



# MAXIM

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

### 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.

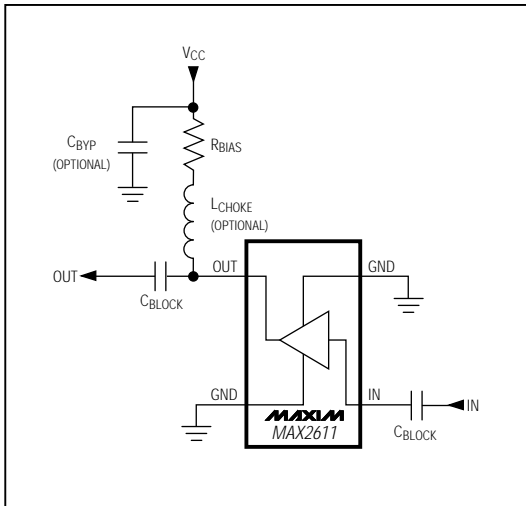
In a typical application, the only external components needed are input and output blocking capacitors and a  $V_{CC}$  series resistor. To improve gain and output power, an RF choke can be added in series to the bias resistor.

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



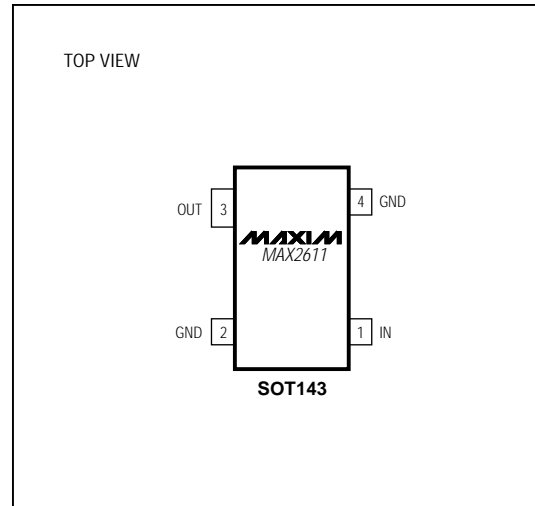
### Features

- ◆ **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  $I_D$**
- ◆ **Ultra-Small SOT143 Package**

### Ordering Information

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

### Pin Configuration



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## 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, 10sec) .....	+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.

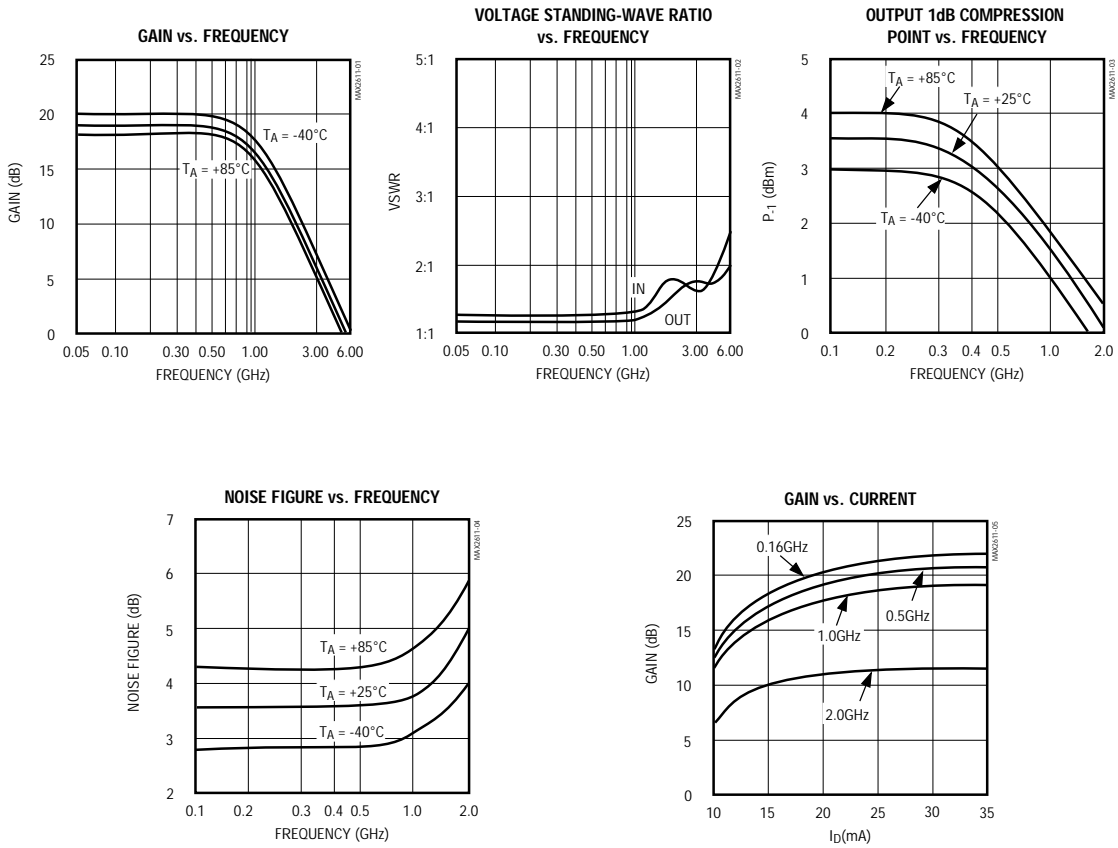
**Note 2:** Guaranteed by design, not tested.

# 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.)

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# DC-to-Microwave, Low-Noise Amplifier

## Pin Description

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

**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.

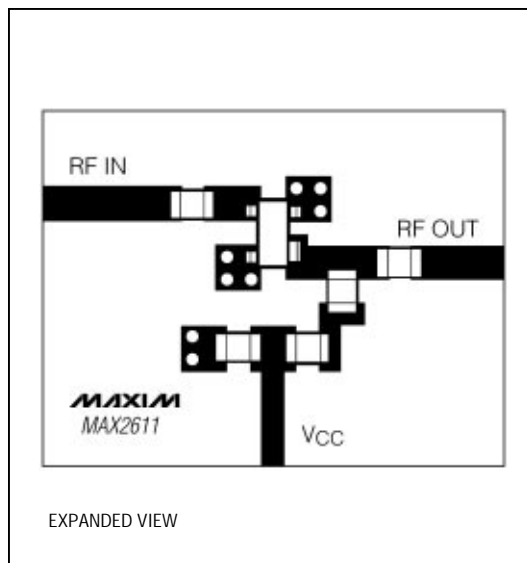
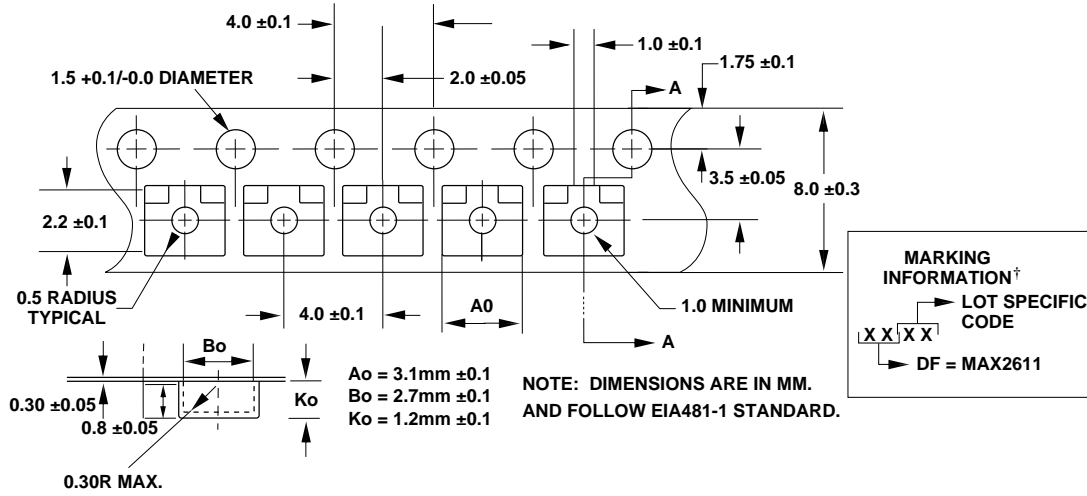


Figure 1. Example PC Board Layout

# DC-to-Microwave, Low-Noise Amplifier

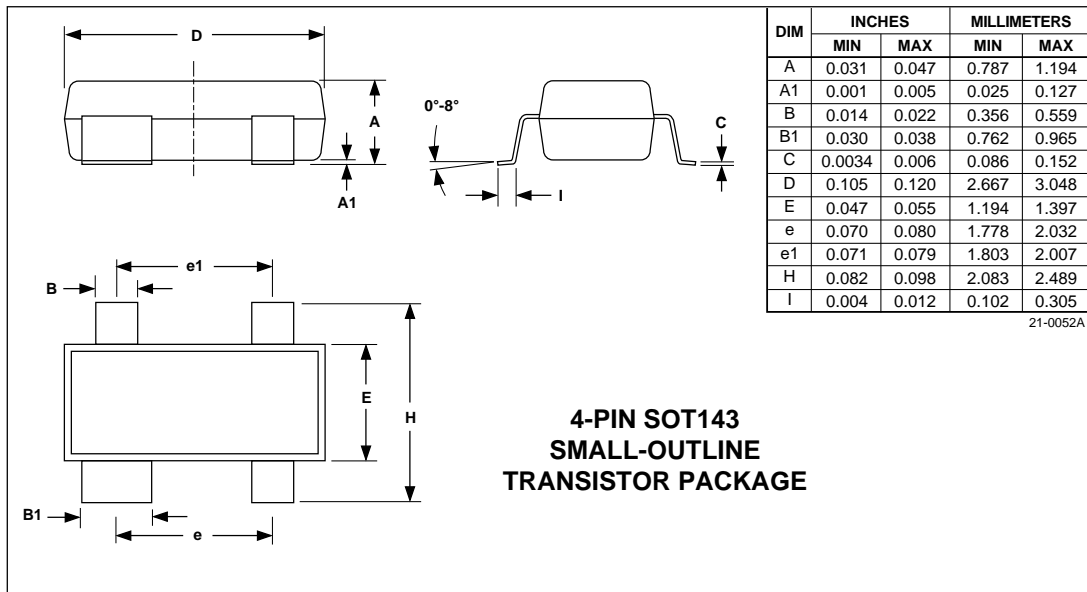
MAX2611

## Tape-and-Reel Information



<sup>†</sup>ICs MAY ALSO BE MARKED WITH FULL PART NAME: 2611

## Package Information



Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.

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