19-2110; Rev 0; 8/01

SOT23, Very High Precision, 3V/5V Rail-to-Rail Op Amps

General Description

The MAX4236/MAX4237 are high-precision op amps that feature an exceptionally low offset voltage and offset voltage temperature coefficient without using any chopper techniques. The MAX4236 and MAX4237 have a typical large-signal, open-loop voltage gain of 120dB. These devices have an ultra-low input-bias current of 1pA. The MAX4236 is unity-gain stable with a gain-bandwidth product of 1.7MHz, while the MAX4237 is stable for closed-loop gains greater than 5V/V with a gain-bandwidth product of 7.5MHz. Both devices have a shutdown function in which the quiescent current is reduced to less than 0.1µA, and the amplifier output is forced into a high-impedance state.

The input common-mode range of the MAX4236/MAX4237 extends below the negative supply range, and the output swings Rail-to-Rail®. These features make the amplifiers ideal for applications with +3V or +5V single power supplies. The MAX4236/MAX4237 are specified for the extended temperature range (-40°C to +85°C) and are available in tiny SOT23, µMAX, and SO packages. For greater accuracy, the A grade µMAX and SO packages are tested to guarantee 20µV (max) offset voltage at +25°C and less then 2µV/°C drift.

Applications

Strain Gauges

Piezoelectric Sensors

Thermocouple Amplifiers

Electrochemical Sensors

Battery-Powered Instrumentation

Instrumentation Amplifiers

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

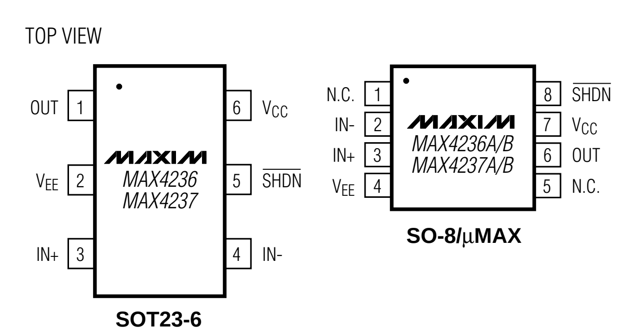
Features

- **Ultra-Low Offset Voltage**
  20µV (max) at +25°C (Grade A)
  50µV (max) at +25°C (Grade B, 6-Pin SOT23)
- **Ultra-Low Offset Voltage Drift**
  2µV/°C (max) (Grade A)
  4.5µV/°C (max) (Grade B, 6-Pin SOT23)
  5.5µV/°C (max) (6-Pin SOT23)
- **Ultra-Low 1pA Input Bias Current**
- **High Open-Loop Voltage Gain: 110dB (min) (R_L = 100kΩ)**
- **Compatible with +3V and +5V Single-Supply Power Systems**
- **Ground Sensing: Input Common-Mode Range Includes Negative Rail**
- **Rail-to-Rail Output Swing into a 1kΩ Load**
- **350µA Quiescent Current**
- **Gain-Bandwidth Product**
  1.7MHz (MAX4236, A_V = 1V/V)
  7.5MHz (MAX4237, A_V = 5V/V)
- **200pF Capacitive Load Handling Capability**
- **Shutdown Mode: 0.1µA Quiescent Current, Places Output in a High-Impedance State**
- **Available in Space-Saving SOT23 and µMAX Packages**

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX4236EUT-T	-40°C to +85°C	6 SOT23-6
MAX4236AEUA	-40°C to +85°C	8 µMAX
MAX4236BEUA	-40°C to +85°C	8 µMAX
MAX4236AESA	-40°C to +85°C	8 SO
MAX4236BESA	-40°C to +85°C	8 SO
MAX4237EUT-T	-40°C to +85°C	6 SOT23-6
MAX4237AEUA	-40°C to +85°C	8 µMAX
MAX4237BEUA	-40°C to +85°C	8 µMAX
MAX4237AESA	-40°C to +85°C	8 SO
MAX4237BESA	-40°C to +85°C	8 SO

Pin Configurations



ABSOLUTE MAXIMUM RATINGS

Supply Voltage (V_{CC} - V_{EE}) ....-0.3V to +6V
Analog Input Voltage (IN+ or IN-) ....(V_{EE} - 0.3V) to (V_{CC} + 0.3V)
Logic Input Voltage ($\overline{SHDN}$) ....(V_{EE} - 0.3V) to (V_{CC} + 0.3V)
Current into Any Pin 20mA
Output Short-Circuit Duration....Continuous to Either V_{CC} or V_{EE}
Continuous Power Dissipation (T_A = +70°C)
6-Pin SOT23-6 (derate 8.7mW/°C above +70°C) 696mW
8-Pin µMAX (derate 4.5mW/°C above +70°C) 362mW
8-Pin SO (derate 5.9mW/°C above +70°C)..................471mW

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 (SO-8 and µMAX-8)

(V_{CC} = +2.4V to +5.5V, V_{EE} = 0, V_{CM} = 0, V_{OUT} = V_{CC}/2, R_L = 100kΩ to V_{CC}/2, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V_{CC} = +5V and T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Supply Voltage Range	V_{CC}	Guaranteed by the PSRR test		2.4		5.5	V
Quiescent Supply Current	I_{CC}	V_{CC} = +5V	In normal mode		350	440	µA
			In shutdown mode		0.1	2	
		V_{CC} = +3V	In normal mode		350	440	
			In shutdown mode		0.1	2	
Input Offset Voltage	V_{OS}	V_{CC} = +5V, Grade A	T_A = +25°C		±5	±20	µV
			T_A = T_{MIN} to T_{MAX}			±150	
		V_{CC} = +5V, Grade B	T_A = +25°C		±5	±50	
			T_A = T_{MIN} to T_{MAX}			±340	
Input Offset Voltage Temperature Coefficient	TCV_{OS}	V_{CC} = +5V (Note 3)	Grade A		±0.6	±2	µV/°C
			Grade B		±0.6	±4.5	
Input Bias Current	I_B	(Note 2)			±1	±500	pA
Input Offset Current	I_{OS}	(Note 2)			±1		pA
Input Resistance	R_{IN}	Differential or common mode			1000		MΩ
Input Common-Mode Voltage	V_{CM}	Guaranteed by the CMRR test		-0.15		V_{CC} - 1.2	V
Common-Mode Rejection Ratio	CMRR	V_{CC} = +5V; -0.15V ≤ V_{CM} ≤ (V_{CC} - 1.2V)	T_A = +25°C	84	102		dB
			T_A = T_{MIN} to T_{MAX}	80			
		V_{CC} = +3.0V; -0.15V ≤ V_{CM} ≤ (V_{CC} - 1.2V)	T_A = +25°C	82	102		
			T_A = T_{MIN} to T_{MAX}	78			
Power-Supply Rejection Ratio	PSRR	V_{CC} = +2.4V to +5.5V	T_A = +25°C	97	120		dB
			T_A = T_{MIN} to T_{MAX}	95			

ELECTRICAL CHARACTERISTICS (SO-8 and µMAX-8) (continued)

(V_{CC} = +2.4V to +5.5V, V_{EE} = 0, V_{CM} = 0, V_{OUT} = V_{CC}/2, R_L = 100kΩ to V_{CC}/2, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V_{CC} = +5V and T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Large-Signal Voltage Gain	A_{VOL}	V_{CC} = +5V, R_L connected to V_{CC}/2, T_A = +25°C	R_L = 100kΩ, V_{OUT} = 15mV to (V_{CC} - 50mV)	110	128		dB
			R_L = 1kΩ, V_{OUT} = 0.15V to (V_{CC} - 0.3V)	105	114		
		V_{CC} = +5V, R_L connected to V_{CC}/2, T_A = T_{MIN} to T_{MAX}	R_L = 100kΩ, V_{OUT} = 15mV to (V_{CC} - 50mV)	110			
			R_L = 1kΩ, V_{OUT} = 0.15V to (V_{CC} - 0.3V)	100			
		V_{CC} = +3V, R_L connected to V_{CC}/2, T_A = +25°C	R_L = 100kΩ, V_{OUT} = 15mV to (V_{CC} - 50mV)	110	128		
			R_L = 1kΩ, V_{OUT} = 0.15V to (V_{CC} - 0.3V)	100	114		
		V_{CC} = +3V, R_L connected to V_{CC}/2, T_A = T_{MIN} to T_{MAX}	R_L = 100kΩ, V_{OUT} = 15mV to (V_{CC} - 50mV)	105			
			R_L = 1kΩ, V_{OUT} = 0.15V to (V_{CC} - 0.3V)	95			
Output Voltage Swing	V_{OUT}	V_{CC} = +5V, R_L connected to V_{CC}/2, R_L = 100kΩ	V_{CC} - V_{OH}		2	10	mV
			V_{OL} - V_{EE}		3	10	
		V_{CC} = +5V, R_L connected to V_{CC}/2, R_L = 1kΩ	V_{CC} - V_{OH}		150	250	
			V_{OL} - V_{EE}		50	100	
Output Short-Circuit Current	$I_{OUT(SC)}$	Shorted to V_{EE}			10		mA
		Shorted to V_{CC}			30		
Gain-Bandwidth Product	GBWP	R_L = ∞, C_L = 5pF	MAX4236		1.7		MHz
			MAX4237		7.5		
Slew Rate	SR	V_{CC} = +5V, V_{OUT} = 4V step	MAX4236		0.3		V/µs
			MAX4237		1.3		
Settling Time	t_S	V_{OUT} settling to within 0.01%	MAX4236		1		µs
			MAX4237		1		
Total Harmonic Distortion	THD	f = 5kHz, V_{OUT} = 2Vp-p, V_{CC} = +5V R_L = 10kΩ			0.001		%

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ELECTRICAL CHARACTERISTICS (SO-8 and µMAX-8) (continued)

(V_{CC} = +2.4V to +5.5V, V_{EE} = 0, V_{CM} = 0, V_{OUT} = V_{CC}/2, R_L = 100kΩ to V_{CC}/2, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V_{CC} = +5V and T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Input Capacitance	C_{IN}	f = 100kHz			7.5		pF
Input Voltage Noise Density	e_n	f = 1kHz			14		nV/√Hz
Input Noise Voltage	e_{np-p}	f = 0.1Hz to 10Hz			0.2		µVp-p
Capacitive Load Stability	C_{LOAD}	No sustained oscillations	MAX4236		200		pF
			MAX4237		200		
Shutdown Mode Output Leakage	$I_{OUT(SH)}$	Device in shutdown mode ($\overline{SHDN}$ = V_{EE}) V_{OUT} = 0 to V_{CC}			±0.01	±1.0	µA
$\overline{SHDN}$ Logic Low	V_{IL}					0.3 × V_{CC}	V
$\overline{SHDN}$ Logic High	V_{IH}			0.7 × V_{CC}			V
$\overline{SHDN}$ Input Current		$\overline{SHDN}$ = V_{EE} or V_{CC}			1	3	µA
Shutdown Delay Time	$t_{(SH)}$	R_L = 1kΩ			1		µs
Shutdown Recovery Time	$t_{(EN)}$	R_L = 1kΩ			4		µs

ELECTRICAL CHARACTERISTICS (SOT23-6)

(V_{CC} = +2.4V to +5.5V, V_{EE} = 0, V_{CM} = 0, V_{OUT} = V_{CC}/2, R_L = 100kΩ to V_{CC}/2, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V_{CC} = +5V and T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Supply Voltage Range	V_{CC}	Guaranteed by the PSRR test		2.4		5.5	V
Quiescent Supply Current	I_{CC}	V_{CC} = +5V	In normal mode		350	440	µA
			In shutdown mode		0.1	2	
		V_{CC} = +3V	In normal mode		350	440	
			In shutdown mode		0.1	2	
Input Offset Voltage	V_{OS}	V_{CC} = +5V	T_A = +25°C		±5	±50	µV
			T_A = T_{MIN} to T_{MAX}			±600	
Input Offset Voltage Temperature Coefficient (Note 2)	TCV_{OS}	V_{CC} = +5V			±0.6	±5.5	µV/°C
Input Bias Current	I_B	(Note 2)			±1	±500	pA
Input Offset Current	I_{OS}	(Note 2)			±1		pA
Input Resistance	R_{IN}	Differential or common mode			1000		MΩ
Input Common-Mode Voltage	V_{CM}	Guaranteed by the CMRR test		-0.15		V_{CC} - 1.2	V
Common-Mode Rejection Ratio	CMRR	V_{CC} = +5V, -0.15V ≤ V_{CM} ≤ (V_{CC} - 1.2V)	T_A = +25°C	82	102		dB
			T_A = T_{MIN} to T_{MAX}	80			
		V_{CC} = +3.0V; -0.15V ≤ V_{CM} ≤ (V_{CC} - 1.2V)	T_A = +25°C	82	102		
			T_A = T_{MIN} to T_{MAX}	78			

ELECTRICAL CHARACTERISTICS (SOT23-6) (continued)

(V_{CC} = +2.4V to +5.5V, V_{EE} = 0, V_{CM} = 0, V_{OUT} = V_{CC}/2, R_L = 100kΩ to V_{CC}/2, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V_{CC} = +5V and T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Power-Supply Rejection Ratio	PSRR	V_{CC} = +2.4V to +5.5V	T_A = +25°C	97	120		dB
			T_A = T_{MIN} to T_{MAX}	95			
Large-Signal Voltage Gain	A_{VOL}	V_{CC} = +5V, R_L connected to V_{CC}/2, T_A = +25°C	R_L = 100kΩ, V_{OUT} = 15mV to (V_{CC} - 50mV)	110	128		dB
			R_L = 1kΩ, V_{OUT} = 0.15V to (V_{CC} - 0.3V)	100	114		
		V_{CC} = +5V, R_L connected to V_{CC}/2, T_A = T_{MIN} to T_{MAX}	R_L = 100kΩ, V_{OUT} = 15mV to (V_{CC} - 50mV)	110			
			R_L = 1kΩ, V_{OUT} = 0.15V to (V_{CC} - 0.3V)	95			
		V_{CC} = +3V, R_L connected to V_{CC}/2, T_A = +25°C	R_L = 100kΩ, V_{OUT} = 15mV to (V_{CC} - 50mV)	110	128		
			R_L = 1kΩ, V_{OUT} = 0.15V to (V_{CC} - 0.3V)	100	114		
		V_{CC} = +3V, R_L connected to V_{CC}/2, T_A = T_{MIN} to T_{MAX}	R_L = 100kΩ, V_{OUT} = 15mV to (V_{CC} - 50mV)	105			
			R_L = 1kΩ, V_{OUT} = 0.15V to (V_{CC} - 0.3V)	95			
Output Voltage Swing	V_{OUT}	V_{CC} = +5V, R_L connected to V_{CC}/2, R_L = 100kΩ	V_{CC} - V_{OH}		2	10	mV
			V_{OL} - V_{EE}		3	10	
		V_{CC} = +5V, R_L connected to V_{CC}/2, R_L = 1kΩ	V_{CC} - V_{OH}		150	250	
			V_{OL} - V_{EE}		50	100	
Output Short-Circuit Current	$I_{OUT(SC)}$	Shorted to V_{EE}			10		mA
		Shorted to V_{CC}			30		
Gain-Bandwidth Product	GBWP	R_L = ∞, C_L = 15pF	MAX4236		1.7		MHz
			MAX4237		7.5		
Slew Rate	SR	V_{CC} = +5V, V_{OUT} = 4V step	MAX4236		0.3		V/µs
			MAX4237		1.3		

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ELECTRICAL CHARACTERISTICS (SOT23-6) (continued)

(V_{CC} = +2.4V to +5.5V, V_{EE} = 0, V_{CM} = 0, V_{OUT} = V_{CC}/2, R_L = 100kΩ to V_{CC}/2, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V_{CC} = +5V and T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Settling Time	t_S	V_{OUT} settling to within 0.01%	MAX4236		1		µs
			MAX4237		1		
Total Harmonic Distortion	THD	f = 5kHz, V_{OUT} = 2Vp-p, V_{CC} = +5V R_L = 10kΩ			0.001		%
Input Capacitance	C_{IN}	f = 100kHz			7.5		pF
Input Voltage Noise Density	e_n	f = 1kHz			14		nV/√Hz
Input Noise Voltage	e_{np-p}	f = 0.1Hz to 10Hz			0.2		µVp-p
Capacitive Load Stability	C_{LOAD}	No sustained oscillations	MAX4236		200		pF
			MAX4237		200		
Shutdown Mode Output Leakage	$I_{OUT(SH)}$	Device in shutdown mode ($\overline{SHDN}$ = V_{EE}) V_{OUT} = 0 to V_{CC}			±0.01	±1.0	µA
$\overline{SHDN}$ Logic Low	V_{IL}					0.3 x V_{CC}	V
$\overline{SHDN}$ Logic High	V_{IH}			0.7 x V_{CC}			V
$\overline{SHDN}$ Input Current		$\overline{SHDN}$ = V_{EE} or V_{CC}			1	3	µA
Shutdown Delay Time	$t_{(SH)}$	R_L = 1kΩ			1		µs
Shutdown Recovery Time	$t_{(EN)}$	R_L = 1kΩ			4		µs

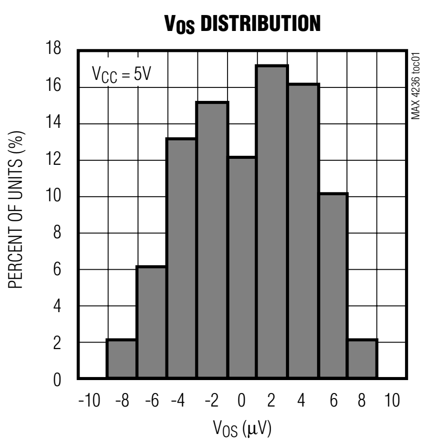
Note 1: All devices are 100% production tested at T_A = +25°C; all specifications over temperature are guaranteed by design, unless otherwise specified.

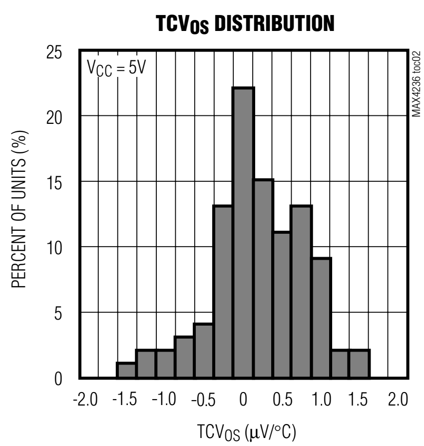
Note 2: Guaranteed by design, not production tested.

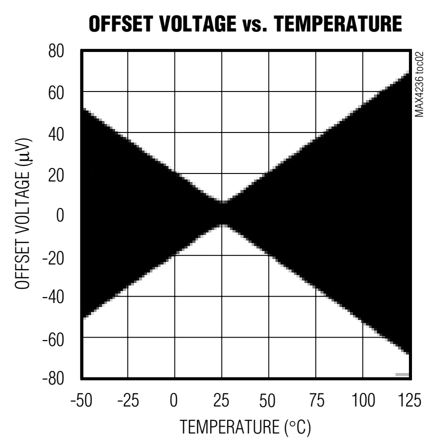
Note 3: Maxim specification limits for the temperature coefficient of the offset voltage (TCV_{OS}) are 100% tested for the A-grade, 8-pin SO and µMAX packages.

Typical Operating Characteristics

(V_{CC} = +5V, V_{EE} = 0, V_{CM} = V_{CC}/2, R_L = 100kΩ to V_{CC}/2, T_A = +25°C, unless otherwise noted.)



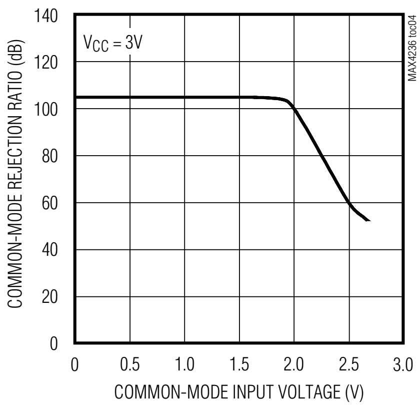




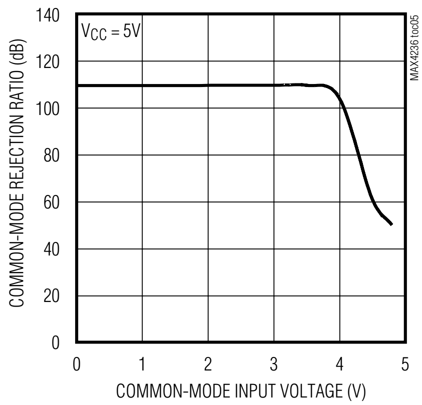
Typical Operating Characteristics (continued)

(V_{CC} = +5V, V_{EE} = 0, V_{CM} = V_{CC}/2, R_L = 100kΩ to V_{CC}/2, T_A = +25°C, unless otherwise noted.)

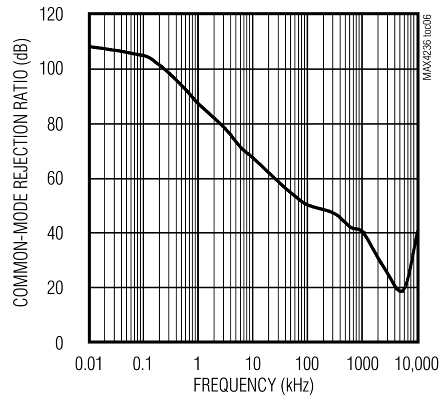
COMMON-MODE REJECTION RATIO vs. COMMON-MODE INPUT VOLTAGE



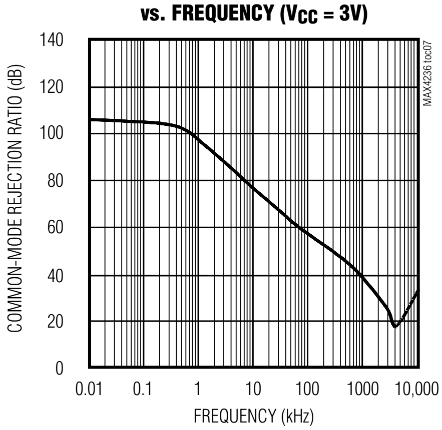
COMMON-MODE REJECTION RATIO vs. COMMON-MODE INPUT VOLTAGE



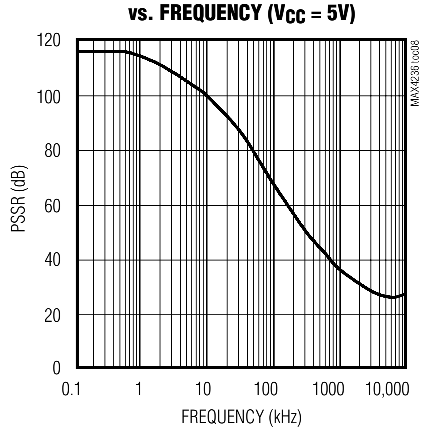
COMMON-MODE REJECTION RATIO vs. FREQUENCY (V_{CC} = 5V)



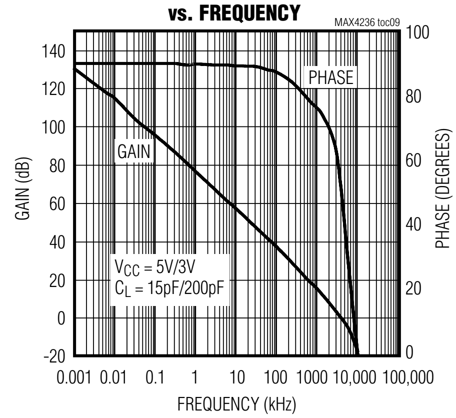
COMMON-MODE REJECTION RATIO vs. FREQUENCY (V_{CC} = 3V)



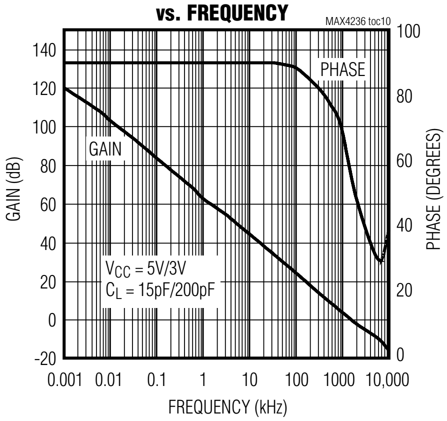
POWER-SUPPLY REJECTION RATIO vs. FREQUENCY (V_{CC} = 5V)



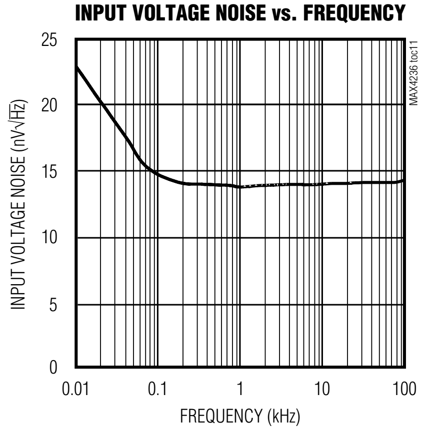
MAX4237 OPEN-LOOP GAIN/PHASE vs. FREQUENCY



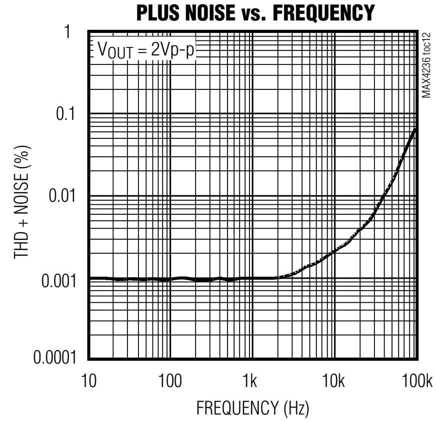
MAX4236 OPEN-LOOP GAIN/PHASE vs. FREQUENCY



INPUT VOLTAGE NOISE vs. FREQUENCY



TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY

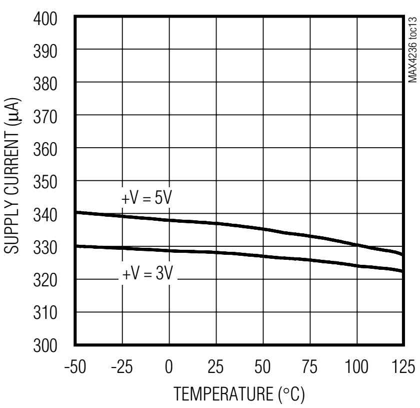


SOT23, Very High Precision, 3V/5V Rail-To-Rail Op Amps

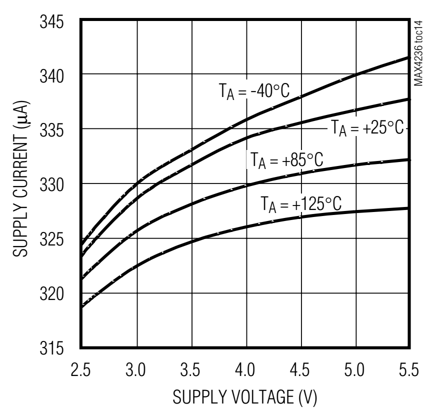
Typical Operating Characteristics (continued)

(V_{CC} = +5V, V_{EE} = 0, V_{CM} = V_{CC}/2, R_L = 100kΩ to V_{CC}/2, T_A = +25°C, unless otherwise noted.)

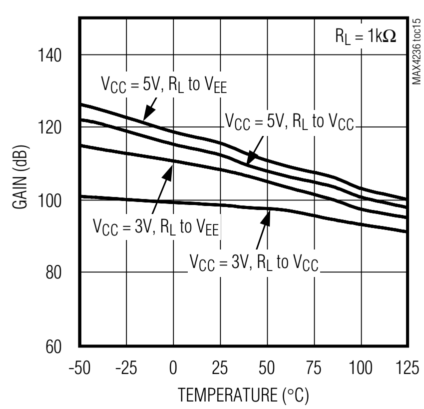
SUPPLY CURRENT vs. TEMPERATURE



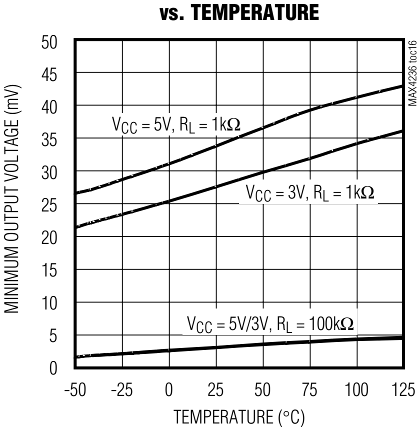
SUPPLY CURRENT vs. SUPPLY VOLTAGE



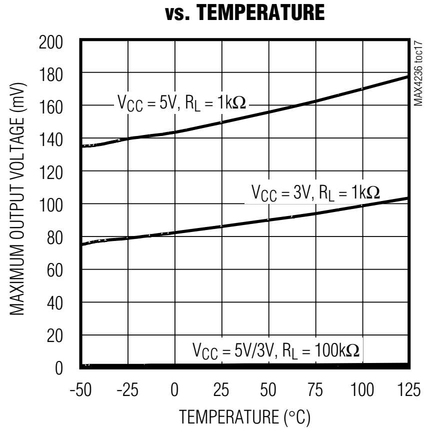
LARGE-SIGNAL GAIN vs. TEMPERATURE



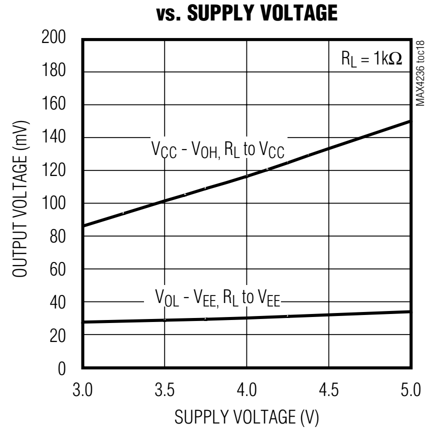
MINIMUM OUTPUT VOLTAGE vs. TEMPERATURE



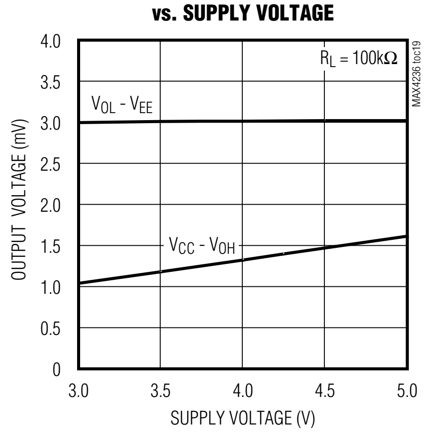
MAXIMUM OUTPUT VOLTAGE vs. TEMPERATURE



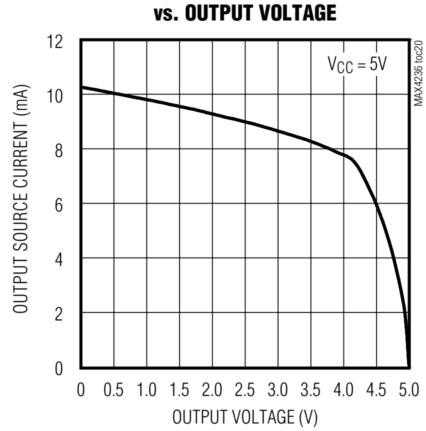
OUTPUT VOLTAGE vs. SUPPLY VOLTAGE



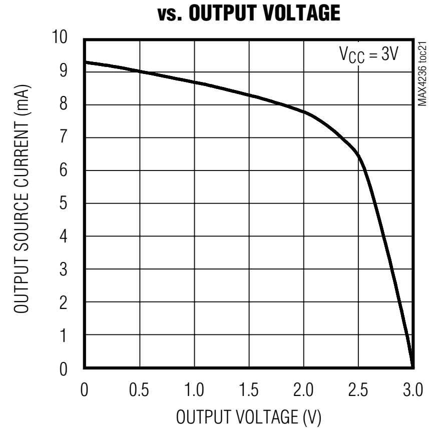
OUTPUT VOLTAGE vs. SUPPLY VOLTAGE



OUTPUT SOURCE CURRENT vs. OUTPUT VOLTAGE



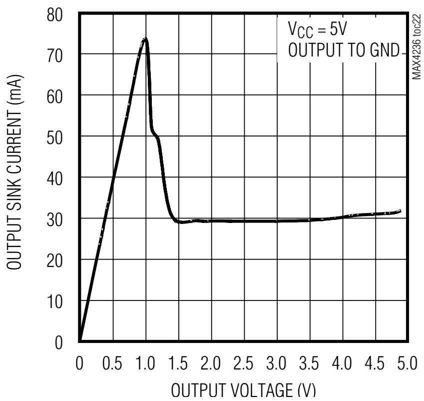
OUTPUT SOURCE CURRENT vs. OUTPUT VOLTAGE



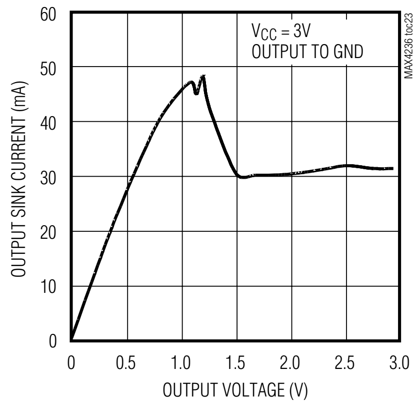
Typical Operating Characteristics (continued)

(V_{CC} = +5V, V_{EE} = 0, V_{CM} = V_{CC}/2, R_L = 100kΩ to V_{CC}/2, T_A = +25°C, unless otherwise noted.)

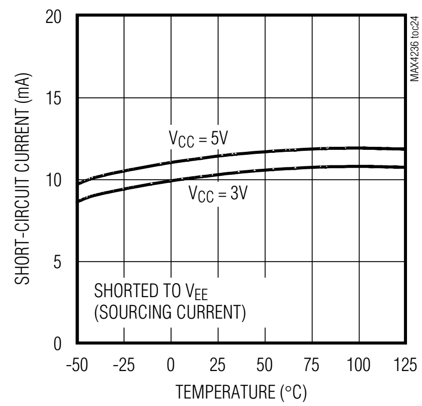
OUTPUT SINK CURRENT vs. OUTPUT VOLTAGE



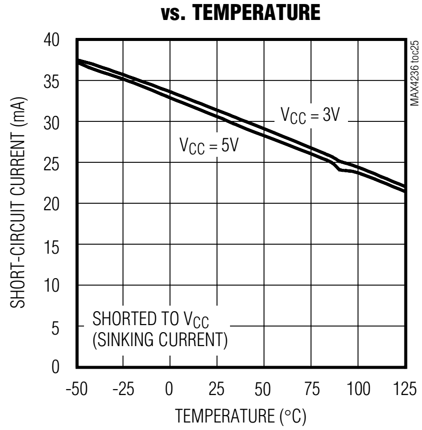
OUTPUT SINK CURRENT vs. OUTPUT VOLTAGE



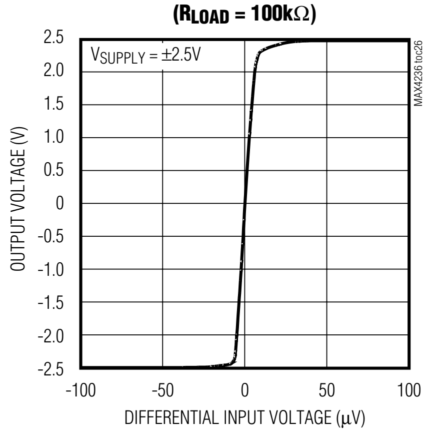
SHORT-CIRCUIT CURRENT vs. TEMPERATURE



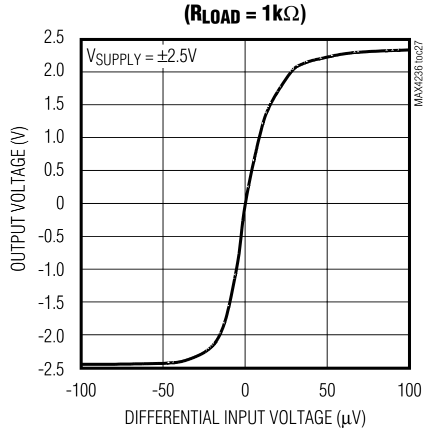
SHORT-CIRCUIT CURRENT vs. TEMPERATURE



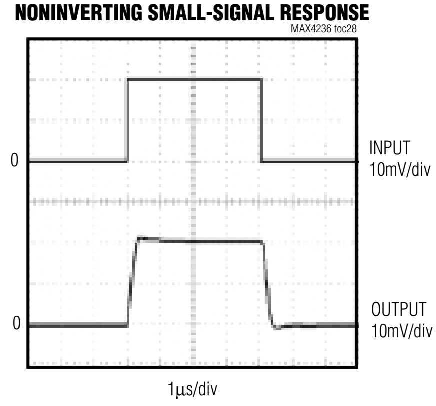
DC I/O TRANSFER CURVE (R_{LOAD} = 100kΩ)



DC I/O TRANSFER CURVE (R_{LOAD} = 1kΩ)

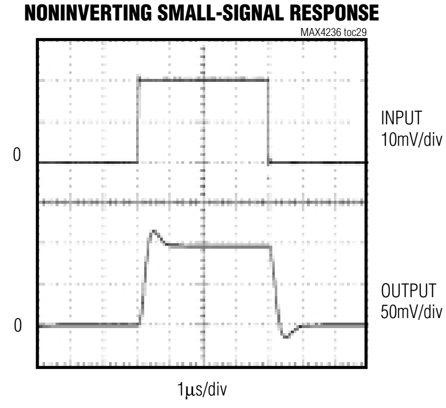


MAX4236 NONINVERTING SMALL-SIGNAL RESPONSE



V_{CC} = ±2.5V
R_L = 1kΩ, C_L = 15pF
A_V = 1V/V

MAX4237 NONINVERTING SMALL-SIGNAL RESPONSE



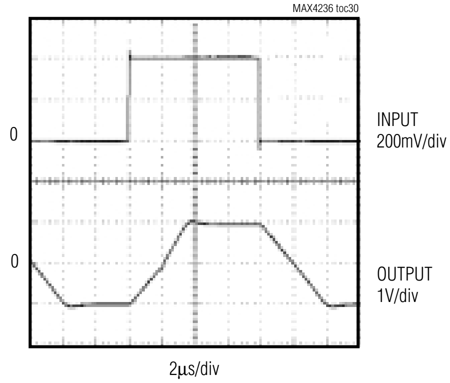
V_{CC} = ±2.5V
R_L = 1kΩ, C_L = 15pF
A_V = 5V/V

SOT23, Very High Precision, 3V/5V Rail-To-Rail Op Amps

Typical Operating Characteristics (continued)

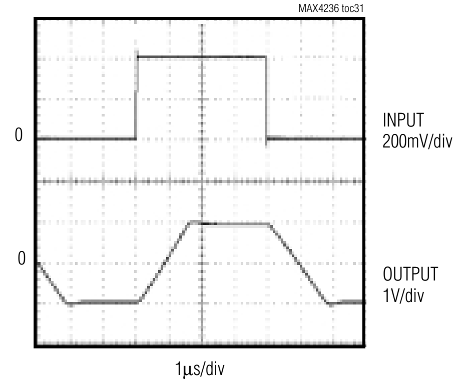
(V_{CC} = +5V, V_{EE} = 0, V_{CM} = V_{CC}/2, R_L = 100kΩ to V_{CC}/2, T_A = +25°C, unless otherwise noted.)

MAX4237
NONINVERTING LARGE-SIGNAL RESPONSE
MAX4236 toc30



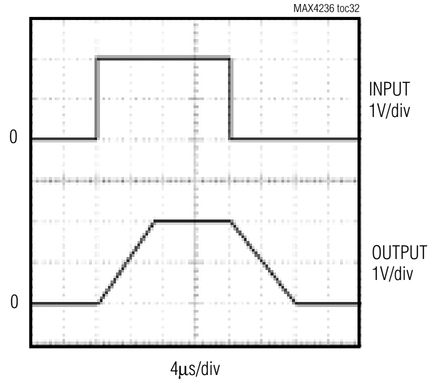
V_{CC} = ±2.5V
R_L = 1kΩ, C_L = 15pF
A_V = 5V/V

MAX4237
NONINVERTING LARGE-SIGNAL RESPONSE
MAX4236 toc31



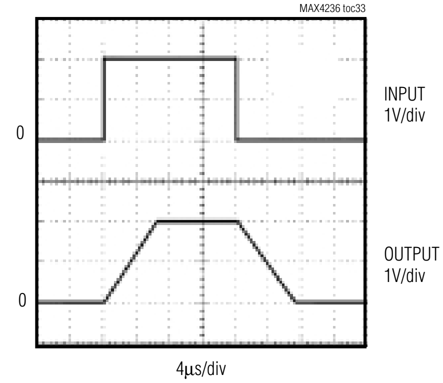
V_{CC} = ±2.5V
R_L = 100kΩ, C_L = 15pF
A_V = 5V/V

MAX4236
NONINVERTING LARGE-SIGNAL RESPONSE
MAX4236 toc32



V_{CC} = ±2.5V
R_L = 1kΩ, C_L = 15pF
A_V = 1V/V

MAX4236
NONINVERTING LARGE-SIGNAL RESPONSE
MAX4236 toc33



V_{CC} = ±2.5V
R_L = 100kΩ, C_L = 15pF
A_V = 1V/V

Pin Description

PIN		NAME	FUNCTION
SOT23	SO/µMAX		
1	6	OUT	Amplifier Output
2	4	V_{EE}	Negative Power Supply. Bypass with a 0.1µF capacitor to ground. Connect to GND for single-supply operation.
3	3	IN+	Noninverting Amplifier Input
4	2	IN-	Inverting Amplifier Input
5	8	$\overline{SHDN}$	Shutdown Input. Do not leave floating. Connect to V_{CC} for normal operation or GND to enter the shutdown mode.
6	7	V_{CC}	Positive Supply Input. Bypass with a 0.1µF capacitor to ground.
—	1, 5	N.C.	No Connection. Not internally connected.

Detailed Description

The MAX4236/MAX4237 are high-precision op amps with a CMOS input stage and an excellent set of DC and AC features. The combination of tight maximum voltage offset, low offset tempco and very low input current make them ideal for use in high-precision DC circuits. They feature low-voltage operation, low-power consumption, high-current drive with rail-to-rail output swing and high-gain bandwidth product.

High Accuracy

The MAX4236/MAX4237 maximum input offset voltage is 20µV (5µV, typ) for grade A version and 50µV for grade B version at +25°C. The maximum temperature coefficient of the offset voltage for grade A and B are guaranteed to be 2µV/°C and 4.5µV/°C respectively. The parts have an input bias current of 1pA. Noise characteristics are 14nV/$\sqrt{Hz}$, and a low frequency noise (0.1Hz to 10Hz) of 0.2µVp-p. The CMRR is 102dB, and the PSRR is 120dB. The combination is what is necessary for the design of circuits to process signals while keeping high signal-to-noise ratios, as in stages preceding high-resolution converters, or when they are produced by sensors or transducers generating very small outputs.

Rail-to-Rail Outputs, Ground-Sensing Input

The input common-mode range extends from (V_{EE} - 0.15V) to (V_{CC} - 1.2V) with excellent common-mode rejection. Beyond this range, the amplifier output is a nonlinear function of the input, but does not undergo phase reversal or latch-up (see *Typical Operating Characteristics*).

The output swings to within 150mV of the power-supply rails with a 1kΩ load. The input ground sensing and the rail-to-rail output substantially increase the dynamic range.

Power-Up and Shutdown Mode

The MAX4236/MAX4237 have a shutdown option. When the shutdown pin ($\overline{SHDN}$) is pulled low, the supply current drops to 0.1µA, and the amplifiers are disabled with the output in a high-impedance state. Pulling $\overline{SHDN}$ high enables the amplifiers. The turn-on time for the amplifiers to come out of shutdown is 4µs.

Applications Information

As described above, the characteristics of the MAX4236/MAX4237 are excellent for high-precision/accuracy circuitry, and the high impedance, low-current, low-offset, and noise specifications are very attractive for piezoelectric transducers applications. In these applications, the sensors generate an amount of electric charge proportional to the changes in the mechanical stress applied to them. These charges are transformed into a voltage proportional to the applied force by injecting them into a capacitance and then amplifying the resulting voltage. The voltage is an inverse function of the capacitance into which the charges generated by the transducer/ sensor are injected. This capacitance and the resistance that discharges it, define the low-frequency response of the circuit. It is desirable, once the preferred low-frequency response is known, to maintain the capacitance as low as possible, because the amount of necessary upstream amplification (and the signal-to-noise ratio deterioration) is directly proportional to the capacitance value. The MAX4236/MAX4237 high-impedance, low-

SOT23, Very High Precision, 3V/5V Rail-To-Rail Op Amps

current, low-noise inputs allow a minimum of capacitance to be used.

Piezoresistive transducers applications require many of the same qualities. For those applications the MAX4236/MAX4237 high CMRR, PSRR, and offset stability are also a good match.

A typical application for a piezoresistive transducer instrumentation amplifier design using the MAX4236/MAX4237 is shown in the *Typical Application Circuit*.

In general, the MAX4236/MAX4237 are good components for any application in which an amplifier with an almost zero input current is required, including high-precision, long time-constant integrators and electrochemical sensors.

Power Supplies

The MAX4236/MAX4237 can operate from a single +2.4V to +5.5V power supply, or from ±1.2V to ±2.75V power supplies. The power supply pin(s) must be bypassed to ground with a 0.1µF capacitor as close to the pin as possible.

Layout and Physical Design

A good layout improves performance by decreasing the amount of parasitic and stray capacitance, inductance and resistance at the amplifier's inputs, outputs, and power-supply connections. Since parasitics might be unavoidable, minimize trace lengths, resistor leads, and place external components as close to the pins as possible.

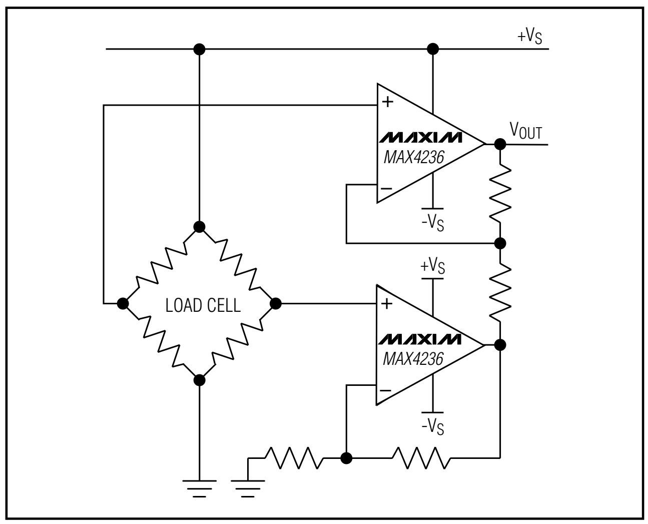
In high impedance, low input current applications, input lines guarding and shielding, special grounding, and other physical design and layout techniques, are mandatory if good results are expected.

The negative effects of crosstalk, EMI and other forms of interference and noise (thermal, acoustic, etc.) must be accounted for and prevented beforehand for good performance in the type of sensitive circuitry in which the MAX4236/MAX4237 are likely to be used.

Selector Guide

PART	GRADE	MINIMUM STABLE GAIN	TOP MARK
MAX4236EUT	—	1	AAUV
MAX4236AEUA	A	1	—
MAX4236BEUA	B	1	—
MAX4236AESA	A	1	—
MAX4236BESA	B	1	—
MAX4237EUT	—	5	AAUW
MAX4237AEUA	A	5	—
MAX4237BEUA	B	5	—
MAX4237AESA	A	5	—
MAX4237BESA	B	5	—

Typical Application Circuit



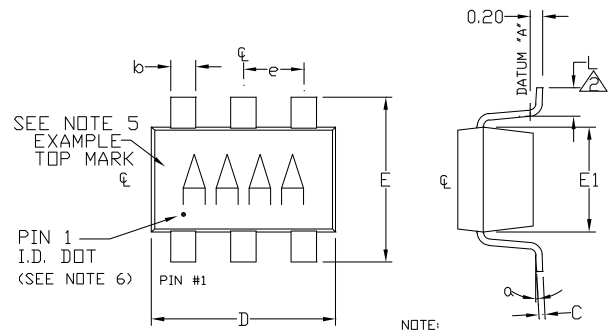
Chip Information

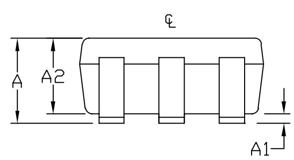
TRANSISTOR COUNTS: 224

PROCESS: BiCMOS

Package Information

6LSOT.EPS



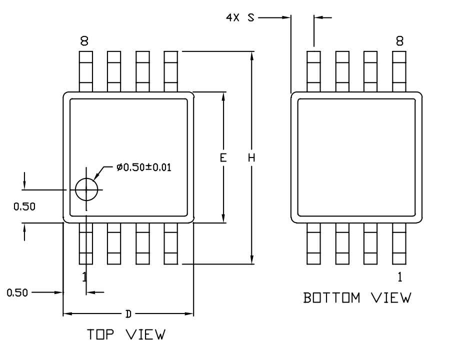


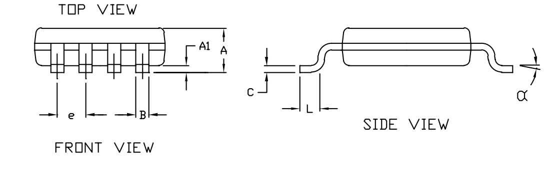
SYMBOL	MIN	MAX
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.35	0.50
C	0.08	0.20
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.75
L	0.35	0.55
e	0.95 REF	
α	0°	10°

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. FOOT LENGTH MEASURED AT INTERCEPT POINT BETWEEN DATUM A & LEAD SURFACE.
3. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & METAL BURR.
4. PACKAGE OUTLINE INCLUSIVE OF SOLDER PLATING.
5. PIN 1 IS LOWER LEFT PIN WHEN READING TOP MARK FROM LEFT TO RIGHT. (SEE EXAMPLE TOP MARK)
6. PIN 1 I.D. DOT IS 0.3 MM Ø MIN. LOCATED ABOVE PIN 1.

MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, SOT23, 6L
APPROVAL | DOCUMENT CONTROL NO. 21-0058 | REV D | 1/1

8LUMAXD.EPS





	INCHES		MILLIMETERS		JEDEC INCHES		JEDEC MILLIMETERS	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	0.037	0.043	0.94	1.10	---	0.043	---	1.10
A1	0.002	0.006	0.05	0.15	0.002	0.006	0.05	0.15
B	0.010	0.014	0.25	0.36	0.010	0.016	0.25	0.40
C	0.005	0.007	0.13	0.18	0.005	0.009	0.13	0.23
D	0.116	0.120	2.95	3.05	0.114	0.122	2.9	3.1
e	0.0256 BSC		0.65 BSC		0.0256 BSC		0.64 BSC	
E	0.116	0.120	2.95	3.05	0.114	0.122	2.9	3.1
H	0.188	0.198	4.78	5.03	0.193 BSC		4.9 BSC	
L	0.016	0.026	0.41	0.66	0.016	0.027	0.40	0.70
α	0°	6°	0°	6°	0°	6°	0°	6°
S	0.0207 BSC		0.5250 BSC					

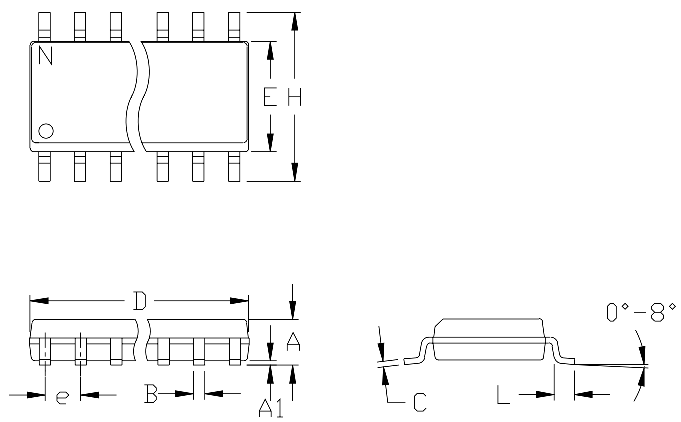
NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15MM (.006").
3. CONTROLLING DIMENSION: MILLIMETERS.
4. MEETS JEDEC MO-187.

MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, 8L uMAX
APPROVAL | DOCUMENT CONTROL NO. 21-0036 | REV I | 1/1

SOT23, Very High Precision, 3V/5V Rail-To-Rail Op Amps

Package Information (continued)

SOICN.EPS



	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.053	0.069	1.35	1.75
A1	0.004	0.010	0.10	0.25
B	0.014	0.019	0.35	0.49
C	0.007	0.010	0.19	0.25
e	0.050		1.27	
E	0.150	0.157	3.80	4.00
H	0.228	0.244	5.80	6.20
h	0.010	0.020	0.25	0.50
L	0.016	0.050	0.40	1.27

	INCHES		MILLIMETERS			
	MIN	MAX	MIN	MAX	N	MS012
D	0.189	0.197	4.80	5.00	8	A
D	0.337	0.344	8.55	8.75	14	B
D	0.386	0.394	9.80	10.00	16	C

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. LEADS TO BE COPLANAR WITHIN .102mm (.004")
4. CONTROLLING DIMENSION: MILLIMETER
5. MEETS JEDEC MS012-XX AS SHOWN IN ABOVE TABLE
6. N = NUMBER OF PINS

MAXIM 120 SAN GABRIEL DR SUNNYVALE CA 94086 FAX (408) 737 7194
PROPRIETARY INFORMATION

TITLE: PACKAGE FAMILY OUTLINE: SOIC .150" 1/1

DOCUMENT CONTROL NUMBER: 21-0041 REV: A