General Description

The SAH2832 is a high-performance operational amplifier combining excellent DC & AC characteristics. It features very low noise, high output-drive capability, high unity-gain and maximum output-swing bandwidths, low distoration, high slew rate, input protection diodes and output short-circuit protection. The operational amplifier is compensated internally for unity-gain operation.

The SAH 2832 is available in Green SOP-8 Package. It operates over an ambient temperature range of -40°C to +85°C.

Features

- Equivalent input noise voltage: **5nV/$\sqrt{Hz}$ (TYP)** at 1kHz
- Unity-gain bandwidth: 8.5MHz(TYP)
- Common mode rejection ratio: 140dB(TYP)
- High DC voltage gain: 140dB(TYP)
- High slew rate: 18V/us(TYP)
- Operating temperature: –40°C to +85°C
- Available in Green SOP-8 Package

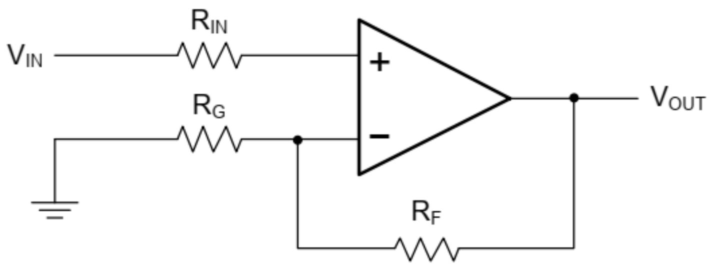
Package Marking and Ordering Information

Part Number	Marking	Package	Units/Tube	Units/Reel
SAH2832	SAH2832	SOP8		4000

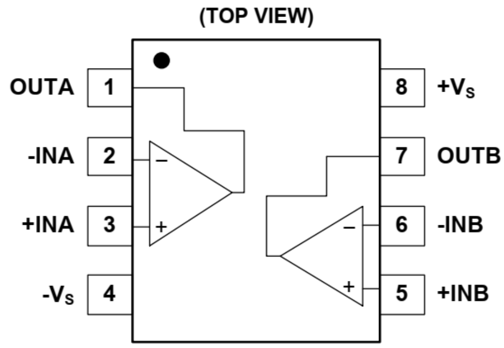
Applications

- AV Receivers
- Embedded PCs/Netbooks
- Media Recorders and Players
- Multichannel Video Transcoders
- Pro Audio Mixers

Functional Block Diagram



PIN Configuration



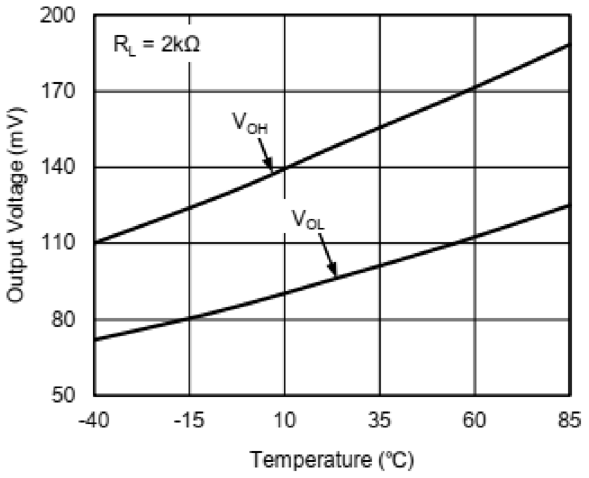
ELECTRICAL CHARACTERISTICS

(At T_A = +25℃, Full = -40℃ to +85℃, V_S = ±15V, R_L = 2kΩ connected to 0V, unless otherwise noted.)

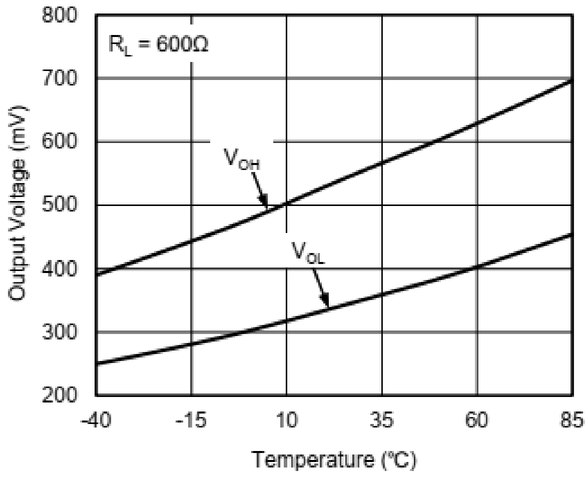
PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS							
Input Offset Voltage	V_{OS}	V_{CM} = 0V	+25℃		100	500	μV
			Full			620	
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$		Full		0.6		μV/℃
Input Bias Current	I_B	V_{CM} = 0V	+25℃		550	750	nA
			Full			900	
Input Offset Current	I_{OS}	V_{CM} = 0V	+25℃		10	70	nA
			Full			100	
Input Common Mode Voltage Range	V_{CM}		Full	-13		13	V
Common Mode Rejection Ratio	CMRR	V_S = ±15V, -13V < V_{CM} < 13V	+25℃	128	140		dB
			Full	124			
Open-Loop Voltage Gain	A_{OL}	V_S = ±15V, V_{OUT} = ±10V, R_L = 2kΩ	+25℃	128	140		dB
			Full	120			
		V_S = ±15V, V_{OUT} = ±10V, R_L = 600Ω	+25℃	112	128		
			Full	108			
OUTPUT CHARACTERISTICS							
Output Voltage Swing from Rail	V_{OUT}	V_S = ±15V, R_L = 2kΩ	+25℃		150	185	mV
			Full			230	
		V_S = ±15V, R_L = 600Ω	+25℃		550	660	
			Full			840	
Output Short-Circuit Current	I_{SC}	V_S = ±15V	+25℃	±27	±36		mA
POWER SUPPLY							
Operating Voltage Range	V_S		Full	5		36	V
Quiescent Current	I_Q	I_{OUT} = 0	+25℃		8.5	17.5	mA
			Full			18	
Power Supply Rejection Ratio	PSRR	V_S = 5V to 36V	+25℃	122	138		dB
			Full	119			
DYNAMIC PERFORMANCE							
Gain-Bandwidth Product	GBP	f = 10kHz			20		MHz
Slew Rate	SR				18		V/μs
Overload Recovery Time	ORT	V_{IN} × G = V_S			1.2		μs
Maximum Output-Swing Bandwidth	B_{OM}	V_S = ±15V, V_{OUT} = ±10V, R_L = 600Ω			280		kHz
Unity-Gain Bandwidth	B_1	R_L = 600Ω			8.5		MHz
Total Harmonic Distortion + Noise	THD+N	V_S = ±15V, V_{OUT} = 10V_{P-P}, f = 1kHz, G = +1, R_L = 600Ω			0.00005		%
NOISE							
Input Voltage Noise		f = 0.1Hz to 10Hz			0.3		$μV_{P-P}$
Input Voltage Noise Density	e_n	f = 30Hz			15		nV/ $\sqrt{Hz}$
		f = 1kHz			5		
Input Current Noise Density	i_n	f = 30Hz			3		pA/ $\sqrt{Hz}$
		f = 1kHz			1		

TYPICAL PERFORMANCE CHARACTERISTICS

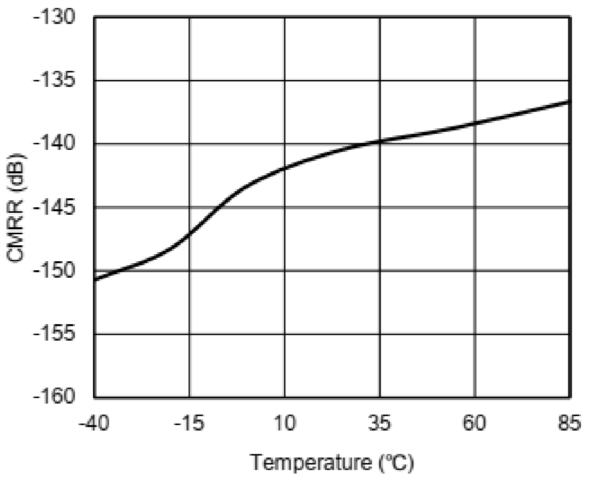
Output Voltage Swing from Rail vs. Temperature



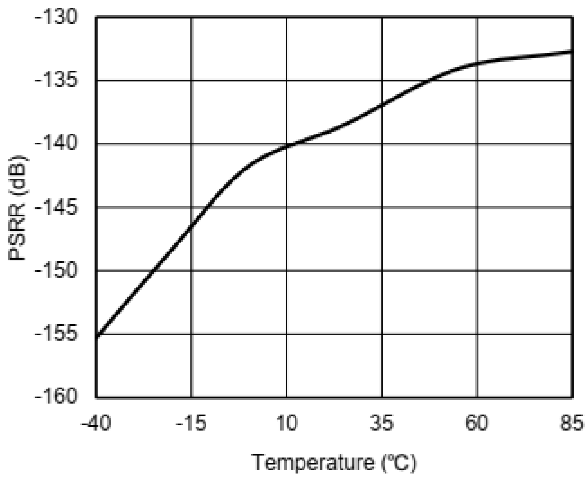
Output Voltage Swing from Rail vs. Temperature



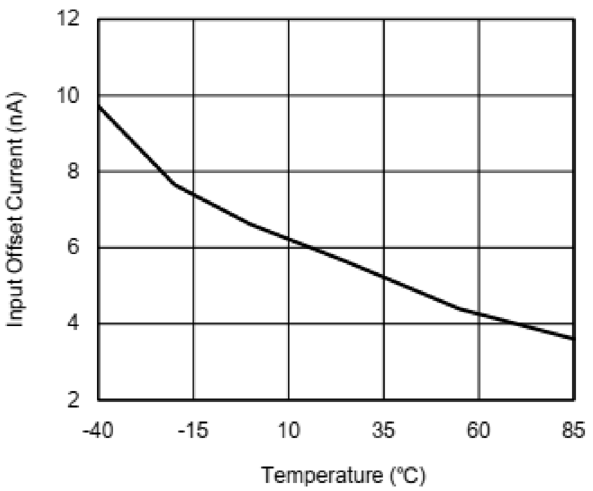
CMRR vs. Temperature



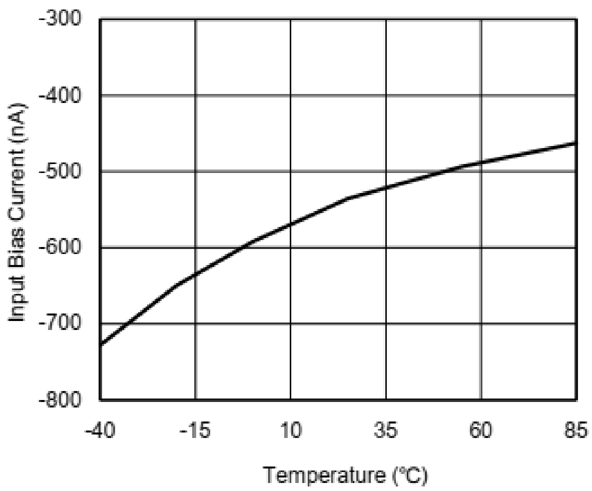
PSRR vs. Temperature



Input Offset Current vs. Temperature

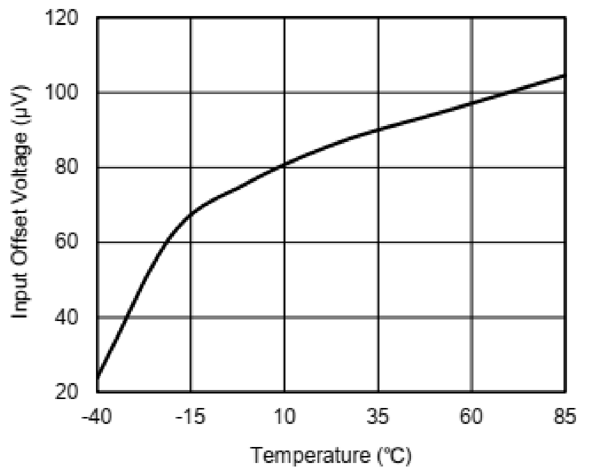


Input Bias Current vs. Temperature

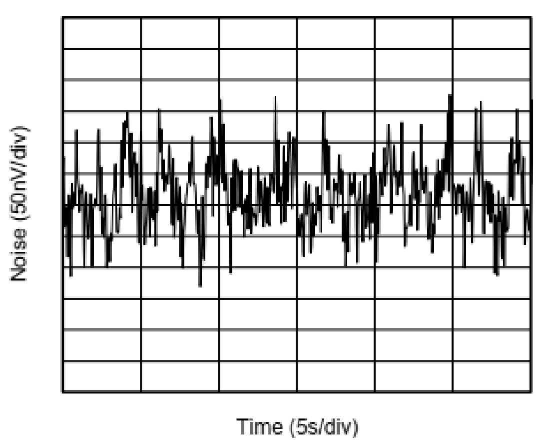


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

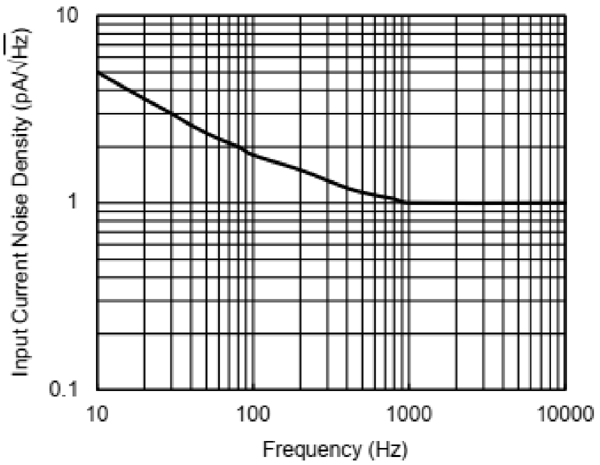
Input Offset Voltage vs. Temperature



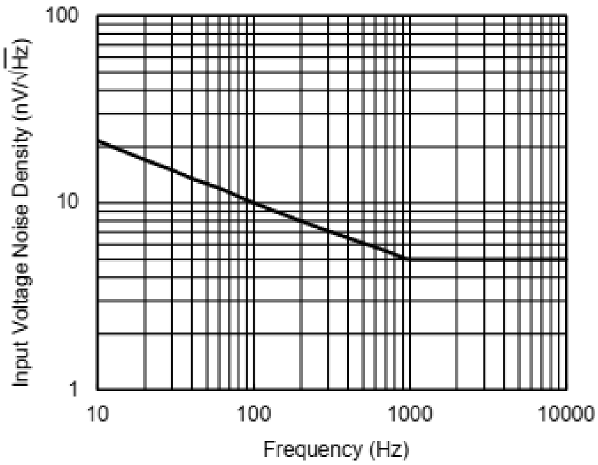
0.1Hz to 10Hz Noise



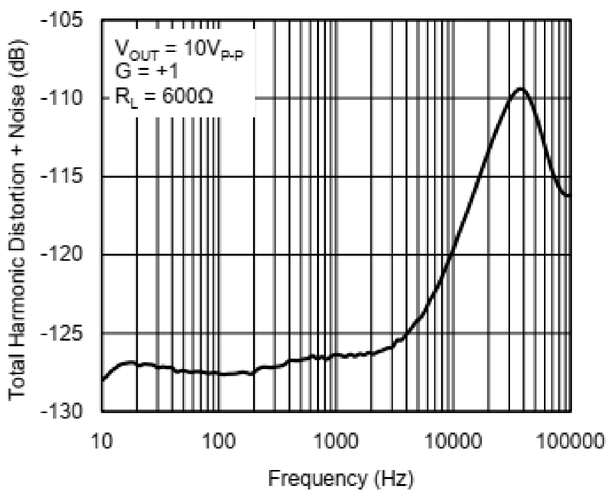
Input Current Noise Density vs. Frequency



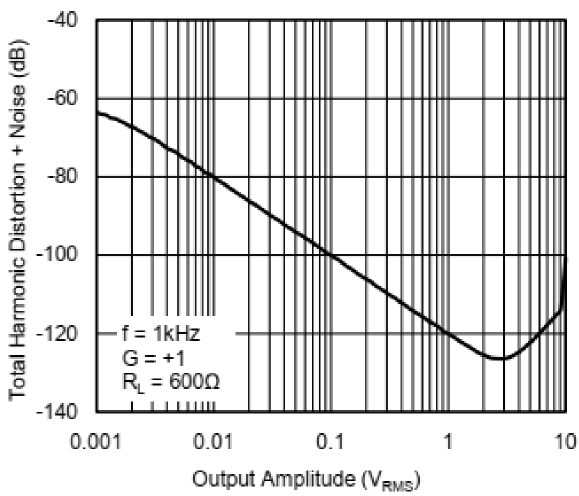
Input Voltage Noise Density vs. Frequency



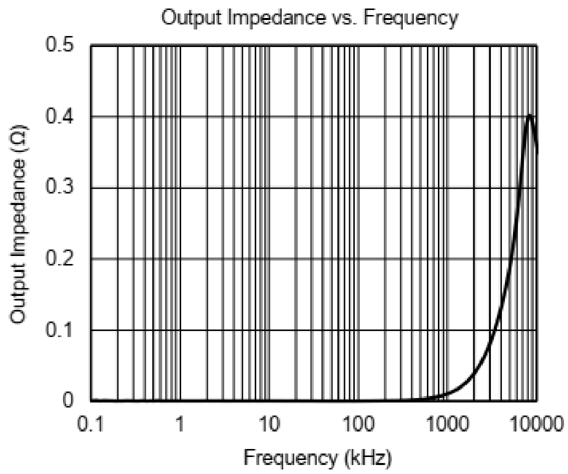
THD+N vs. Frequency

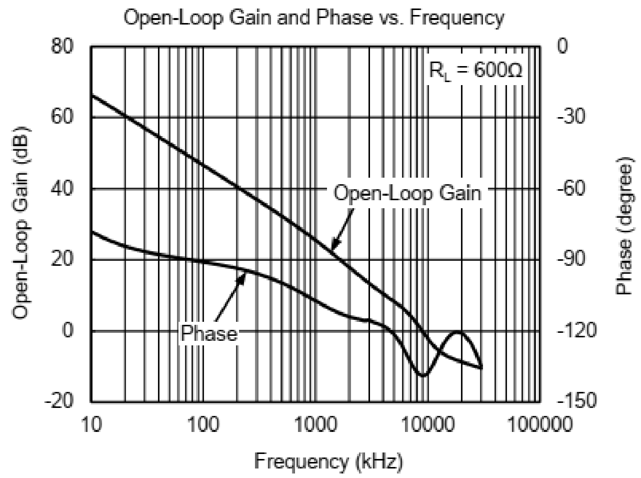


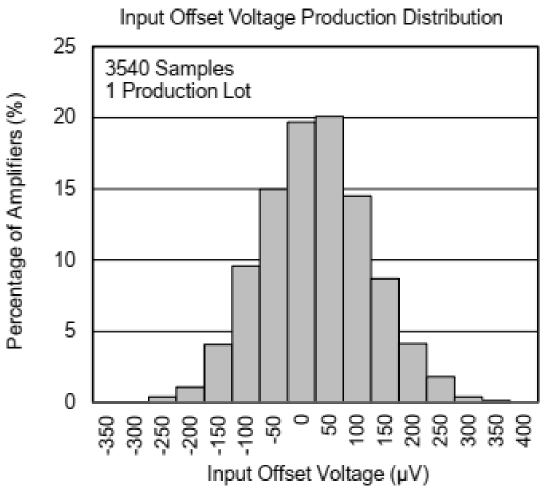
THD+N vs. Output Amplitude



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

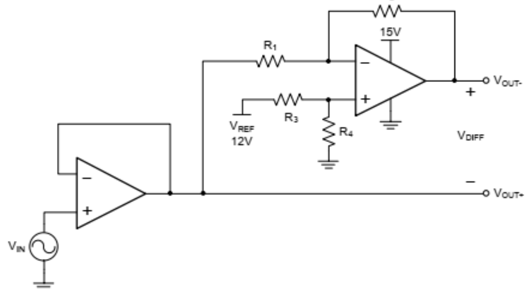






APPLICATION INFORMATION

Some applications require differential signals. Figure below shows a simple circuit to convert a single-ended input of 2V to 10V into differential output of ±8V on a single 15V supply. The output range is intentionally limited to maximize linearity. The circuit is composed of two amplifiers. One amplifier acts as a buffer and creates a voltage, VOUT+. The second amplifier inverts the input and adds a reference voltage to generate VOUT-. Both VOUT+ and VOUT- range from 2V to 10V. The difference, VDIFF, is the difference between VOUT+ and VOUT-.



POWER SUPPLY RECOMMENDATIONS

The SAH2832 device is specified for operation over the range of ±2.5V to ±18V; many specifications apply from -40℃ to +85℃. Place 0.1μF bypass capacitors close to the power-supply pins to reduce errors coupling in from noisy or high impedance power supplies. For more detailed information on bypass capacitor placement, refer to the Layout Guidelines.

Caution

Supply voltages outside of the ±18V range can permanently damage the device (see the Absolute Maximum Ratings).

Detailed Design Procedure

The circuit in Figure 2 takes a single-ended input signal, VIN, and generates two output signals, VOUT+ and VOUT- using two amplifiers and a reference voltage, VREF. VOUT+ is the output of the first amplifier and is a buffered version of the input signal, VIN in Equation 1. VOUT- is the output of the second amplifier which uses VREF to add an offset voltage to VIN and feedback to add inverting gain. The transfer function for VOUT- is Equation 2.

$$V_{OUT+} = V_{IN} \quad (1)$$

$$V_{OUT-} = V_{REF} \times \left(\frac{R_4}{R_3 + R_4} \right) \times \left(1 + \frac{R_2}{R_1} \right) - V_{IN} \times \frac{R_2}{R_1} \quad (2)$$

The differential output signal, VDIFF, is the difference between the two single-ended output signals, VOUT+ and VOUT-. Equation 3 shows the transfer function for VDIFF. By applying the conditions that R1 = R2 and R3 = R4, the transfer function is simplified into Equation 6. Using this configuration, the maximum input signal is equal to the reference voltage and the maximum output of each amplifier is equal to the VREF. The differential output range is 2 × VREF. Furthermore, the common mode voltage will be one half of VREF (see Equation 7).

$$V_{DIFF} = V_{OUT+} - V_{OUT-} = V_{IN} \times \left(1 + \frac{R_2}{R_1} \right) - V_{REF} \times \left(\frac{R_4}{R_3 + R_4} \right) \left(1 + \frac{R_2}{R_1} \right) \quad (3)$$

$$V_{OUT+} = V_{IN} \quad (4)$$

$$V_{OUT-} = V_{REF} - V_{IN} \quad (5)$$

$$V_{DIFF} = 2 \times V_{IN} - V_{REF} \quad (6)$$

$$V_{CM} = \left(\frac{V_{OUT+} + V_{OUT-}}{2} \right) = \frac{1}{2} V_{REF} \quad (7)$$

Amplifier Selection

Linearity over the input range is key for good DC accuracy. The input common mode range and the output swing limitations determine the linearity. In general, an amplifier with rail-to-rail input and output swing is required. Bandwidth is a key concern for this design. Since the SAH2832 has a bandwidth of 8.5MHz, this circuit will only be able to process signals with frequencies of less than 8.5MHz.

Passive Component Selection

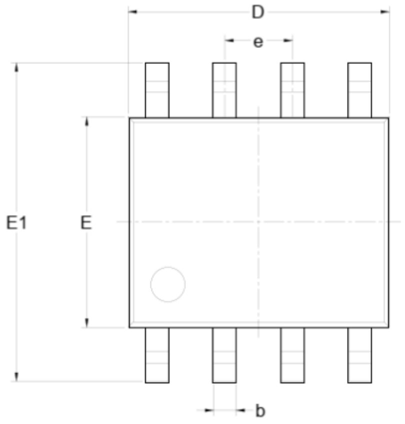
Because the transfer function of VOUT- is heavily reliant on resistors (R1, R2, R3, and R4), use resistors with low tolerances to maximize performance and minimize error. This design used resistors with resistance values of 36kΩ with tolerances measured to be within 2%. But, if the noise of the system is a key parameter, the user can select smaller resistance values (6kΩ or lower) to keep the overall system noise low. This ensures that the noise from the resistors is lower than the amplifier noise.

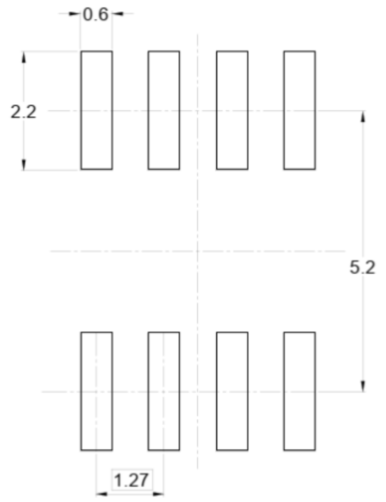
Layout Guidelines

For best operational performance of the device, use good PCB layout practices, including:

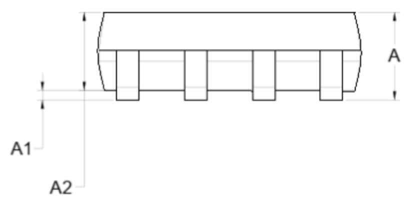
- Noise can propagate into analog circuitry through the power pins of the circuit as a whole and the operational amplifier. Bypass capacitors are used to reduce the coupled noise by providing low impedance power sources local to the analog circuitry.
- Connect low-ESR, 0.1μF ceramic bypass capacitors between each supply pin and ground, placed as close to the device as possible. A single bypass capacitor from +VS to ground is applicable for single supply applications.
- Separate grounding for analog and digital portions of circuitry is one of the simplest and most-effective methods of noise suppression. One or more layers on multilayer PCBs are usually devoted to ground planes. A ground plane helps distribute heat and reduces EMI noise pickup. Make sure to physically separate digital and analog grounds, paying attention to the flow of the ground current.
- To reduce parasitic coupling, run the input traces as far away from the supply or output traces as possible. If it is not possible to keep them separate, it is much better to cross the sensitive trace perpendicular as opposed to in parallel with the noisy trace.
- Place the external components as close to the device as possible. Keeping RF and RG close to the inverting input minimizes parasitic capacitance.
- Keep the length of input traces as short as possible. Always remember that the input traces are the most sensitive part of the circuit.
- Consider a driven, low-impedance guard ring around the critical traces. A guard ring can significantly reduce leakage currents from nearby traces that are at different potentials.

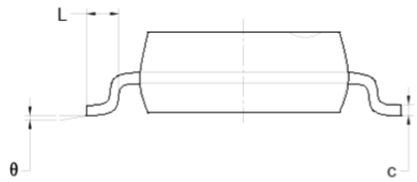
PACKAGE SOP-8





RECOMMENDED LAND PATTERN (Unit: mm)





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

SOP8 Package Outline Dimensions

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