

Features

- Single-Supply Operation from +2.1V ~ +5.5V
- Rail-to-Rail Input / Output
- Gain-Bandwidth Product: 6MHz (Typ.)
- Low Input Bias Current: 1pA (Typ.)
- Low Offset Voltage: 3.5mV (Max.)
- Quiescent Current: 470μA per Amplifier (Typ.)
- Operating Temperature: -40°C ~ +125°C
- Small Package: GS8632C Available in SOP-8 Package

General Description

The GS8632C have a high gain-bandwidth product of 6MHz, a slew rate of 4.2V/μs, and a quiescent current of 470 μA per amplifier at 5V. The GS8632C is designed to provide optimal performance in low voltage and low noise systems. They provide rail-to-rail output swing into heavy loads. The input common mode voltage range includes ground, and the maximum input offset voltage is 3.5mV for GS8632C. They are specified over the extended industrial temperature range (-40°C to +125°C). The GS8632C dual is available in Green SOP-8 package.

Applications

- Sensors
- Active Filters
- Cellular and Cordless Phones
- Laptops and PDAs
- Audio
- Handheld Test Equipment
- Battery-Powered Instrumentation
- A/D Converters

Pin Configuration

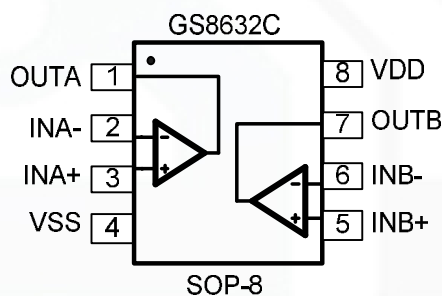


Figure 1. Pin Assignment Diagram

Absolute Maximum Ratings

Condition	Min	Max
Power Supply Voltage (V_{DD} to V_{SS})	-0.5V	+7.5V
Analog Input Voltage ($IN+$ or $IN-$)	$V_{SS}-0.5V$	$V_{DD}+0.5V$
PDB Input Voltage	$V_{SS}-0.5V$	+7V

Operating Temperature Range	-40°C	+125°C
Junction Temperature	+160°C	
Storage Temperature Range	-55°C	+150°C
Lead Temperature (soldering, 10sec)	+260°C	
Package Thermal Resistance (TA=+25°C)		
SOP-14, θ_{JA}	125°C/W	
ESD Susceptibility		
HBM	8KV	
MM	400V	

Note: Stress greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions outside those indicated in the operational sections of this specification are not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Package/Ordering Information

MODEL	CHANNEL	ORDER NUMBER	PACKAGE DESCRIPTION	PACKAGE OPTION	MARKING INFORMATION
GS8632C	Dual	GS8632C-SR	SOP-8	Tape and Reel,4000	GS8632

Electrical Characteristics

(At $V_S=5V$, $T_A = +25^{\circ}C$, $V_{CM} = V_S/2$, $R_L = 600\Omega$, unless otherwise noted.)

PARAMETER	CONDITIONS	GS8632C						
		TYP	MIN/MAX OVER TEMPERATURE					
		+25℃	+25℃	0℃ to 70℃	-40℃ to 85℃	-40℃ to 125℃	UNITS	MIN / MAX
INPUT CHARACTERISTICS								
Input Offset Voltage (V _{OS})	V _S = 5.5V	0.8	3.5	3.9	4.3	4.6	mV	MAX
Input Bias Current (I _B)		1					pA	TYP
Input Offset Current (I _{OS})		1					pA	TYP
Input Common Mode Voltage Range (V _{CM})		-0.1 to +5.6					V	TYP
Common Mode Rejection Ratio (CMRR)	V _S = 5.5V, V _{CM} = -0.1V to 4V	90	73	70	70	65	dB	MIN
	V _S = 5.5V, V _{CM} = -0.1V to 5.6V	83					dB	MIN
Open-Loop Voltage Gain (A _{OL})	R _L = 600Ω, V _O = 0.15V to 4.85V	97	90	87	86	79	dB	MIN
	R _L = 10kΩ, V _O = 0.05V to 4.95V	108					dB	MIN
Input Offset Voltage Drift (ΔV _{OS} /ΔT)		2.4					μV/℃	TYP
OUTPUT CHARACTERISTICS								
Output Voltage Swing from Rail	R _L = 600Ω	0.1					V	TYP
	R _L = 10kΩ	0.015					V	TYP
Output Current (I _{OUT})		53	49	45	40	35	mA	MIN
Closed-Loop Output Impedance	f = 200kHz, G = 1	3					Ω	TYP
POWER-DOWN DISABLE								
Turn-On Time		4					μs	TYP
Turn-Off Time		1.2					μs	TYP
POWER SUPPLY								
Operating Voltage Range	V _S = +2.5V to +5.5V V _{CM} = (-V _S) + 0.5V		2.1	2.1	2.1	2.1	V	MIN
			5.5	5.5	5.5	5.5	V	MAX
Power Supply Rejection Ratio (PSRR)		91	74	72	72	68	dB	MIN
Quiescent Current/Amplifier (I _Q)		470	650	727	750	815	μA	MAX

Electrical Characteristics

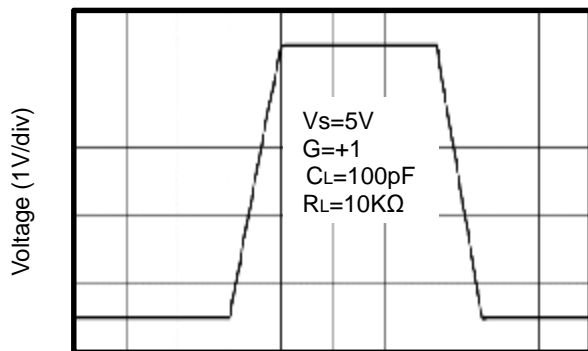
(At $V_S=5V$, $T_A = +25^{\circ}C$, $V_{CM} = V_S/2$, $R_L = 600\Omega$, unless otherwise noted.)

PARAMETER	CONDITIONS	GS8632C						
		TYP	MIN/MAX OVER TEMPERATURE					MIN / MAX
		+25°C	+25°C	0°C to 70°C	-40°C to 85°C	-40°Cto 125°C	UNITS	
DYNAMIC PERFORMANCE								
Gain-Bandwidth Product (GBP)	R _L = 10kΩ, C _L = 100pF	6					MHz	TYP
Phase Margin (φ _o)	R _L = 10kΩ, C _L = 100pF	53					Degrees	TYP
Full Power Bandwidth (BWP)	< 1% distortion, R _L = 600Ω	250					kHz	TYP
Slew Rate (SR)	G = +1, 2V Step, R _L = 10kΩ	4.2					V/μs	TYP
Settling Time to 0.1% (t _s)	G = +1, 2V Step, R _L = 600Ω	0.4					μs	TYP
Overload Recovery Time	V _{IN} ·Gain = V _S , R _L = 600Ω	2.5					μs	TYP
NOISE PERFORMANCE								
Voltage Noise Density (e _n)	f = 1kHz	13					nV / √Hz	TYP
	f = 10kHz	9.5					nV / √Hz	TYP

Typical Performance characteristics

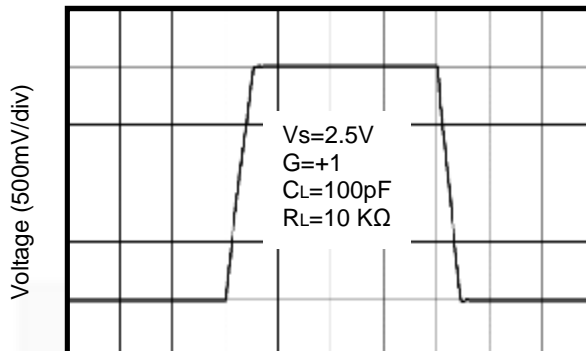
(At $V_S=5V$, $T_A = +25^{\circ}C$, $V_{CM} = V_S/2$, $R_L = 600\Omega$, unless otherwise noted.)

Large-Signal Step Response



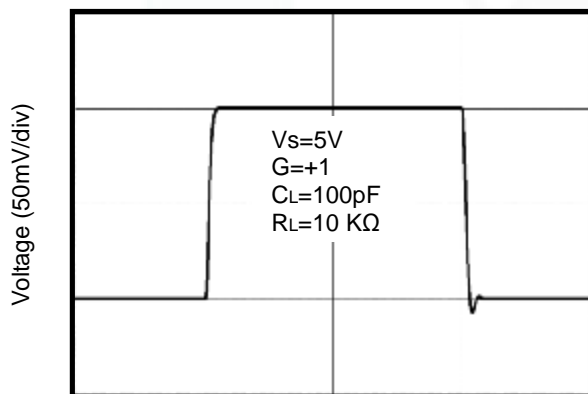
Time (1 μs /div)

Large-Signal Step Response



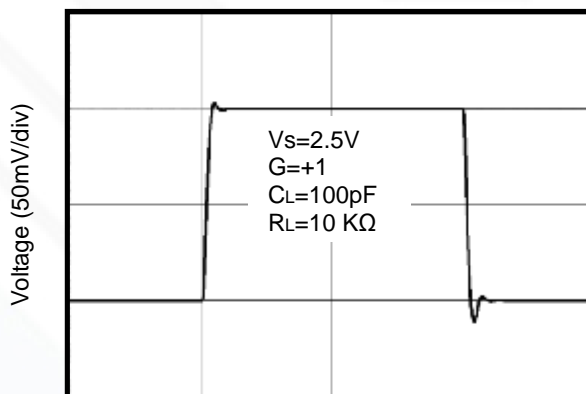
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Small-Signal Step Response



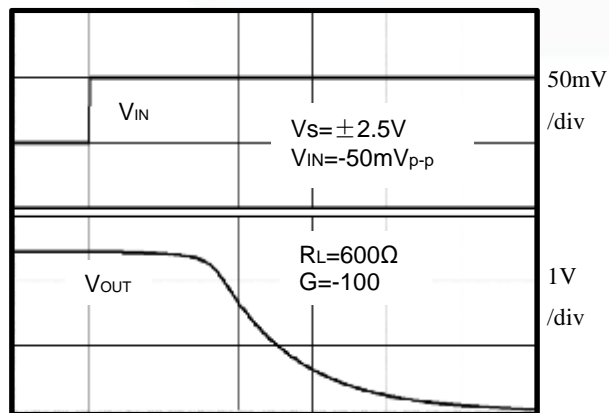
Time (1 μs /div)

Small-Signal Step Response



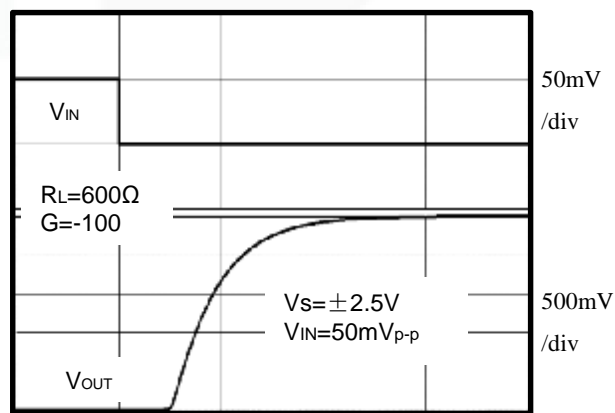
Time (1 μs /div)

Positive Overload Recovery



Time (2 μs /div)

Negative Overload Recovery

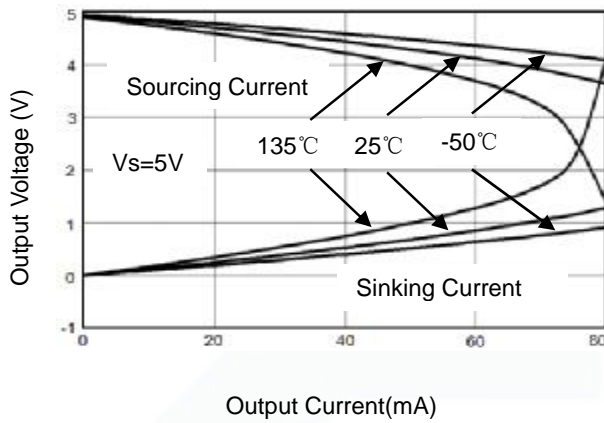


Time (2 μs /div)

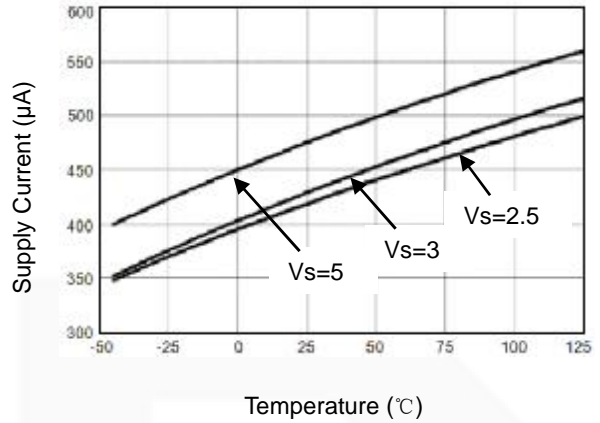
Typical Performance characteristics

(At $V_s=5V$, $T_A = +25^\circ C$, $V_{CM} = V_s/2$, $R_L = 600\Omega$, unless otherwise noted.)

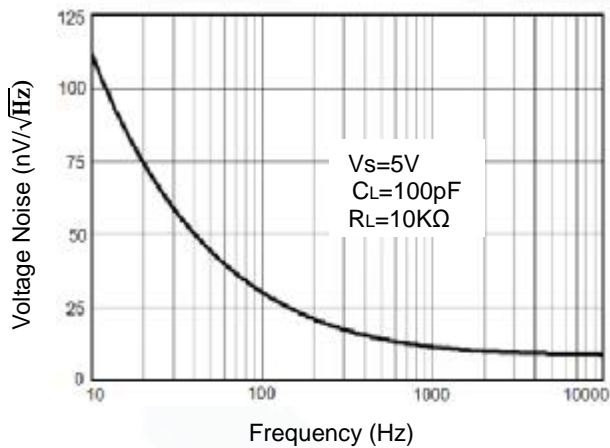
Output Voltage Swing vs. Output Current



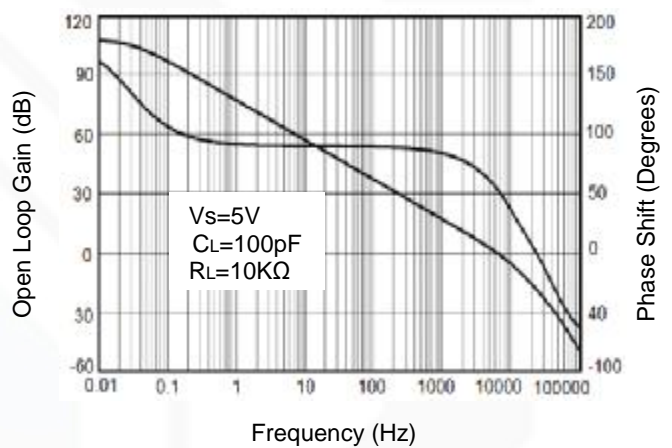
Supply Current vs. Temperature



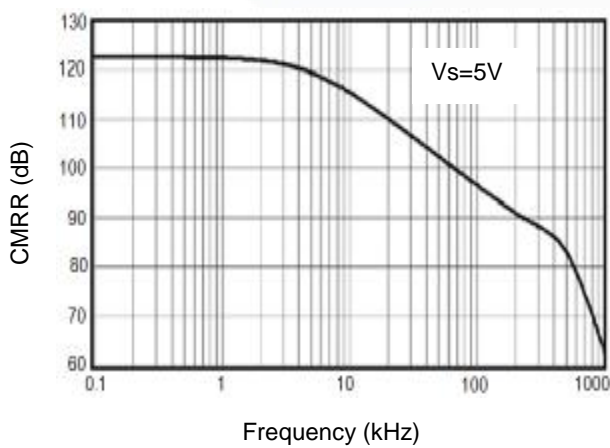
Input Voltage Noise Spectral Density vs. Frequency



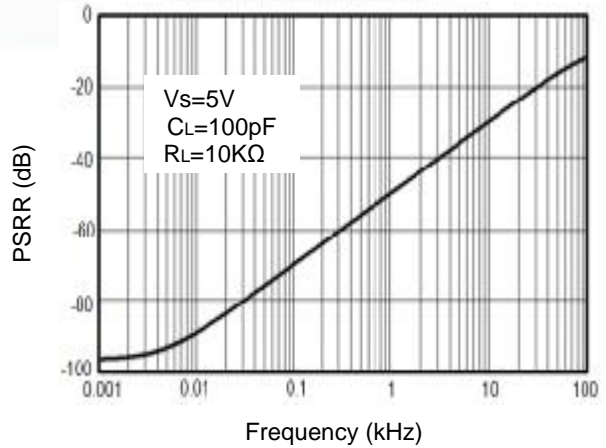
Open Loop Gain, Phase Shift vs. Frequency



CMRR vs. Frequency



PSRR vs. Frequency



Application Note

Size

GS8632C opamp is unity-gain stable and suitable for a wide range of general-purpose applications. The small footprints of the GS8632C package save space on printed circuit boards and enable the design of smaller electronic products.

Power Supply Bypassing and Board Layout

GS8632C operate from a single 2.1V to 5.5V supply or dual $\pm 1.05\text{V}$ to $\pm 2.75\text{V}$ supplies. For best performance, a $0.1\mu\text{F}$ ceramic capacitor should be placed close to the V_{DD} pin in single supply operation. For dual supply operation, both V_{DD} and V_{SS} supplies should be bypassed to ground with separate $0.1\mu\text{F}$ ceramic capacitors.

Low Supply Current

The low supply current (typical 470uA per channel) of GS8632C will help to maximize battery life. They are ideal for battery powered systems

Operating Voltage

GS8632C operate under wide input supply voltage (2.1V to 5.5V). In addition, all temperature specifications apply from -40°C to $+125^{\circ}\text{C}$. Most behavior remains unchanged throughout the full operating voltage range. These guarantees ensure operation throughout the single Li-Ion battery lifetime

Rail-to-Rail Input

The input common-mode range of GS8632C extends 100mV beyond the supply rails ($V_{\text{SS}}-0.1\text{V}$ to $V_{\text{DD}}+0.1\text{V}$). This is achieved by using complementary input stage. For normal operation, inputs should be limited to this range.

Rail-to-Rail Output

Rail-to-Rail output swing provides maximum possible dynamic range at the output. This is particularly important when operating in low supply voltages. The output voltage of GS8632C can typically swing to less than 2mV from supply rail in light resistive loads ($>100\text{k}\Omega$), and 60mV of supply rail in moderate resistive loads ($10\text{k}\Omega$).

Capacitive Load Tolerance

The GS8632C is optimized for bandwidth and speed, not for driving capacitive loads. Output capacitance will create a pole in the amplifier's feedback path, leading to excessive peaking and potential oscillation. If dealing with load capacitance is a requirement of the application, the two strategies to consider are (1) using a small resistor in series with the amplifier's output and the load capacitance and (2) reducing the bandwidth of the amplifier's feedback loop by increasing the overall noise gain. Figure 2. shows a unity gain follower using the series resistor strategy. The resistor isolates the output from the capacitance and, more importantly, creates a zero in the feedback path that compensates for the pole created by the output capacitance.

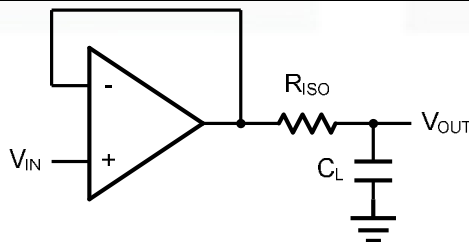


Figure 2. Indirectly Driving a Capacitive Load Using Isolation Resistor

The bigger the R_{ISO} resistor value, the more stable V_{OUT} will be. However, if there is a resistive load R_L in parallel with the capacitive load, a voltage divider (proportional to R_{ISO}/R_L) is formed, this will result in a gain error.

The circuit in Figure 3 is an improvement to the one in Figure 2. R_F provides the DC accuracy by feed-forward the V_{IN} to R_L . C_F and R_{ISO} serve to counteract the loss of phase margin by feeding the high frequency component of the output signal back to the

amplifier's inverting input, thereby preserving the phase margin in the overall feedback loop. Capacitive drive can be increased by increasing the value of C_F . This in turn will slow down the pulse response.

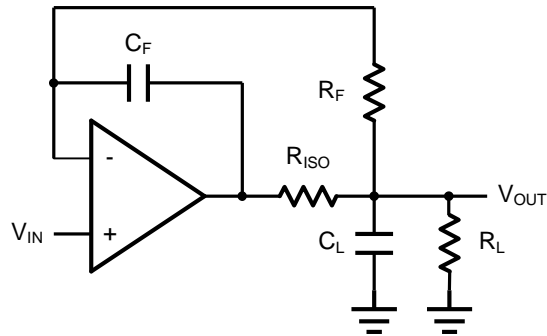


Figure 3. Indirectly Driving a Capacitive Load with DC Accuracy

Typical Application Circuits

Differential amplifier

The differential amplifier allows the subtraction of two input voltages or cancellation of a signal common the two inputs. It is useful as a computational amplifier in making a differential to single-end conversion or in rejecting a common mode signal. Figure 4. shown the differential amplifier using GS8632C.

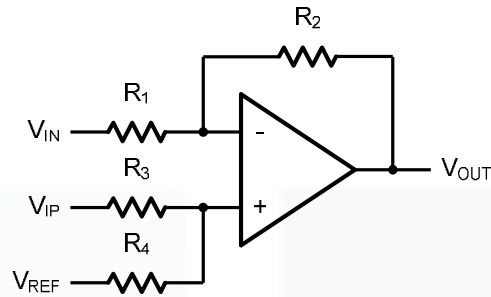


Figure 4. Differential Amplifier

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

If the resistor ratios are equal (i.e. $R_1 = R_3$ and $R_2 = R_4$), then

$$V_{OUT} = \frac{R_2}{R_1} (V_{IP} - V_{IN}) + V_{REF}$$

Low Pass Active Filter

The low pass active filter is shown in Figure 5. The DC gain is defined by $-R_2/R_1$. The filter has a -20dB/decade roll-off after its corner frequency $f_c = 1/(2\pi R_3 C_1)$.

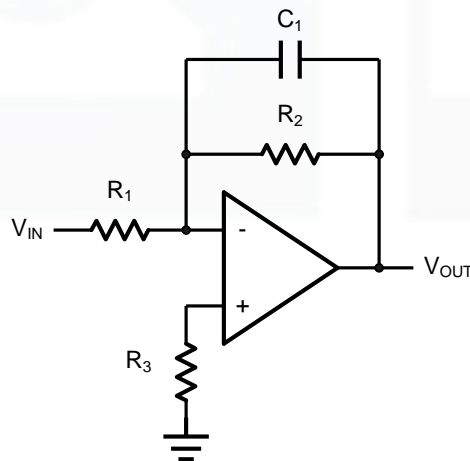


Figure 5. Low Pass Active Filter

Instrumentation Amplifier

The triple GS8632C can be used to build a three-op-amp instrumentation amplifier as shown in Figure 6. The amplifier in Figure 6 is a high input impedance differential amplifier with gain of R_2/R_1 . The two differential voltage followers assure the high input impedance of the amplifier.

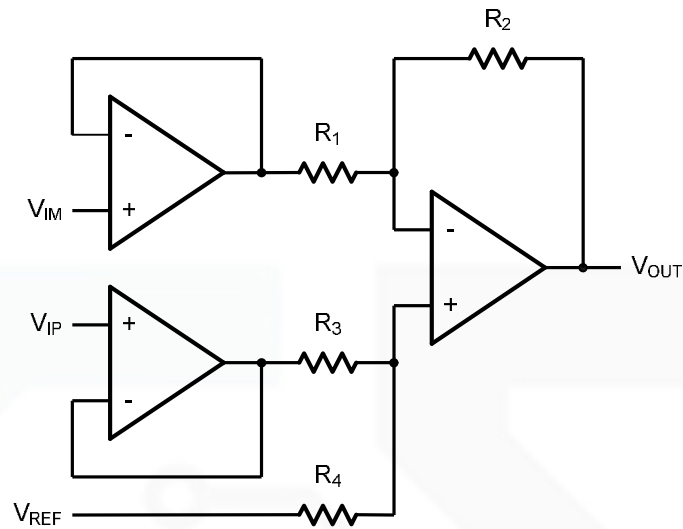
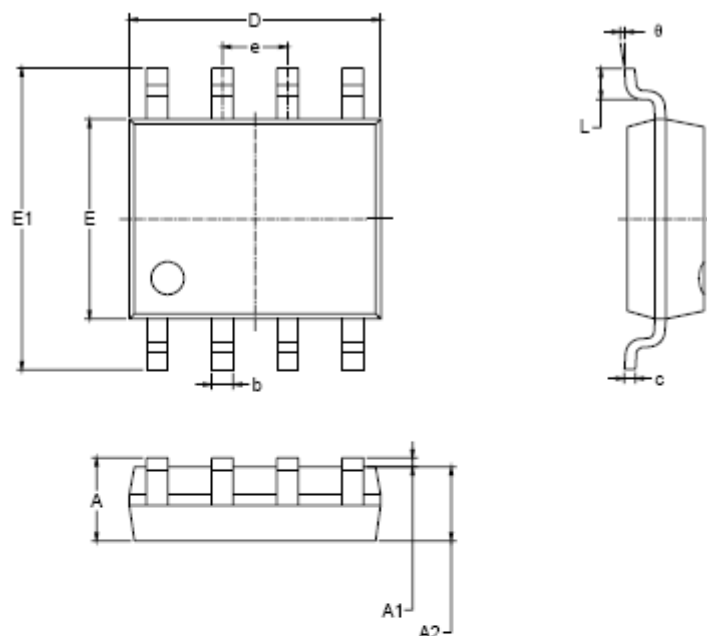


Figure 6. Instrument Amplifier

Package Information

SOP-8



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	0.008	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°

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