19-2408; Rev 0; 4/02

MAXIM

Differential Microphone Preamplifiers with Internal Bias and Complete Shutdown

General Description

The MAX4060–MAX4063 are differential-input microphone preamplifiers optimized for notebook/PDA audio systems. These devices feature Rail-to-Rail® outputs with excellent power-supply rejection and common-mode rejection ratios, making them ideal for low-noise applications in portable audio systems.

The MAX4060/MAX4062/MAX4063 are capable of switching their output between the differential input and a single-ended auxiliary microphone amplifier input. In addition, the MAX4060/MAX4062/MAX4063 have a low-noise microphone bias generator. The differential gain of the MAX4061/MAX4062/MAX4063 is set with a single resistor. The MAX4060 has a fixed gain of 10V/V and is PC99/2001 compliant. The MAX4063 has a complementary output allowing CODECs with differential inputs to be optimally driven. The MAX4061/MAX4063 include a complete shutdown mode. In shutdown, the supply current is reduced to 0.3µA and the current to the microphone bias is cut off for ultimate power saving.

The MAX4060 operates from a 4.5V to 5.5V single supply and the MAX4061/MAX4062/MAX4063 operate from 2.4V to 5.5V. All devices are specified over the extended operating temperature range, -40°C to +85°C. The MAX4060/MAX4061 are available in tiny 8-pin QFN and 8-pin µMAX packages. The MAX4062 is available in a 10-pin µMAX package and the MAX4063 in a 14-pin TSSOP package.

Applications

- Notebook Audio Systems
- PDA Audio Systems
- USB Audio Peripherals
- AES-42 Compliant Microphones
- Signal Conditioning

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE	TOP MARK
MAX4060EGA	-40°C to +85°C	8 QFN	ABY
MAX4060EUA	-40°C to +85°C	8 µMAX	—
MAX4061EGA	-40°C to +85°C	8 QFN	ABZ
MAX4061EUA	-40°C to +85°C	8 µMAX	—
MAX4062EUB	-40°C to +85°C	10 µMAX	—
MAX4063EUD*	-40°C to +85°C	14 TSSOP	—

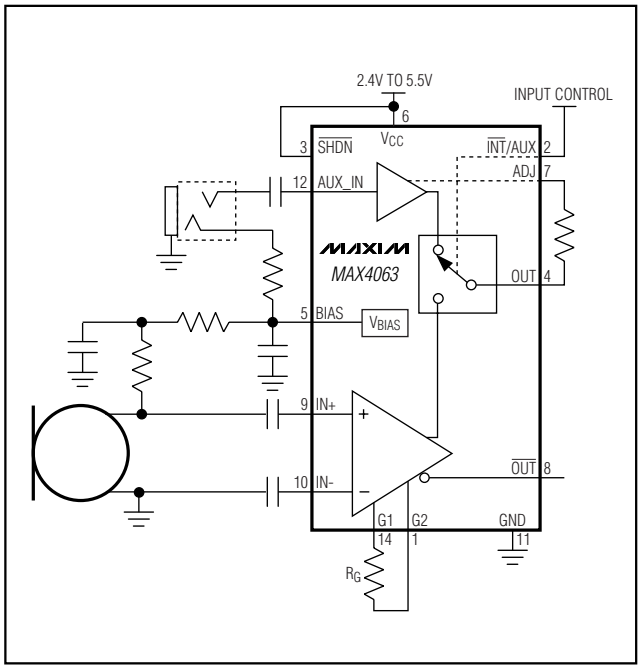
**Future product—contact factory for availability.*

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

Features

- **2.4V to 5.5V Single-Supply Operation**
- **Adjustable Gain**
- **High PSRR (86dB at 1kHz)**
- **High CMRR (70dB at 1kHz)**
- **Low Input-Referred Noise**
- **On-Board Microphone Bias**
- **750µA Supply Current**
- **0.3µA Shutdown Current**
- **±4kV ESD Protection (AUX_IN)**
- **Complementary Output (MAX4063)**
- **Rail-to-Rail Outputs**
- **THD + N: 0.04% at 1kHz**
- **Available in Space-Saving Packages**
  - **8-Pin QFN (MAX4060/MAX4061)**
  - **8-Pin µMAX (MAX4060/MAX4061)**
  - **10-Pin µMAX (MAX4062)**
  - **14-Pin TSSOP (MAX4063)**

Typical Operating Circuit



Pin Configurations and Selector Guide appear at end of data sheet.

Differential Microphone Preamplifiers with Internal Bias and Complete Shutdown

ABSOLUTE MAXIMUM RATINGS

Supply Voltage (V_{CC} to GND). .....-0.3V to +6V
Any Other Pin to GND .....-0.3V to (V_{CC} + 0.3V)
Duration of Short Circuit to GND or V_{CC} .....Continuous
Continuous Input Current (any pin) ..... ±10mA
Continuous Power Dissipation (T_A = +70°C)
8-Pin QFN (derate 4.7mW/°C above +70°C) 379mW
8-Pin µMAX (derate 4.1mW/°C above +70°C).....330mW
10-Pin µMAX (derate 5.6mW/°C above +70°C) 444mW
14-Pin TSSOP (derate 8.3mW/°C above +70°C) 667mW
Operating Temperature Range .....-40°C to +85°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_{CC} = 3V for MAX4061/MAX4062/MAX4063, V_{CC} = 5V for MAX4060, GND = 0, $\overline{SHDN}$ = V_{CC}, $\overline{INT}$/AUX = 0, R_G = 11.11kΩ, R_L = 100kΩ to 1.5V, R_{BIAS} = ∞, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Notes 1 and 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Supply Voltage Range	V_{CC}	Inferred from PSRR test	MAX4061/MAX4062/MAX4063	2.4		5.5	V
			MAX4060	4.5		5.5	
Supply Current	I_{CC}				0.75	1.2	mA
Output Voltage Swing	V_{OUT}	R_L = 100kΩ	V_{CC} - V_{OH}		2	50	mV
			V_{OL} - GND		2	50	
		R_L = 2kΩ	V_{CC} - V_{OH}		50	200	
			V_{OL} - GND		50	200	
Output Common-Mode Voltage	V_{OCM}			1.25	1.5	1.75	V
Slew Rate	SR	A_V = 10V/V			±1		V/µs
Supply Current in Shutdown	$I_{\overline{SHDN}}$	$V_{\overline{SHDN}}$ = 0, MAX4061/MAX4063		0.001		1	µA
Output Short-Circuit Current	I_{SC}	To GND			30		mA
		To V_{CC}			30		
DIFFERENTIAL INPUT ($\overline{INT}$/AUX = 0 for MAX4060/MAX4062/MAX4063, default for MAX4061)							
Input Offset Voltage	V_{OS}				±0.1	±5	mV
Common-Mode Input Voltage Range	V_{CM}	Inferred from CMRR test		1		2	V
Maximum Differential Input Voltage	$V_{DIFFMAX}$	A_V = 1V/V, MAX4061/MAX4062/MAX4063			1		V
Small-Signal Bandwidth	BW_{-3dB}				600		kHz
Input Resistance	R_{IN}	Either differential input			100		kΩ
Input Resistance Match	R_{MATCH}				1		%

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = 3V for MAX4061/MAX4062/MAX4063, V_{CC} = 5V for MAX4060, GND = 0, $\overline{SHDN}$ = V_{CC}, $\overline{INT}$/AUX = 0, R_G = 11.11kΩ, R_L = 100kΩ to 1.5V, R_{BIAS} = ∞, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Notes 1 and 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Input Noise-Voltage Density	e_n	A_V = 10V/V, f = 1kHz			100		nV/√Hz
		A_V = 100V/V, f = 1kHz, MAX4061/MAX4062/MAX4063 only			20		
RMS Output Noise Voltage	V_{NRMS}	A_V = 10V/V, BW = 22Hz to 22kHz			125		μV_{RMS}
Total Harmonic Distortion Plus Noise	THD + N	A_V = 10V/V, f = 1kHz, V_{OUT} = 0.7V_{RMS}, BW = 22Hz to 22kHz			0.04		%
Differential Gain	A_{VDIFF}	1V < V_{CM} < 2V, V_{OUT} = 0.7V_{RMS}, MAX4061/MAX4062/MAX4063	R_G = open	1	1.13	1.3	V/V
			R_G = 11.11kΩ	9.6	10	10.4	
			R_G = 1.01kΩ	96	100	104	
		1V < V_{CM} < 2V, V_{OUT} = 0.7V_{RMS}, MAX4060		9.6	10.0	10.4	
Common-Mode Rejection Ratio	CMRR	V_{CM} = 500mV_{P-P}, f = 1kHz			70		dB
Power-Supply Rejection Ratio	PSRR	T_A = +25°C		72	86		dB
		T_A = T_{MIN} - T_{MAX}		60			
		V_{CC} = 5V ±100mV, f = 1kHz			86		
AUXILIARY INPUT (MAX4060/MAX4062/MAX4063, INT/AUX = V_{CC})							
Small-Signal Bandwidth	BW_{-3dB}				200		kHz
Input Resistance	R_{IN}				100		kΩ
Input Noise-Voltage Density	e_n	f = 1kHz			45		nV/√Hz
RMS Output Noise Voltage	V_{NRMS}	BW = 22Hz to 22kHz			385		μV_{RMS}
Total Harmonic Distortion Plus Noise	THD + N	f = 1kHz, BW = 22Hz to 22kHz			0.05		%
Power-Supply Rejection Ratio	PSRR	T_A = +25°C		65	90		dB
		T_A = T_{MIN} - T_{MAX}		50			
Voltage Gain (Note 4)	A_{VAUX}	V_{OUT} = 0.7V_{RMS}		-10.7	-10	-9.3	V/V
BIAS OUTPUT (MAX4060/MAX4062/MAX4063)							
Output Voltage	V_{OUT}	I_{BIAS} = 0.8mA to GND, MAX4060		2	2.2		V
		I_{BIAS} = 0.5mA to GND, MAX4062/MAX4063		2	2.2		

Differential Microphone Preamplifiers with Internal Bias and Complete Shutdown

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = 3V for MAX4061/MAX4062/MAX4063, V_{CC} = 5V for MAX4060, GND = 0, $\overline{SHDN}$ = V_{CC}, $\overline{INT}$/AUX = 0, R_G = 11.11kΩ, R_L = 100kΩ to 1.5V, R_{BIAS} = ∞, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Notes 1 and 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Output Resistance	R_{OUT}	I_{BIAS} = 0.8mA to GND, MAX4060		2	2.5		kΩ
		I_{BIAS} = 0.5mA to GND, MAX4062/MAX4063			22	40	Ω
Output Noise Voltage	V_{NRMS}	I_{BIAS} = 0.8mA to GND, BW = 22Hz to 22kHz, MAX4060			50		μV_{RMS}
		I_{BIAS} = 0.5mA to GND, BW = 22Hz to 22kHz, MAX4062/MAX4063 (Note 3)			20		
Power-Supply Rejection Ratio	PSRR	MAX4060	I_{BIAS} = 0.8mA to GND, V_{CC} = 4.5V to 5.5V	50	80		dB
			I_{BIAS} = 0.8mA, V_{CC} = 5V + 100mV_{P-P}, f = 1kHz		70		
		MAX4062/MAX4063 (Note 3)	I_{BIAS} = 0.5mA to GND, V_{CC} = 2.4V to 5.5V	50	74		
			I_{BIAS} = 0.5mA, V_{CC} = 3V + 100mV_{P-P}, f = 1kHz		71		
DIGITAL INPUTS ($\overline{SHDN}$ for MAX4061/MAX4063 and $\overline{INT}$/AUX for MAX4060/MAX4062/MAX4063)							
Input Leakage Current	I_{IN}	V_{IN} = 0 or V_{CC}				±1	µA
Input Voltage High	V_{INH}			0.7 × V_{CC}			V
Input Voltage Low	V_{INL}					0.3 × V_{CC}	V
Shutdown Enable Time	t_{ON}	MAX4061/MAX4063			10		µs
Shutdown Disable Time	t_{OFF}	MAX4061/MAX4063			10		µs

Note 1: All specifications are 100% tested at T_A = +25°C. Specification limits over temperature (T_A = T_{MIN} to T_{MAX}) are guaranteed by design, not production tested.

Note 2: MAX4062/MAX4063 require a 1µF capacitor from BIAS to ground.

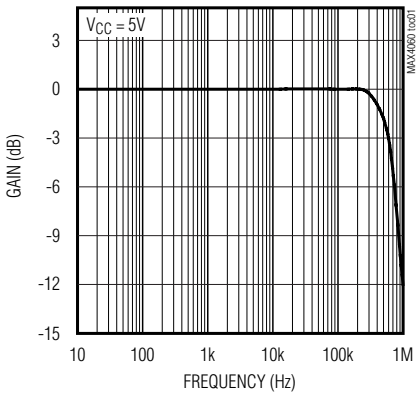
Note 3: The ADJ pin is open circuit (MAX4063 only).

Differential Microphone Preamplifiers with Internal Bias and Complete Shutdown

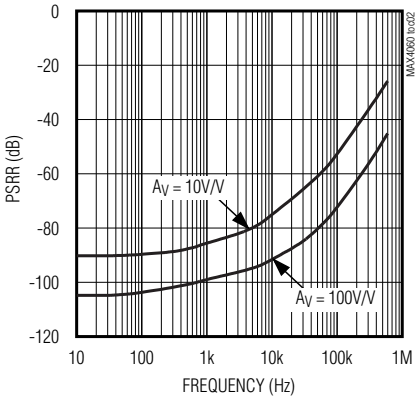
Typical Operating Characteristics

(V_{CC} = 3V (MAX4061/MAX4062/MAX4063), V_{CC} = 5V for MAX4060, A_V = 10V/V, $R_L \geq 100k\Omega$ to 1.5V, $\overline{SHDN}$ = V_{CC} (MAX4061/MAX4063 only), T_A = +25°C.)

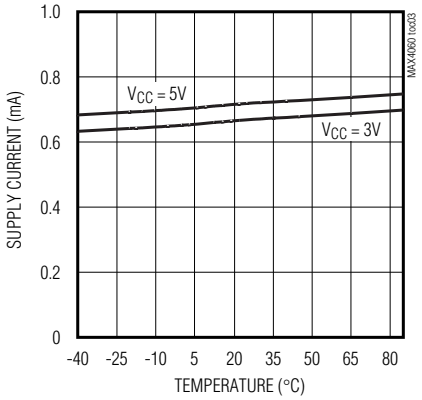
GAIN vs. FREQUENCY (NO LOAD)



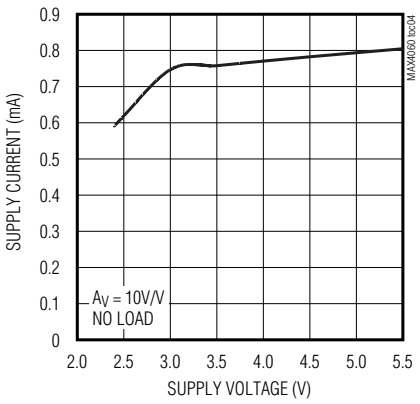
POWER-SUPPLY REJECTION RATIO vs. FREQUENCY (DIFF INPUT)



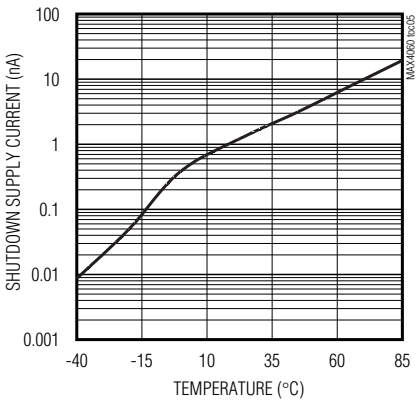
SUPPLY CURRENT vs. TEMPERATURE



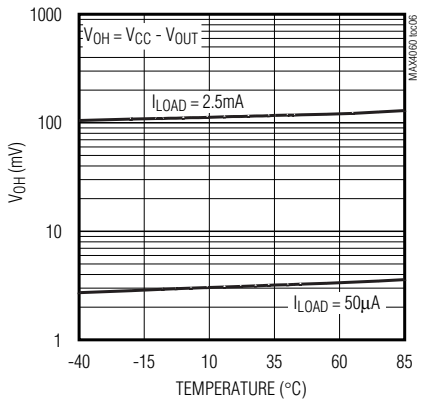
SUPPLY CURRENT vs. SUPPLY VOLTAGE



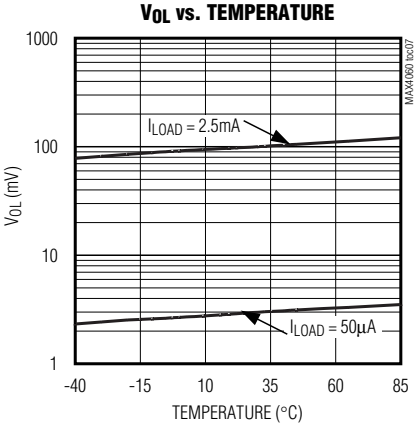
SHUTDOWN SUPPLY CURRENT vs. TEMPERATURE



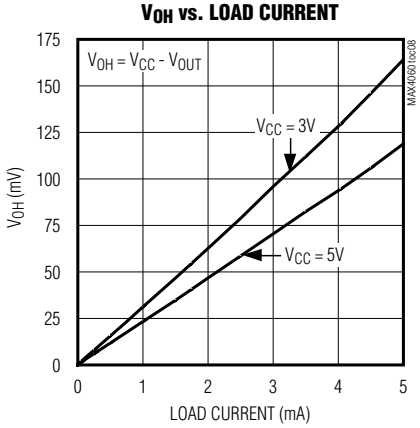
VOH vs. TEMPERATURE



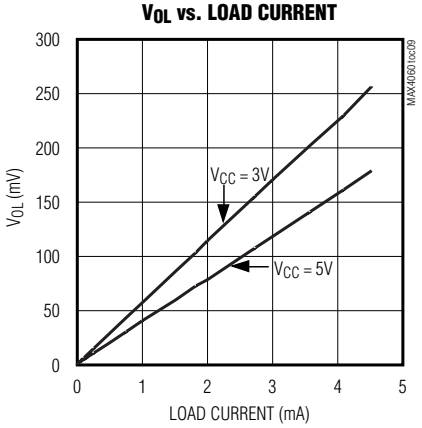
VOL vs. TEMPERATURE



VOH vs. LOAD CURRENT



VOL vs. LOAD CURRENT

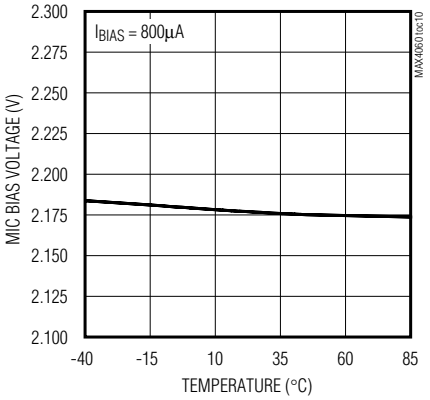


Differential Microphone Preamplifiers with Internal Bias and Complete Shutdown

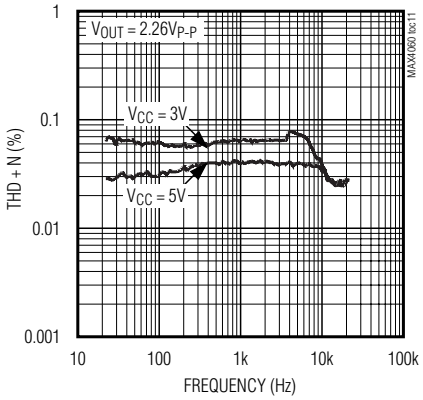
Typical Operating Characteristics (continued)

(V_{CC} = 3V (MAX4061/MAX4062/MAX4063), V_{CC} = 5V for MAX4060, A_V = 10V/V, $R_L \geq 100k\Omega$ to 1.5V, $\overline{SHDN}$ = V_{CC} (MAX4061/MAX4063 only), T_A = +25°C.)

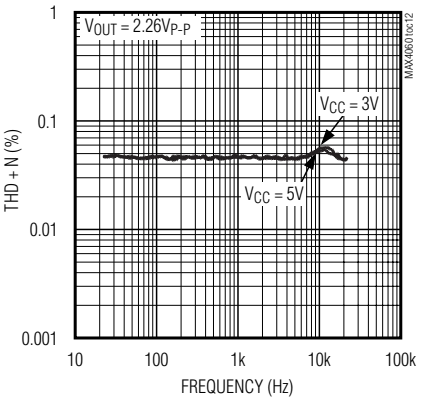
MAX4060
MIC BIAS VOLTAGE vs. TEMPERATURE



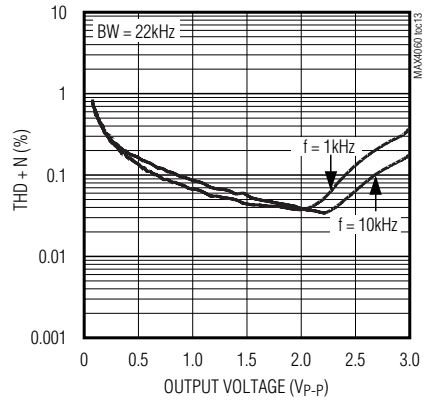
TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY (DIFF INPUT)



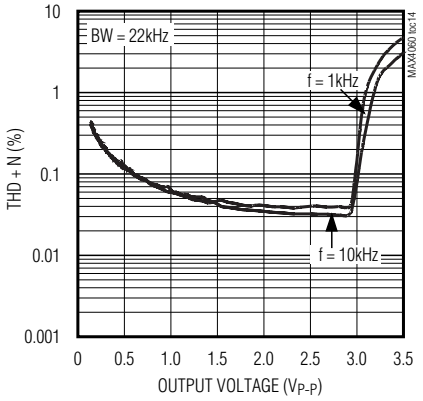
TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY (AUX INPUT)



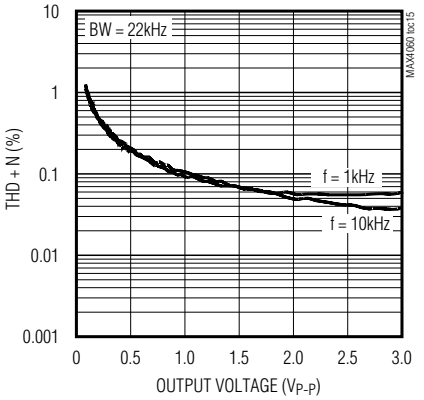
TOTAL HARMONIC DISTORTION PLUS NOISE vs. OUTPUT AMPLITUDE (DIFF INPUT, V_{CC} = 3V)



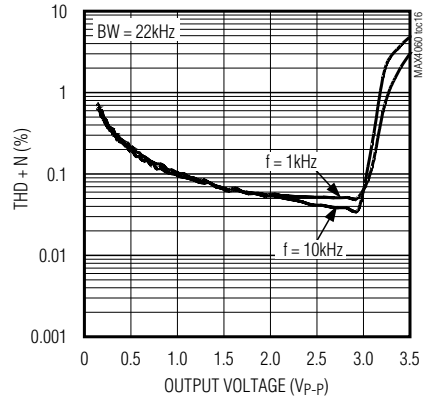
TOTAL HARMONIC DISTORTION PLUS NOISE vs. OUTPUT AMPLITUDE (DIFF INPUT, V_{CC} = 5V)



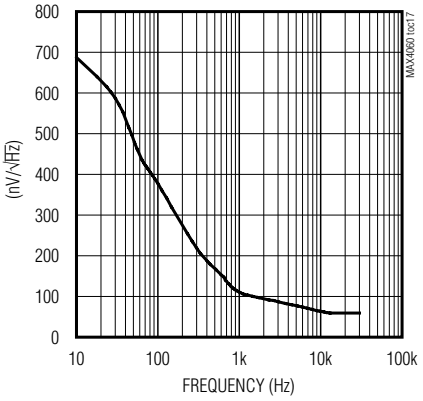
TOTAL HARMONIC DISTORTION PLUS NOISE vs. OUTPUT AMPLITUDE (AUX INPUT, V_{CC} = 3V)



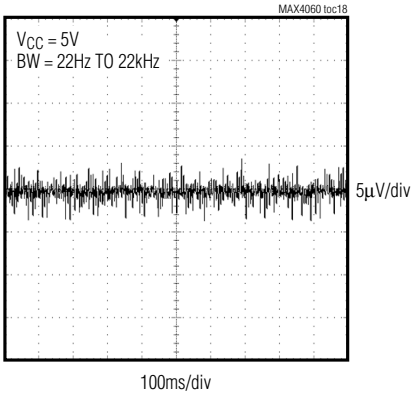
TOTAL HARMONIC DISTORTION PLUS NOISE vs. OUTPUT AMPLITUDE (AUX INPUT, V_{CC} = 5V)



INPUT-REFERRED NOISE vs. FREQUENCY (DIFF INPUT)



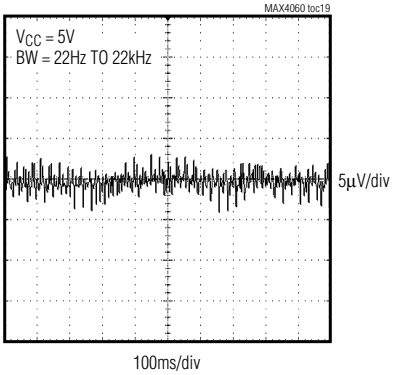
MAX4060
MIC BIAS OUTPUT NOISE



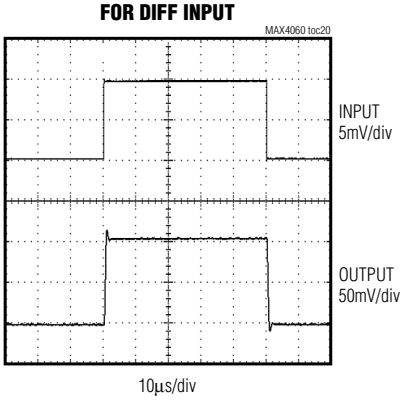
Typical Operating Characteristics (continued)

(V_{CC} = 3V (MAX4061/MAX4062/MAX4063), V_{CC} = 5V for MAX4060, A_V = 10V/V, $R_L \geq 100k\Omega$ to 1.5V, $\overline{SHDN}$ = V_{CC} (MAX4061/MAX4063 only), T_A = +25°C.)

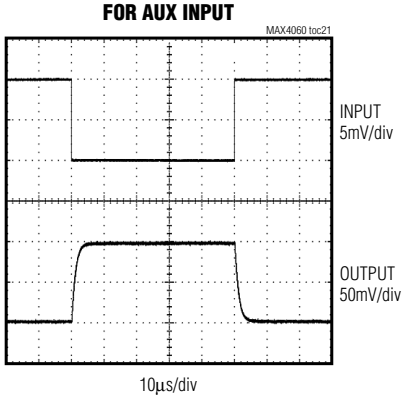
MAX4062
MIC BIAS OUTPUT NOISE



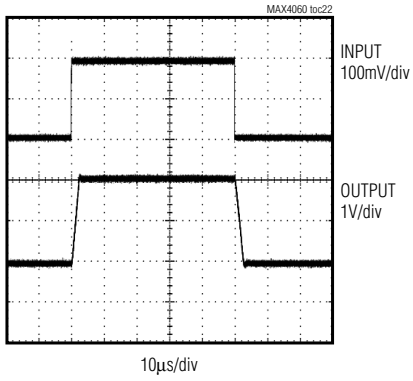
SMALL-SIGNAL TRANSIENT RESPONSE FOR DIFF INPUT



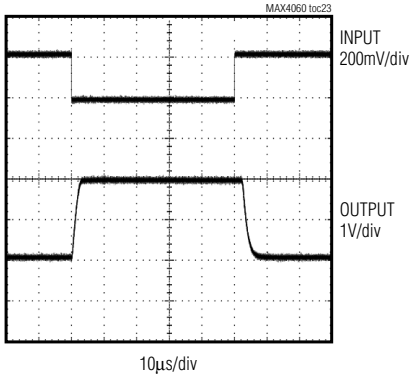
SMALL-SIGNAL TRANSIENT RESPONSE FOR AUX INPUT



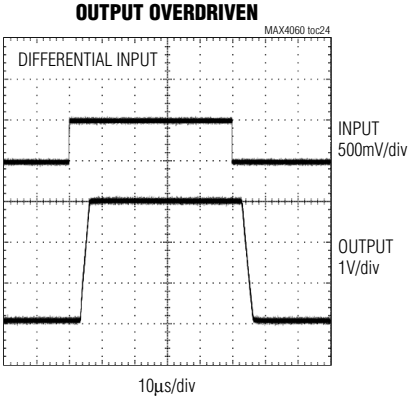
LARGE-SIGNAL TRANSIENT RESPONSE FOR DIFF INPUT



LARGE-SIGNAL TRANSIENT RESPONSE FOR AUX INPUT



OUTPUT OVERDRIVEN



Differential Microphone Preamplifiers with Internal Bias and Complete Shutdown

Pin Description

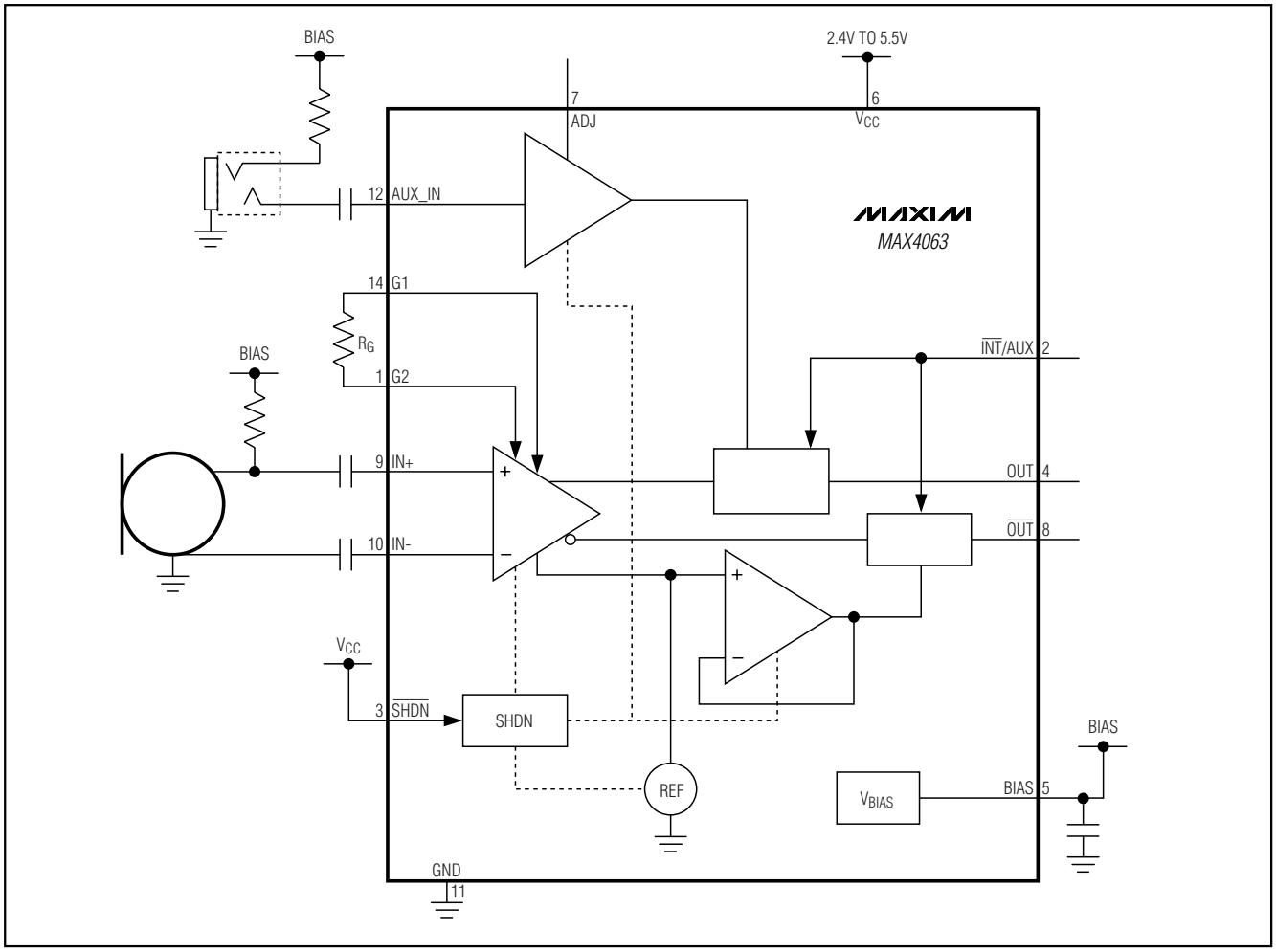
PIN				NAME	FUNCTION
MAX4060	MAX4061	MAX4062	MAX4063		
1	—	2	2	$\overline{INT}$/AUX	Internal (Differential) or Auxiliary (Single-Ended) Input Select. Drive $\overline{INT}$/AUX low to select internal or high to select auxiliary mic input.
2	3	3	4	OUT	Amplifier Output. OUT is high impedance when in shutdown mode.
3	—	—	—	BIAS	External Electret Microphone Capsule Bias Output. BIAS has a greater than 2kΩ output impedance.
4	4	5	6	V_{CC}	Power Supply. Bypass the V_{CC} to GND with a 0.1µF capacitor.
5	5	6	9	IN+	Noninverting Differential Amplifier Input. AC-couple the audio signal into IN+.
6	6	7	10	IN-	Inverting Differential Amplifier Input. AC-couple the audio signal into IN-.
7	7	8	11	GND	Ground
8	—	9	12	AUX_IN	Single-Ended Input for Auxiliary Microphone. AC-couple the audio signal into AUX_IN.
—	1	1	1	G2	Gain-Selectable Input. Connect an external resistor between G1 and G2 to set the gain for the differential amplifier. (See *Adjustable Differential-Gain Setting* section).
—	2	—	3	$\overline{SHDN}$	Shutdown Input. Drive $\overline{SHDN}$ high for normal operation. Drive $\overline{SHDN}$ low for shutdown mode.
—	—	4	5	BIAS	External Electret Microphone Capsule Bias Output Bypass BIAS with 1µF Capacitor to Ground
—	—	—	7	ADJ	Adjustable Gain Select for AUX_IN (see *Auxiliary Input-Gain Adjustment* section).
—	—	—	8	$\overline{OUT}$	Complementary Amplifier Output. When $\overline{INT}$/AUX = low, this is the complement signal of the OUT pin, biased around the internally derived reference. When $\overline{INT}$/AUX = high, $\overline{OUT}$ is a buffered version of the internal DC reference used by the AUX amplifier.
—	—	—	13	N.C.	No Connection. Not internally connected.
—	8	10	14	G1	Gain-Selectable Input. Connect an external resistor between G1 and G2 to set the gain for the differential amplifier.

Detailed Description

The MAX4060–MAX4063 are differential microphone preamplifiers providing high-quality audio, optimized for use in computer and mobile applications. These devices feature rail-to-rail outputs, very high power-supply rejection, and common-mode rejection, making them ideal for low-noise applications. The MAX4060–MAX4063 are particularly effective when layout constraints force the microphone amplifier to be physically remote from the ECM microphone and/or the rest of the audio circuitry.

The MAX4060/MAX4062/MAX4063 are capable of switching their output between the differential input and an inverting single-ended input. INT/AUX selects either the differential input or single-ended auxiliary input. In addition, the MAX4060/MAX4061/MAX4063 have an internal bias generator to bias the microphone in either differential or single-ended modes. The MAX4063 has a complementary output allowing CODECs and other devices with differential inputs to be optimally driven (see *Functional Diagram*). The MAX4061/MAX4063

Functional Diagram



include a complete 0.3µA shutdown mode for ultimate power savings. The differential gain of the MAX4061/MAX4062/MAX4063 is set with a single resistor connected between the G1 and G2 pins. The MAX4060 has a fixed gain of 10V/V, while the MAX4063 has an internal default gain of 10V/V on the AUX_IN input, although this can be adjusted to different values (see the Differential Gain-Setting and Auxiliary Input-Gain Adjustment sections).

Differential Input

The main microphone input is a low-noise, differential input structure. This is an almost essential element when faced with amplification of low-amplitude analog signals in digitally intense environments such as notebook PCs or PDAs. Used correctly, the advantages over a single-ended solution are:

- Better power-supply noise rejection
- Less degradation from noise in PC board ground planes
- Microphone and preamplifier may be placed physically further apart, easing PC board layout restrictions

Fixed Differential Gain (MAX4060)

The MAX4060 has an internal fixed gain of 10V/V for its differential input. This feature simplifies design, reduces pin count and footprint, and eliminates external gain-setting resistors.

Differential Microphone Preamplifiers with Internal Bias and Complete Shutdown

Adjustable Differential-Gain Setting

The MAX4061/MAX4062/MAX4063 allow the user to alter the gain to optimize the signal-to-noise ratio (SNR) of their system. The gain is set by a single external resistor (R_G) connected between the G1 and G2 pins, where:

$$R_G = 100k\Omega / (A_V - 1)$$

where A_V is the required voltage gain.

Hence, an 11.11kΩ resistor yields a gain of 10V/V, or 20dB. Leaving the pins unconnected results in a gain of 1V/V. Gain is defined as:

For MAX4061/MAX4062/MAX4063:

$$A_V = V_{OUT} / (V_{IN+} - V_{IN-})$$

For MAX4063:

$$A_V = (V_{OUT} - V_{\overline{OUT}}) / (V_{IN+} - V_{IN-})$$

The resistor can be either fixed or variable, allowing the use of a digitally controlled potentiometer to alter the gain under software control.

Auxiliary Input-Gain Adjustment (MAX4063)

On the MAX4060/MAX4061/MAX4062, the voltage gain of the auxiliary input is internally fixed at -10V/V.

The MAX4063 provides the option to adjust this gain. Connect a resistor R_{ADJ1} between the ADJ and OUT pins to reduce the gain. To increase the gain, connect resistor R_{ADJ2} between the ADJ and AUX_IN pins. R_{ADJ1} and R_{ADJ2} are calculated from the following formulas:

$$R_{ADJ1} = 2.5M\Omega / ((50 / A_V) - 5)$$
(to decrease the gain)

$$R_{ADJ2} = (0.5M\Omega) / (A_V - 10)$$
(to increase the gain)

where A_V is the voltage gain. R_{ADJ1} and R_{ADJ2} are in Ω.

Input Capacitors

The two differential microphone inputs and the single-ended auxiliary input of the MAX4060–MAX4063 have on-chip bias components, allowing the user to AC-couple any signals on to the input. The input resistance is 100kΩ (typ), so the capacitor size may be chosen accordingly to define the LF rolloff desired. This can be calculated as:

$$C_{IN} = 1 / (2\pi f_{CUT} R_{IN})$$

This assumes a low source impedance driving the inputs.

A further consideration for the differential input is the effect of these series input capacitors on low-frequency, common-mode rejection. Any mismatch in the values of these two capacitors degrades the CMRR at frequencies where the impedance of the capacitor is significant compared to the input resistance of the amplifier—this is usually most noticeable at low frequencies. One way to avoid the need for matched or tight tolerance capacitors is to deliberately oversize the values on the differential inputs and to set the lower 3dB point (f_{CUT}) of the amplifier by sizing the output capacitor appropriately.

The input impedance matching on the differential input is typically 1%, allowing input capacitor matching to be effective at improving low-frequency PSRR.

Common-Mode Rejection Ratio

The common-mode rejection ratio (CMRR) refers to the amount of rejection that the amplifier is capable of providing to any signal applied equally to the IN+ and IN- inputs. In the case of amplifying low-level microphone signals in noisy digital environments, it is a key figure of merit. In audio circuits, this is generally measured for V_{IN} as an AC signal:

$$CMRR(dB) = A_{DM} / A_{CM} = V_{INDIFF} / \Delta V_{INCM}$$

where A_{DM} is the differential gain, A_{CM} is the common-mode gain, ΔV_{INCM} is the change in input common-mode voltage (IN+ and IN- connected together) and V_{INDIFF} is the differential input voltage.

Input voltages are sufficiently small such that the output is not clipped in either differential or common-mode application. The topology used in the MAX4061/MAX4062/MAX4063 means that the CMRR actually improves at higher differential gains—another advantage of using differential sensing.

Auxiliary Input

The auxiliary input is a single-ended input intended to be used with a jack-socket type microphone input (Figure 1). Internal DC-bias components (as on the main inputs) allow the input signal to be AC-coupled. Mechanically switched jack sockets can be used in conjunction with the $\overline{INT}$/AUX select pin, allowing the auxiliary microphone input to be automatically selected when a jack socket is inserted.

Microphone Bias Voltage

MAX4060

The MAX4060 has a microphone bias voltage designed to comply with the Microsoft/Intel PC99/2001 audio standard. It features source impedance of greater than 2kΩ, and delivers more than 2V of bias when loaded with a current of 800µA. This limits operation of this part to supplies between 4.5V to 5.5V (see Figure 2).

MAX4061/MAX4062/MAX4063

The MAX4061/MAX4062/MAX4063 have a lower bias voltage and low-impedance outputs (optimum electret bias resistor can then be set externally). This gives a

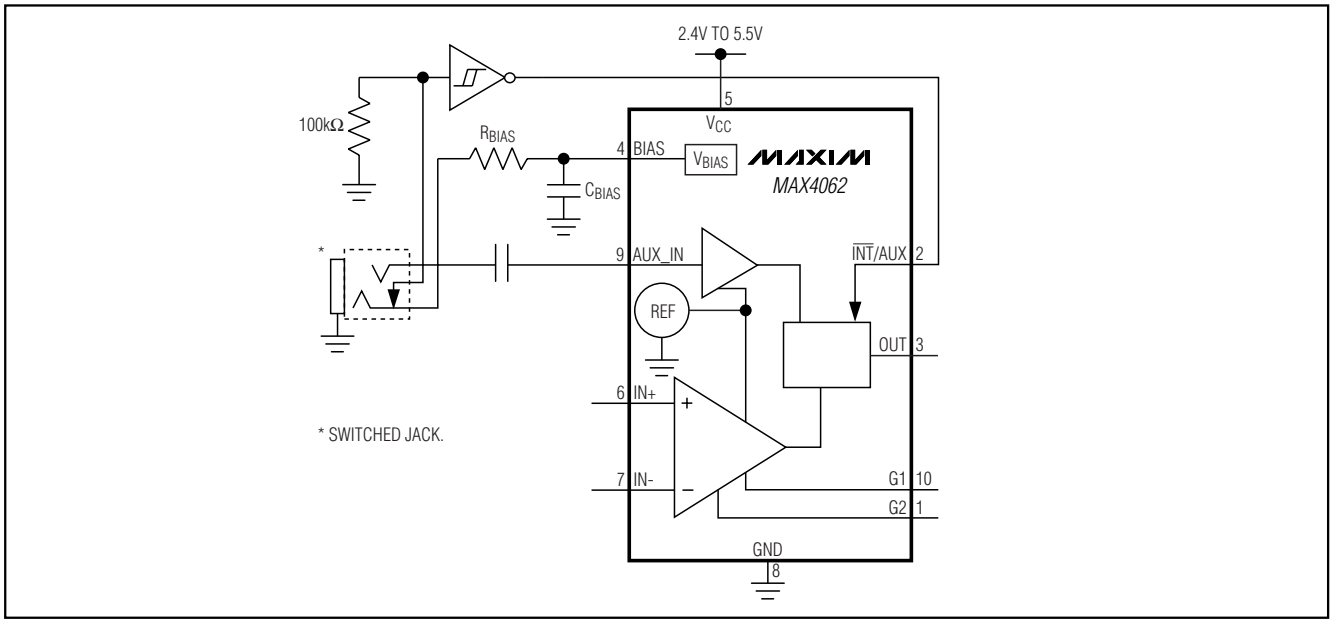


Figure 1. MAX4062 with Auxiliary Input Configuration

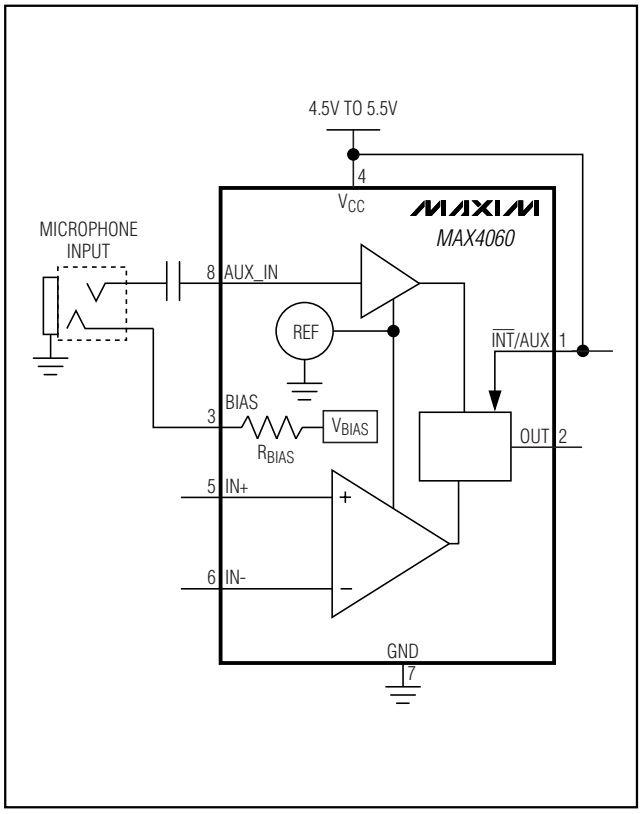


Figure 2. MAX4060 Used for Biasing a Microphone

low-noise, flexible solution that can run from 2.4V to 5.5V, suitable for hand-held devices such as PDAs that typically have audio power supplies in the 3V region.

Output

MAX4060/MAX4061/MAX4063 DC Bias

The output voltage has a DC-bias voltage independent of the power supplies, resulting in superior PSRR performance. The MAX4061/MAX4063 outputs are high impedance when the part is in shutdown mode. AC-coupling the output into the next audio stage (e.g., CODEC) is recommended (see Figure 4).

Differential Output (MAX4063)

The MAX4063 features a differential output stage (OUT and $\overline{OUT}$), allowing optimum performance when connected to ADCs and CODECs with differential inputs. This differential output is particularly useful in designs where the microphone preamplifier is mounted some distance away from the CODEC/ADC, as the low-impedance, differential line provides excellent noise rejection and immunity (see Figure 4).

When the AUX input is selected, $\overline{OUT}$ is a buffered version of the internal DC reference.

Applications Information

Shutdown Mode

The MAX4061/MAX4063 feature a low-power, complete shutdown mode. When $\overline{SHDN}$ goes low, the supply cur-

Differential Microphone Preamplifiers with Internal Bias and Complete Shutdown

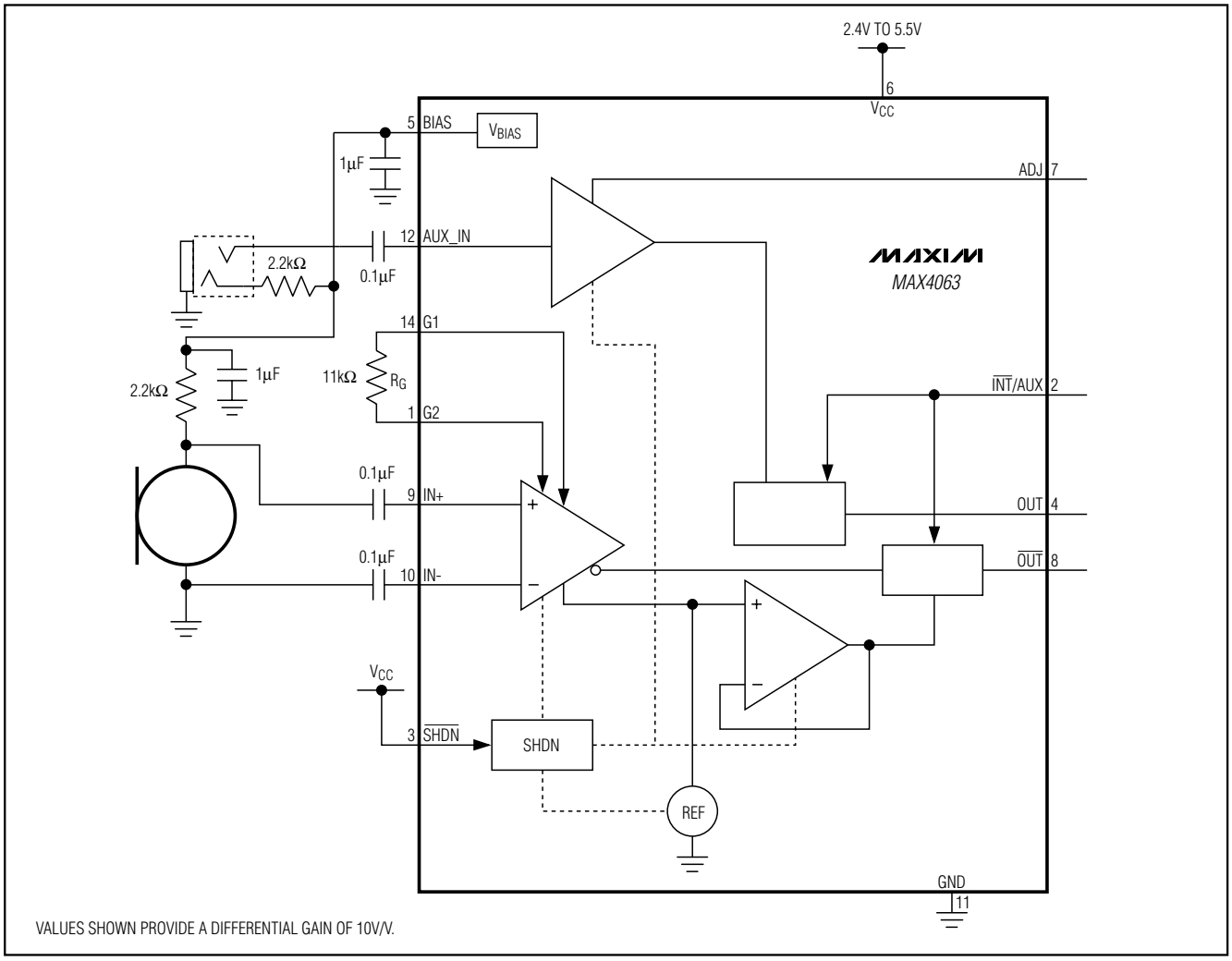


Figure 3. MAX4063 Used to Bias a Microphone Connected to the Auxiliary Input and the Differential Input

rent drops to 0.3µA, the output enters a high-impedance state, and the bias current to the microphone is switched off. Driving $\overline{SHDN}$ high enables the amplifier. $\overline{SHDN}$ should not be left floating.

Power Supplies and Layout

The MAX4060 operates from a 4.5V to 5.5V single supply and the MAX4061/MAX4062/MAX4063 operate from a 2.4V to 5.5V single supply. Bypass the power supply with a 0.1µF capacitor to ground. In systems where analog and digital grounds are available, the MAX4060/MAX4061/MAX4063 should be connected to the analog ground.

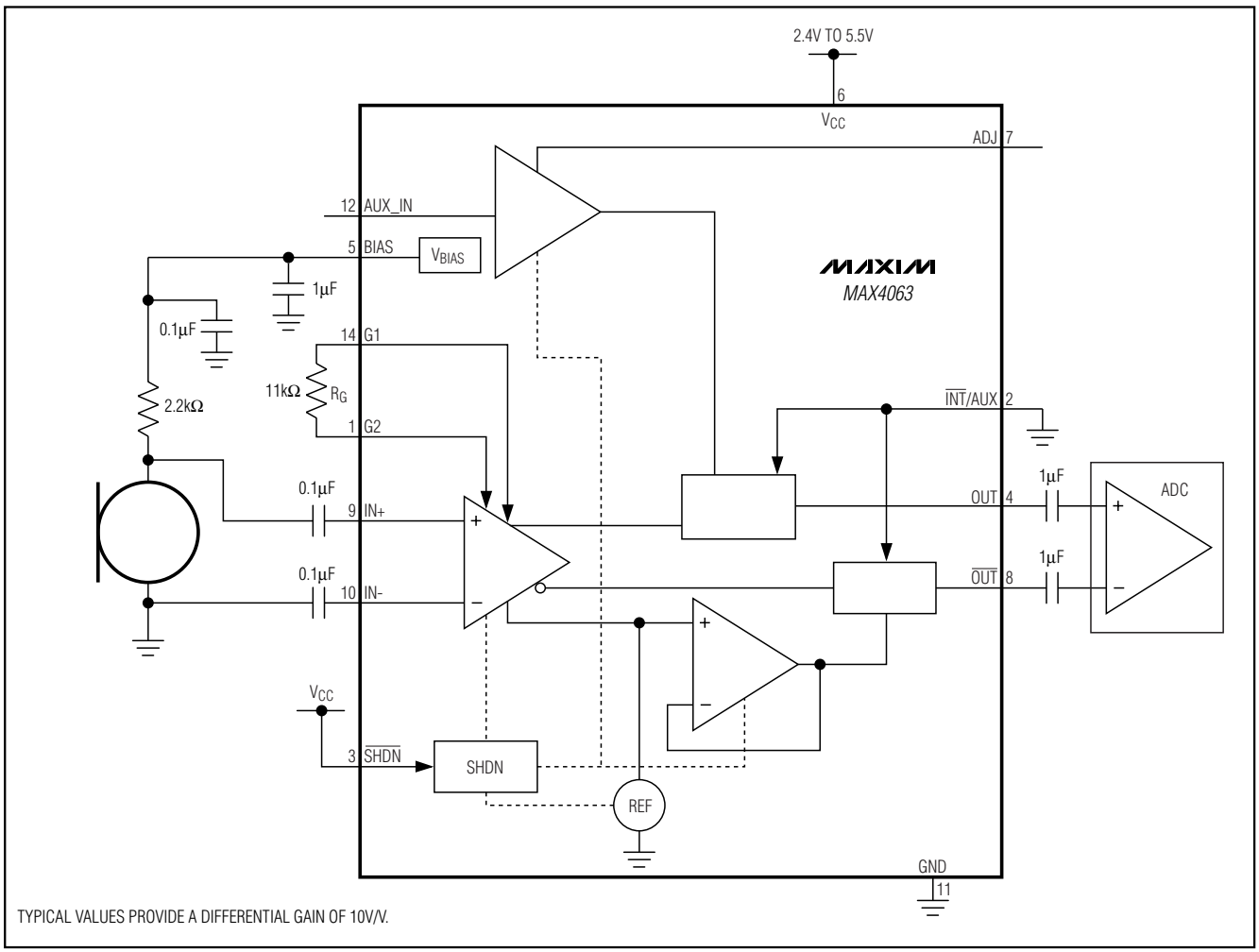
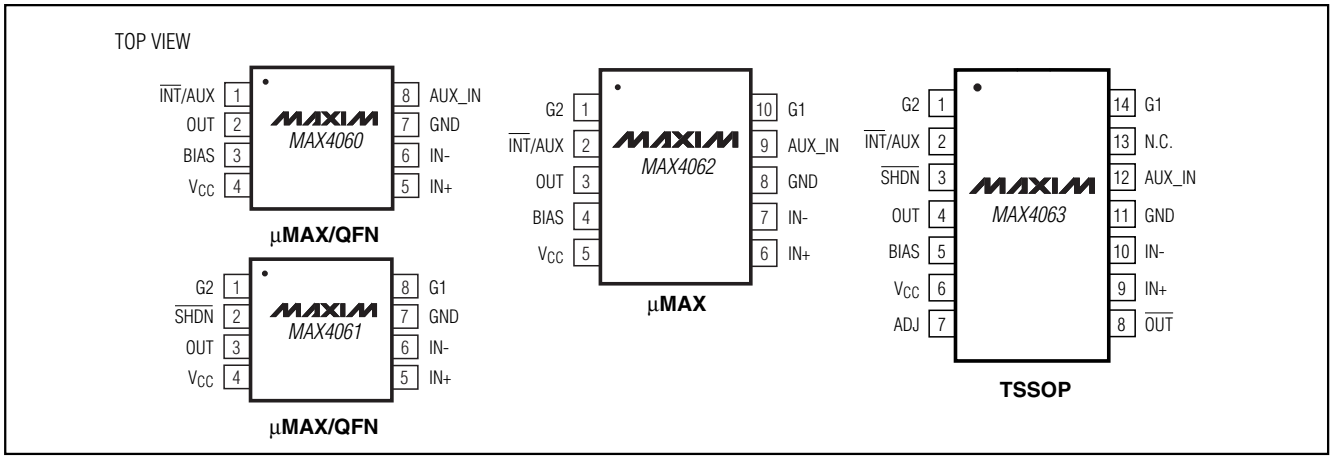


Figure 4. Using the MAX4063 with Differential Input and Differential Output Configuration

Differential Microphone Preamplifiers with Internal Bias and Complete Shutdown

Pin Configurations



Selector Guide

PRODUCT	AUXILIARY INPUT	DIFF INPUT GAIN	SINGLE-ENDED INPUT GAIN	MICROPHONE BIAS	SHUTDOWN MODE	DIFF OUTPUT	SUPPLY VOLTAGE (V)
MAX4060	✔	20dB	20dB	✔	—	—	4.5 to 5.5
MAX4061	—	ADJ	—	—	✔	—	2.4 to 5.5
MAX4062	✔	ADJ	20dB	✔	—	—	2.4 to 5.5
MAX4063	✔	ADJ	ADJ	✔	✔	✔	2.4 to 5.5

Chip Information

MAX4060/MAX4061/4062 TRANSISTOR COUNT: 264

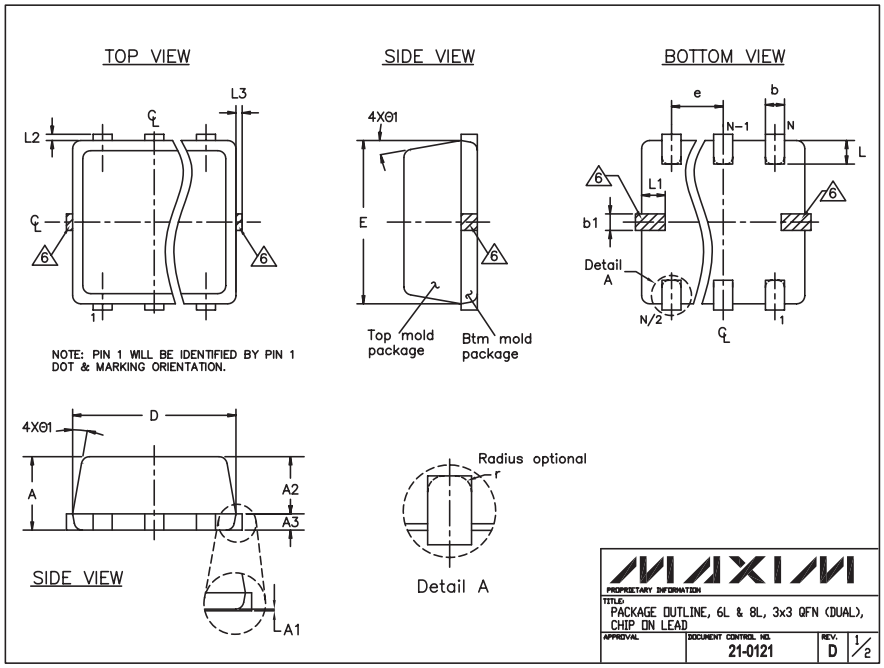
MAX4063 TRANSISTOR COUNT: 351

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 **www.maxim-ic.com/packages**.)

6L, 8L QFN(DUAL).EPS



COMMON DIMENSIONS		
SYMBOL	MIN	MAX
A	0.80	1.00
A1	0	0.05
A2	0.65	0.90
A3	0.15	0.25
L2	0	0.10
L3	0	0.10
b1	0.17	0.30
Θ1	0°	12°

VARIATIONS				
SYMBOL	MIN	MAX	MIN	MAX
D	2.90	3.10	2.90	3.10
E	2.90	3.10	2.90	3.10
N	6		8	
e	0.95 BSC		0.65 BSC	
b	0.27	0.43	0.25	0.40
L	0.21	0.44	0.21	0.44
L1	0.21	0.37	0.21	0.37
JEDEC SPEC	——		MO-220 VARIATION EEC-2	

Note:
1. All dimensions are in mm.
2. Package outline exclusive of mold flash & metal burr.
3. Package outline inclusive of plating.
4. N is the total number of terminals.
5. Package surface finishing of Ra0.4µm max.
6. Shaded areas are not leads. Do not make electrical contact in this area. Use numbered leads for electrical contact.

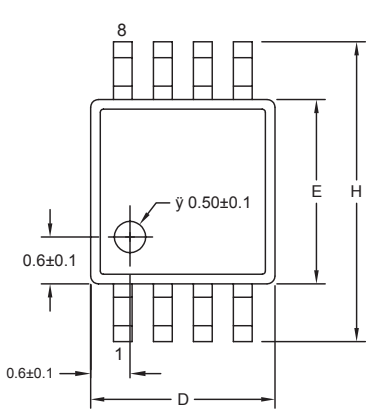
MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, 6L & 8L, 3x3 QFN (DUAL), CHIP ON LEAD
APPROVAL
DOCUMENT CONTROL NO. 21-0121
REV. D
2/2

Differential Microphone Preamplifiers with Internal Bias and Complete Shutdown

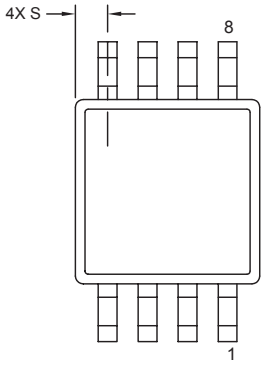
Package Information (continued)

(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**.)

8LUMAXD.EPS

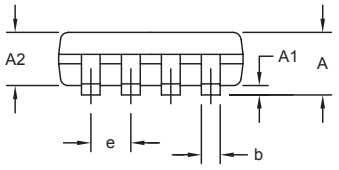


TOP VIEW

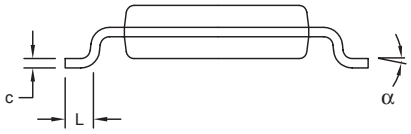


BOTTOM VIEW

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	-	0.043	-	1.10
A1	0.002	0.006	0.05	0.15
A2	0.030	0.037	0.75	0.95
b	0.010	0.014	0.25	0.36
c	0.005	0.007	0.13	0.18
D	0.116	0.120	2.95	3.05
e	0.0256 BSC		0.65 BSC	
E	0.116	0.120	2.95	3.05
H	0.188	0.198	4.78	5.03
L	0.016	0.026	0.41	0.66
α	0∞	6∞	0∞	6∞
S	0.0207 BSC		0.5250 BSC	



FRONT VIEW



SIDE VIEW

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15MM (.006").
3. CONTROLLING DIMENSION: MILLIMETERS.
4. MEETS JEDEC MO-187C-AA.

DALLAS SEMICONDUCTOR MAXIM

PROPRIETARY INFORMATION

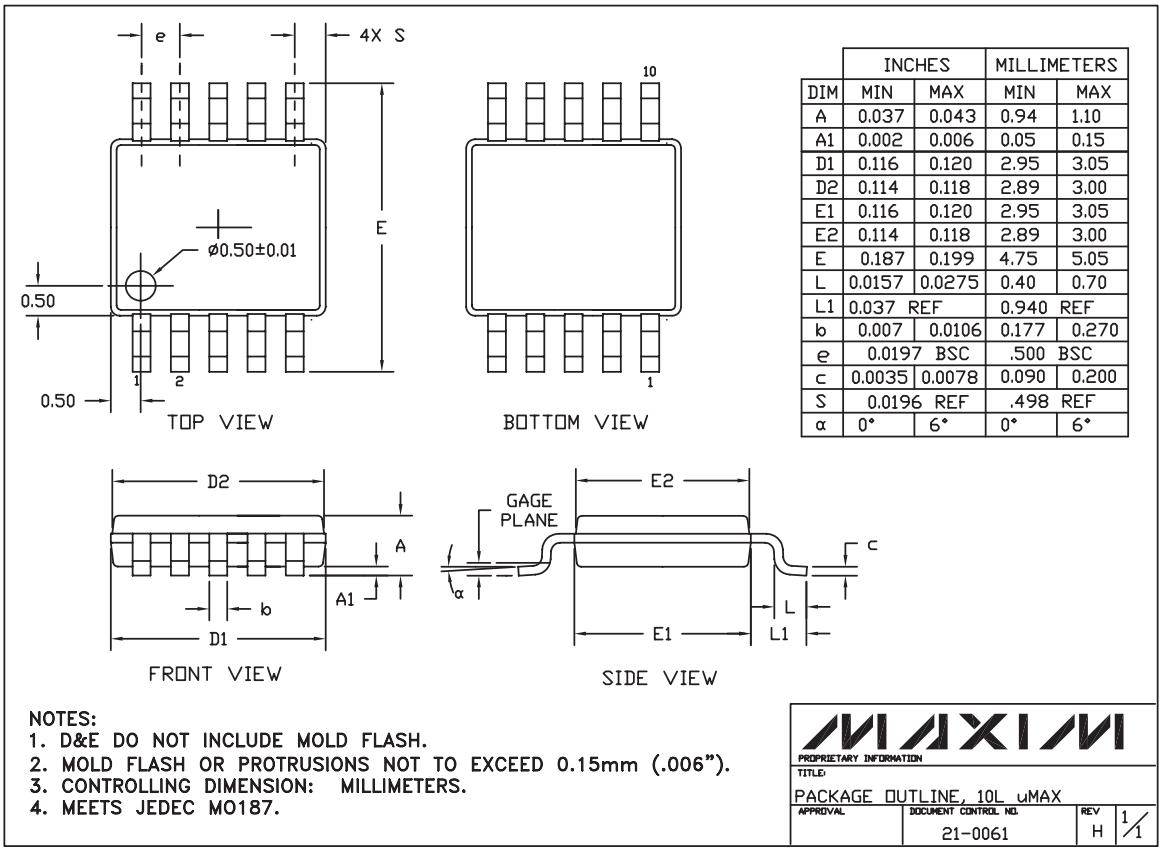
TITLE: PACKAGE OUTLINE, 8L uMAX/uSOP

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0036	J	1/1

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**.)

10LUMAX.EPS



	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.037	0.043	0.94	1.10
A1	0.002	0.006	0.05	0.15
D1	0.116	0.120	2.95	3.05
D2	0.114	0.118	2.89	3.00
E1	0.116	0.120	2.95	3.05
E2	0.114	0.118	2.89	3.00
E	0.187	0.199	4.75	5.05
L	0.0157	0.0275	0.40	0.70
L1	0.037 REF		0.940 REF	
b	0.007	0.0106	0.177	0.270
e	0.0197 BSC		.500 BSC	
c	0.0035	0.0078	0.090	0.200
S	0.0196 REF		.498 REF	
α	0°	6°	0°	6°

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm (.006").
3. CONTROLLING DIMENSION: MILLIMETERS.
4. MEETS JEDEC MO187.

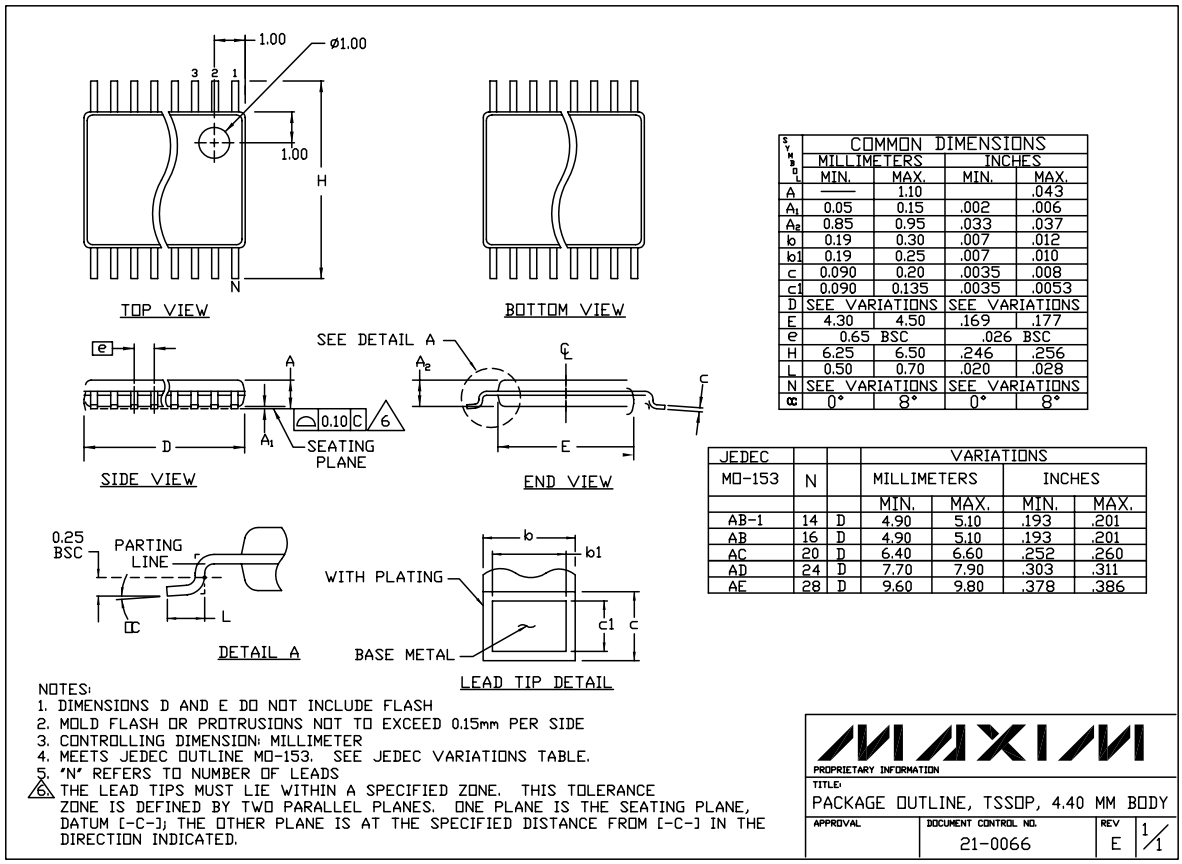
MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, 10L uMAX
APPROVAL | DOCUMENT CONTROL NO. 21-0061 | REV H | 1/1

Differential Microphone Preamplifiers with Internal Bias and Complete Shutdown

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**.)

TSSOP,NO PADS.EPS



SYMBOL	COMMON DIMENSIONS			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	——	1.10		.043
A_1	0.05	0.15	.002	.006
A_2	0.85	0.95	.033	.037
b	0.19	0.30	.007	.012
b1	0.19	0.25	.007	.010
c	0.090	0.20	.0035	.008
c1	0.090	0.135	.0035	.0053
D	SEE VARIATIONS		SEE VARIATIONS	
E	4.30	4.50	.169	.177
e	0.65 BSC		.026 BSC	
H	6.25	6.50	.246	.256
L	0.50	0.70	.020	.028
N	SEE VARIATIONS		SEE VARIATIONS	
α	0°	8°	0°	8°

JEDEC			VARIATIONS			
MO-153	N		MILLIMETERS		INCHES	
			MIN.	MAX.	MIN.	MAX.
AB-1	14	D	4.90	5.10	.193	.201
AB	16	D	4.90	5.10	.193	.201
AC	20	D	6.40	6.60	.252	.260
AD	24	D	7.70	7.90	.303	.311
AE	28	D	9.60	9.80	.378	.386

NOTES:
1. DIMENSIONS D AND E DO NOT INCLUDE FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm PER SIDE
3. CONTROLLING DIMENSION: MILLIMETER
4. MEETS JEDEC OUTLINE MO-153. SEE JEDEC VARIATIONS TABLE.
5. "N" REFERS TO NUMBER OF LEADS
6. THE LEAD TIPS MUST LIE WITHIN A SPECIFIED ZONE. THIS TOLERANCE ZONE IS DEFINED BY TWO PARALLEL PLANES. ONE PLANE IS THE SEATING PLANE, DATUM [-C-]; THE OTHER PLANE IS AT THE SPECIFIED DISTANCE FROM [-C-] IN THE DIRECTION INDICATED.

MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, TSSOP, 4.40 MM BODY
APPROVAL | DOCUMENT CONTROL NO. 21-0066 | REV E | 1/1

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