Features



## Tiny, Low-Cost, Single/Dual-Input, Fixed-Gain Microphone Amplifiers with Integrated Bias

### **General Description**

The MAX9812/MAX9813 are single/dual-input, 20dB fixed-gain microphone amplifiers. They offer tiny packaging and a low-noise, integrated microphone bias, making them ideal for portable audio applications such as notebook computers, cell phones, and PDAs. These amplifiers feature a 500kHz bandwidth, Rail-to-Rail® outputs, an industry-leading 100dB power-supply rejection ratio, and a very low 0.015% THD+N. Power-saving features include very low 230µA supply current and a total shutdown mode that cuts the combined supply and BIAS currents to only 100nA.

The MAX9812 is a single amplifier in a 6-pin SC70 package (2mm x 2.1mm) and the MAX9813 is a dualinput amplifier available in an 8-pin SOT23 (3mm x 3mm) package. The MAX9813 has two inputs allowing two microphones to be multiplexed to a single output.

The MAX9812/MAX9813 are offered in two grades. The MAX9812L/MAX9813L are optimized for 3.3V supply operation (2.7V to 3.6V). The MAX9812H/MAX9813H are PC2001 compliant and are optimized for 5V operation (4.5V to 5.5V). Both devices are specified over the -40°C to +85°C extended operating temperature range.

### **Applications**

**Notebook Computers** 

**PDAs** 

**Smart Phones** 

Car Kit Adapters

Digital Cameras

Video Tape Recorders

#### ♦ PC2001 Compliant

- ♦ 100dB at 217Hz Power-Supply Rejection Ratio
- ♦ Very Low 230µA Quiescent Current
- ♦ Low 0.015% THD+N
- ♦ Available in Two Versions MAX9812L/MAX9813L-2.7V to 3.6V MAX9812H/MAX9813H-4.5V to 5.5V
- ♦ Internal Low-Noise Microphone Bias Supply 2.3V for MAX9812L/MAX9813L 4.0V for MAX9812H/MAX9813H
- ♦ 100nA Low-Power Shutdown Mode
- ♦ Rail-to-Rail Outputs
- ♦ 20dB Fixed Gain
- ♦ Available in Tiny 6-Pin SC70 (2mm x 2.1mm) and 8-Pin SOT23 (3mm x 3mm) Packages
- ♦ Extended Temperature Range -40°C to +85°C

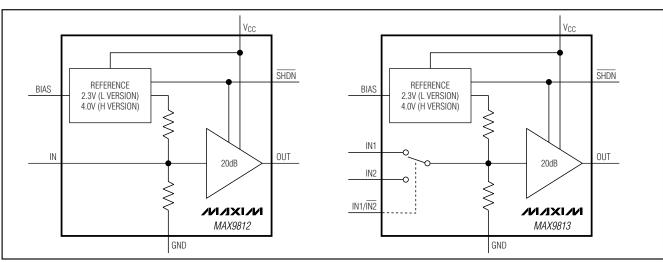
### Ordering Information

		PIN-	
PART	TEMP RANGE	PACKAGE	Vcc (V)
MAX9812LEXT-T	-40°C to +85°C	6 SC70-6	2.7 to 3.6
MAX9812HEXT-T	-40°C to +85°C	6 SC70-6	4.5 to 5.5
MAX9813LEKA-T	-40°C to +85°C	8 SOT23-8	2.7 to 3.6
MAX9813HEKA-T	-40°C to +85°C	8 SOT23-8	4.5 to 5.5

Pin Configurations, Selector Guide, and Typical Operating Circuits appear at end of data sheet.

Rail-to-Rail is a trademark of Nippon Motorola Ltd.

## Simplified Block Diagrams



MIXIM

Maxim Integrated Products 1

#### **ABSOLUTE MAXIMUM RATINGS**

(All voltages referenced to GND)	Operating Ten
V <sub>CC</sub> 0.3V to +6.0V	Storage Temp
All Other Pins0.3V to (V <sub>CC</sub> + 0.3V)	Junction Temp
Continuous Current (IN, SHDN, IN1, IN2, IN1/IN2)±20mA	Lead Tempera
OUT, BIAS Short-Circuit Duration (to GND or VCC)Continuous	
Continuous Power Dissipation (T <sub>A</sub> = +70°C)	
6-Pin SC70 (derate 3.1mW/°C above +70°C)245mW	
8-Pin SOT23 (derate 8.9mw/°C above +70°C)714mW	

Operating Temperature Range	40°C to +85°C
Storage Temperature Range	65°C to +150°C
Junction Temperature	+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**

 $(\text{VCC} = 3.3\text{V}, \text{I}_{\text{BIAS}} = 500\mu\text{A} \text{ (MAX9812L/MAX9813L)}, \text{ V}_{\text{CC}} = 5\text{V}, \text{I}_{\text{BIAS}} = 800\mu\text{A} \text{ (MAX9812H/MAX9813H)}, \text{ GND} = 0\text{V}, \text{ R}_{\text{L}} = \text{open}, \\ \hline \text{SHDN} = \text{V}_{\text{CC}}, \text{T}_{\text{A}} = \text{T}_{\text{MIN}} \text{ to T}_{\text{MAX}}, \text{ unless otherwise noted. Typical values are at T}_{\text{A}} = +25^{\circ}\text{C.}) \text{ (Note 1)}$ 

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
GENERAL	•			•			•
Supply Voltage Range	Vcc	MAX9812L/MAX9813L	Inferred from	2.7		3.6	V
		MAX9812H/MAX9813H	PSRR test	4.5		5.5	
Supply Current	Icc	I <sub>BIAS</sub> = 0			230	400	μΑ
Shutdown Supply Current	ICC_SHDN	SHDN = GND			0.1	1	μΑ
Amplifier Output Bias Voltage	M	MAX9812L/MAX9813L		1.35	1.5	1.65	- V
Ampliner Output bias voltage	Vout_dc	MAX9812H/MAX9813H		2.25	2.5	2.75	
Input Resistance	R <sub>IN</sub>				85		kΩ
Voltage Gain	Ay			19	20	21	dB
Power-Supply Rejection Ratio	PSRR <sub>OUT</sub>	Input referred, T <sub>A</sub> = +25°C	DC	90	100		dB
			f = 217Hz		100		
			f = 1kHz		100		
			f = 10kHz		90		
	Voн	$R_L = 10k\Omega$ to $V_{CC}/2$			V <sub>CC</sub> - 0.1		
Output Voltage Swing		$R_L = 1k\Omega$ to $V_{CC}/2$		V <sub>CC</sub> - 0.25V	V <sub>CC</sub> - 0.1V		V
		$R_L = 10k\Omega$ to $V_{CC}/2$			0.1		
	VoL	$R_L = 1k\Omega$ to $V_{CC}/2$			0.1	0.25	
Output Short-Circuit Current	IOUT_SC	Sinking or sourcing		3	12	24	mA
Small-Signal -3dB Bandwidth	BW	V <sub>OUT</sub> = 10mV <sub>P-P</sub>			400		kHz
Output Capacitive-Load Stability	CL	No sustained oscillations			50		рF
Output Impedance	Z <sub>OUT</sub>	f = 1kHz			0.5		Ω
Output Slew Rate	SR	V <sub>OUT</sub> = 1V step			1		V/µs

## **ELECTRICAL CHARACTERISTICS (continued)**

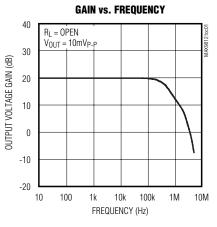
 $\frac{(V_{CC}=3.3V,\ I_{BIAS}=500\mu\text{A}\ (MAX9812L/MAX9813L),\ V_{CC}=5V,\ I_{BIAS}=800\mu\text{A}\ (MAX9812H/MAX9813H),\ GND=0V,\ R_{L}=open,\ SHDN=V_{CC},\ T_{A}=T_{MIN}\ to\ T_{MAX},\ unless\ otherwise\ noted.$  Typical values are at  $T_{A}=+25^{\circ}\text{C.}$ ) (Note 1)

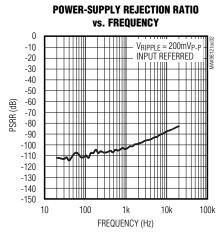
PARAMETER	SYMBOL	CONDITION	IS	MIN	TYP	MAX	UNITS	
Amplifier Input Voltage-Noise Density	en	Inputs at AC GND	f = 1kHz		40		nV/√Hz	
Total Integrated Input Noise	Vn	22Hz to 22kHz BW, inputs a	at AC GND		5		μV <sub>RMS</sub>	
Off-Isolation		Input referred, MAX9813 only	1kHz		75		dB	
Oli-Isolation			10kHz		60			
Total Harmonic Distortion Plus Noise	THD+N	$f = 1kHz$ , $R_L = 10k\Omega$ to $V_{CC}/2$ , $BW = 22Hz$ to $22kHz$	VOUT = 1V <sub>P-P</sub> (L version)		0.04		- %	
	THD+N		VOUT = 4V <sub>P-P</sub> (H version)		0.015			
BIAS								
Bias Output Voltage Range	V <sub>BIAS</sub>	MAX9812L/MAX9813L		2.1	2.30	2.55		
Bias Output Voltage Harige	V BIAS	MAX9812H/MAX9813H		3.6	4.0	4.4	V	
Bias Output Resistance	R <sub>BIAS</sub>				0.1		Ω	
	PSRR <sub>BIAS</sub>	DC, T <sub>A</sub> = +25°C		70	80			
Power-Supply Rejection Ratio		f = 217Hz			80		dB	
(V <sub>CC</sub> to BIAS)		f = 1kHz			75			
		f = 10kHz			55			
BIAS Current Limit	IBIAS_SC	BIAS short to GND		5	22	50	mA	
BIAS Capacitive-Load Stability	CBIAS	No sustained oscillations			50		рF	
Total Integrated BIAS Noise	Vn	22Hz to 22kHz BW			29		μV <sub>RMS</sub>	
DIGITAL INPUTS (SHDN, IN1/IN2)								
Logic-Low Threshold	VIL					0.8	V	
Logic-High Threshold	VIH			2.0			V	
Logic Input Current	I <sub>IN</sub>	SHDN = GND or V <sub>CC</sub>				±1	μΑ	
Shutdown Enable Time	tshdn_on	95% of settled value			10		ms	
Shutdown Disable Time	tSHDN_OFF				50		μs	
IN1/IN2 Select Time	tsel				10		μs	

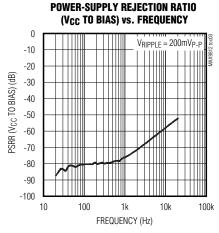
Note 1: All specifications are 100% tested at  $T_A = +25$ °C. Temperature limits are guaranteed by design.

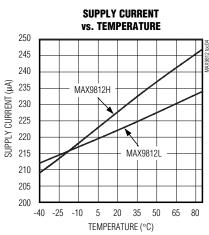
### **Typical Operating Characteristics**

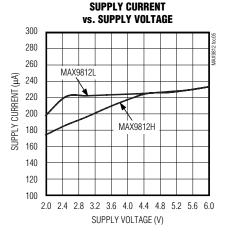
 $(V_{CC}=3.3V \text{ (MAX9812L/MAX9813L)}, V_{CC}=5V \text{ (MAX9812H/MAX9813H)}, \text{ GND}=0V, \text{ R}_{L}=10\text{k}\Omega \text{ to } V_{CC}/2, \overline{SHDN}=V_{CC}, \text{ T}_{A}=+25^{\circ}\text{C}, \text{ unless otherwise noted.)}$ 

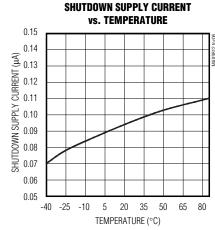


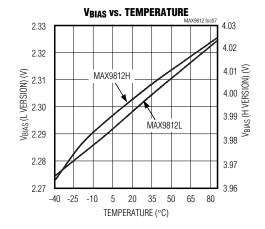


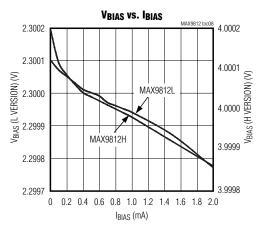








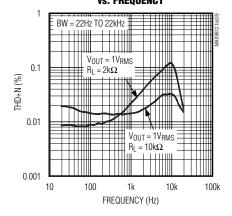




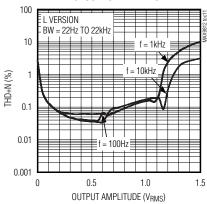
### **Typical Operating Characteristics (continued)**

 $(V_{CC}=3.3V \text{ (MAX9812L/MAX9813L)}, V_{CC}=5V \text{ (MAX9812H/MAX9813H)}, \text{ GND}=0V, \text{ R}_{L}=10\text{k}\Omega \text{ to } V_{CC}/2, \overline{\text{SHDN}}=V_{CC}, \text{ T}_{A}=+25^{\circ}\text{C}, \text{ unless otherwise noted.})$ 

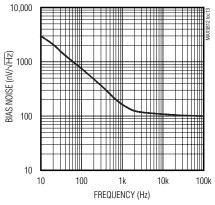
## TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY



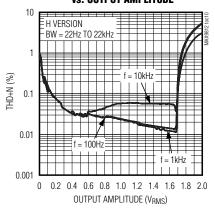
## TOTAL HARMONIC DISTORTION PLUS NOISE vs. Output amplitude



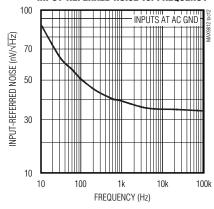
#### **BIAS NOISE vs. FREQUENCY**



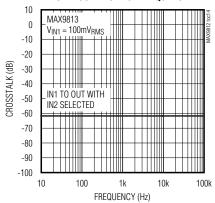
## TOTAL HARMONIC DISTORTION PLUS NOISE vs. Output amplitude



#### **INPUT-REFERRED NOISE vs. FREQUENCY**

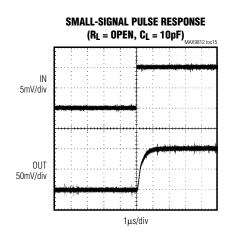


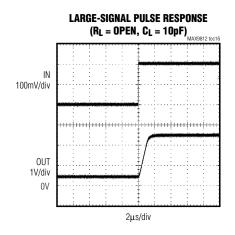
#### **OFF-ISOLATION vs. FREQUENCY**

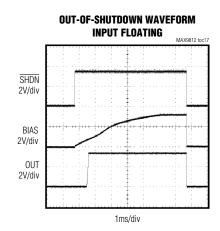


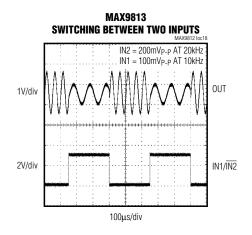
### Typical Operating Characteristics (continued)

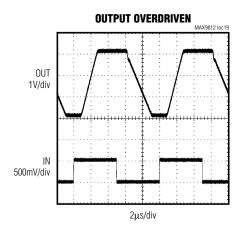
 $(V_{CC}=3.3V \text{ (MAX9812L/MAX9813L)}, V_{CC}=5V \text{ (MAX9812H/MAX9813H)}, \text{ GND}=0V, \text{ R}_{L}=10\text{k}\Omega \text{ to } V_{CC}/2, \overline{\text{SHDN}}=V_{CC}, \text{ T}_{A}=+25^{\circ}\text{C}, \text{ unless otherwise noted.})$ 











### **Pin Description**

Р	PIN		
MAX9812L/ MAX9812H	MAX9813L/ MAX9813H	NAME	FUNCTION
1	3	SHDN	Active-Low Shutdown Input. Connect SHDN to V <sub>CC</sub> for normal operation. Connect SHDN to GND for shutdown. SHDN is a high-impedance input; do not leave floating.
2	2	GND	Ground
3	1	OUT	Amplifier Output
4	8	V <sub>CC</sub>	Positive Supply. Bypass V <sub>CC</sub> to GND with a 0.1µF capacitor.
5	7	BIAS	Low-Noise Microphone Bias Output. 2.3V output for MAX9812L/MAX9813L. 4V output for MAX9812H/MAX9813H.
6	_	IN	Amplifier Input (MAX9812)
_	6	IN1	Amplifer Input 1 (MAX9813)
	5	IN2	Amplifier Input 2 (MAX9813)
_	4	IN1/IN2	Input Selector. When IN1/IN2 is high, IN1 is selected. When IN1/IN2 low, IN2 is selected.

### Detailed Description

The MAX9812\_/MAX9813\_ are low-power fixed-gain microphone amplifiers available in a single- or dual-input configuration. The gain is set at 10V/V (20dB) with a 400kHz, -3dB bandwidth. They also feature a low-noise, integrated microphone input bias voltage.

#### Single/Dual Input

The MAX9812L/MAX9812H are single-input amplifiers and the MAX9813L/MAX9813H are dual-input amplifiers. All devices typically have an input impedance of 85kΩ. The inputs to the dual version are controlled through a fast 2:1 mux, selectable through the IN1/IN2 pin. Driving IN1/IN2 high selects IN1 and driving the IN1/IN2 low selects IN2. IN1/IN2 is designed to be driven by a logic high of ≥2V and a logic low ≤0.8V. The IN1/IN2 has a 10µs switching time from one channel to the other.

#### PC2001 Low-Noise Microphone BIAS

The MAX9812\_/MAX9813\_ provide a low-noise voltage BIAS designed for biasing electret condenser microphone (ECM) cartridges. The BIAS output is regulated to typically 2.3V for the MAX9812L/MAX9813L and 4V for the MAX9812H/MAX9813H. In the single-input version (MAX9812\_), the BIAS output can source up to 1mA. In the dual-input version (MAX9813\_), the BIAS output can source up to 2mA. The MAX9812H/MAX9813H provides a PC2001-compliant BIAS voltage.

#### **Output Stage**

The MAX9812\_/MAX9813\_ rail-to-rail output (OUT) typically swings to within 100mV of the rails when driving 10k $\Omega$ .

The output DC bias point is set to 1.5V for the MAX9812L/MAX9813L and 2.5V for the MAX9812H/MAX9813H.

#### **Shutdown Mode**

 $\overline{SHDN}$  controls whether the MAX9812\_/MAX9813\_ is active or in shutdown mode. Driving  $\overline{SHDN}$  low forces a low-power (100nA) shutdown mode. In this mode, the OUT pin is set to a high-impedance state and the BIAS pin is pulled down (70kΩ). Driving  $\overline{SHDN}$  high enables the MAX9812\_/MAX9813\_.  $\overline{SHDN}$  is a high-impedance input and cannot be left floating.

#### **Driving Capacitive Loads**

The MAX9812\_/MAX9813\_ output can drive up to 50pF of capacitance without sustained oscillations.

#### **Thermal Shutdown**

The thermal shutdown feature protects the MAX9812\_/MAX9813\_ from destruction due to overheating caused by shorting the outputs. This protection feature causes OUT and BIAS to shut down and go high impedance when the die temperature reaches +140°C. The device restarts after the die temperature falls below +120°C.

## **Applications Information**

#### Power-Up

The MAX9812\_/MAX9813\_ output typically settles to 95% within 10ms after power-up.

#### **Typical Application Circuit**

Figure 1 shows the MAX9813H used as a preamplifier with the MAX9760 3W audio power amplifier.

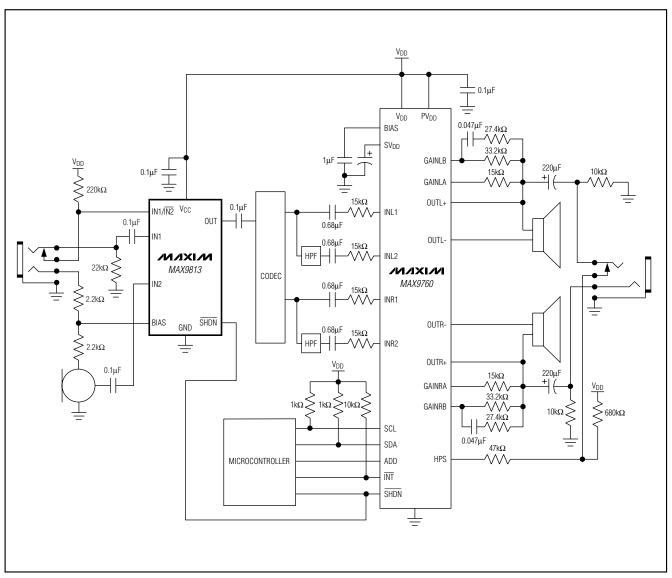
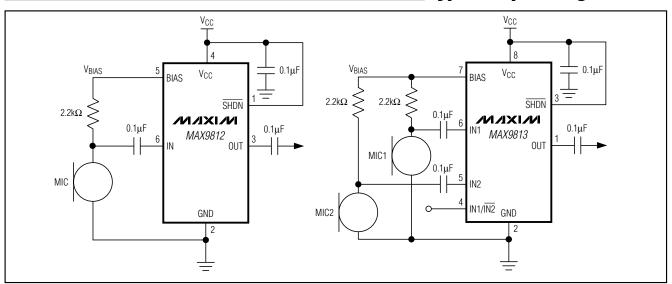


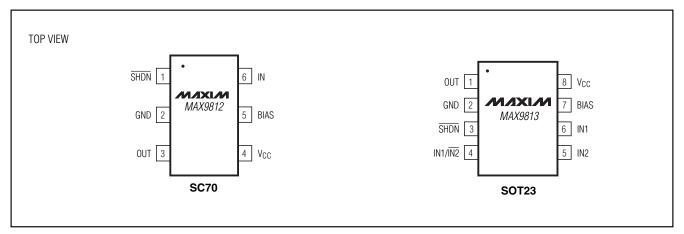
Figure 1. Typical Application Circuit

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## **Typical Operating Circuits**



### **Pin Configurations**



#### **Selector Guide**

PART	PIN-PACKAGE	V <sub>CC</sub> (V)	TOP MARK
MAX9812LEXT-T	6 SC70-6	2.7 to 3.6	ABJ
MAX9812HEXT-T	6 SC70-6	4.5 to 5.5	ABK
MAX9813LEKA-T	8 SOT23-8	2.7 to 3.6	AEEU
MAX9813HEKA-T	8 SOT23-8	4.5 to 5.5	AEEV

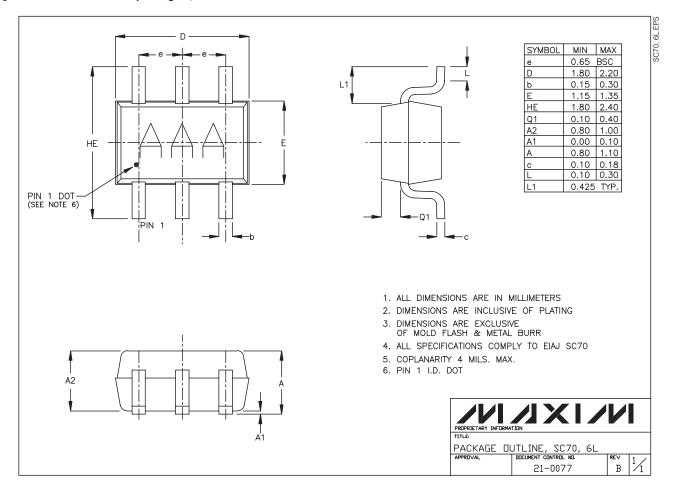
## Chip Information

MAX9812 TRANSISTOR COUNT: 264 MAX9813 TRANSISTOR COUNT: 269

PROCESS: BICMOS

### **Package Information**

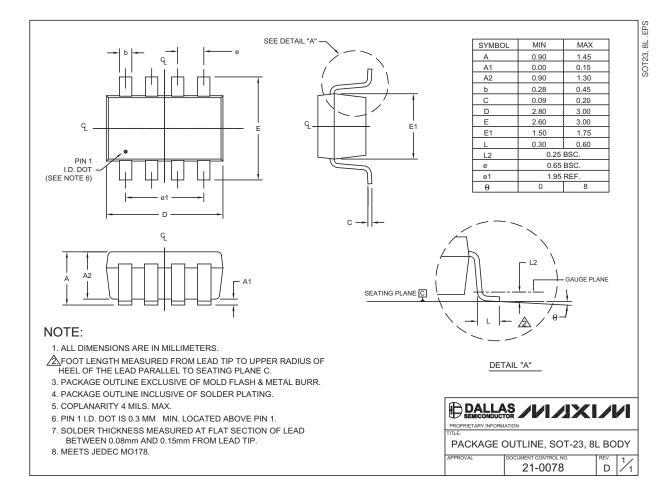
(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to <a href="https://www.maxim-ic.com/packages">www.maxim-ic.com/packages</a>.)



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### **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 <a href="https://www.maxim-ic.com/packages">www.maxim-ic.com/packages</a>.)



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