

# MSA-0311

## Cascadable Silicon Bipolar MMIC Amplifier



### Data Sheet

#### Description

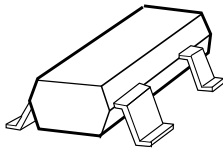
The MSA-0311 is a low cost silicon bipolar Monolithic Microwave Integrated Circuit (MMIC) housed in the surface mount plastic SOT-143 package. This MMIC is designed for use as a general purpose 50  $\Omega$  gain block. Typical applications include narrow and broad band IF and RF amplifiers in commercial 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.

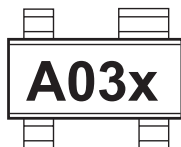
#### Features

- Cascadable 50  $\Omega$  Gain Block
- 3 dB Bandwidth: DC to 2.3 GHz
- 11.0 dB Typical Gain at 1.0 GHz
- 9.0 dBm Typical  $P_{1\text{ dB}}$  at --1.0 GHz
- Unconditionally Stable ( $k > 1$ )
- Low Cost Surface Mount Plastic Package
- Tape-and-Reel Packaging Option Available
- Lead-free Option Available

#### SOT-143 Package



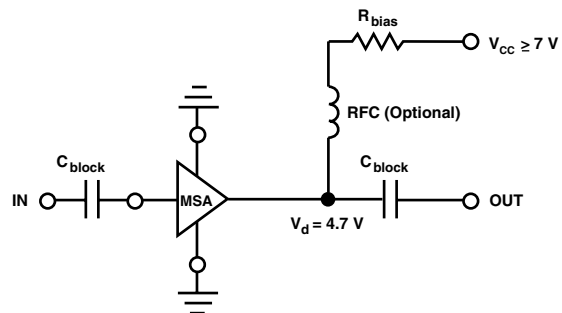
#### Pin Connections and Package Marking



#### Notes:

**Top View. Package Marking provides orientation and identification.**  
"x" is the date code.

#### Typical Biasing Configuration



## MSA-0311 Absolute Maximum Ratings

| Parameter                          | Absolute Maximum <sup>[1]</sup> |
|------------------------------------|---------------------------------|
| Device Current                     | 60 mA                           |
| Power Dissipation <sup>[2,3]</sup> | 240 mW                          |
| RF Input Power                     | +13 dBm                         |
| Junction Temperature               | 150°C                           |
| Storage Temperature                | -65 to 150°C                    |

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

$$\theta_{jc} = 500^{\circ}\text{C/W}$$

#### Notes:

1. Permanent damage may occur if any of these limits are exceeded.
2.  $T_{\text{CASE}} = 25^{\circ}\text{C}$ .
3. Derate at 2.0 mW/°C for  $T_C > 30^{\circ}\text{C}$ .

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

| Symbol             | Parameters and Test Conditions: $I_d = 35 \text{ mA}$ , $Z_0 = 50 \Omega$     | Units | Min. | Typ.         | Max. |
|--------------------|-------------------------------------------------------------------------------|-------|------|--------------|------|
| $G_P$              | Power Gain ( $ S_{21} ^2$ )<br>$f = 0.1 \text{ GHz}$<br>$f = 1.0 \text{ GHz}$ | dB    | 9.0  | 11.5<br>11.0 |      |
| $\Delta G_P$       | Gain Flatness<br>$f = 0.1 \text{ to } 1.6 \text{ GHz}$                        | dB    |      | $\pm 0.7$    |      |
| $f_{3 \text{ dB}}$ | 3 dB Bandwidth                                                                | GHz   |      | 2.3          |      |
| VSWR               | Input VSWR<br>$f = 0.1 \text{ to } 3.0 \text{ GHz}$                           |       |      | 1.5:1        |      |
|                    | Output VSWR<br>$f = 0.1 \text{ to } 3.0 \text{ GHz}$                          |       |      | 1.7:1        |      |
| NF                 | 50 $\Omega$ Noise Figure<br>$f = 1.0 \text{ GHz}$                             | dB    |      | 6.0          |      |
| $P_{1 \text{ dB}}$ | Output Power at 1 dB Gain Compression<br>$f = 1.0 \text{ GHz}$                | dBm   |      | 9.0          |      |
| $IP_3$             | Third Order Intercept Point<br>$f = 1.0 \text{ GHz}$                          | dBm   |      | 22.0         |      |
| $t_D$              | Group Delay<br>$f = 1.0 \text{ GHz}$                                          | psec  |      | 140          |      |
| $V_d$              | Device Voltage<br>$T_C = 25^{\circ}\text{C}$                                  | V     | 3.8  | 4.7          | 5.6  |
| dV/dT              | Device Voltage Temperature Coefficient                                        | mV/°C |      | -8.0         |      |

#### Notes:

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

## Ordering Information

| Part Numbers  | No. of Devices | Comments |
|---------------|----------------|----------|
| MSA-0311-BLK  | 100            | Bulk     |
| MSA-0311-BLKG | 100            | Bulk     |
| MSA-0311-TR1  | 3000           | 7" Reel  |
| MSA-0311-TR1G | 3000           | 7" Reel  |
| MSA-0311-TR2  | 10000          | 13" Reel |
| MSA-0311-TR2G | 10000          | 13" Reel |

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

# MSA-0311 Typical Scattering Parameters ( $Z_0 = 50 \Omega$ , $T_A = 25^\circ\text{C}$ , $I_d = 35 \text{ mA}$ )

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |      |     | $S_{12}$ |      |     | $S_{22}$ |      |
|--------------|----------|------|----------|------|-----|----------|------|-----|----------|------|
|              | Mag      | Ang  | dB       | Mag  | Ang | dB       | Mag  | Ang | Mag      | Ang  |
| 0.1          | .06      | 25   | 11.7     | 3.84 | 175 | -17.9    | .127 | 2   | .24      | -7   |
| 0.2          | .07      | 31   | 11.7     | 3.83 | 170 | -17.9    | .128 | 3   | .23      | -13  |
| 0.4          | .07      | 38   | 11.6     | 3.78 | 159 | -17.8    | .129 | 6   | .24      | -28  |
| 0.6          | .07      | 30   | 11.4     | 3.72 | 149 | -17.6    | .132 | 18  | .24      | -40  |
| 0.8          | .08      | 21   | 11.2     | 3.65 | 140 | -17.3    | .136 | 11  | .24      | -53  |
| 1.0          | .08      | 10   | 11.0     | 3.56 | 130 | -17.0    | .141 | 13  | .24      | -65  |
| 1.5          | .09      | -32  | 10.4     | 3.31 | 106 | -15.9    | .160 | 17  | .24      | -91  |
| 2.0          | .09      | -105 | 9.5      | 2.99 | 84  | -14.9    | .179 | 16  | .23      | -115 |
| 2.5          | .13      | -151 | 8.5      | 2.66 | 70  | -14.1    | .197 | 19  | .23      | -133 |
| 3.0          | .19      | -176 | 7.4      | 2.35 | 51  | -13.5    | .212 | 15  | .22      | -145 |
| 3.5          | .24      | 166  | 6.2      | 2.04 | 35  | -13.0    | .224 | 11  | .23      | -151 |
| 4.0          | .27      | 152  | 5.1      | 1.80 | 20  | -12.7    | .232 | 6   | .24      | -151 |
| 5.0          | .36      | 114  | 2.9      | 1.39 | -6  | -12.1    | .250 | -1  | .25      | -152 |
| 6.0          | .50      | 88   | 0.8      | 1.10 | -28 | -11.8    | .258 | -8  | .25      | -166 |

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

(unless otherwise noted)

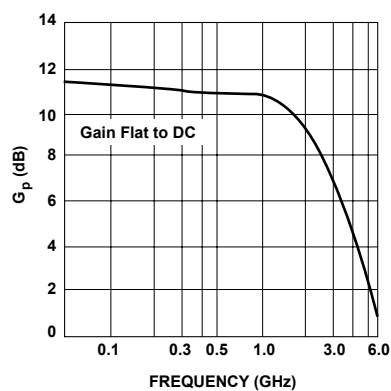


Figure 1. Typical Power Gain vs. Frequency,  $I_d = 35 \text{ mA}$ .

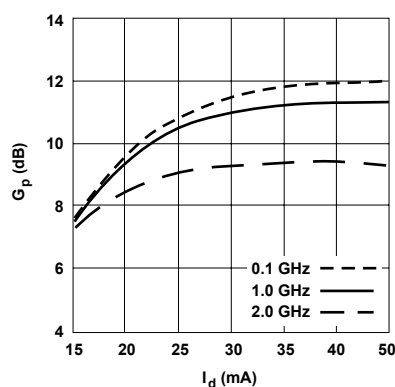


Figure 2. Power Gain vs. Current.

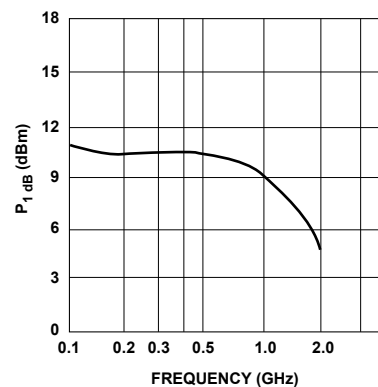


Figure 3. Output Power at 1 dB Gain Compression vs. Frequency,  $I_d = 35 \text{ mA}$ .

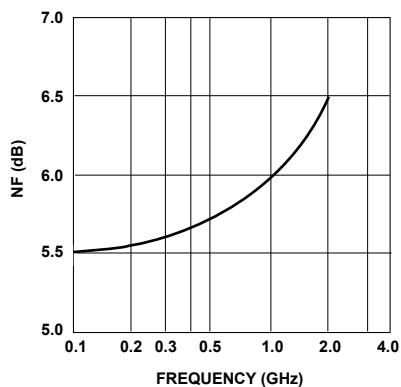
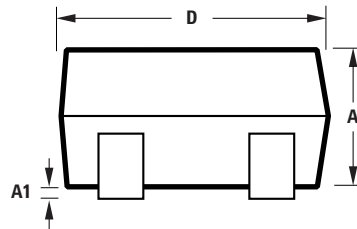
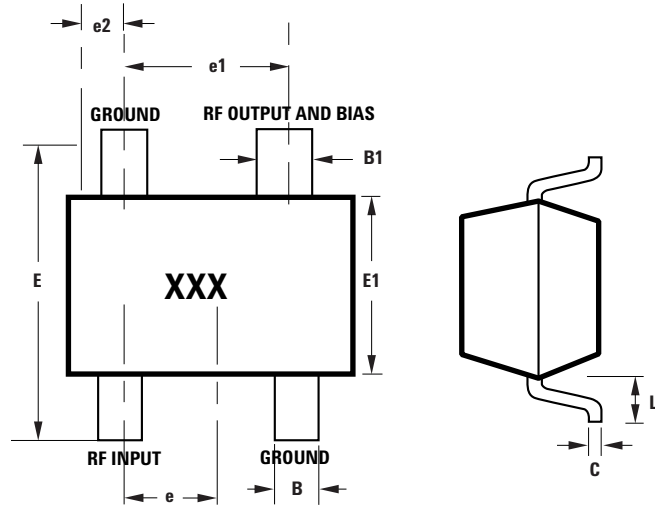


Figure 4. Noise Figure vs. Frequency,  $I_d = 35 \text{ mA}$ .

## SOT-143 Package Dimensions



Notes:  
XXX-package marking  
Drawings are not to scale

| SYMBOL | DIMENSIONS (mm) |       |
|--------|-----------------|-------|
|        | MIN.            | MAX.  |
| A      | 0.79            | 1.097 |
| A1     | 0.013           | 0.10  |
| B      | 0.36            | 0.54  |
| B1     | 0.76            | 0.92  |
| C      | 0.086           | 0.152 |
| D      | 2.80            | 3.06  |
| E1     | 1.20            | 1.40  |
| e      | 0.89            | 1.02  |
| e1     | 1.78            | 2.04  |
| e2     | 0.45            | 0.60  |
| E      | 2.10            | 2.65  |
| L      | 0.45            | 0.69  |

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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