14.1    | .198 | 18  | .38      | -102 | 0.73 |
| 0.05         | .24      | -145 | 8.5      | 2.65 | 156 | -13.7    | .205 | 5   | .25      | -143 | 1.08 |
| 0.1          | .22      | -164 | 7.7      | 2.43 | 166 | -13.5    | .211 | 4   | .22      | -158 | 1.17 |
| 0.2          | .21      | -179 | 7.5      | 2.37 | 167 | -13.5    | .212 | 1   | .22      | -172 | 1.20 |
| 0.4          | .21      | 165  | 7.4      | 2.34 | 162 | -13.4    | .214 | -1  | .22      | 179  | 1.20 |
| 0.6          | .22      | 155  | 7.4      | 2.33 | 156 | -13.5    | .212 | -2  | .22      | 175  | 1.21 |
| 0.8          | .22      | 145  | 7.3      | 2.33 | 149 | -13.4    | .213 | -2  | .23      | 171  | 1.21 |
| 1.0          | .23      | 136  | 7.3      | 2.32 | 142 | -13.4    | .214 | -4  | .24      | 167  | 1.20 |
| 1.5          | .24      | 118  | 7.2      | 2.30 | 125 | -13.3    | .217 | -6  | .26      | 157  | 1.19 |
| 2.0          | .25      | 106  | 7.2      | 2.28 | 109 | -13.0    | .224 | -10 | .28      | 148  | 1.16 |
| 2.5          | .26      | 100  | 7.2      | 2.29 | 94  | -13.0    | .224 | -12 | .33      | 139  | 1.15 |
| 3.0          | .26      | 94   | 7.1      | 2.26 | 77  | -13.0    | .224 | -15 | .34      | 128  | 1.15 |
| 3.5          | .26      | 95   | 7.0      | 2.23 | 60  | -12.8    | .229 | -21 | .36      | 116  | 1.14 |
| 4.0          | .28      | 96   | 6.7      | 2.17 | 43  | -13.1    | .221 | -25 | .35      | 104  | 1.18 |
| 4.5          | .31      | 100  | 6.5      | 2.10 | 26  | -13.6    | .210 | -31 | .32      | 94   | 1.23 |
| 5.0          | .37      | 101  | 6.0      | 2.00 | 9   | -14.2    | .196 | -35 | .26      | 86   | 1.30 |
| 5.5          | .44      | 97   | 5.4      | 1.86 | -7  | -14.9    | .181 | -38 | .19      | 88   | 1.38 |
| 6.0          | .51      | 94   | 4.6      | 1.69 | -22 | -15.8    | .162 | -37 | .14      | 107  | 1.47 |

**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, Noise Figure and Power Gain vs. Case Temperature,  $f = 2.0 \text{ GHz}$ ,  $I_d = 35 \text{ mA}$ .**

**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)

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