4.5MHZ 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: 4.5MHz (Typ@25°C)**
- **Low Input Bias Current: 20pA (Typ@25°C)**
- **Low Offset Voltage: 30μV (Max @25°C)**
- **Quiescent Current: 550μA per Amplifier (Typ)**
- **Operating Temperature: -45°C ~ +125°C**
- **Zero Drift: 0.01μV/°C (Typ)**
- **Embedded RF Anti-EMI Filter**
- **Small Package:**

OPA340 Available in SOT23-5 and SOP-8 Packages
OPA2340 Available in MSOP-8 and SOP-8 Packages
OPA4340 Available in SOP-14 and TSSOP-14 Packages

General Description

The OPAx340 amplifier is single/dual/quad supply, micro-power, zero-drift CMOS operational amplifiers, the amplifiers offer bandwidth of 4.5MHz, rail-to-rail inputs and outputs, and single-supply operation from 1.8V to 5.5V. OPAx340 uses chopper stabilized technique to provide very low offset voltage (less than 30μV maximum) and near zero drift over temperature. Low quiescent supply current of 550μA 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 OPAx340 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 OPA340 is available in SOT23-5 and SOP-8 packages. And the OPA2340 is available in MSOP-8 and SOP-8 packages. The OPA4340 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

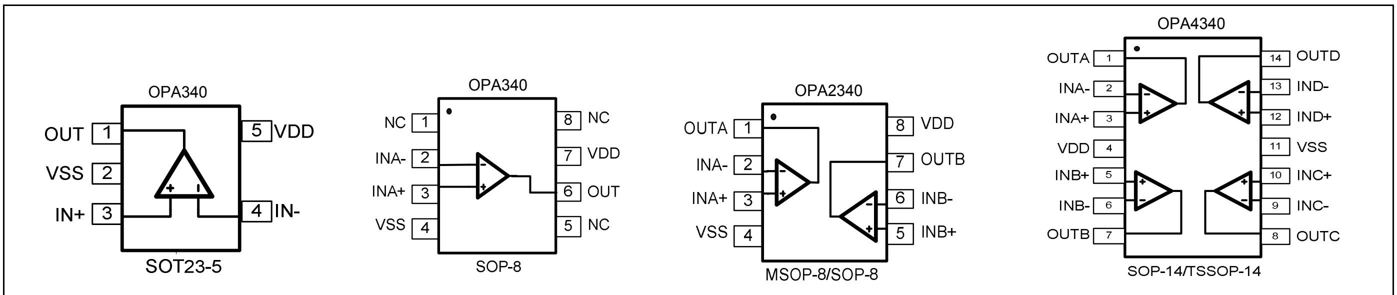


Figure 1. Pin Assignment Diagram

Ordering Information

DEVICE	Package Type	MARKING	Packing	Packing Qty
OPA340M5/TR	SOT23-5	A340	REEL	3000pcs/reel
OPA340M/TR	SOP8L	A340	REEL	2500pcs/reel
OPA2340M/TR	SOP8L	A2340	REEL	2500pcs/reel
OPA2340MM/TR	MSOP8L	A2340	REEL	3000pcs/reel
OPA4340M/TR	SOP14L	OPA4340	REEL	2500pcs/reel
OPA4340MT/TR	TSOP14L	A4340	REEL	2500pcs/reel

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)	+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.

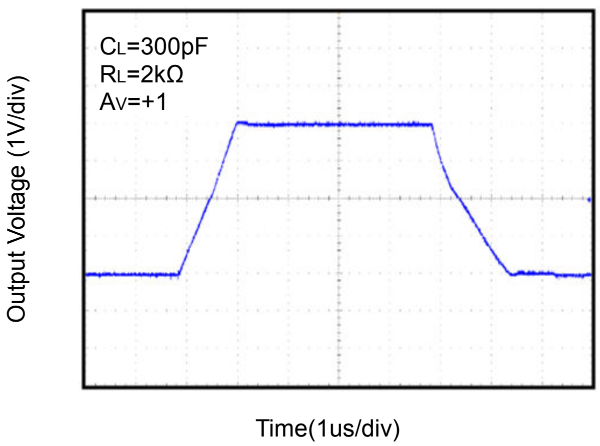
Electrical Characteristics

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

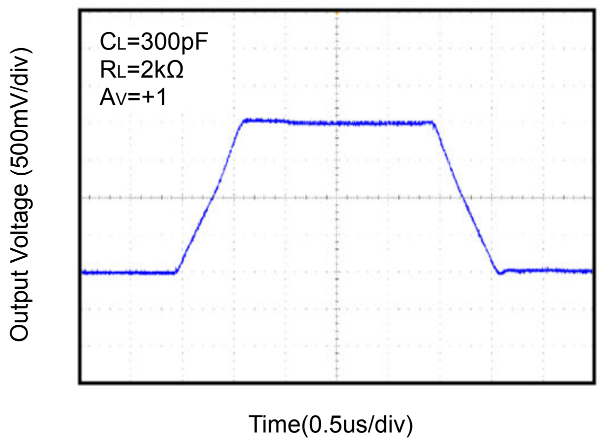
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS					
Input Offset Voltage (V_{OS})			1	30	μV
Input Bias Current (I_B)			20		pA
Input Offset Current (I_{OS})			10		pA
Common-Mode Rejection Ratio (CMRR)	V_{CM} = 0V to 5V		110		dB
Large Signal Voltage Gain (A_{VO})	R_L = 10kΩ, V_O = 0.3V to 4.7V		145		dB
Input Offset Voltage Drift ($\Delta V_{OS}/\Delta_T$)			10	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		550		μA
DYNAMIC PERFORMANCE					
Gain-Bandwidth Product (GBP)	G = +100		4.5		MHz
Slew Rate (SR)	R_L = 10kΩ		2.5		V/μs
Overload Recovery Time			0.10		ms
NOISE PERFORMANCE					
Voltage Noise (e_n p-p)	0Hz to 10Hz		0.2		μV_{P-P}
Voltage Noise Density (e_n)	f = 1kHz		30		$nV/\sqrt{Hz}$

Typical Performance characteristics

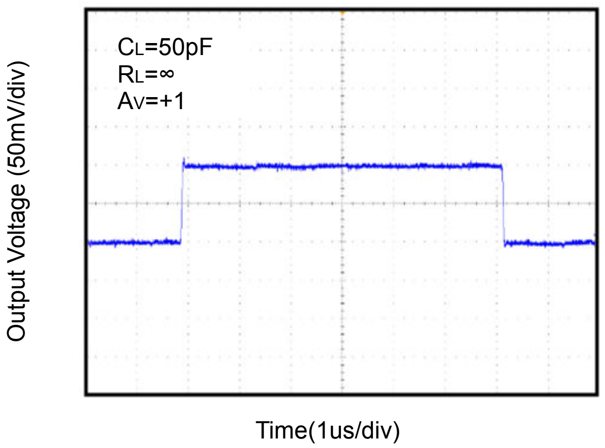
Large Signal Transient Response at +5V



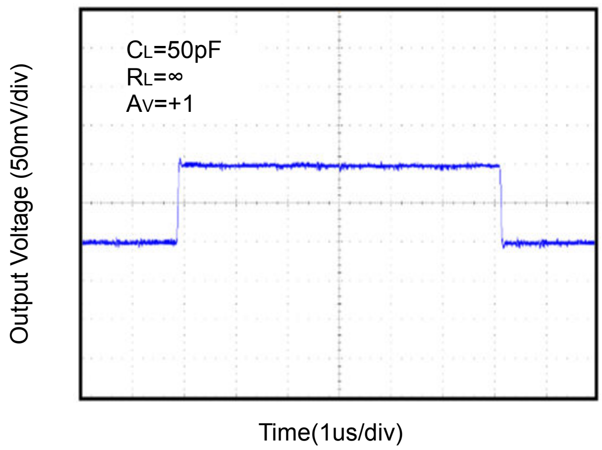
Large Signal Transient Response at +2.5V



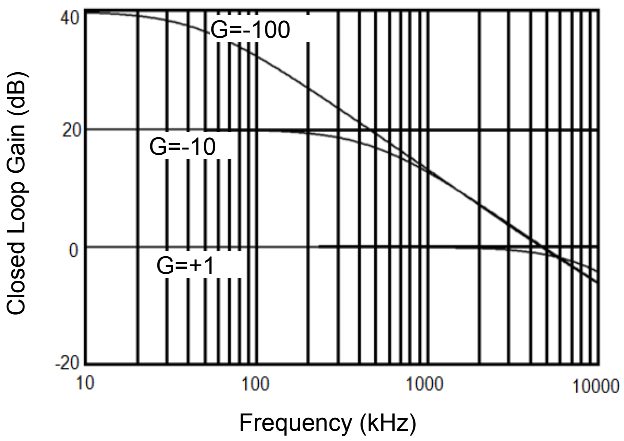
Small Signal Transient Response at +5V



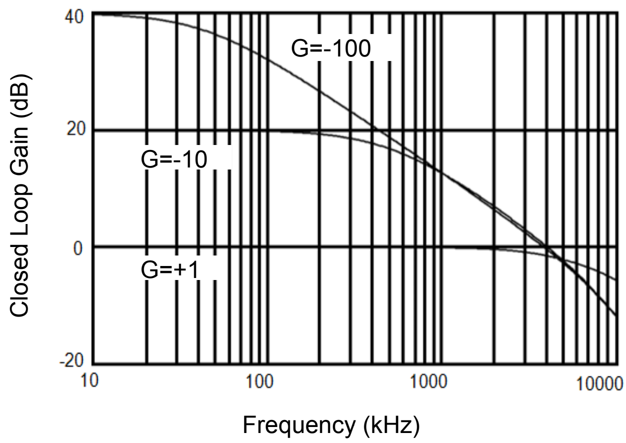
Small Signal Transient Response at +2.5V



Closed Loop Gain vs. Frequency at +5V

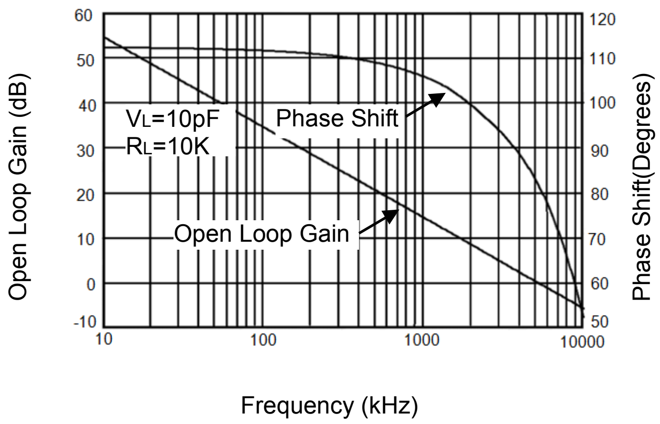


Closed Loop Gain vs. Frequency at +2.5V

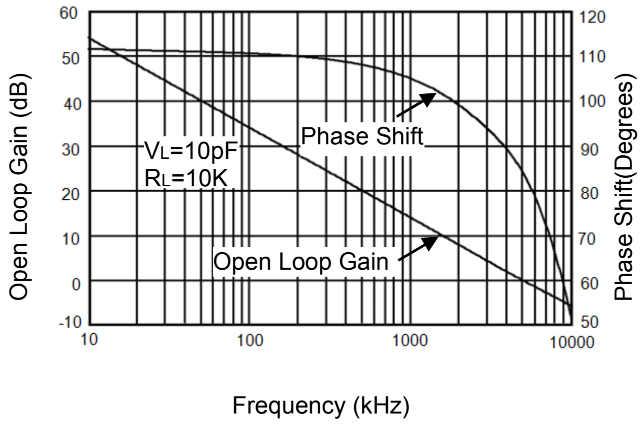


Typical Performance characteristics

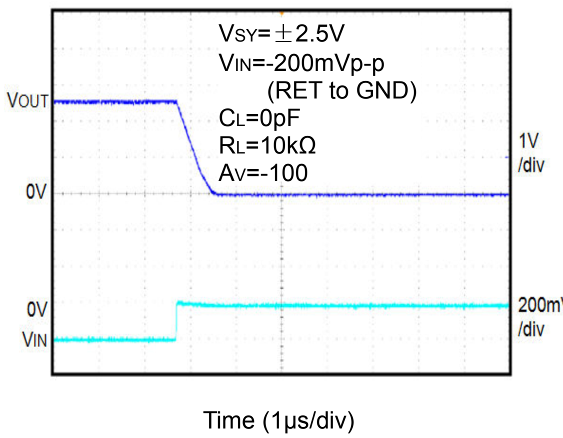
Open Loop Gain, Phase Shift
vs. Frequency at +5V



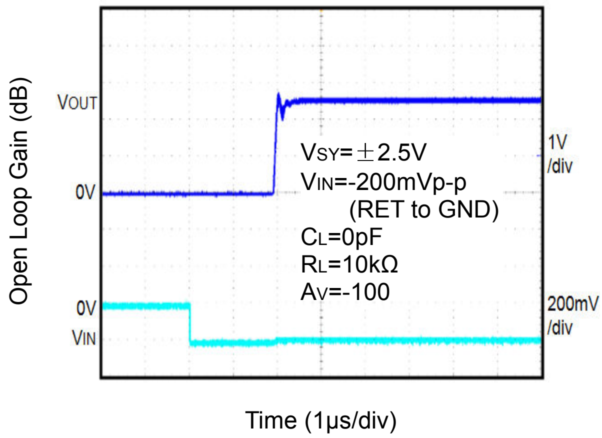
Open Loop Gain, Phase Shift
vs. Frequency at +2.5V



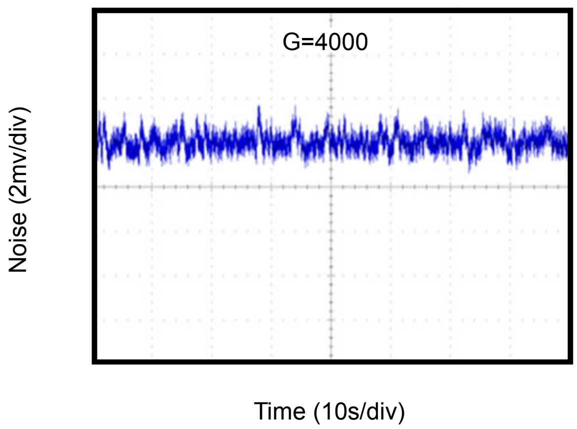
Positive Overvoltage Recovery



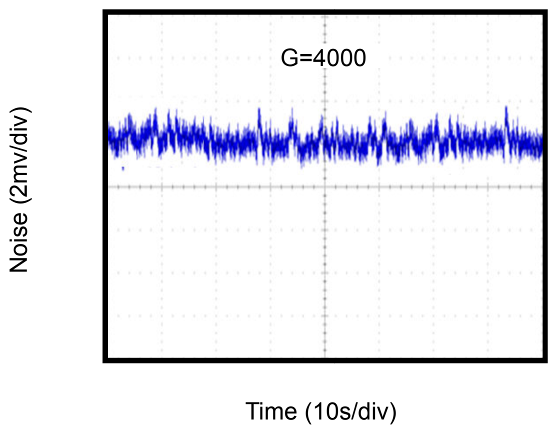
Negative Overvoltage Recovery



0.1Hz to 10Hz Noise at +5V



0.1Hz to 10Hz Noise at +2.5V



Application Note

Size

OPAx340 series op amps are unity-gain stable and suitable for a wide range of general-purpose applications. The small footprints of the OPAx340 series packages save space on printed circuit boards and enable the design of smaller electronic products.

Power Supply Bypassing and Board Layout

OPAx340 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 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 550μA per channel) of OPAx340 series will help to maximize battery life . They are ideal for battery powered systems.

Operating Voltage

OPAx340 series operate under wide input supply voltage (1.8V to 5.5V). In addition, all temperature specifications 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 OPAx340 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 OPAx340 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 OPAx340 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.

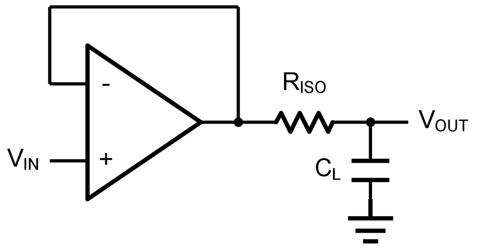


Figure 2. Indirectly Driving a Capacitive Load Using Isolation Resistor

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.

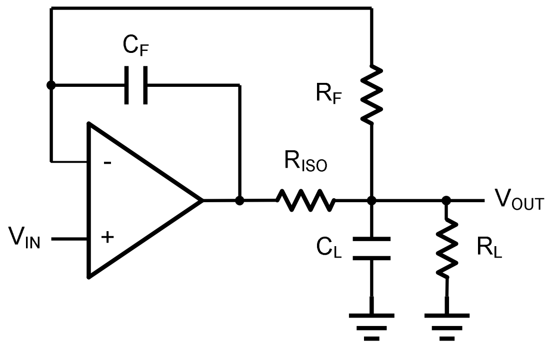


Figure 3. Indirectly Driving a Capacitive Load with DC Accuracy

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 OPAx340.

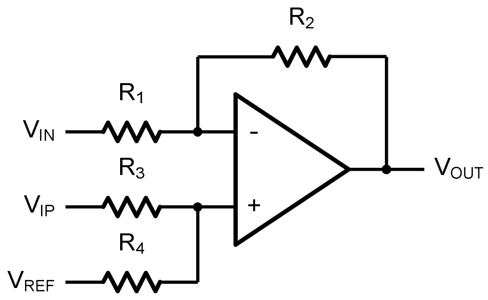


Figure 4. Differential Amplifier

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

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

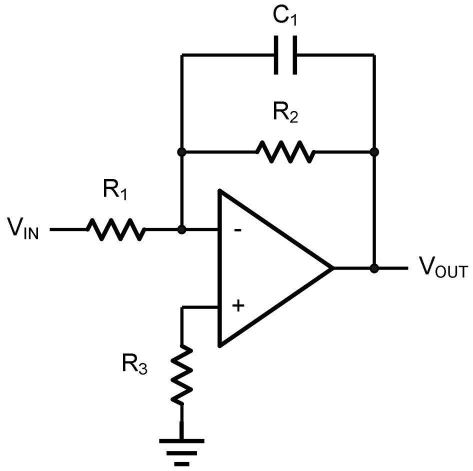


Figure 5. Low Pass Active Filter

Instrumentation Amplifier

The triple OPAx340 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.

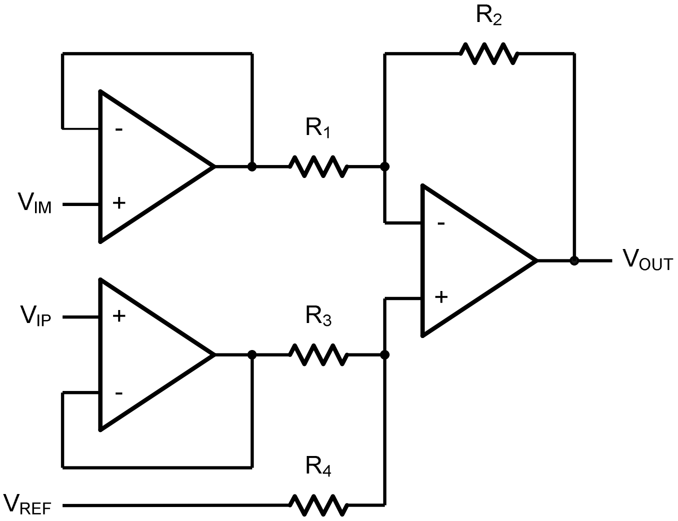


Figure 6. Instrument Amplifier

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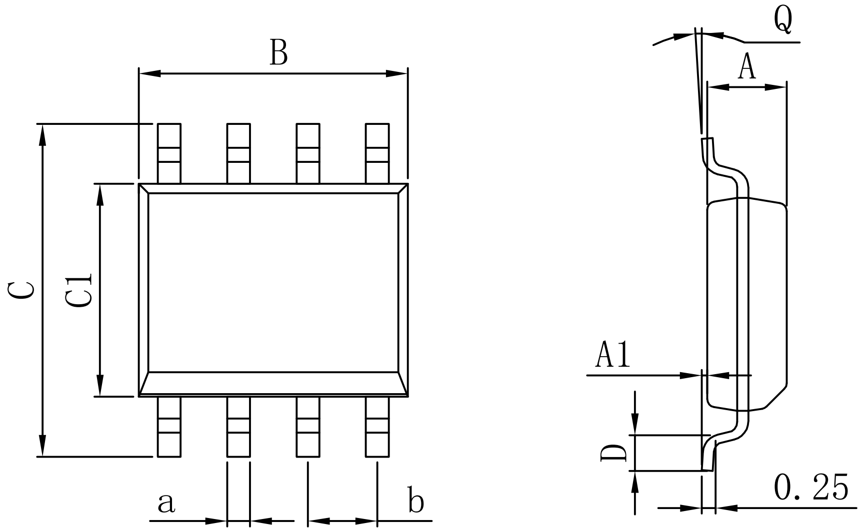
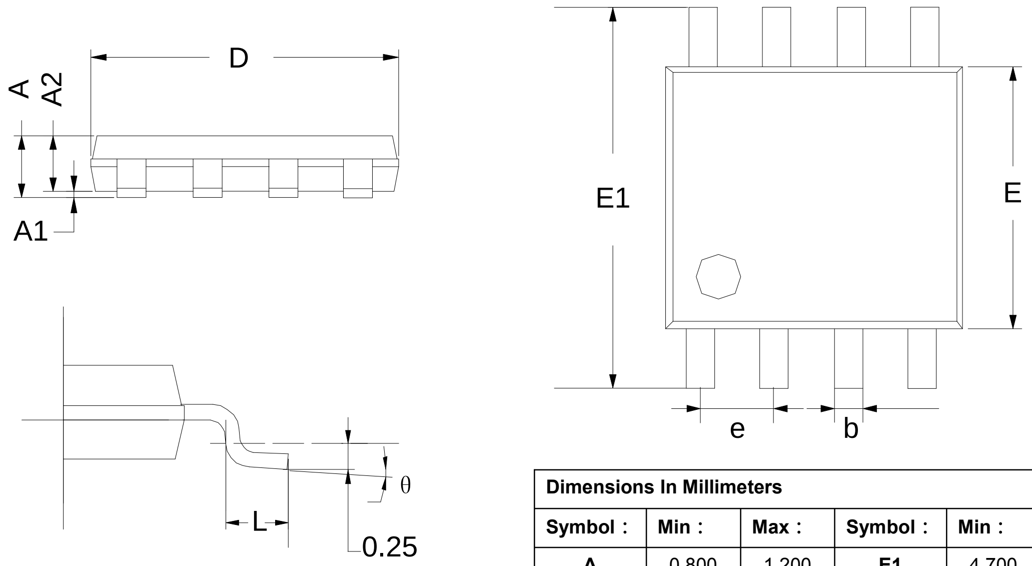
PACKAGE

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			

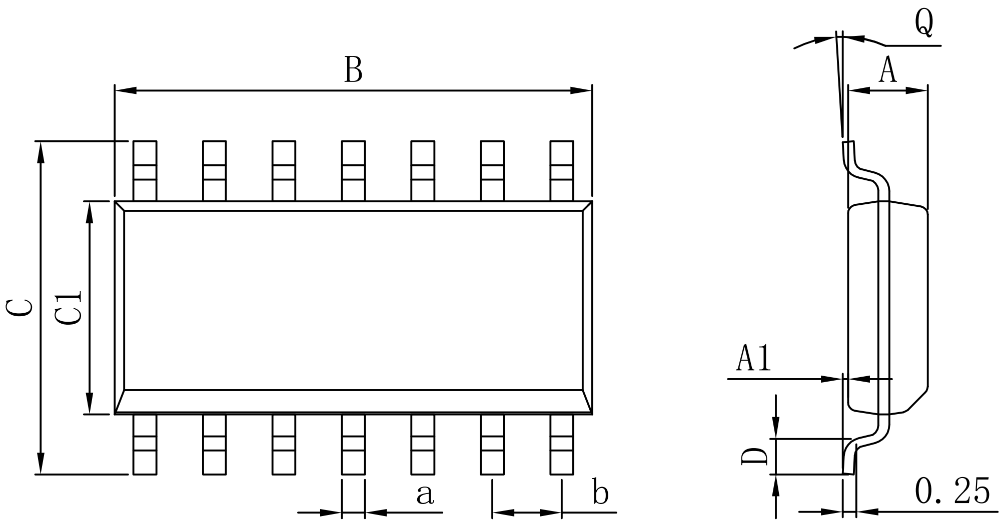
MSOP8



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	

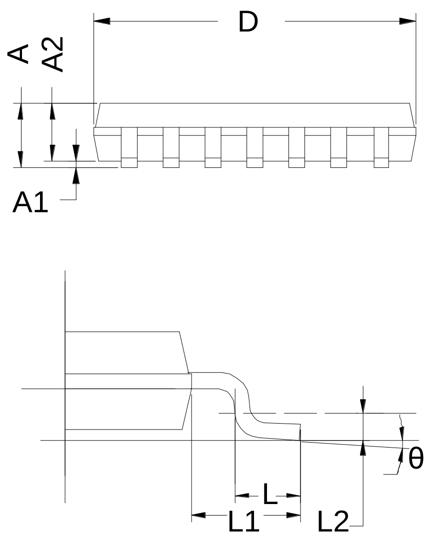
PACKAGE

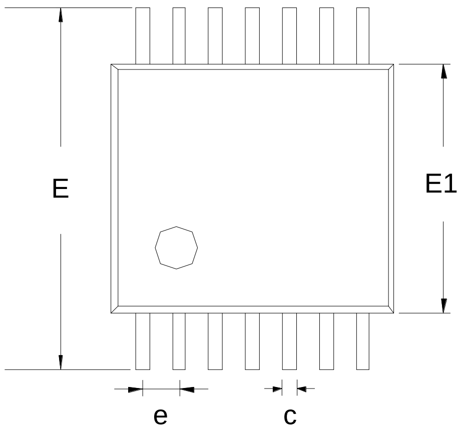
SOP14



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	8.500	9.000	**a**	0.420 TYP	
C	5.800	6.250	**b**	1.270 TYP	
C1	3.800	4.000			

TSSOP14

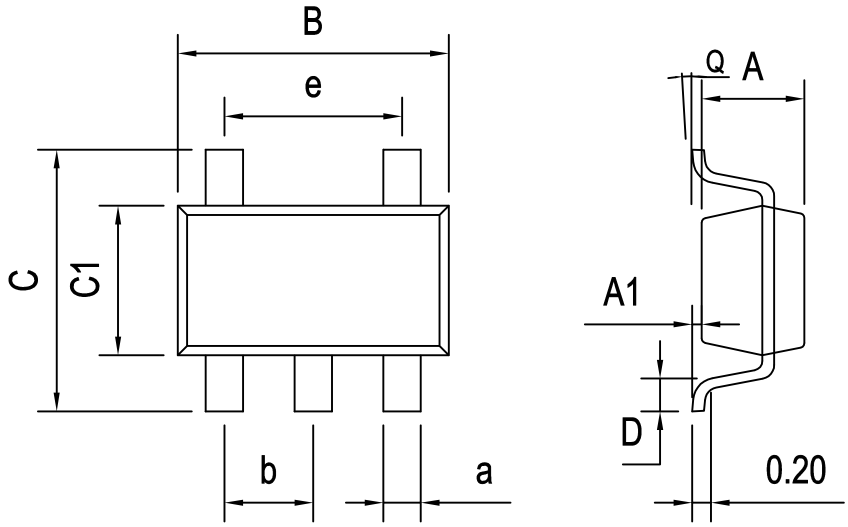




Dimensions In Millimeters					
Symbol :	**Min :**	**Max :**	**Symbol :**	**Min :**	**Max :**
A	0.900	1.150	**E1**	4.300	4.500
A1	0.050	0.150	**L**	0.450	0.750
A2	0.800	1.000	**θ**	0°	8°
B	0.200	0.280	**e**	0.650 BSC	
C	0.100	0.190	**L1**	1.000 REF	
D	4.860	5.060	**L2**	1.250 BSC	
E	6.200	6.600			

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	

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