



# VHF-to-Microwave, +3V, General-Purpose Amplifiers

MAX2630-MAX2633

## General Description

The MAX2630/MAX2631/MAX2632/MAX2633 are low-voltage, low-noise amplifiers for use from VHF to microwave frequencies. Operating from a single +2.7V to +5.5V supply, these devices have a flat gain response to 900MHz. Their low noise figure and low supply current make them ideal for receive, buffer, and transmit IF applications.

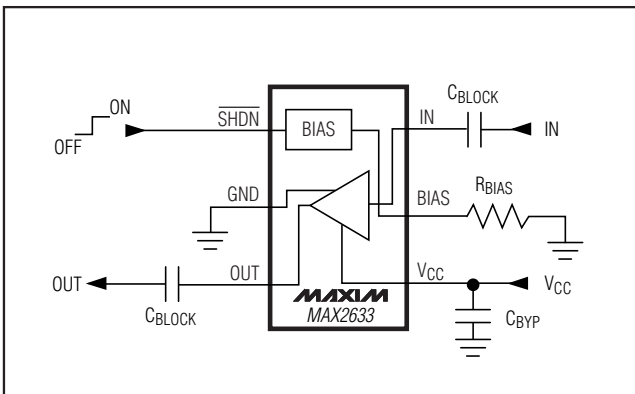
The MAX2630/MAX2631 are biased internally, eliminating the need for external bias resistors or inductors. The MAX2632/MAX2633 have a user-selectable supply current, which can be adjusted by adding a single external resistor. This allows customized output power and gain according to specific applications requirements. The MAX2631/MAX2633 feature a shutdown pin that allows them to be powered down to less than 1µA supply current. Aside from a single bias resistor required for the MAX2632/MAX2633, the only external components needed for this family of amplifiers are input and output blocking capacitors and a VCC bypass capacitor.

The MAX2630 comes in a 4-pin SOT143 package, requiring minimal board space. The MAX2631/MAX2632 come in small 5-pin SOT23 packages. The MAX2633 comes in a 6-pin SOT23 package.

## Applications

- |                                |                 |
|--------------------------------|-----------------|
| Personal Communicating Systems | Cordless Phones |
| Global Positioning Systems     | Cellular Phones |
| Wireless Local Area Networks   | ISM Radios      |
| Wireless Local Loops           | TV Tuners       |
| Land Mobile Radios             | Set-Top Boxes   |

## Typical Operating Circuit



## Features

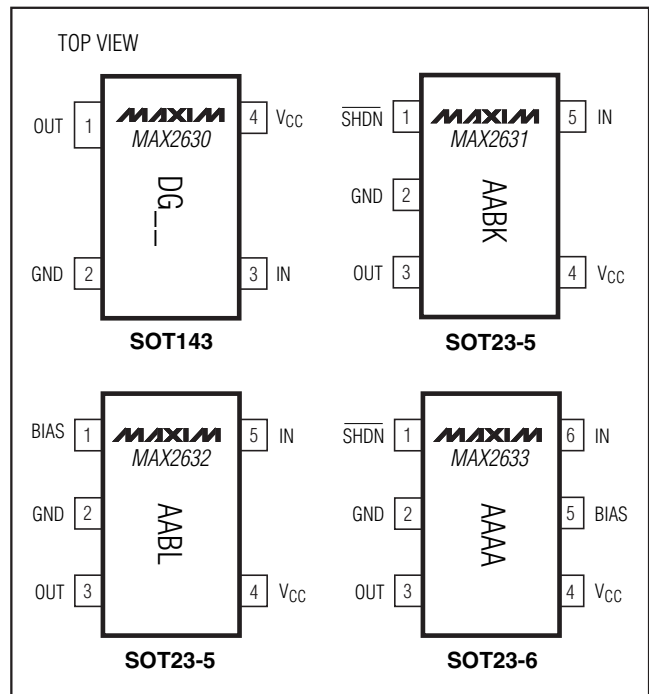
- ◆ Single +2.7V to +5.5V Operation
- ◆ Internally Biased (MAX2630/MAX2631)
- ◆ Adjustable Bias (MAX2632/MAX2633)
- ◆ 6.6mA Supply Current (insensitive to supply voltage)
- ◆ 1µA Shutdown Current (MAX2631/MAX2633)
- ◆ 3.7dB Noise Figure
- ◆ 13.4dB Gain
- ◆ Ultra-Small SOT Packages

## Ordering Information

| PART         | TEMP RANGE     | PIN-PACKAGE | SOT TOP MARK* |
|--------------|----------------|-------------|---------------|
| MAX2630EUS-T | -40°C to +85°C | 4 SOT143-4  | DG__          |
| MAX2631EUK-T | -40°C to +85°C | 5 SOT23-5   | AABK          |
| MAX2632EUK-T | -40°C to +85°C | 5 SOT23-5   | AABL          |
| MAX2633EUT-T | -40°C to +85°C | 6 SOT23-6   | AAAA          |

\*The first two letters in the SOT top mark identify the part, while the remaining two letters are the lot-tracking code.

## Pin Configurations



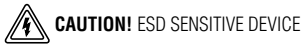
# VHF-to-Microwave, +3V, General-Purpose Amplifiers

## ABSOLUTE MAXIMUM RATINGS

|  |                                   |
|--|-----------------------------------|
| V <sub>CC</sub> to GND .....                     | -0.3V to 6V                       |
| Input Power .....                                | 5dBm                              |
| OUT Current .....                                | ±12mA                             |
| IN to GND Voltage .....                          | -1.2V to 1.2V                     |
| Bias to GND Voltage .....                        | 0.0V to 3V                        |
| Voltage at SHDN Input<br>(MAX2631/MAX2633) ..... | -0.3V to (V <sub>CC</sub> + 0.3V) |
| Current into SHDN Input (MAX2631/MAX2633) .....  | 100µA                             |

|   |                 |
|---|-----------------|
| Continuous Power Dissipation (T <sub>A</sub> = +70°C) |                 |
| SOT143 (derate 4mW/°C above +70°C) .....              | 320mW           |
| SOT23-5 (derate 7.1mW/°C above +70°C) .....           | 571mW           |
| SOT23-6 (derate 7.1mW/°C above +70°C) .....           | 571mW           |
| Operating Temperature Range .....                     | -40°C to +85°C  |
| Junction Temperature .....                            | +150°C          |
| Storage Temperature Range .....                       | -65°C to +150°C |
| 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

(V<sub>CC</sub> = +3V, Z<sub>0</sub> = 50Ω, f<sub>IN</sub> = 900MHz, R<sub>BIAS</sub> = 10kΩ (MAX2632/MAX2633), V<sub>SHDN</sub> = V<sub>CC</sub> (MAX2631/MAX2633), T<sub>A</sub> = +25°C, unless otherwise noted.)

| PARAMETERS                         | CONDITIONS   | MIN   | TYP    | MAX  | UNITS   |      |
|------------------------------------|--|---|--------|------|---------|------|
| Operating Temperature Range        | (Note 1)   | -40   |        | 85   | degrees |      |
| Supply Voltage                     |  | 2.7   |        | 5.5  | V       |      |
| Power Gain                         | T <sub>A</sub> = +25°C   | 11  | 13.4   | 16.5 | dB      |      |
|                                    | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> (Note 1) | 9.4   |        | 18.4 |         |      |
| Noise Figure                       |  |   | 3.8    |      | dB      |      |
| Output 1dB Compression Point       |  |   | -11    |      | dBm     |      |
| Output IP3                         |  |   | -1     |      | dBm     |      |
| Input Voltage Standing-Wave Ratio  | f <sub>IN</sub> = 800MHz to 1000MHz                            |   | 1.3:1  |      |         |      |
| Output Voltage Standing-Wave Ratio | f <sub>IN</sub> = 800MHz to 1000MHz                            |   | 1.25:1 |      |         |      |
| Supply Current                     | R <sub>BIAS</sub> = 40kΩ                                       |   | 1.3    | 1.5  | mA      |      |
|                                    | R <sub>BIAS</sub> = 10kΩ                                       | V <sub>CC</sub> = 3V, T <sub>A</sub> = +25°C  | 5.5    | 6.5  |         | 8.0  |
|                                    |  | V <sub>CC</sub> = 3V, T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> (Note1) | 4.2    | 6.5  |         | 9.2  |
|                                    |  | V <sub>CC</sub> = 2.7V to 5.5V, T <sub>A</sub> = +25°C                              | 5.2    | 6.5  |         | 11.0 |
|                                    | R <sub>BIAS</sub> = 500Ω                                       | 15  | 17     |      |         |      |
| Shutdown Supply Current            | MAX2631/MAX2633  |   | <0.1   | 1    | µA      |      |
| SHDN Input Low Voltage             | MAX2631/MAX2633, V <sub>CC</sub> = 2.7V to 5.5V                |   |        | 0.45 | V       |      |
| SHDN Input High Voltage            | MAX2631/MAX2633, V <sub>CC</sub> = 2.7V to 5.5V                | 2.0   |        |      | V       |      |
| SHDN Input Bias Current            | MAX2631/<br>MAX2633  | V <sub>SHDN</sub> = V <sub>CC</sub>   |        | 30   | µA      |      |
|                                    |  | V <sub>SHDN</sub> = GND   |        | 1    |         |      |

**Note 1:** Guaranteed by design and characterization.

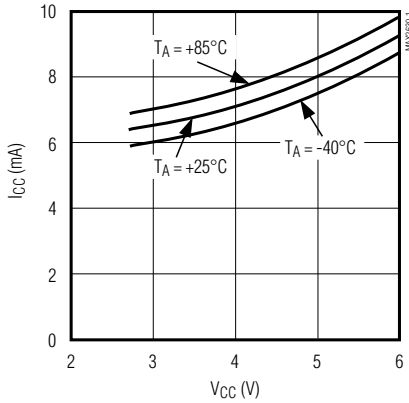
# VHF-to-Microwave, +3V, General-Purpose Amplifiers

## Typical Operating Characteristics

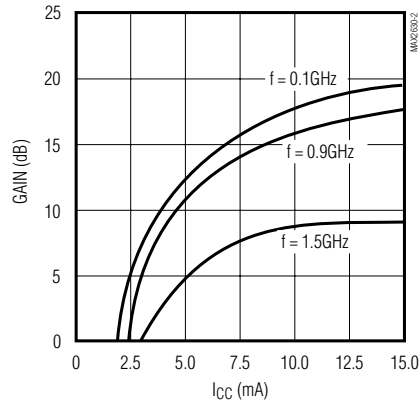
( $V_{CC} = +3V$ ,  $V_{SHDN} = V_{CC}$  (MAX2631/MAX2633),  $Z_0 = 50\Omega$ ,  $f_{IN} = 900MHz$ ,  $R_{BIAS} = 10k\Omega$  (MAX2632/MAX2633),  $T_A = +25^\circ C$ , unless otherwise noted.)

MAX2630-MAX2633

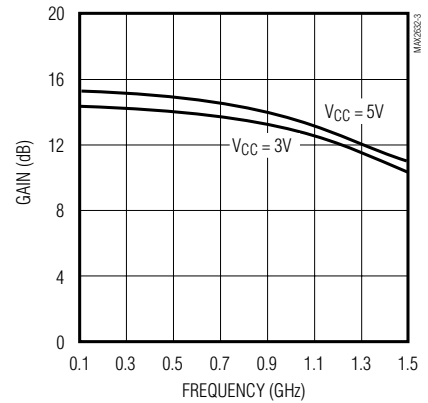
**SUPPLY CURRENT vs. SUPPLY VOLTAGE**



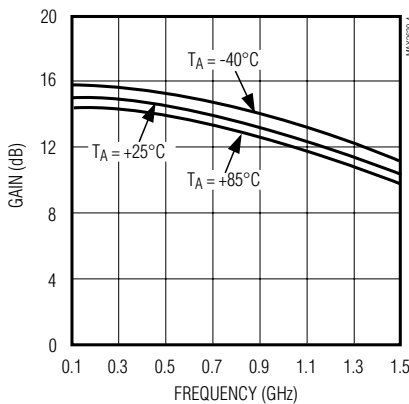
**MAX2632/MAX2633 GAIN vs. SUPPLY CURRENT**



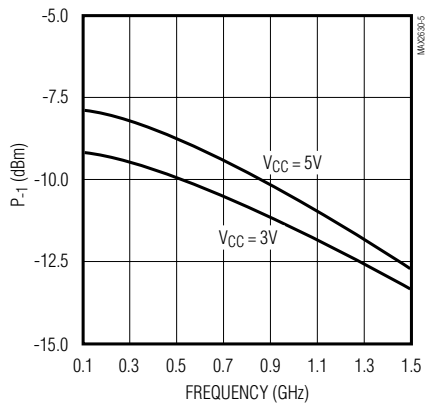
**GAIN vs. FREQUENCY AND VOLTAGE**



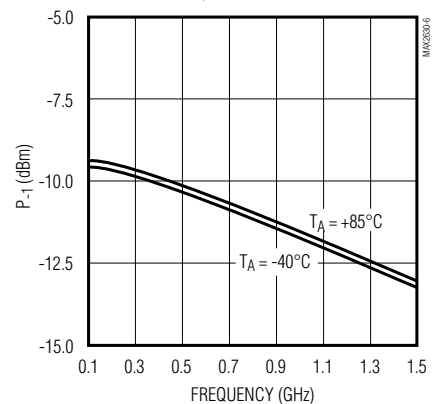
**GAIN vs. FREQUENCY AND TEMPERATURE**



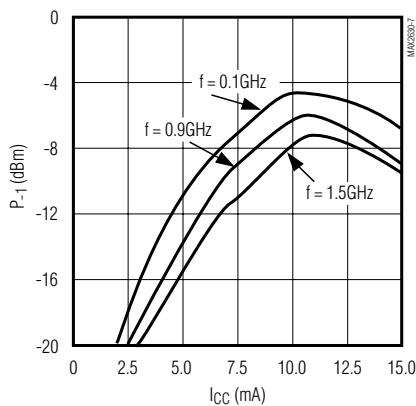
**OUTPUT 1dB COMPRESSION POWER vs. FREQUENCY AND VOLTAGE**



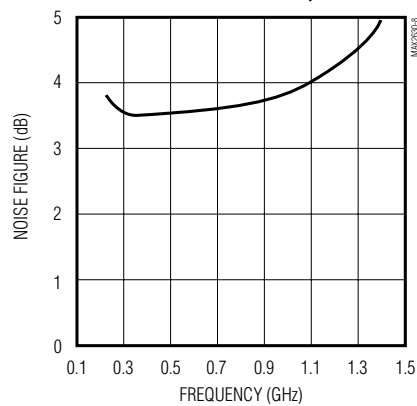
**OUTPUT 1dB COMPRESSION POWER vs. FREQUENCY AND TEMPERATURE**



**MAX2632/MAX2633 OUTPUT 1dB COMPRESSION POWER vs. SUPPLY CURRENT**



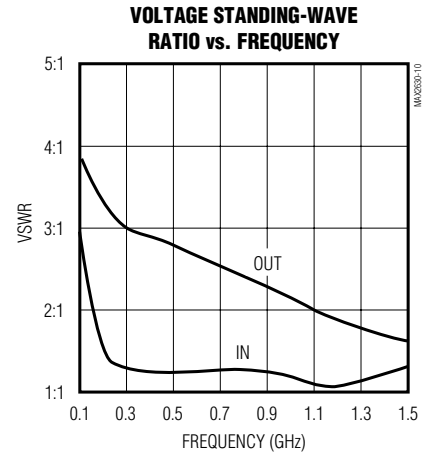
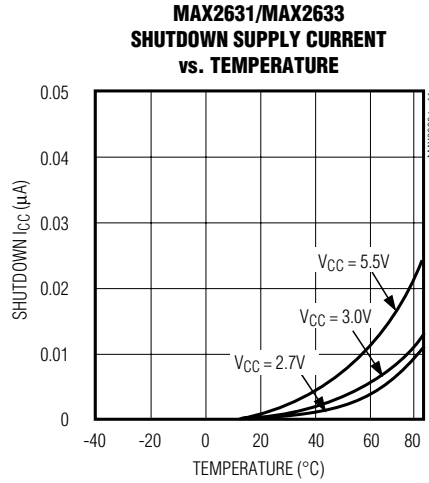
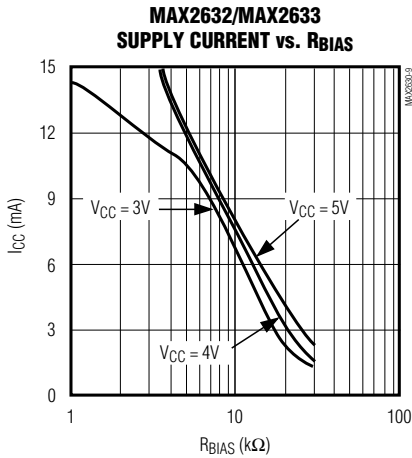
**NOISE FIGURE vs. FREQUENCY**



# VHF-to-Microwave, +3V, General-Purpose Amplifiers

## Typical Operating Characteristics (continued)

( $V_{CC} = +3V$ ,  $V_{\overline{SHDN}} = V_{CC}$  (MAX2631/MAX2633),  $Z_0 = 50\Omega$ ,  $f_{IN} = 900MHz$ ,  $R_{BIAS} = 10k\Omega$  (MAX2632/MAX2633),  $T_A = +25^\circ C$ , unless otherwise noted.)



## Pin Description

| PIN     |         |         |         | NAME              | FUNCTION   |
|---------|---------|---------|---------|-------------------|--|
| MAX2630 | MAX2631 | MAX2632 | MAX2633 |                   |  |
| 3       | 5       | 5       | 6       | IN                | Amplifier Input. Use a series blocking capacitor with less than 3 $\Omega$ reactance at your lowest operating frequency.   |
| 2       | 2       | 2       | 2       | GND               | Ground Connection. For optimum performance, provide a low-inductance connection to the ground plane.   |
| 1       | 3       | 3       | 3       | OUT               | Amplifier Output. Use a series blocking capacitor with less than 3 $\Omega$ reactance at your lowest operating frequency.  |
| 4       | 4       | 4       | 4       | $V_{CC}$          | Supply Connection. Bypass directly at the supply pin. The value of the bypass capacitor is determined by the lowest operating frequency, and is typically the same as the blocking capacitor value. Additional bypassing may be necessary for long $V_{CC}$ lines. |
| —       | 1       | —       | 1       | $\overline{SHDN}$ | Shutdown Input. Driving $\overline{SHDN}$ with a logic low turns off the amplifier.  |
| —       | —       | 1       | 5       | BIAS              | Bias Resistor Connection. Connect a resistor to GND to set the bias current. See the Supply Current vs. $R_{BIAS}$ graph in the <i>Typical Operating Characteristics</i> .   |

# VHF-to-Microwave, +3V, General-Purpose Amplifiers

MAX2630-MAX2633

**Table 1a. Typical Scattering Parameters**

( $V_{CC} = +3V$ ,  $V_{SHDN} = V_{CC}$ ,  $Z_0 = 50\Omega$ ,  $R_{BIAS} = 10k\Omega$ ,  $T_A = +25^\circ C$ .)

| FREQUENCY<br>(GHz) | S11<br>(mag) | S11<br>(ang) | S21<br>(dB) | S21<br>(mag) | S21<br>(ang) | S12<br>(dB) | S12<br>(mag) | S12<br>(ang) | S22<br>(mag) | S22<br>(ang) | K    |
|--------------------|--------------|--------------|-------------|--------------|--------------|-------------|--------------|--------------|--------------|--------------|------|
| 0.05               | 0.59         | -50          | 12.9        | 4.39         | 46           | -38.7       | 0.012        | 37           | 0.62         | -19          | 4.30 |
| 0.10               | 0.37         | -70          | 14.2        | 5.11         | 1            | -36.7       | 0.015        | 12           | 0.57         | -29          | 4.07 |
| 0.20               | 0.22         | -86          | 14.5        | 5.32         | -49          | -35.8       | 0.016        | -13          | 0.54         | -49          | 3.93 |
| 0.30               | 0.17         | -100         | 14.5        | 5.32         | -89          | -35.0       | 0.018        | -32          | 0.53         | -71          | 3.74 |
| 0.40               | 0.16         | -109         | 14.5        | 5.28         | -125         | -34.4       | 0.019        | -51          | 0.51         | -94          | 3.61 |
| 0.50               | 0.15         | -99          | 14.3        | 5.19         | -138         | -33.6       | 0.021        | -70          | 0.50         | -118         | 3.45 |
| 0.60               | 0.14         | -86          | 14.1        | 5.05         | -127         | -33.0       | 0.022        | -89          | 0.48         | -109         | 3.38 |
| 0.70               | 0.14         | -68          | 13.9        | 4.93         | -116         | -32.2       | 0.025        | -107         | 0.46         | -96          | 3.27 |
| 0.80               | 0.14         | -49          | 13.5        | 4.75         | -104         | -31.3       | 0.027        | -124         | 0.44         | -82          | 3.16 |
| 0.90               | 0.13         | -31          | 13.0        | 4.49         | -93          | -30.3       | 0.031        | -142         | 0.42         | -68          | 3.05 |
| 1.00               | 0.13         | -10          | 12.6        | 4.25         | -82          | -29.0       | 0.035        | -161         | 0.40         | -53          | 2.87 |
| 1.20               | 0.06         | 19           | 10.8        | 3.48         | -58          | -25.8       | 0.051        | 153          | 0.33         | -25          | 2.59 |
| 1.40               | 0.11         | -60          | 7.9         | 2.48         | -110         | -23.7       | 0.065        | 113          | 0.26         | -12          | 2.90 |
| 1.60               | 0.24         | -31          | 5.6         | 1.91         | -162         | -23.6       | 0.066        | 122          | 0.26         | -7           | 3.51 |
| 1.80               | 0.30         | -26          | 4.8         | 1.73         | 144          | -23.7       | 0.065        | 120          | 0.26         | -34          | 3.76 |
| 2.00               | 0.31         | -66          | 4.3         | 1.63         | 86           | -23.3       | 0.069        | 117          | 0.25         | -63          | 3.80 |
| 2.20               | 0.27         | -98          | 3.6         | 1.51         | 27           | -22.3       | 0.077        | 116          | 0.24         | -83          | 3.80 |
| 2.40               | 0.24         | -115         | 2.6         | 1.36         | 5            | -21.3       | 0.086        | 116          | 0.25         | -97          | 3.81 |
| 2.50               | 0.22         | -120         | 2.2         | 1.29         | 12           | -21.0       | 0.089        | 114          | 0.27         | -106         | 3.86 |

# VHF-to-Microwave, +3V, General-Purpose Amplifiers

**Table 1b. MAX2633 Typical Scattering Parameters**

( $V_{CC} = +5V$ ,  $V_{SHDN} = V_{CC}$ ,  $Z_0 = 50\Omega$ ,  $R_{BIAS} = 10k$ ,  $T_A = +25^\circ C$ .)

| FREQUENCY<br>(GHz) | S11<br>(mag) | S11<br>(ang) | S21<br>(dB) | S21<br>(mag) | S21<br>(ang) | S12<br>(dB) | S12<br>(mag) | S12<br>(ang) | S22<br>(mag) | S22<br>(ang) | K    |
|--------------------|--------------|--------------|-------------|--------------|--------------|-------------|--------------|--------------|--------------|--------------|------|
| 0.05               | 0.58         | -53          | 13.6        | 4.80         | 45           | -39.2       | 0.011        | 36           | 0.62         | -22          | 4.26 |
| 0.10               | 0.35         | -76          | 15.0        | 5.62         | 1            | -36.9       | 0.014        | 13           | 0.57         | -29          | 3.83 |
| 0.20               | 0.20         | -97          | 15.4        | 5.87         | -48          | -36.1       | 0.016        | -14          | 0.55         | -49          | 3.75 |
| 0.30               | 0.14         | -101         | 15.4        | 5.91         | -87          | -35.2       | 0.017        | -31          | 0.53         | -72          | 3.48 |
| 0.40               | 0.12         | -94          | 15.4        | 5.91         | -123         | -34.7       | 0.018        | -50          | 0.52         | -95          | 3.35 |
| 0.50               | 0.11         | -82          | 15.4        | 5.87         | -141         | -33.8       | 0.020        | -68          | 0.51         | -119         | 3.14 |
| 0.60               | 0.11         | -66          | 15.2        | 5.78         | -130         | -33.1       | 0.022        | -86          | 0.49         | -108         | 3.02 |
| 0.70               | 0.11         | -45          | 15.1        | 5.68         | -119         | -32.3       | 0.024        | -104         | 0.48         | -94          | 2.87 |
| 0.80               | 0.11         | -22          | 14.9        | 5.54         | -108         | -31.3       | 0.027        | -121         | 0.45         | -79          | 2.73 |
| 0.90               | 0.12         | -2           | 14.5        | 5.30         | -96          | -30.0       | 0.032        | -139         | 0.43         | -65          | 2.51 |
| 1.00               | 0.12         | 21           | 14.1        | 5.09         | -85          | -28.5       | 0.038        | -158         | 0.42         | -49          | 2.28 |
| 1.20               | 0.08         | -54          | 12.5        | 4.22         | -59          | -25.2       | 0.055        | 153          | 0.34         | -18          | 2.01 |
| 1.40               | 0.10         | -103         | 9.3         | 2.93         | -112         | -23.1       | 0.070        | 114          | 0.24         | -4           | 2.36 |
| 1.60               | 0.22         | -44          | 6.7         | 2.16         | -163         | -23.3       | 0.068        | 125          | 0.24         | -7           | 3.07 |
| 1.80               | 0.29         | -20          | 5.8         | 1.96         | 145          | -23.7       | 0.065        | 124          | 0.24         | -37          | 3.41 |
| 2.00               | 0.30         | -60          | 5.3         | 1.85         | 89           | -23.3       | 0.069        | 120          | 0.23         | -65          | 3.41 |
| 2.20               | 0.26         | -92          | 4.9         | 1.75         | 29           | -22.2       | 0.078        | 117          | 0.21         | -83          | 3.31 |
| 2.40               | 0.24         | -110         | 3.9         | 1.57         | 2            | -21.7       | 0.082        | 116          | 0.23         | -95          | 3.48 |
| 2.50               | 0.23         | -113         | 3.5         | 1.50         | 10           | -20.9       | 0.090        | 115          | 0.25         | -100         | 3.35 |

# VHF-to-Microwave, +3V, General-Purpose Amplifiers

MAX2630-MAX2633

## Detailed Description

The MAX2630-MAX2633 are broadband amplifiers with 3dB bandwidth greater than 1GHz. Their small size and internal bias circuitry make them ideal for applications where board space is limited. The MAX2632/MAX2633 have a user-selectable bias current that allows the user to set both gain and output power for a particular application, and the MAX2631/MAX2633 incorporate shut-down capability.

## Applications Information

### External Components

The MAX2630-MAX2633 are easy to use, as shown in the *Typical Operating Circuit* and Figures 1, 2 and 3. Input and output series capacitors may be necessary to block DC bias voltages generated by the amplifiers 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 megahertz) is the minimum operating frequency.

The  $V_{\text{CC}}$  pin must be RF bypassed for correct operation. To accomplish this, connect a capacitor between the  $V_{\text{CC}}$  pin and ground, as close to the package as is practical. Use the same equation given above (for DC-blocking capacitor values) to calculate the minimum capacitor value. If the PC board has long  $V_{\text{CC}}$  lines, additional bypassing may be necessary. This can be done farther away from the package, if needed.

Proper grounding of the GND pin is essential. If the PC board uses a topside RF ground, connect it directly to the GND pin. For a board where the ground plane is not on the component side, the best technique is to connect the GND pin to it with a plated through-hole close to the package.

An on-chip buffer at the MAX2631/MAX2633's SHDN pin makes bypassing this pin unnecessary except in very noisy applications. When RF filtering is needed, use a bypass capacitor similar to the one used on  $V_{\text{CC}}$ . Since negligible current flows into this pin, additional RF filtering may be done with a series resistor.

To set the MAX2632/MAX2633's supply current, connect a resistor from the BIAS pin to ground. To estimate the value of this resistor, refer to the graph Supply Current vs.  $R_{\text{BIAS}}$  in the *Typical Operating Characteristics*.

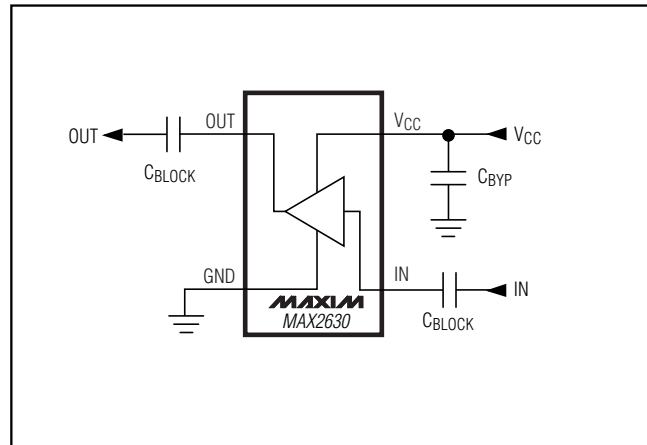


Figure 1. MAX2630 Typical Operating Circuit

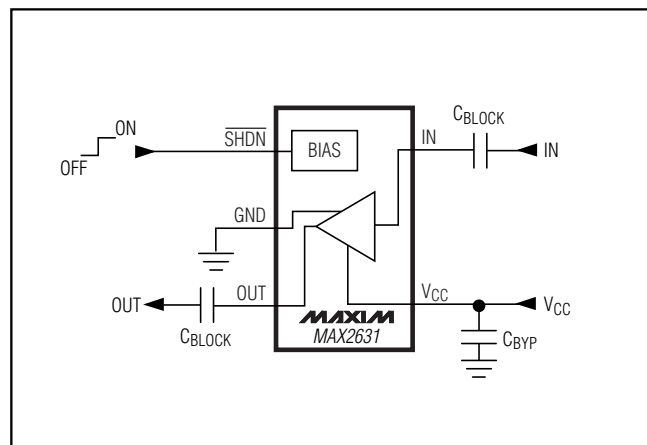


Figure 2. MAX2631 Typical Operating Circuit

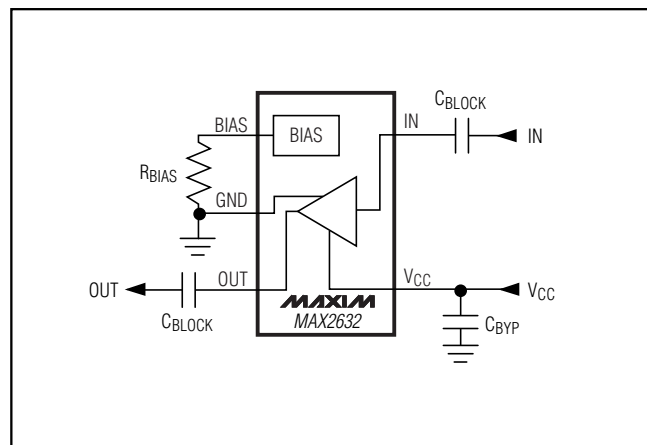


Figure 3. MAX2632 Typical Operating Circuit

# VHF-to-Microwave, +3V, General-Purpose Amplifiers

## PC Board Layout Example

Example PC board layouts are given in Figures 4 to 7. They use FR-4 with a 31mil layer thickness between the RF lines and the ground plane. The boards satisfy all of the above recommendations.

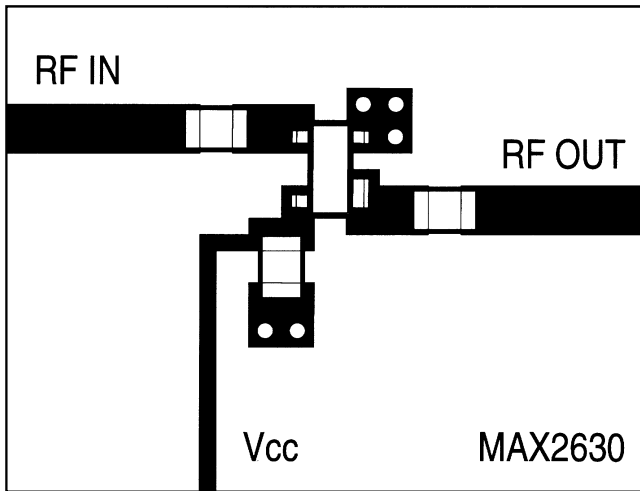


Figure 4. MAX2630 Example PC Board Layout

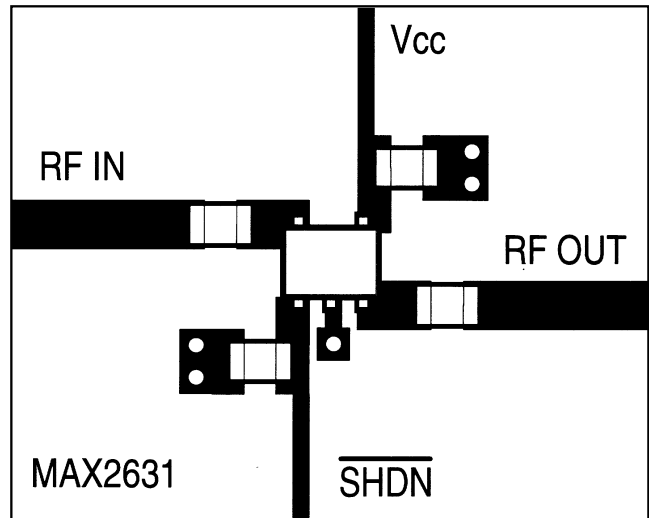


Figure 5. MAX2631 Example PC Board Layout

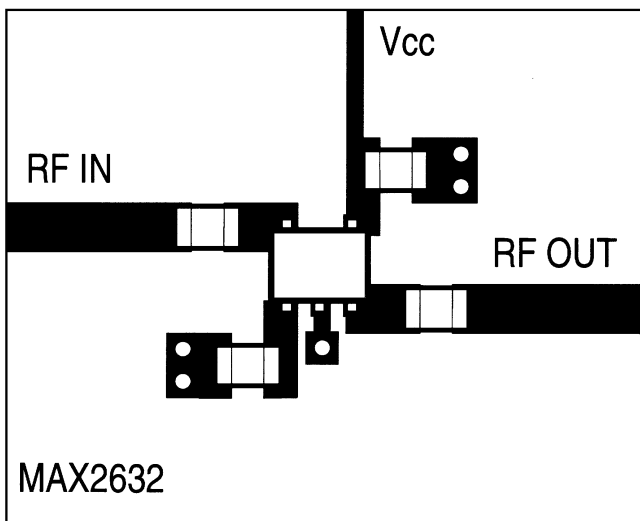


Figure 6. MAX2632 Example PC Board Layout

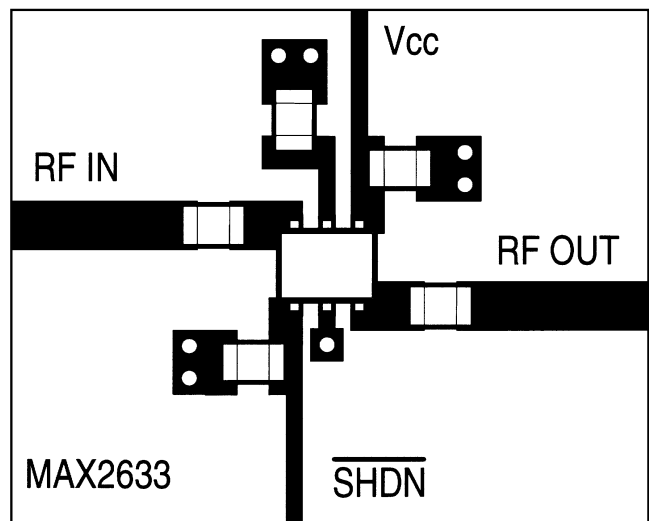


Figure 7. MAX2633 Example PC Board Layout



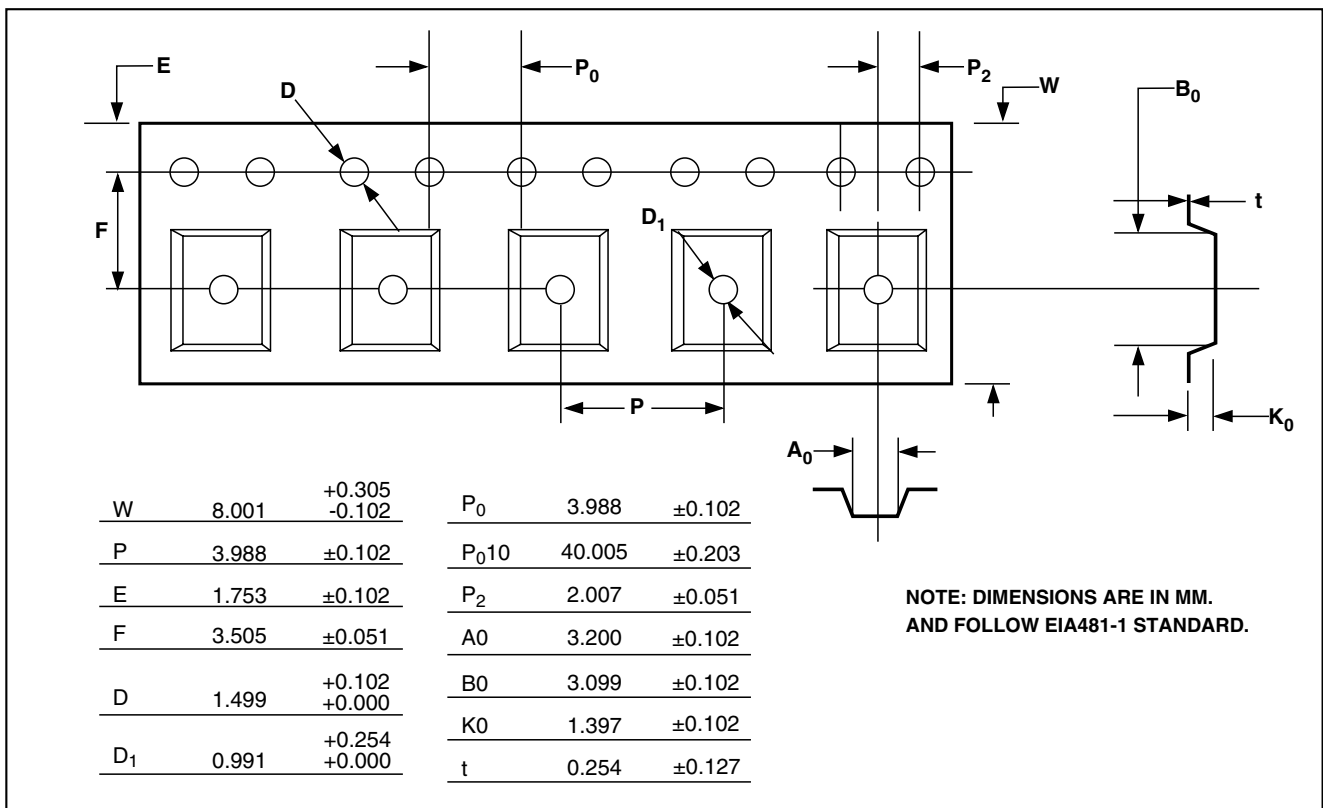
# VHF-to-Microwave, +3V, General-Purpose Amplifiers

**MAX2630-MAX2633**

## Chip Information

TRANSISTOR COUNT: 199

## Tape-and-Reel Information



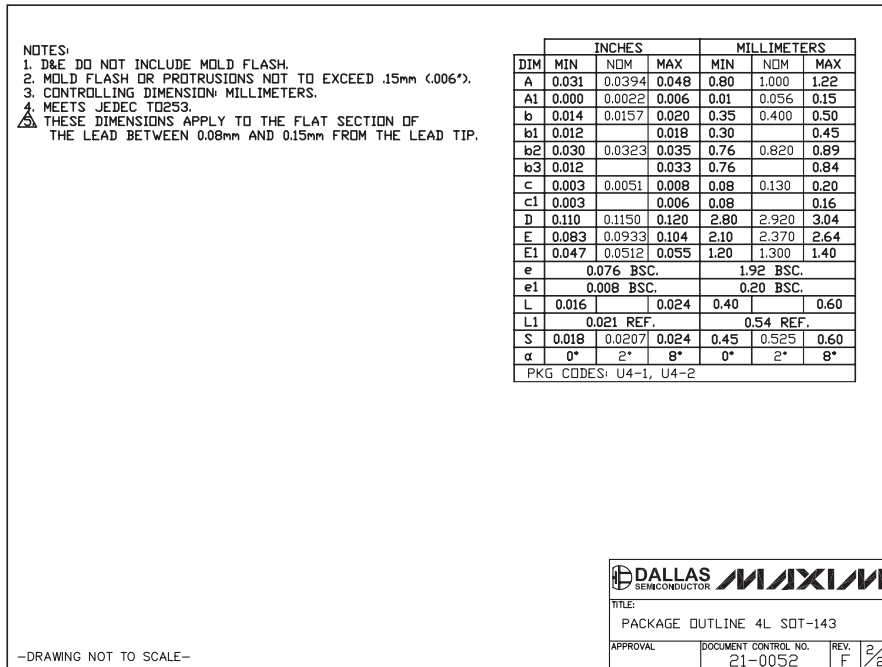
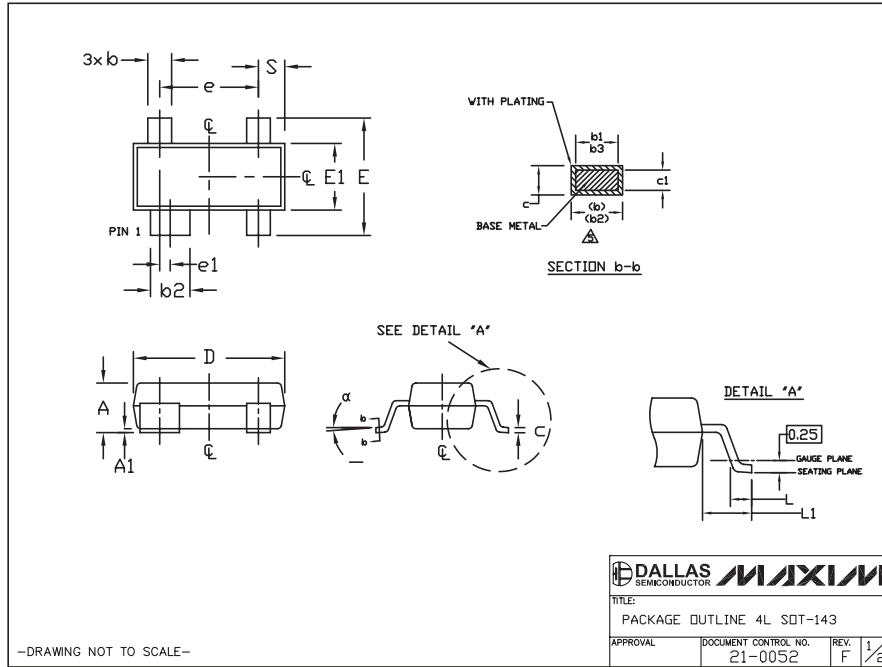
## Revision History

Pages changed at Rev 3: 1, 4, 9-12.

# VHF-to-Microwave, +3V, General-Purpose Amplifiers

## Package Information

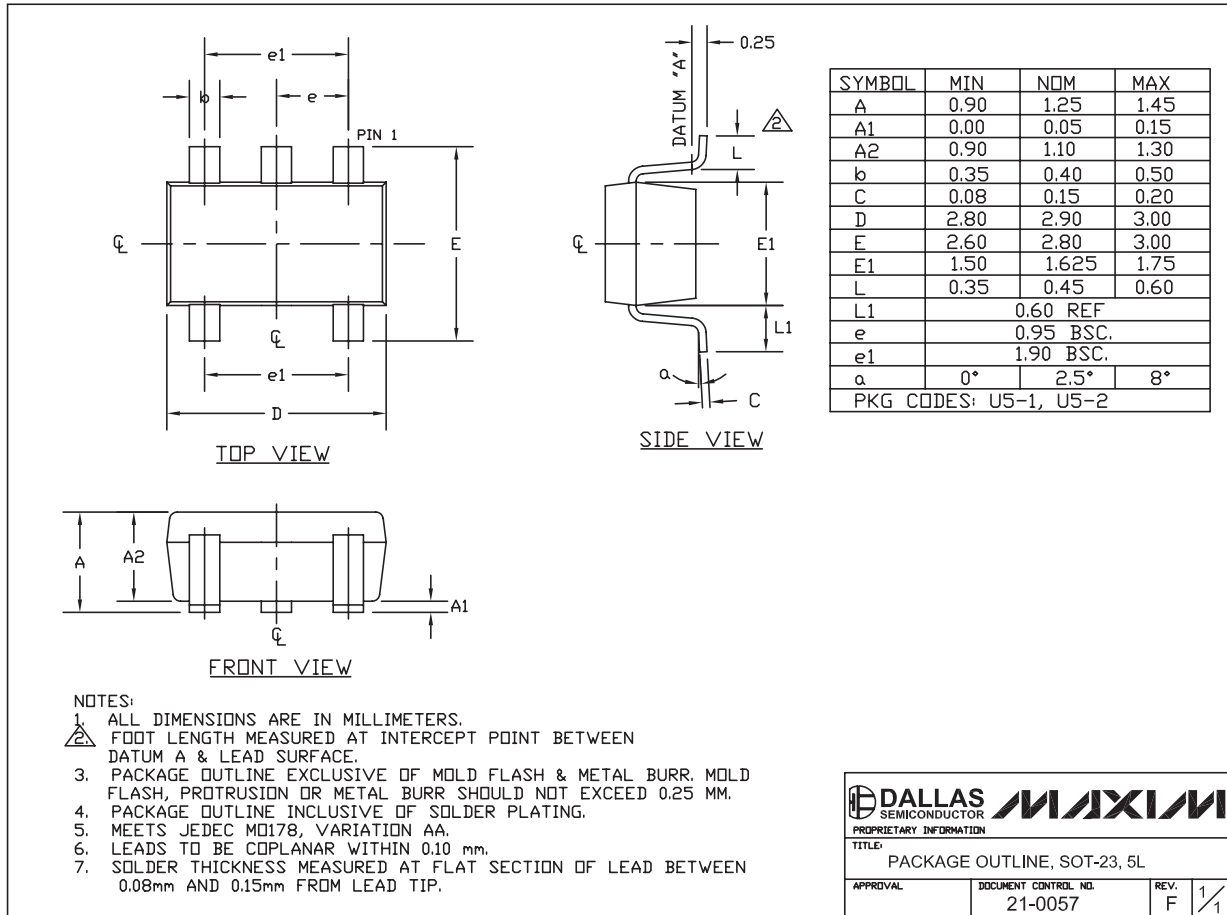
(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)



# VHF-to-Microwave, +3V, General-Purpose Amplifiers

## Package Information (continued)

(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).)



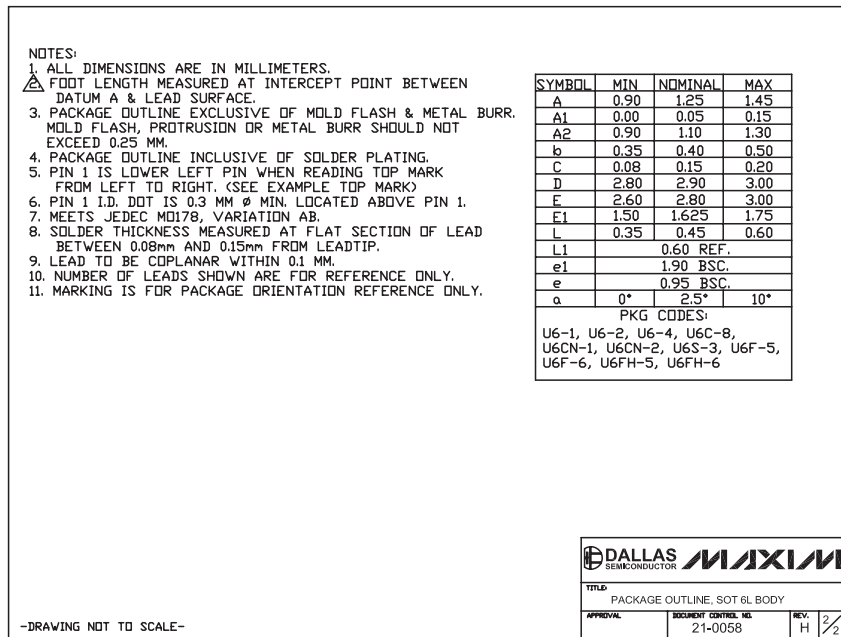
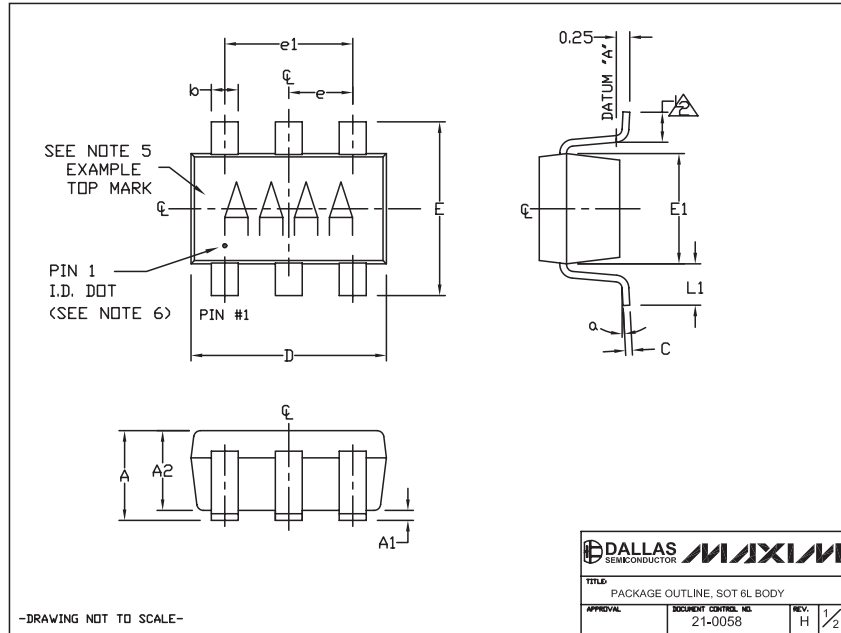
SOT-23 5L, EPS

MAX2630-MAX2633

# VHF-to-Microwave, +3V, General-Purpose Amplifiers

## Package Information (continued)

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