1.5MHZ Zero-Drift CMOS Rail-to-Rail IO Opamp with RF Filter

Features

- **Single-Supply Operation from +2.1V ~ +5.5V**
- **Rail-to-Rail Input / Output**
- **Gain-Bandwidth Product: 1.5MHz (Typ. @25°C)**
- **Low Input Bias Current: 20pA (Typ. @25°C)**
- **Low Offset Voltage: 5uV (Max. @25°C)**
- **Quiescent Current: 320μA per Amplifier (Typ.)**
- **Operating Temperature: -40°C ~ +125°C**
- **Zero Drift: 0.05μV/°C (Max.)**
- **Embedded RF Anti-EMI Filter**
- **Small Package:**

OPA335 Available in SOT23-5 and SOP-8 Packages

OPA2335 Available in MSOP-8 and SOP-8 Packages

General Description

The OPAx335 amplifier is single/dual supply, micro-power, zero-drift CMOS operational amplifiers, the amplifiers offer bandwidth of 1.5MHz, rail-to-rail inputs and outputs, and single-supply operation from 2.1V to 5.5V. OPAx335 uses chopper stabilized technique to provide very low offset voltage (less than 5μV maximum) and near zero drift over temperature. Low quiescent supply current of 320μA 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 OPAx335 offers excellent CMRR without the crossover associated with traditional complementary input stages. This design results in superior performance for driving analog-to-digital converters (ADCs) without degradation of differential linearity.

The OPA335 is available in SOT23-5 and SOP8 packages. And the OPA2335 is available in MSOP8 and SOP8 packages. The extended temperature range of -40°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

ORDERING INFORMATION

DEVICE	Package Type	MARKING	Packing	Packing Qty
OPA335M5/TR	SOT23-5	A335	REEL	3000pcs/reel
OPA335M/TR	SOP-8L	OPA335	REEL	2500pcs/reel
OPA2335M/TR	SOP-8L	OPA2335	REEL	2500pcs/reel
OPA2335MM/TR	MSOP-8L	A2335	REEL	3000pcs/reel

Pin Configuration

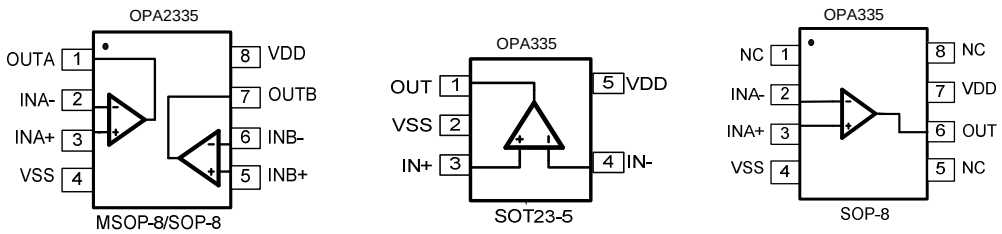


Figure 1. Pin Assignment Diagram

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	-40°C	+125°C
Junction Temperature	+160°C	
Storage Temperature Range	-55°C	+150°C
Lead Temperature (soldering, 10sec)	+260°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.

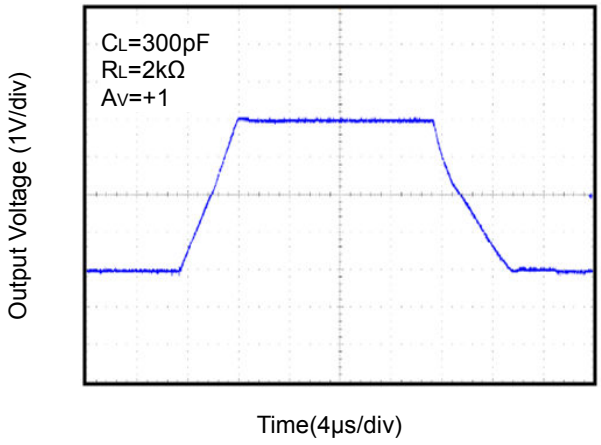
Electrical Characteristics

(V_S = +5V, V_{CM} = +2.5V, V_O = +2.5V, T_A = +25℃, unless otherwise noted.)

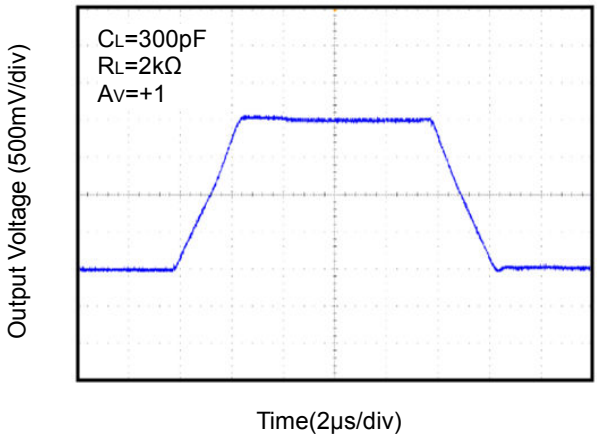
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS					
Input Offset Voltage (V_{OS})			1	5	μV
Input Bias Current (I_B)			20		pA
Input Offset Current (I_{OS})			10		pA
Common-Mode Rejection Ratio (CMRR)	V_{CM} = 0V to 5V		110		dB
Large Signal Voltage Gain (A_{VO})	R_L = 10kΩ, V_O = 0.3V to 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		2		mV
	R_L = 10kΩ to + V_S		5		mV
Short Circuit Limit (I_{SC})	R_L =10Ω to - V_S		43		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		320		μA
DYNAMIC PERFORMANCE					
Gain-Bandwidth Product (GBP)	G = +100		1.5		MHz
Slew Rate (SR)	R_L = 10kΩ		0.84		V/μs
Overload Recovery Time			0.10		ms
NOISE PERFORMANCE					
Voltage Noise (e_n p-p)	0Hz to 10Hz		0.81		μV_{P-P}
Voltage Noise Density (e_n)	f = 1kHz		49		$nV/\sqrt{Hz}$

Typical Performance characteristics

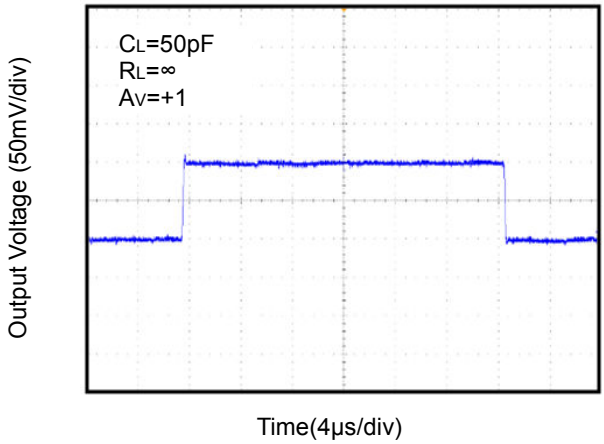
Large Signal Transient Response at +5V



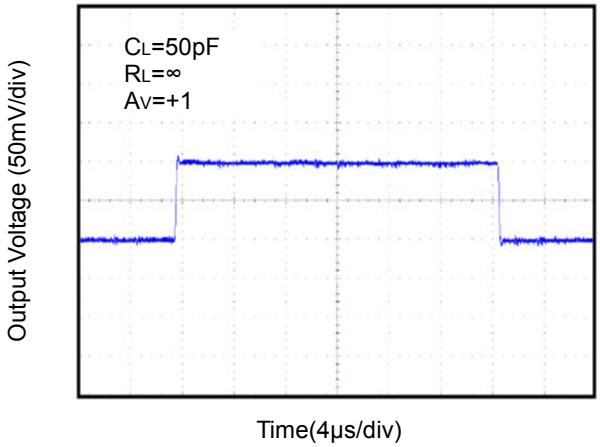
Large Signal Transient Response at +2.5V



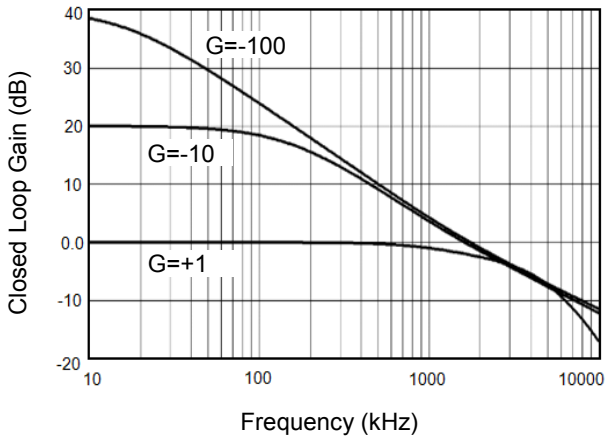
Small Signal Transient Response at +5V



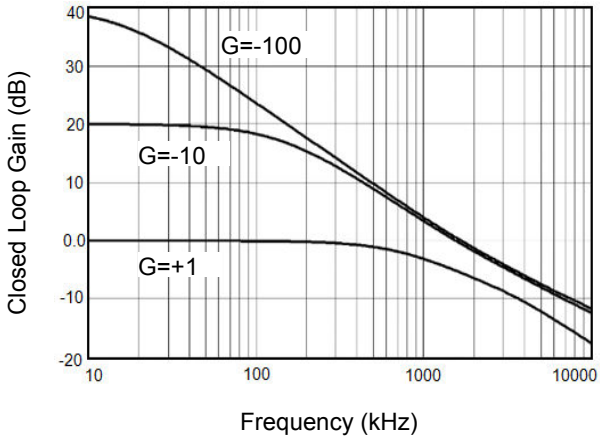
Small Signal Transient Response at +2.5V



Closed Loop Gain vs. Frequency at +5V

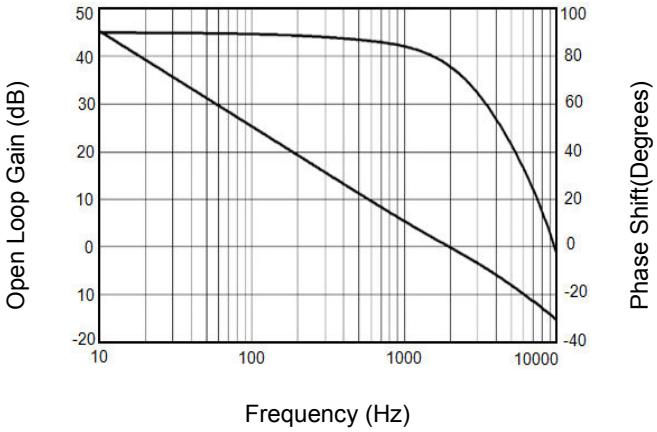


Closed Loop Gain vs. Frequency at +2.5V

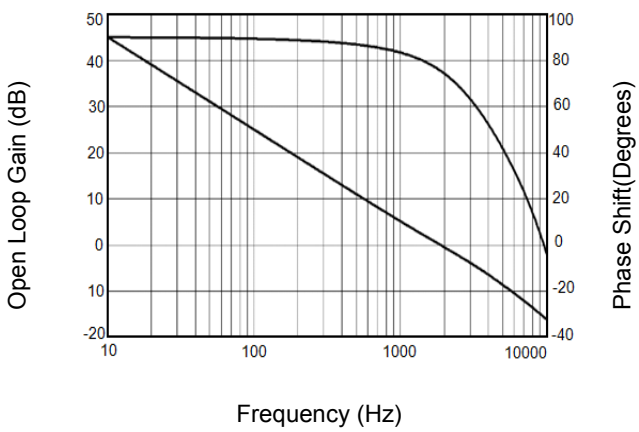


Typical Performance characteristics

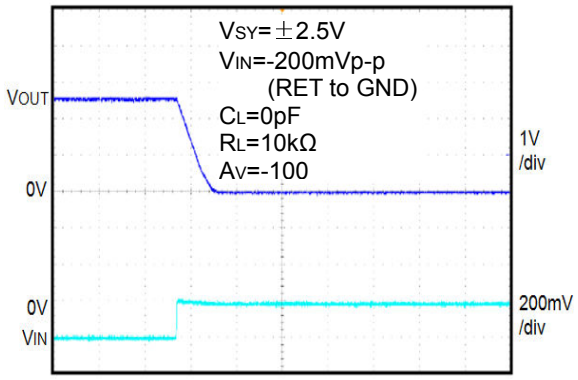
Open Loop Gain, Phase Shift vs. Frequency at +5V



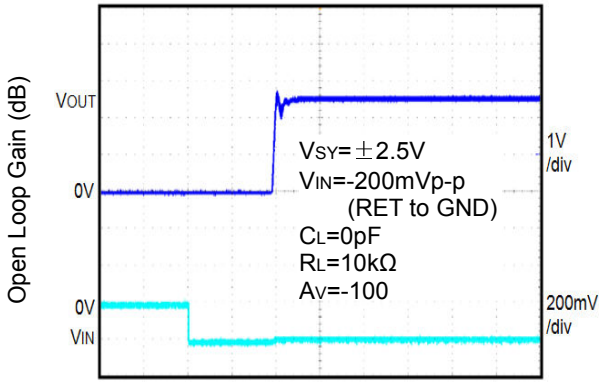
Open Loop Gain, Phase Shift vs. Frequency at +2.5V



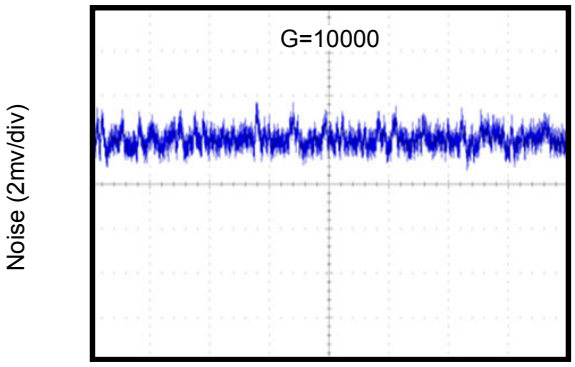
Positive Overvoltage Recovery



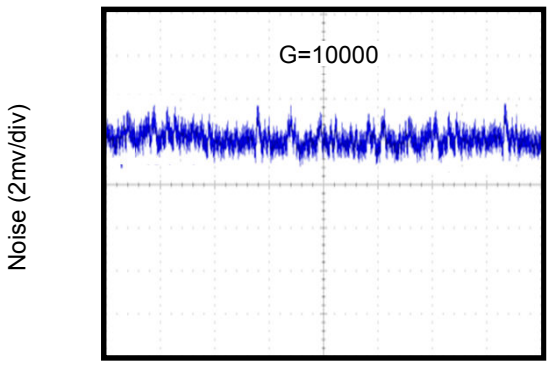
Negative Overvoltage Recovery



0.1Hz to 10Hz Noise at +5V



0.1Hz to 10Hz Noise at +2.5V



Application Note

Size

OPAx335 series op amps are unity-gain stable and suitable for a wide range of general-purpose applications. The small footprints of the OPAx335 series packages save space on printed circuit boards and enable the design of smaller electronic products.

Power Supply Bypassing and Board Layout

OPAx335 series operates from a single 2.1V to 5.5V supply or dual ±1.05V to ±2.75V supplies. For best performance, a 0.1μF 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 0.1μF ceramic capacitors.

Low Supply Current

The low supply current (typical 320uA per channel) of OPAx335 series will help to maximize battery life. They are ideal for battery powered systems

Operating Voltage

OPAx335 series operate under wide input supply voltage (2.1V to 5.5V). In addition, all temperature speci fications apply from -40°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 OPAx335 series extends 100mV beyond the supply rails (V_{SS}-0.1V to V_{DD}+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 OPAx335 series can typically swing to less than 5mV from supply rail in light resistive loads (>100kΩ), and 60mV of supply rail in moderate resistive loads (10kΩ).

Capacitive Load Tolerance

The OPAx335 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.

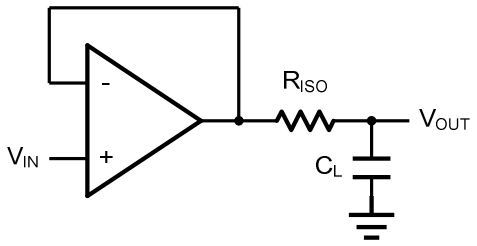


Figure 2. Indirectly Driving a Capacitive Load Using Isolation Resistor

The bigger the 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.

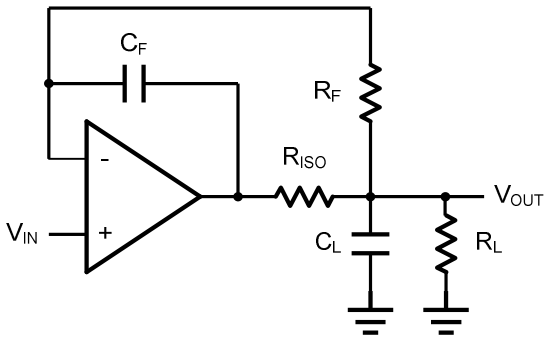


Figure 3. Indirectly Driving a Capacitive Load with DC Accuracy

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 OPAx335.

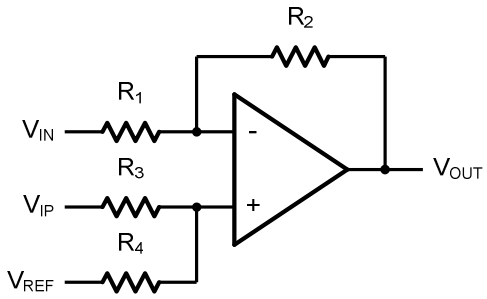


Figure 4. Differential Amplifier

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

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

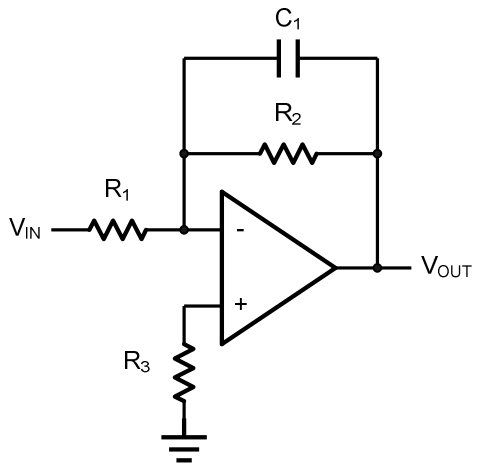


Figure 5. Low Pass Active Filter

Instrumentation Amplifier

The triple OPAx335 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.

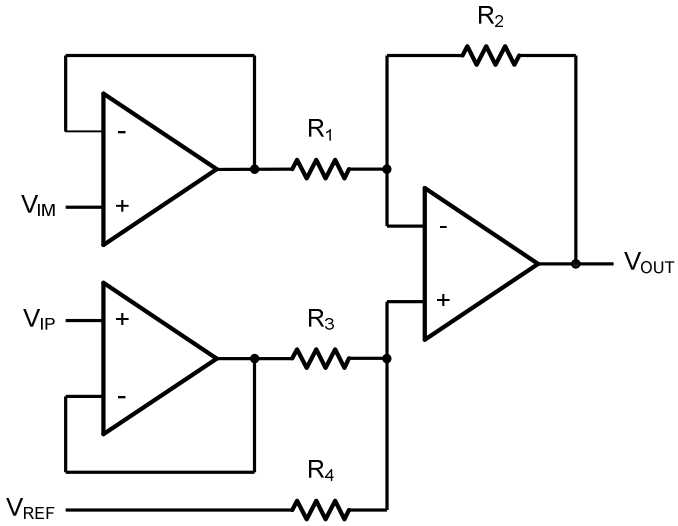
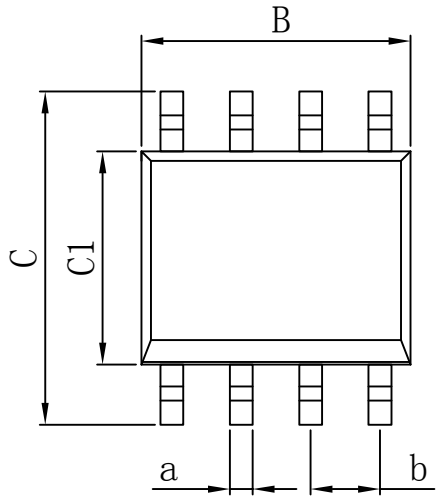


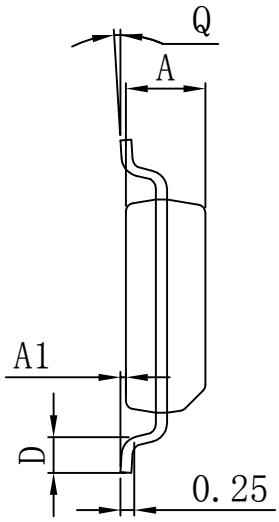
Figure 6. Instrument Amplifier

.

PACKAGE

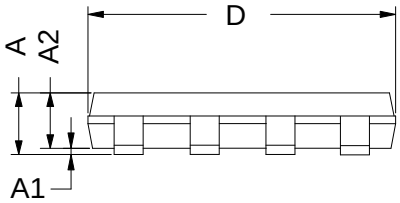
SOP8

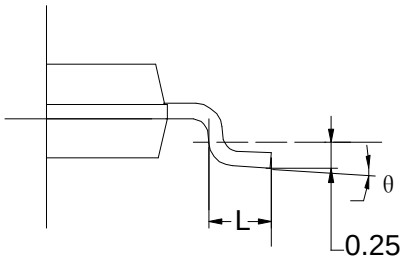


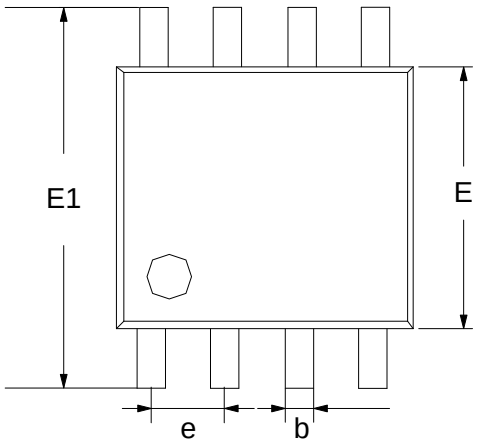


Dimensions In Millimeters					
Symbol :	Min :	Max :	Symbol :	Min :	Max :
A	1.225	1.570	D	0.400	0.950
A1	0.100	0.250	Q	0°	8°
B	4.800	5.100	a	0.420 TYP	
C	5.800	6.250	b	1.270 TYP	
C1	3.800	4.000			

MSOP8



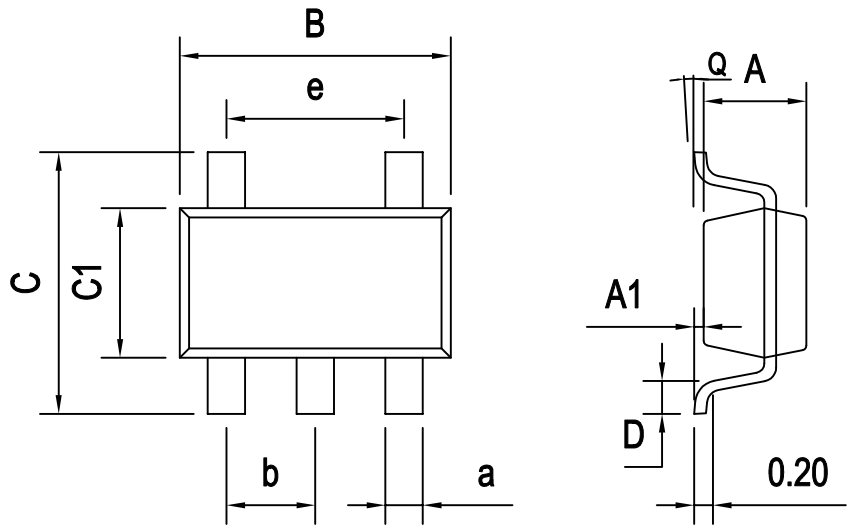




Dimensions In Millimeters					
Symbol :	Min :	Max :	Symbol :	Min :	Max :
A	0.800	1.200	E1	4.700	5.100
A1	0	0.200	L	0.410	0.650
A2	0.760	0.970	θ	0°	6°
D	2.900	3.100	b	0.300 TYP	
E	2.900	3.100	e	0.650 TYP	

PACKAGE

SOT23-5



Dimensions In Millimeters					
Symbol :	Min :	Max :	Symbol :	Min :	Max :
A	1.050	1.150	D	0.300	0.600
A1	0.000	0.100	Q	0°	8°
B	2.820	3.020	a	0.400 TYP	
C	2.650	2.950	b	0.950 TYP	
C1	1.500	1.700	e	1.900 TYP	

Important statement:

Huaguan Semiconductor Co,Ltd. reserves the right to change the products and services provided without notice. Customers should obtain the latest relevant information before ordering, and verify the timeliness and accuracy of this information.

Customers are responsible for complying with safety standards and taking safety measures when using our products for system design and machine manufacturing to avoid potential risks that may result in personal injury or property damage.

Our products are not licensed for applications in life support, military, aerospace, etc., so we do not bear the consequences of the application of these products in these fields.

Our documentation is only permitted to be copied without any tampering with the content, so we do not accept any responsibility or liability for the altered documents.

X-ON Electronics

Largest Supplier of Electrical and Electronic Components

Click to view similar products for Precision Amplifiers ***category:***

Click to view products by HGSEMI ***manufacturer:***

Other Similar products are found below :

561681F NCS20166SN2T1G NCS21802MUTBG OPA209AIDR MCP6V52-E/MS COS4333TRC COS4333SRB COS4333TRA COS4333SRA COS1333TRD COS4333TRB COS8551TRB COS2333MRC COS27SR COS8554TRA COS2333MRB COS2333MRA COS4227UATR HGV8541MM/TR RS8559XP HT8603ARTZ GS8538-SR OPA2335M/TR GS8548-SR HT2771BRTZ ADA4692-4ARUZ-RL GS8552-FR TLC27L7CP TLV2473CDR LMP2234AMA/NOPB LMP7707MA/NOPB LMP2231AMAE/NOPB LMP2234AMTE/NOPB LMP8672MA/NOPB LMC6022IM/NOPB LMC6024IM/NOPB LMC6081IMX/NOPB LMP2011MA/NOPB LMP2231AMFE/NOPB LMP2232BMA/NOPB LMP2234AMAE/NOPB LMP7715MFE/NOPB LMP7717MAE/NOPB LMV2011MA/NOPB LT1013DDR TL034ACDR TLC2201AMDG4 MCP6061T-E/MNY TS507IYLT TS9222IYDT