350KHZ Zero-Drift CMOS Rail-to-Rail IO Opamp with RF Filter

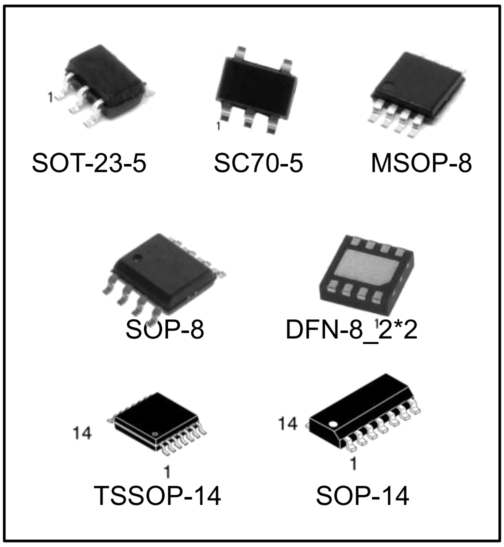
Features

- Single-Supply Operation from +1.8V ~ +5.5V
- Rail-to-Rail Input / Output
- Gain-Bandwidth Product: 350KHz (Typ. @25°C)
- Low Input Bias Current: 20pA (Typ. @25°C)
- Low Offset Voltage: 10uV (Max. @25°C)
- Quiescent Current: 25μA per Amplifier (Typ)
- Operating Temperature: -45°C ~ +125°C
- Zero Drift: 0.05μV/°C (Typ)
- Embedded RF Anti-EMI Filter
- Small Package:

  HXA317A Available in SOT23-5, SC70-5 and SOP-8 Packages

  HXA2317A Available in SOP-8, MSOP-8 and DFN-8 Packages

  HXA4317A Available in SOP-14 and TSSOP-14 Packages



Ordering Information

DEVICE	Package Type	MARKING	Packing	Packing Qty
HXA317AIDRG	SOP-8	A317AI	REEL	2500pcs/Reel
HXA317AIDRG4	SOP-8	A317AI	REEL	4000pcs/Reel
HXA317AIDBVRG	SOT-23-5	A317A	REEL	3000pcs/Reel
HXA317AIDCKRG	SC70-5	A317A	REEL	3000pcs/Reel
HXA2317AIDRG	SOP-8	A2317AI	REEL	2500pcs/Reel
HXA2317AIDRG4	SOP-8	A2317AI	REEL	4000pcs/Reel
HXA2317AIDGKRG	MSOP-8	A2317AI	REEL	3000pcs/Reel
HXA2317AIDQRG	DFN-8 2*2	A2317AI	REEL	2500pcs/Reel
HXA4317AIDRG	SOP-14	HXA4317AI	REEL	2500pcs/Reel
HXA4317AIDRG4	SOP-14	HXA4317AI	REEL	4000pcs/Reel
HXA4317AIPWRG	TSSOP-14	A4317AI	REEL	2500pcs/Reel

General Description

The HXAx317 amplifier is single/dual/quad supply, micro-power, zero-drift CMOS operational amplifiers, the amplifiers offer bandwidth of 350 kHz, rail-to-rail inputs and outputs, and single-supply operation from 1.8V to 5.5V. HXAx317 uses chopper stabilized technique to provide very low offset voltage (less than 10μV maximum) and near zero drift over temperature. Low quiescent supply current of 25μA per amplifier and very low input bias current of 20pA make the devices an ideal choice for low offset, low power consumption and high impedance applications.

The HXA317A is available in SOT23-5, SC70-5 and SOP8 packages. And the HXA2317A is available in SOP8, MSOP8 and DFN-8 packages. The HXA4317A Quad is available in Green SOP-14 and TSSOP-14 packages. The extended temperature range of -45°C to +125°C over all supply voltages offers additional design flexibility.

Applications

- Transducer Application
- Temperature Measurements
- Electronics Scales
- Handheld Test Equipment
- Battery-Powered Instrumentation

Pin Configuration

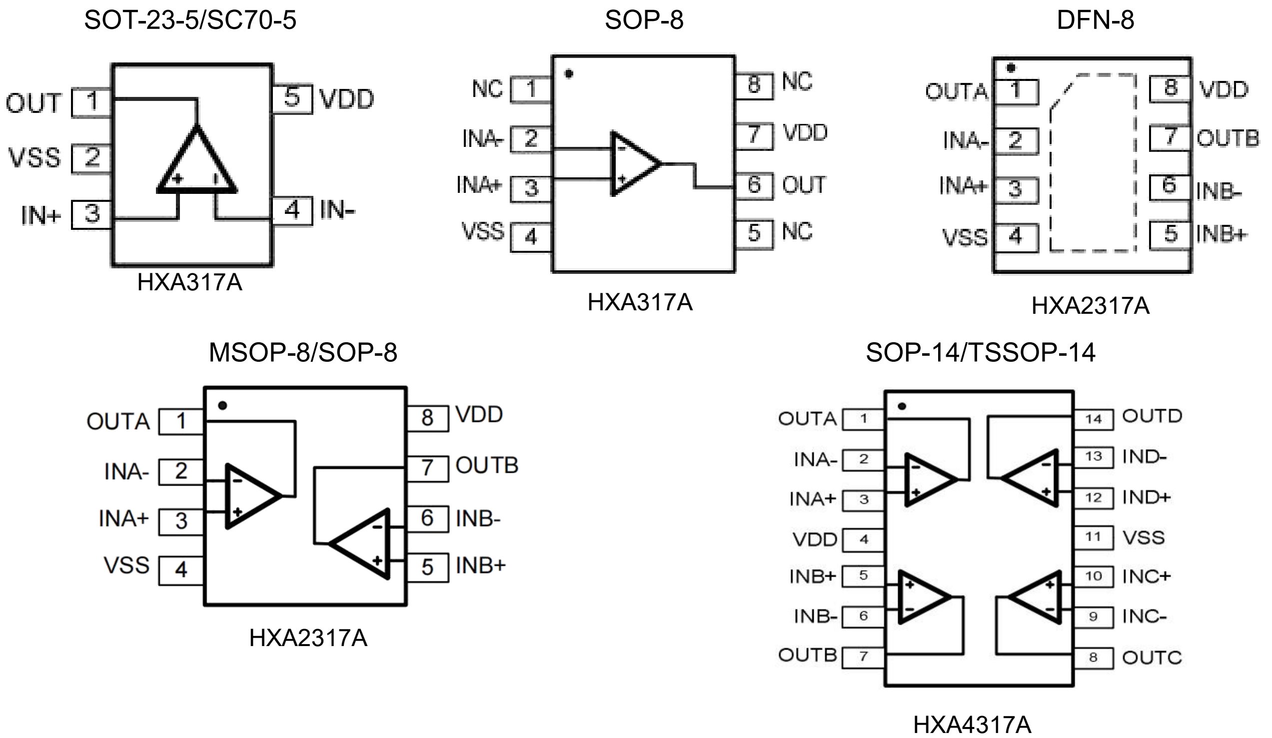


Figure 1. Pin Assignment Diagram

Absolute Maximum Ratings

Condition		Min	Max
Power Supply Voltage (V_{DD} to Vss)		-0.5V	+7.5V
Analog Input Voltage (IN+ or IN-)		Vss-0.5V	V_{DD}+0.5V
PDB Input Voltage		Vss-0.5V	+7V
Operating Temperature Range		-45°C	+125°C
Junction Temperature		-	+160°C
Storage Temperature Range		-55°C	+150°C
Lead Temperature (soldering, 10sec)		-	245°C
Package Thermal Resistance (T_A=+25℃)	SOP-8, θ_{JA}	-	125°C/W
	MSOP-8, θ_{JA}	-	216°C/W
	SOT23-5, θ_{JA}	-	190°C/W
ESD Susceptibility	HBM	-	6KV
	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.

Electrical Characteristics

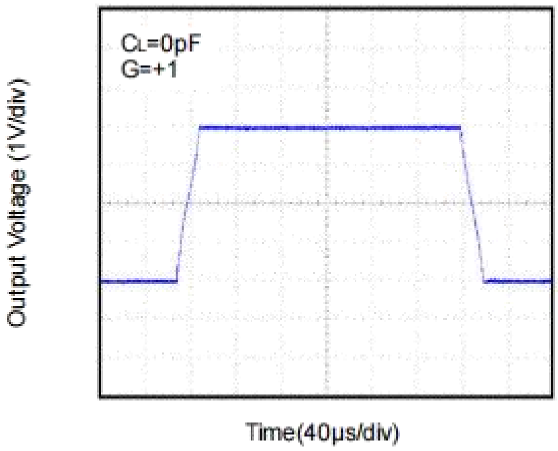
(At Vs=5V, TA = +25℃, VCM = VS/2, RL = 10KΩ, unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS					
Input Offset Voltage (V_{OS})			2	10	μV
Input Bias Current (I_B)			20		pA
Input Offset Current (I_{OS})			10		pA
Common-Mode Rejection Ratio (CMRR)	V_{CM} = 0V to 5V		110		dB
Large Signal Voltage Gain (A_{VO})	R_L = 10kΩ, V_O = 0.3V to 4.7V		145		dB
Input Offset Voltage Drift ($\Delta V_{OS}/\Delta T$)			50		nV/℃
OUTPUT CHARACTERISTICS					
Output Voltage High (V_{OH})	R_L = 100kΩ to - V_S		4.998		V
	R_L = 10kΩ to - V_S		4.994		V
Output Voltage Low (V_{OL})	R_L = 100kΩ to + V_S		5		mV
	R_L = 10kΩ to + V_S		20		mV
Short Circuit Limit (I_{SC})	R_L =10Ω to - V_S		20		mA
Output Current (I_O)			30		mA
POWER SUPPLY					
Power Supply Rejection Ratio (PSRR)	V_S = 2.5V to 5.5V		115		dB
Quiescent Current (I_Q)	V_O = 0V, R_L = 0Ω		25		μA
DYNAMIC PERFORMANCE					
Gain-Bandwidth Product (GBP)	G = +100		350		KHz
Slew Rate (SR)	R_L = 10kΩ		0.2		V/μs
NOISE PERFORMANCE					
Voltage Noise (e_n p-p)	0Hz to 10Hz		1.1		μVP-P
Voltage Noise Density (e_n)	f = 1kHz		70		$nV/\sqrt{Hz}$

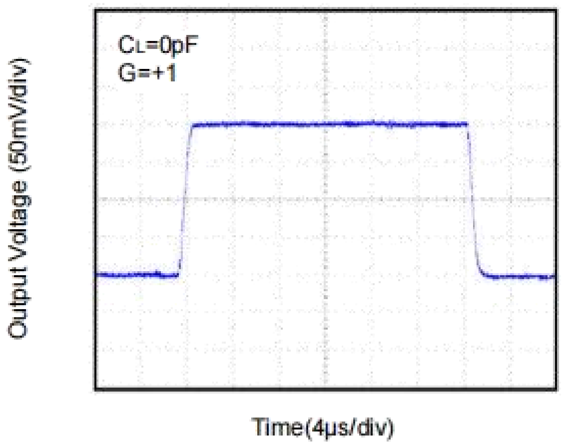
Typical Performance characteristics

(T_A=+25°C, Vs=5V, R_L=10 kΩ connected to V_S/2 and V_{OUT}= V_S/2, unless otherwise noted.)

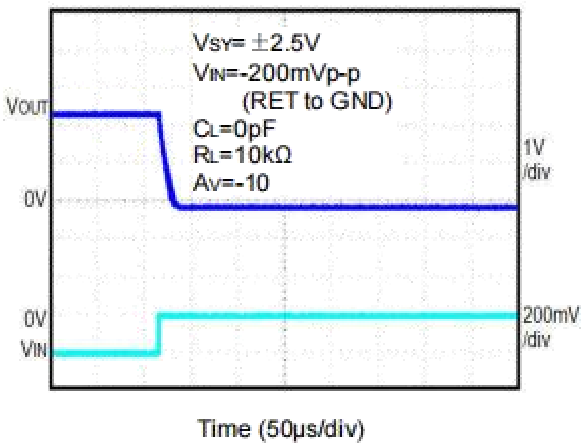
Large Signal Transient Response



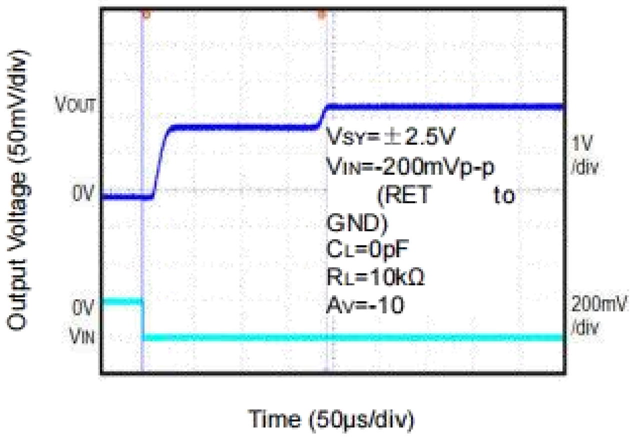
Large Signal Transient Response



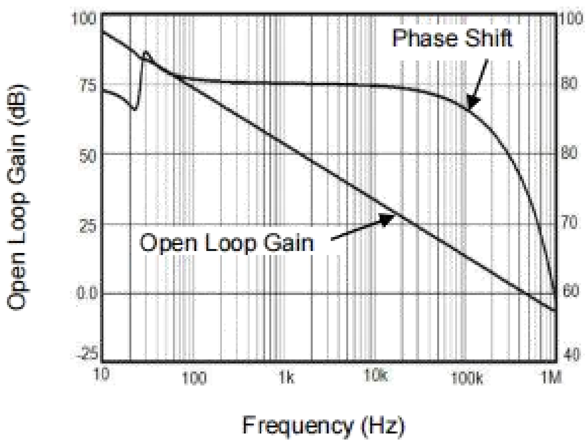
Positive Overvoltage Recovery



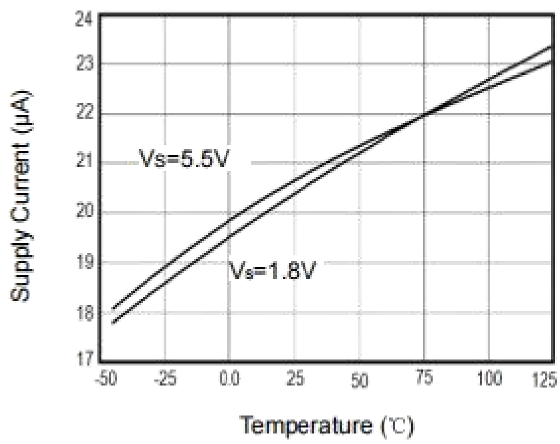
Negative Overvoltage Recovery



Open Loop Gain, Phase Shift vs. Frequency

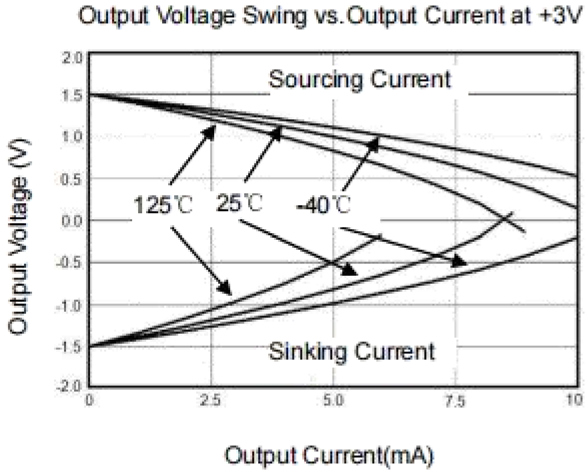


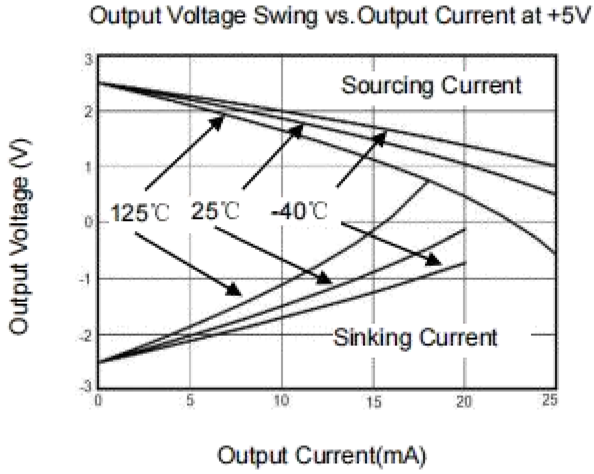
Supply Current vs. Temperature



Typical Performance characteristics

(TA=+25°C, Vs=5V, RL=10 kΩ connected to VS/2 and VOUT= VS/2, unless otherwise noted.)





Application Note

Size

HXAx317 series op amps are unity-gain stable and suitable for a wide range of general-purpose applications. The small footprints of the HXAx317 series packages save space on printed circuit boards and enable the design of smaller electronic products.

Power Supply Bypassing and Board Layout

HXAx317 series operates from a single 1.8V to 5.5V supply or dual ±0.9V to ±2.75V supplies. For best performance, a 0.1μF ceramic capacitor should be placed close to the VDD pin in single supply operation. For dual supply operation, both V_{DD} and VSS supplies should be bypassed to ground with separate 0.1μF ceramic capacitors.

Low Supply Current

The low supply current (typical 25uA per channel) of HXAx317 series will help to maximize battery life. They are ideal for battery powered systems

Operating Voltage

HXAx317 series operate under wide input supply voltage (1.8V to 5.5V). In addition, all temperature specifications apply from -45 °C to +125 °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 HXAx317 series extends 100mV beyond the supply rails (VSS-0.1V to VDD+0.1V). 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 HXAx317 series can typically swing to less than 5mV from supply rail in light resistive loads (>100kΩ), and 100mV of supply rail in moderate resistive loads (10kΩ).

Capacitive Load Tolerance

The HXAx317 family 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.

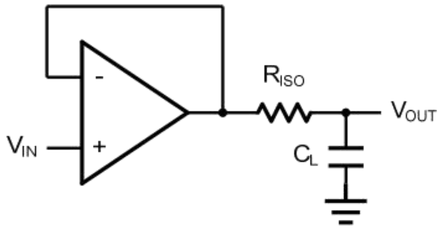


Figure 2. Indirectly Driving a Capacitive Load Using Isolation Resistor

The bigger the RISO resistor value, the more stable VOUT will be. However, if there is a resistive load RL in parallel with the capacitive load, a voltage divider (proportional to RISO/RL) is formed, this will result in a gain error. The circuit in Figure 3 is an improvement to the one in Figure 2. RF provides the DC accuracy by feed-forward the VIN to RL. CF and RISO 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 CF. This in turn will slow down the pulse response.

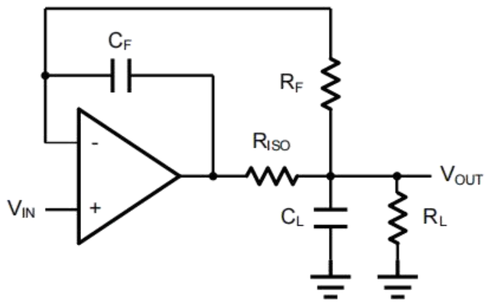


Figure 3. Indirectly Driving a Capacitive Load with DC Accuracy

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 HXAx317.

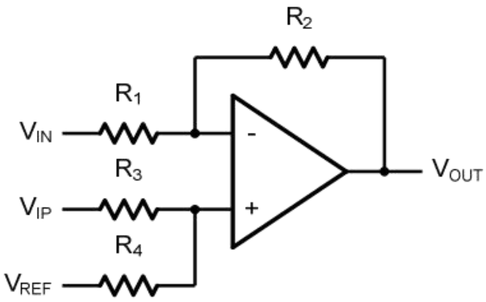


Figure 4. Differential Amplifier

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

If the resistor ratios are equal (i.e. R1=R3 and R2=R4), then

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

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 $f_C=1/(2\pi R_3C_1)$.

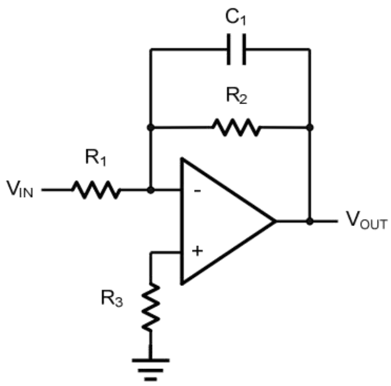


Figure 5. Low Pass Active Filter

Instrumentation Amplifier

The triple HXAx317 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.

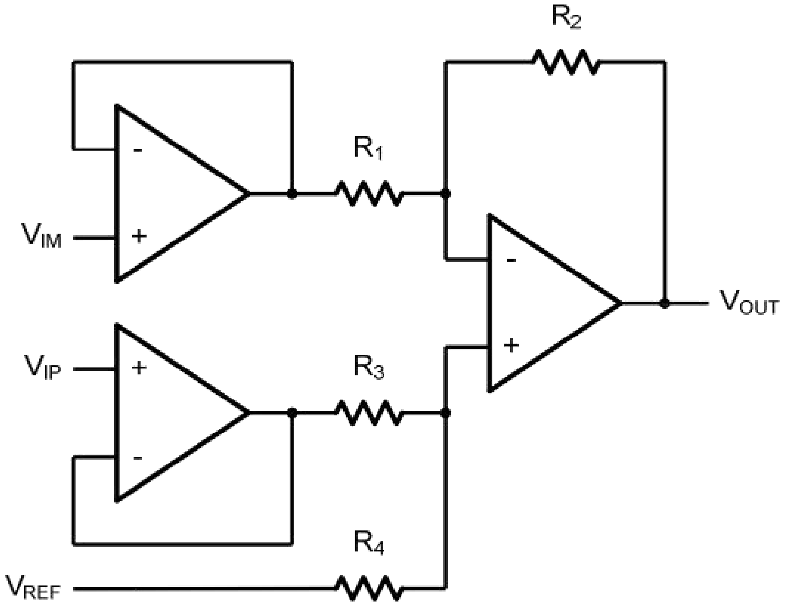
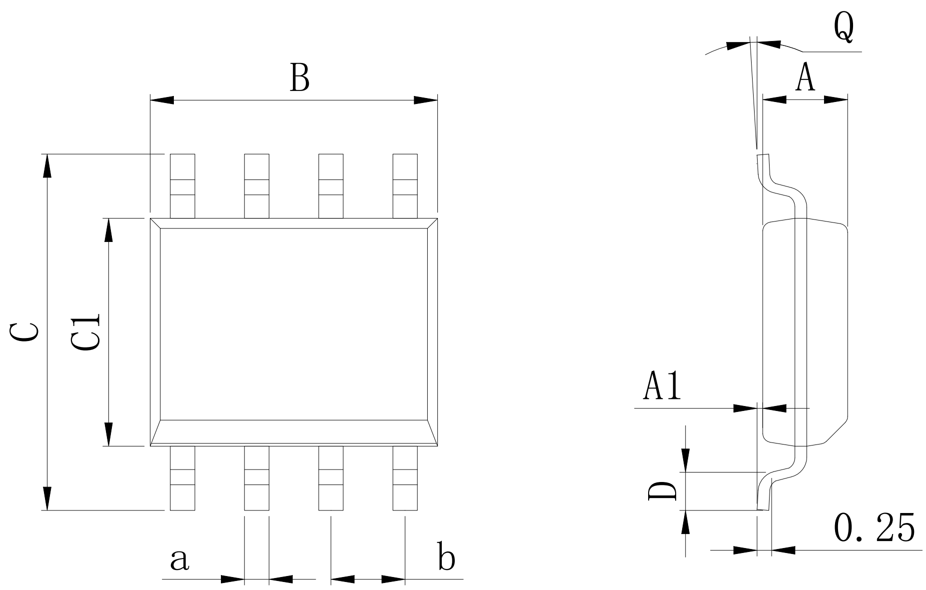


Figure 6. Instrument Amplifier

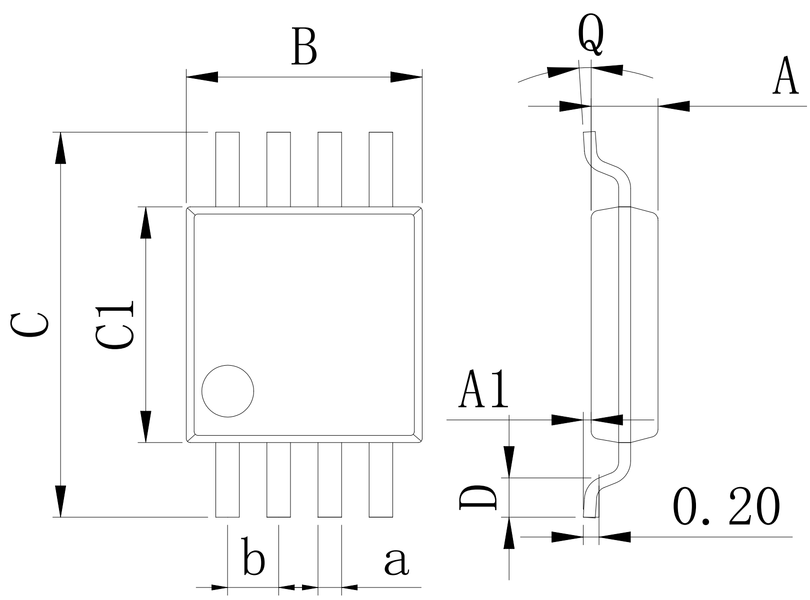
Physical Dimensions

SOP-8



Dimensions In Millimeters(SOP-8)									
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	1.35	0.05	4.90	5.80	3.80	0.40	0°	0.35	1.27 BSC
Max:	1.55	0.20	5.10	6.20	4.00	0.80	8°	0.45	

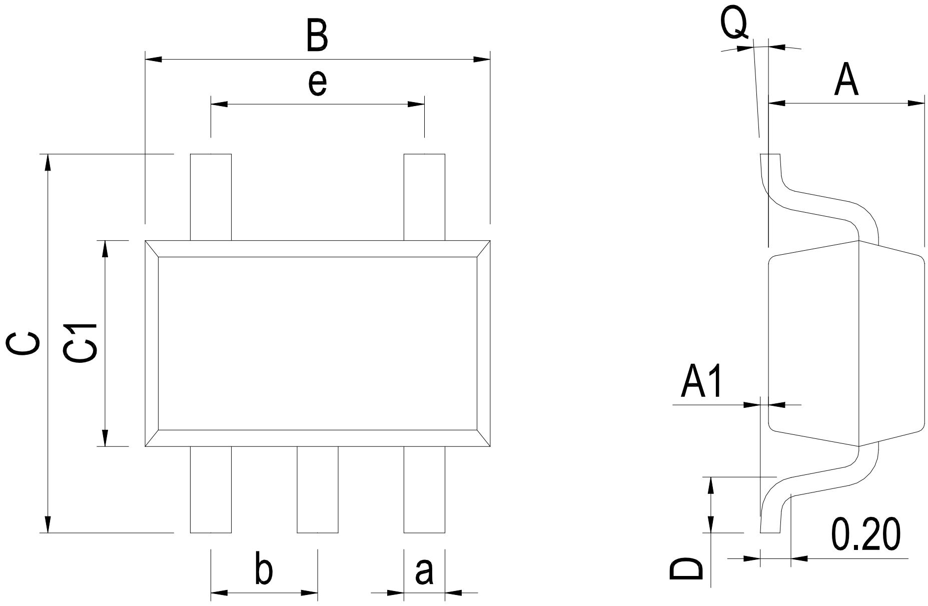
MSOP-8



Dimensions In Millimeters(MSOP-8)									
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	0.80	0.05	2.90	4.75	2.90	0.35	0°	0.25	0.65 BSC
Max:	0.90	0.20	3.10	5.05	3.10	0.75	8°	0.35	

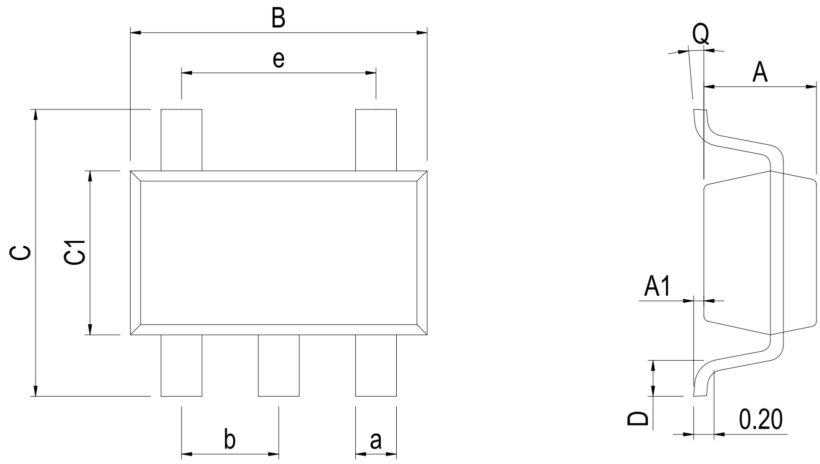
Physical Dimensions

SOT-23-5



Dimensions In Millimeters(SOT-23-5)										
Symbol:	A	A1	B	C	C1	D	Q	a	b	e
Min:	1.00	0.00	2.82	2.65	1.50	0.30	0°	0.30	0.95 BSC	1.90 BSC
Max:	1.15	0.15	3.02	2.95	1.70	0.60	8°	0.50		

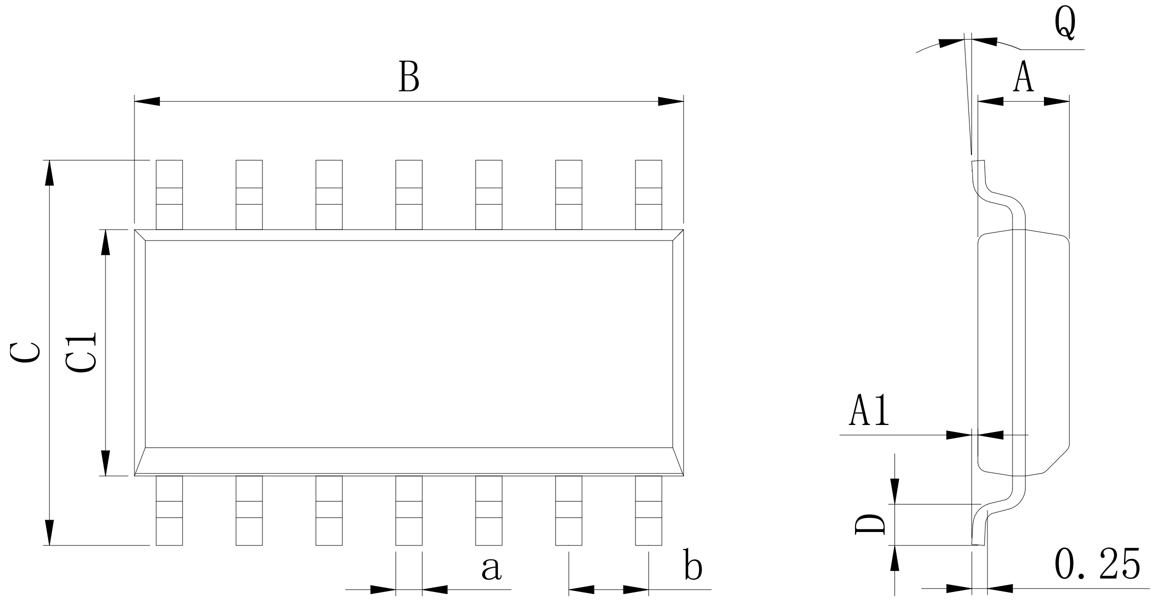
SC70-5



Dimensions In Millimeters(SC70-5)										
Symbol:	A	A1	B	C	C1	D	Q	a	b	e
Min:	0.90	0.00	2.00	2.15	1.15	0.26	0°	0.15	0.65 BSC	1.30 BSC
Max:	1.00	0.15	2.20	2.45	1.35	0.46	8°	0.35		

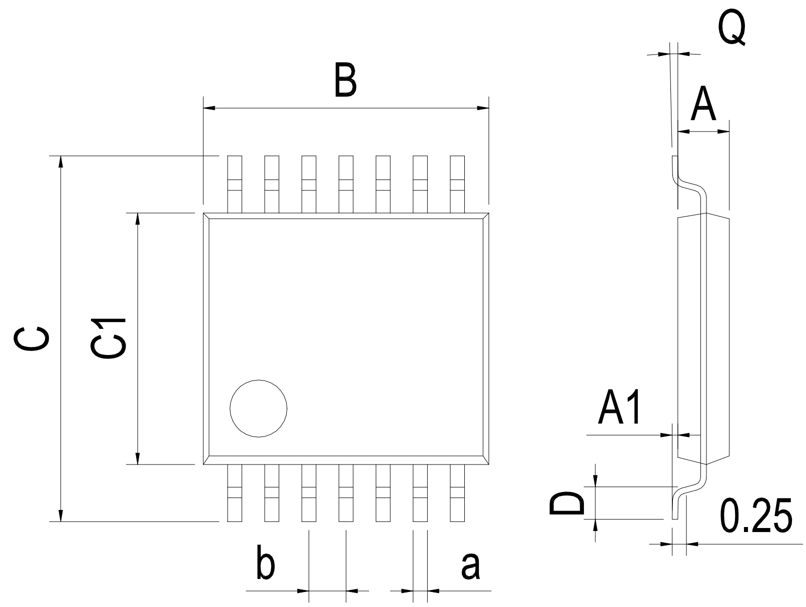
Physical Dimensions

SOP-14



Dimensions In Millimeters(SOP-14)									
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	1.35	0.05	8.55	5.80	3.80	0.40	0°	0.35	1.27 BSC
Max:	1.55	0.20	8.75	6.20	4.00	0.80	8°	0.45	

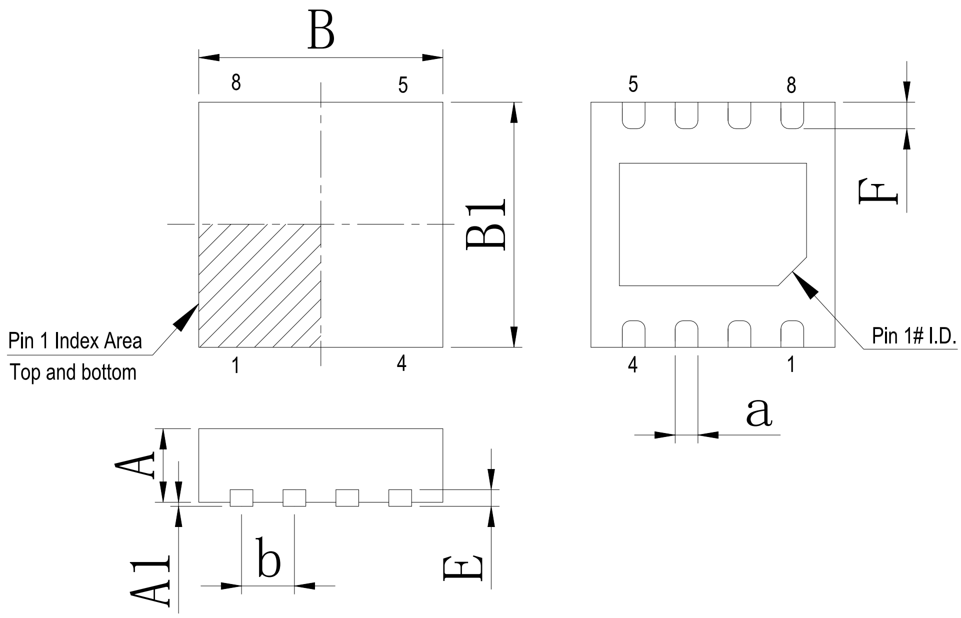
TSSOP-14



Dimensions In Millimeters(TSSOP-14)									
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	0.85	0.05	4.90	6.20	4.30	0.40	0°	0.20	0.65 BSC
Max:	0.95	0.20	5.10	6.60	4.50	0.80	8°	0.25	

Physical Dimensions

DFN-8 2*2



Dimensions In Millimeters(DFN-8 2*2)								
Symbol:	A	A1	B	B1	E	F	a	b
Min:	0.85	0	1.90	1.90	0.15	0.25	0.18	0.50TYP
Max:	0.95	0.05	2.10	2.10	0.25	0.45	0.30	

Revision History

REVISION NUMBER	DATE	REVISION	PAGE
V1.0	2016-9	New	1-15
V1.1	2023-8	Update encapsulation type、Update Lead Temperature	1、3
V1.2	2024-10	Update SOT-23-5 Physical dimension	11

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