## **MSA-0311** Cascadable Silicon Bipolar MMIC Amplifier

## **Data Sheet**



#### Description

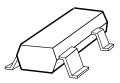
The MSA-0311 is a low cost silicon bipolar Monolithic Microwave Integrated Circuit (MMIC) housed in the surface mount plastic SOT-143 package. This MMIC is designed for use as a general purpose 50  $\Omega$  gain block. Typical applications include narrow and broad band IF and RF amplifiers in commercial 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 Ω Gain Block
- 3 dB Bandwidth: DC to 2.3 GHz
- 11.0 dB Typical Gain at 1.0 GHz
- 9.0 dBm Typical P<sub>1 dB</sub> 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



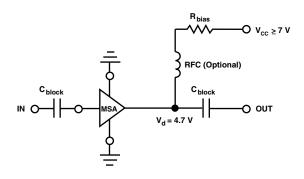
Pin Connections and Package Marking



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>:

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

#### Notes:

1. Permanent damage may occur if any of these limits are exceeded.

2.  $T_{CASE} = 25^{\circ}C.$ 

3. Derate at 2.0 mW/°C for  $T_C > 30^{\circ}C$ .

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

| Symbol            | Parameters and Test Conditions: I             | Units                      | Min.  | Тур. | Max.         |     |
|-------------------|---|----------------------------|-------|------|--------------|-----|
| G <sub>P</sub>    | Power Gain ( S <sub>21</sub>   <sup>2</sup> ) | f = 0.1 GHz<br>f = 1.0 GHz | dB    | 9.0  | 11.5<br>11.0 |     |
| $\Delta G_P$      | Gain Flatness                                 | f = 0.1 to 1.6 GHz         | dB    |      | ±0.7         |     |
| f <sub>3 dB</sub> | 3 dB Bandwidth                                |                            | GHz   |      | 2.3          |     |
| VSWR              | Input VSWR                                    | f = 0.1 to 3.0 GHz         |       |      | 1.5:1        |     |
| V3WIT             | Output VSWR                                   | f = 0.1 to 3.0 GHz         |       |      | 1.7:1        |     |
| NF                | 50 Ω Noise Figure                             | f = 1.0 GHz                | dB    |      | 6.0          |     |
| P <sub>1 dB</sub> | Output Power at 1 dB Gain Compression         | f = 1.0 GHz                | dBm   |      | 9.0          |     |
| IP <sub>3</sub>   | Third Order Intercept Point                   | f = 1.0 GHz                | dBm   |      | 22.0         |     |
| t <sub>D</sub>    | Group Delay                                   | f = 1.0 GHz                | psec  |      | 140          |     |
| V <sub>d</sub>    | Device Voltage                                | T <sub>C</sub> = 25°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**

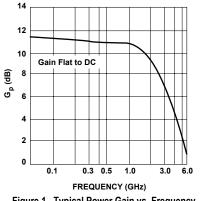
| Part Numbers  | No. of Devices | Comments |  |
|---------------|----------------|----------|--|
| MSA-0311-BLK  | 100            | Bulk     |  |
| MSA-0311-BLKG | 100            | Bulk     |  |
| MSA-0311-TR1  | 3000           | 7" Reel  |  |
| MSA-0311-TR1G | 3000           | 7" Reel  |  |
| MSA-0311-TR2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

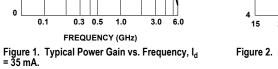
Note: Order part number with a "G" suffix if lead-free option is desired.

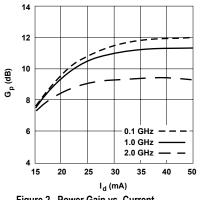
| Freq. | Freq. S <sub>11</sub> |      | S <sub>21</sub> |      | S <sub>12</sub> |       |      |     | S <sub>22</sub> |      |
|-------|-----------------------|------|-----------------|------|-----------------|-------|------|-----|-----------------|------|
| GHz   | Mag                   | Ang  |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

MSA-0311 Typical Scattering Parameters (Z\_0 = 50  $\Omega$ , T<sub>A</sub> = 25°C, I<sub>d</sub> = 35 mA)

# **Typical Performance,** T<sub>A</sub> = 25°C (unless otherwise noted)









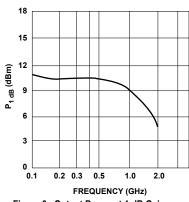
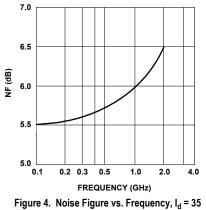
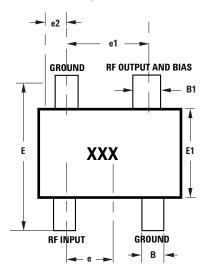


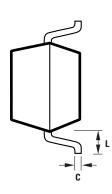
Figure 3. Output Power at 1 dB Gain Compression vs. Frequency,  $I_d = 35$  mA.

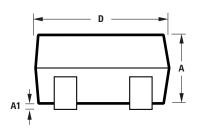


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#### **SOT-143 Package Dimensions**







Notes: XXX-package marking Drawings are not to scale

|        | DIMENSIONS (mm) |       |  |  |
|--------|-----------------|-------|--|--|
| SYMBOL | MIN.            | MAX.  |  |  |
| Α      | 0.79            | 1.097 |  |  |
| A1     | 0.013           | 0.10  |  |  |
| В      | 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

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