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## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



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# MAXIM

## DC-to-Microwave, Low-Noise Amplifier

MAX2611

### General Description

The MAX2611 is a low-voltage, low-noise amplifier for use from DC to microwave frequencies. Operating from a single +5V supply, it has a 3dB bandwidth of 1100MHz. The MAX2611's low noise figure and high drive capability make it ideal for a variety of transmit, receive, and buffer applications.

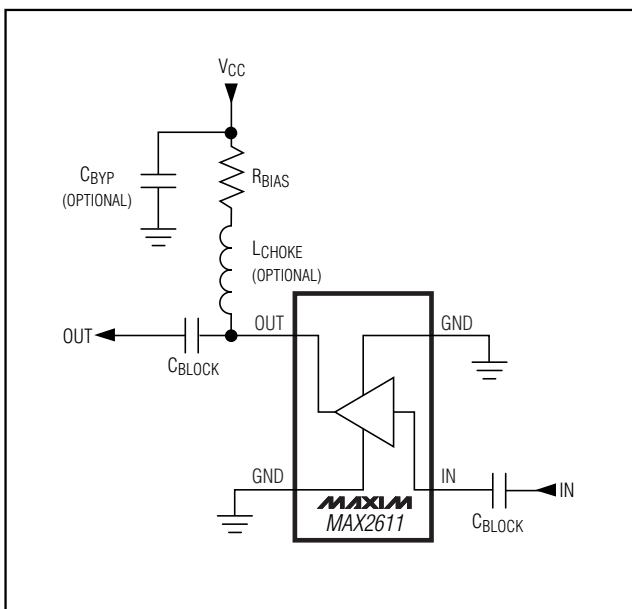
In a typical application, the only external components needed are input and output blocking capacitors and a VCC series resistor. To improve gain and output power, an RF choke can be added in series to the bias resistor.

The MAX2611 comes in a 4-pin SOT143 package, requiring minimal board space.

### Applications

- Satellite Receivers
- TV Tuners
- Wireless Local Loops
- ISM Radios
- Global Positioning Systems
- Wireless Local-Area Networks
- Land Mobile Radios
- Set-Top Boxes

### Typical Operating Circuit



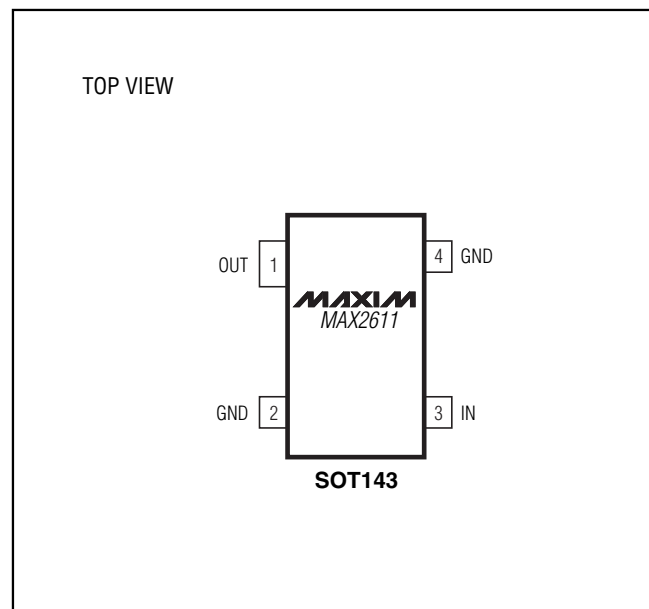
### Features

- ◆ Single +5V Supply Operation
- ◆ 3dB Bandwidth: DC to 1100MHz
- ◆ High Gain: 18dB at 500MHz
- ◆ Low Noise Figure: 3.5dB at 500MHz
- ◆ High Drive Capability: +3dBm at 16mA I<sub>D</sub>
- ◆ Ultra-Small SOT143 Package

### Ordering Information

| PART         | TEMP RANGE     | PIN-PACKAGE |
|--------------|----------------|-------------|
| MAX2611EUS-T | -40°C to +85°C | 4 SOT143-4  |

### Pin Configuration

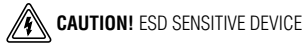


# DC-to-Microwave, Low-Noise Amplifier

## ABSOLUTE MAXIMUM RATINGS

|   |        |   |                 |
|---|--------|---|-----------------|
| I <sub>D</sub> .....                                  | 40mA   | Operating Temperature Range .....       | -40°C to +85°C  |
| Input Power .....                                     | +13dBm | Junction Temperature .....              | +150°C          |
| Continuous Power Dissipation (T <sub>A</sub> = +70°C) |        | Storage Temperature Range .....         | -65°C to +150°C |
| SOT143-4 (derate 4mW/°C above +70°C).....             | 320mW  | Lead Temperature (soldering, 10s) ..... | +300°C          |

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.



## ELECTRICAL CHARACTERISTICS

(I<sub>D</sub> = 16mA, Z<sub>0</sub> = 50Ω, f<sub>IN</sub> = 500MHz, T<sub>A</sub> = +25°C, unless otherwise noted.)

| PARAMETER                                  | CONDITIONS   | MIN  | TYP   | MAX  | UNITS |
|--|--|------|-------|------|-------|
| Operating Temperature Range                | (Note 1)   | -40  |       | 85   | °C    |
| Power Gain                                 | f <sub>IN</sub> = 100MHz                                       |      | 19.0  |      | dB    |
|  | f <sub>IN</sub> = 500MHz                                       | 17.3 | 18.3  |      |       |
| Gain Flatness                              | f <sub>IN</sub> = 100MHz to 500MHz                             |      | ±0.3  |      | dB    |
| 3dB Bandwidth                              |  |      | 1100  |      | MHz   |
| Input Voltage Standing-Wave Maximum Ratio  | f <sub>IN</sub> = 100MHz to 1500MHz                            |      | 1.9:1 |      |       |
| Output Voltage Standing-Wave Maximum Ratio | f <sub>IN</sub> = 100MHz to 1500MHz                            |      | 1.6:1 |      |       |
| Output 1dB Compression Point               |  |      | 2.9   |      | dBm   |
| Noise Figure                               |  |      | 3.5   |      | dB    |
| Output IP3                                 |  |      | 13    |      | dBm   |
| Group Delay                                |  |      | 210   |      | ps    |
| Device Voltage                             |  | 3.5  | 3.8   | 4.0  | V     |
|  | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> (Note 2) | 3.25 | 3.8   | 4.26 |       |
| Device Voltage Temperature Coefficient     |  |      | -6.1  |      | mV/°C |

**Note 1:** Parts are designed to operate over specified temperature range. Specifications are production tested and guaranteed at +25°C.

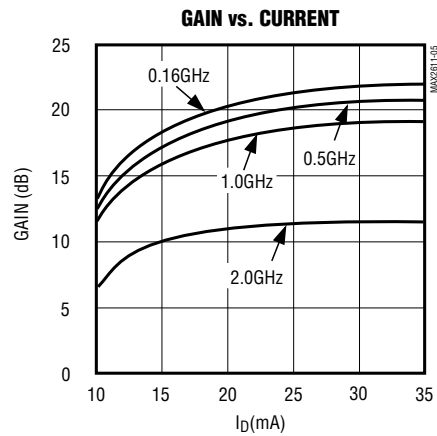
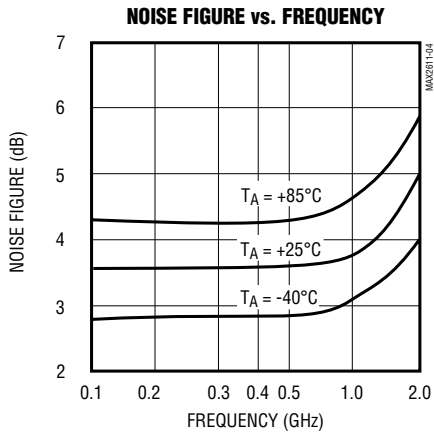
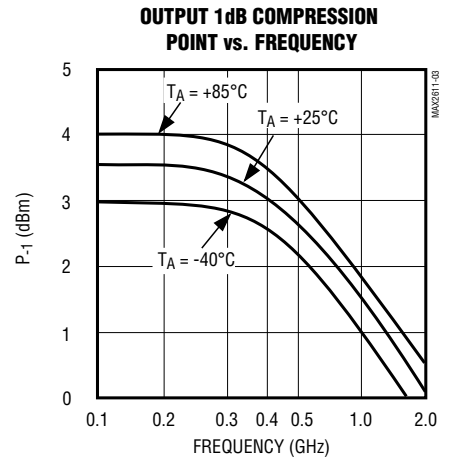
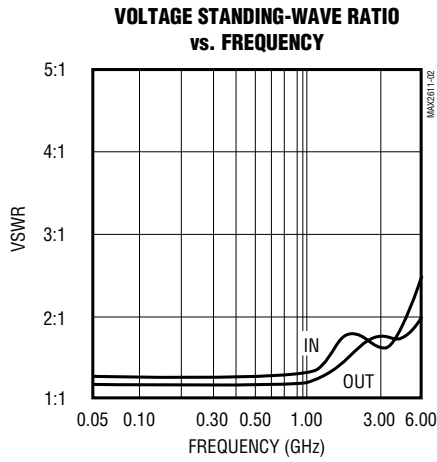
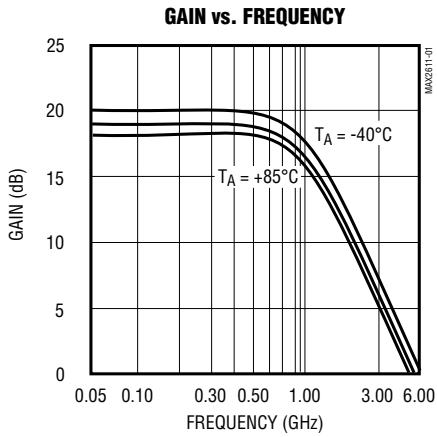
**Note 2:** Guaranteed by design, not tested.

# DC-to-Microwave, Low-Noise Amplifier

## Typical Operating Characteristics

( $I_D = 16\text{mA}$ ,  $Z_0 = 50\Omega$ ,  $f_{IN} = 500\text{MHz}$ ,  $T_A = +25^\circ\text{C}$ , unless otherwise noted.)

MAX2611



# DC-to-Microwave, Low-Noise Amplifier

## Pin Description

| PIN  | NAME | FUNCTION   |
|------|------|--|
| 1    | OUT  | Amplifier Output. Use a series blocking capacitor with less than 3Ω reactance at your lowest operating frequency. Bias with an external resistor and an optional RF choke. |
| 2, 4 | GND  | Ground Connection. For optimum performance, provide a low-inductance connection to the ground plane.   |
| 3    | IN   | Amplifier Input. Use a series blocking capacitor with less than 3Ω reactance at your lowest operating frequency.   |

**Table 1. Typical Scattering Parameters**

( $I_D = 16\text{mA}$ ,  $Z_0 = 50\Omega$ ,  $T_A = +25^\circ\text{C}$ )

| FREQUENCY (GHz) | S11 (mag) | S11 (ang) | S21 (dB) | S21 (mag) | S21 (ang) | S12 (dB) | S12 (mag) | S12 (ang) | S22 (mag) | S22 (ang) | K    |
|-----------------|-----------|-----------|----------|-----------|-----------|----------|-----------|-----------|-----------|-----------|------|
| 0.1             | 0.12      | -11       | 19.0     | 8.90      | 173       | -22.6    | 0.074     | 2         | 0.05      | 53        | 1.08 |
| 0.2             | 0.11      | -44       | 18.8     | 8.73      | 166       | -21.9    | 0.081     | 4         | 0.03      | 12        | 1.06 |
| 0.3             | 0.13      | -58       | 18.6     | 8.53      | 158       | -21.6    | 0.083     | 5         | 0.04      | 45        | 1.05 |
| 0.4             | 0.14      | -78       | 18.5     | 8.43      | 151       | -21.6    | 0.083     | 6         | 0.06      | 32        | 1.06 |
| 0.5             | 0.15      | -89       | 18.3     | 8.26      | 144       | -21.6    | 0.083     | 7         | 0.08      | 34        | 1.06 |
| 0.6             | 0.15      | 77        | 18.1     | 7.99      | 137       | -21.6    | 0.083     | 9         | 0.09      | 26        | 1.07 |
| 0.8             | 0.13      | 50        | 17.4     | 7.45      | 123       | -21.6    | 0.083     | 10        | 0.10      | 23        | 1.10 |
| 1.0             | 0.12      | 16        | 16.6     | 6.79      | 109       | -20.9    | 0.090     | 10        | 0.10      | 35        | 1.11 |
| 1.5             | 0.32      | -60       | 14.1     | 5.07      | 79        | -21.8    | 0.081     | 11        | 0.21      | -86       | 1.29 |
| 2.0             | 0.31      | -72       | 10.3     | 3.27      | 59        | -22.2    | 0.078     | 18        | 0.22      | -72       | 1.87 |
| 2.5             | 0.32      | -76       | 7.9      | 2.48      | 47        | -22.6    | 0.074     | 25        | 0.26      | -53       | 2.44 |
| 3.0             | 0.20      | -70       | 5.9      | 1.98      | 32        | -22.3    | 0.077     | 37        | 0.24      | -29       | 3.10 |
| 3.5             | 0.24      | -64       | 3.0      | 1.41      | 13        | -21.4    | 0.086     | 30        | 0.19      | 47        | 3.83 |
| 4.0             | 0.31      | -68       | -0.7     | 0.92      | 17        | -23.0    | 0.070     | 35        | 0.24      | 82        | 6.66 |

# DC-to-Microwave, Low-Noise Amplifier

MAX2611

## Detailed Description

The MAX2611 is a broadband amplifier with flat gain and 50Ω input and output ports. Its small size and simple bias circuitry make it ideal for applications where board space is limited.

## Applications Information

### External Components

As shown in the *Typical Operating Circuit*, the MAX2611 is easy to use. Input and output series capacitors may be necessary to block DC bias voltages (generated by the MAX2611) from interacting with adjacent circuitry. These capacitors must be large enough to contribute negligible reactance in a 50Ω system at the minimum operating frequency. Use the following equation to calculate their minimum value:

$$C_{\text{BLOCK}} = \frac{53,000}{f} \text{ (pF)}$$

where  $f$  (in MHz) is the minimum operating frequency.

Bias current is supplied to the MAX2611 through an external resistor and optional RF choke connected between  $V_{CC}$  and the OUT pin. A bypass capacitor from  $V_{CC}$  to GND may be necessary to isolate the  $V_{CC}$  line from other circuitry. The resistor value determines the bias current from the following equation:

$$I_D = \frac{V_{CC} - V_D}{R_{\text{BIAS}}}$$

where  $V_D$  is the device voltage, nominally 3.8V.

An optional RF choke can be added to improve the MAX2611's gain and output power. The choke should be large enough to reduce the loading effect that the bias resistor has on the amplifier output. This is a function of  $R_{\text{BIAS}}$ , frequency of operation, and output impedance.

### Grounding

Proper grounding of the GND pins is essential. If the PC board uses a topside RF ground, the GND pins should be connected directly to it. For a board where the ground plane is not on the component side, the best technique is to connect the GND pins to it through multiple plated through-holes.

### PC Board Layout Example

An example PC board layout is given in Figure 1. It uses FR-4 with 31mil layer thickness between the RF lines and the ground plane. This board satisfies all the above requirements.

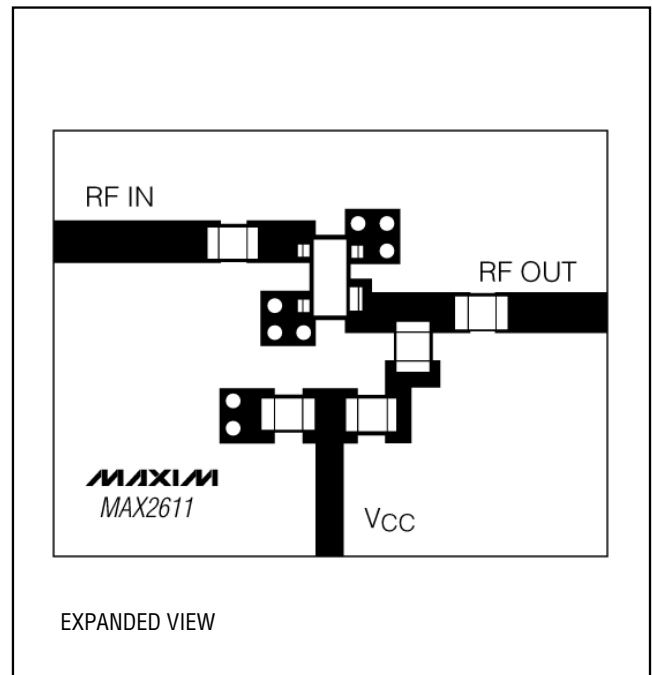
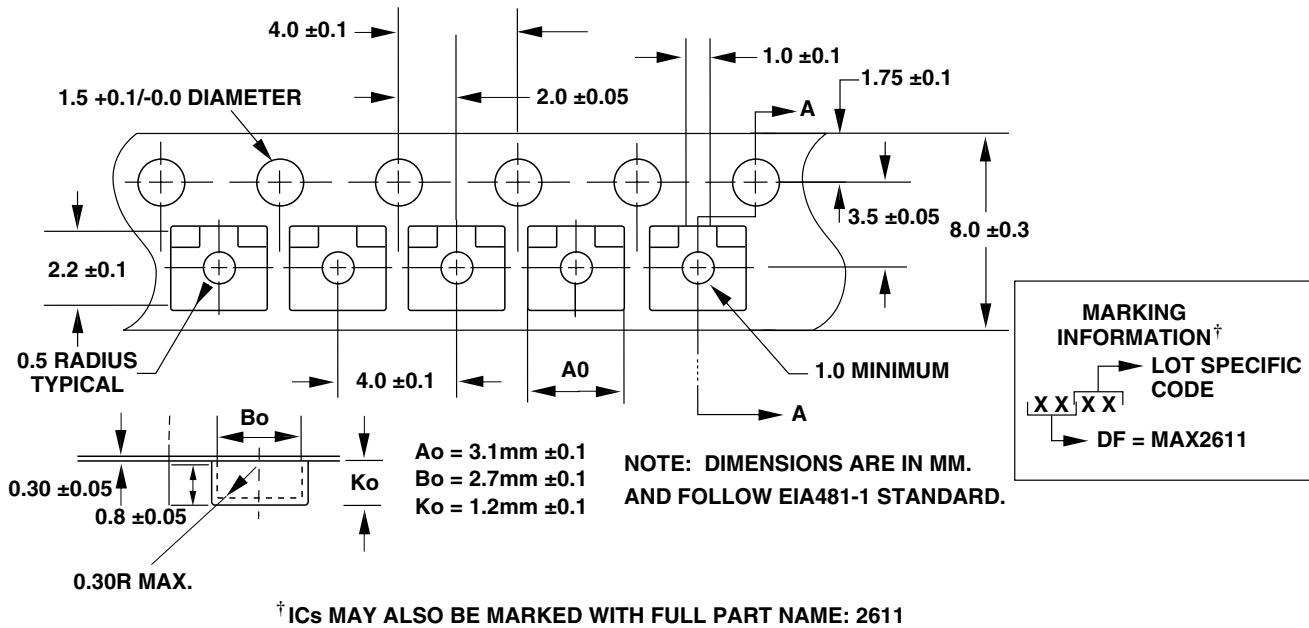


Figure 1. Example PC Board Layout

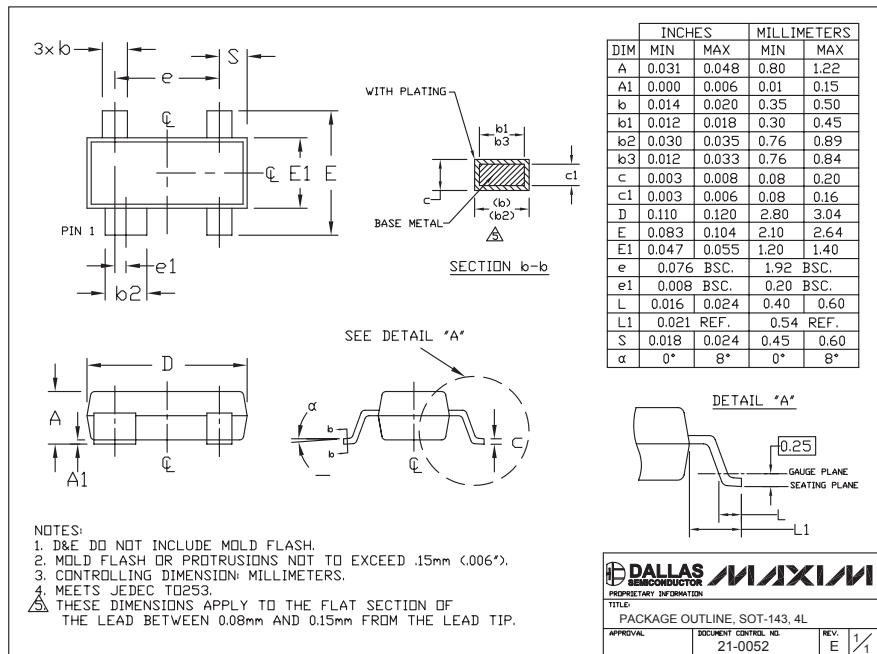
# DC-to-Microwave, Low-Noise Amplifier

## Tape-and-Reel Information



## Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)



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