DESCRIPTION

The AO2369 has a high gain-bandwidth product of 14.5KHz, a slew rate of 6V/ms, and a quiescent current of 600nA/amplifier at 5V.

The AO2369 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 3mV for AO2369.

AO2369 is specified over the extended industrial temperature range (-40℃ to +125℃).
The operating range is from 1.4V to 5.5V.

The AO2369 is available in SOP8 and MSOP8 packages.

FEATURES

- Single-Supply Operation from +1.4V ~ +5.5V
- Rail-to-Rail Input / Output
- Gain-Bandwidth Product: 14.5KHz (Typ.)
- Low Input Bias Current: 1pA (Typ.)
- Low Offset Voltage: 3mV (Max.)
- Quiescent Current: 600nA per Amplifier (Typ.)
- Operating Temperature: -40°C ~ +125°C
- Embedded RF Anti-EMI Filter

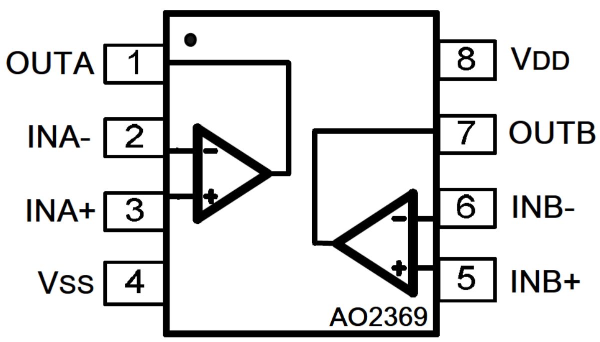
APPLICATION

- ASIC Input or Output Amplifier
- Sensor Interface
- Medical Communication
- Smoke Detectors
- Audio Output
- Piezoelectric Transducer Amplifier
- Medical Instrumentation
- Portable Systems

ORDERING INFORMATION

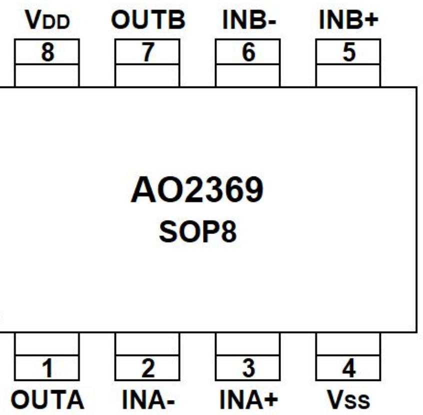
Package Type	Part Number	
SOP8 SPQ: 4,000pcs/Reel	M8	AO2369M8R
		AO2369M8VR
MSOP8 SPQ: 3,000pcs/Reel	MS8	AO2369MS8R
		AO2369MS8VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

TYPICAL APPLICATION

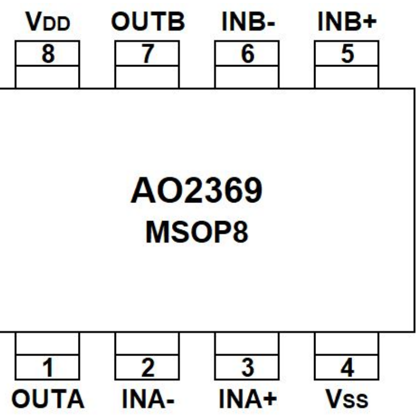


SOP8/MSOP8

PIN DESCRIPTION



SOP8, M8
Top View



MSOP8, MS8
Top View

Pin #		Symbol	Functions
SOP8	MSOP8		
1	1	OUTA	Output Voltage A.
2	2	INA-	Analog Inverting Input A.
3	3	INA+	Analog Positive Input A.
4	4	V_{SS}	Ground or Negative Power Supply Input.
5	5	INB+	Analog Positive Input B.
6	6	INB-	Analog Inverting Input B.
7	7	OUTB	Output Voltage B.
8	8	V_{DD}	Positive Power Supply Input.

ABSOLUTE MAXIMUM RATINGS

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℃ ~ +125℃
Junction Temperature		+160℃
Storage Temperature Range		-55℃ ~ +150℃
Lead Temperature (soldering, 10sec)		+260℃
Package Thermal Resistance $θ_{JA}$ (T_A=+25℃)	SOP8	125℃/W
	MSOP8	216℃/W
ESD Susceptibility	HBM	6KV
	MM	300V

Stresses above may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated in the Electrical Characteristics are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

V_S = +5V, R_L = 1MΩ connected to V_S/2, and V_{OUT} = V_S/2, unless otherwise noted

Parameter	Symbol	Conditions	Typ.	Min.	Max.	Unit
INPUT CHARACTERISTICS						
Input Offset Voltage	V_{OS}	V_{CM} = V_S/2	0.4	-	3	mV
Input Bias Current	I_B	-	1	-	-	pA
Input Offset Current	I_{OS}	-	1	-	-	pA
Common-Mode Voltage Range	V_{CM}	V_S = 5.5V	-0.1 to +5.6	-	-	V
Common-Mode Rejection Ratio	C_{MRR}	V_S = 5V, V_{CM} = -0.1V to 2.5V	78	66	-	dB
		V_S = 5V, V_{CM} = -0.1V to 5.1V	84	67	-	
Open-Loop Voltage Gain	A_{OL}	V_S=1.4V, R_L = 50kΩ, V_O = V_S-0.1V	86	75	-	dB
		V_S=5V, R_L = 50kΩ, V_O = V_S-0.1V	93	84	-	
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta_T$	-	2.5	-	-	μV/℃
OUTPUT CHARACTERISTICS						
Output Voltage Swing from Rail	V_{OH}	V_S=1.4V, R_L = 50kΩ	1.395	1.390	-	V
	V_{OL}		4.5	-	10	mV
	V_{OH}	V_S=5V, R_L = 50kΩ	4.997	4.990	-	V
	V_{OL}		3.5	-	10	mV
Output Current	I_{SOURCE}	R_L = 10Ω to V_S/2	20	-	-	mA
	I_{SINK}		20	-	-	mA
POWER SUPPLY						
Operating Voltage Range			1.4	-	-	V
			5.5	-	-	V
Power Supply Rejection Ratio	P_{SRR}	V_S = +1.4V to +5.5V, V_{CM} = +0.5V	80	77	-	dB
Quiescent Current / Amplifier	I_Q		600	-	-	nA
DYNAMIC PERFORMANCE (C_L = 100pF)						
Gain-Bandwidth Product	G_{BP}		14.5	-	-	KHz
Slew Rate	S_R	G = +1, 2V Output Step	6	-	-	V/ms

TYPICAL PERFORMANCE CHARACTERISTICS

Fig.1 Large Signal Inverting Pulse Response

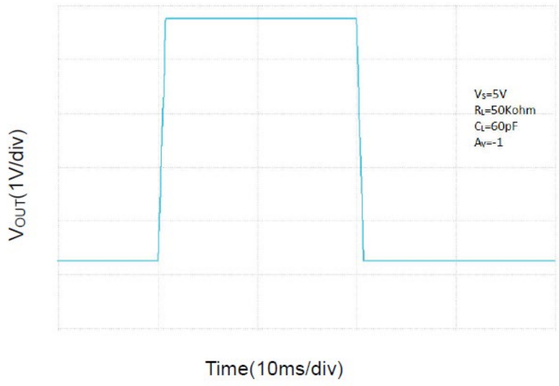


Fig.2 Large Signal Non-Inverting Pulse Response

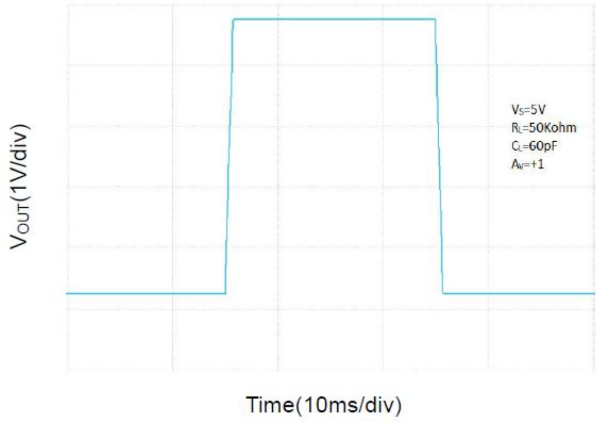


Fig.3 Small Signal Inverting Pulse Response

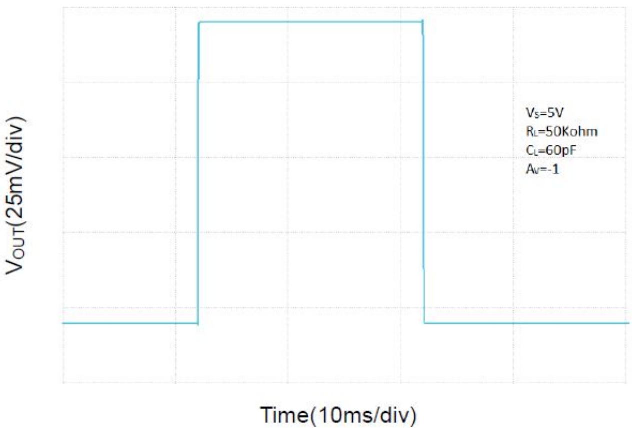


Fig.4 Small Signal Non-Inverting Pulse Response

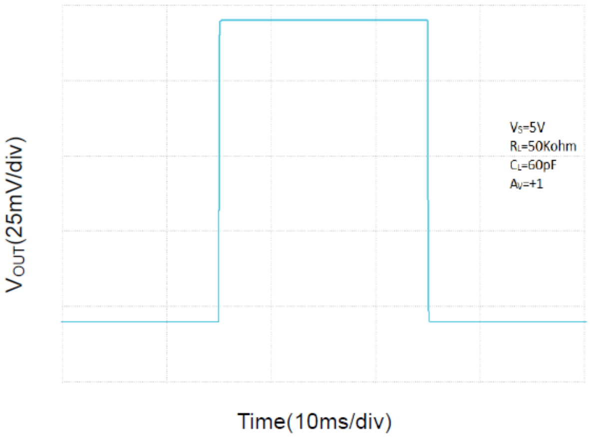


Fig.5 No Phase Reversal

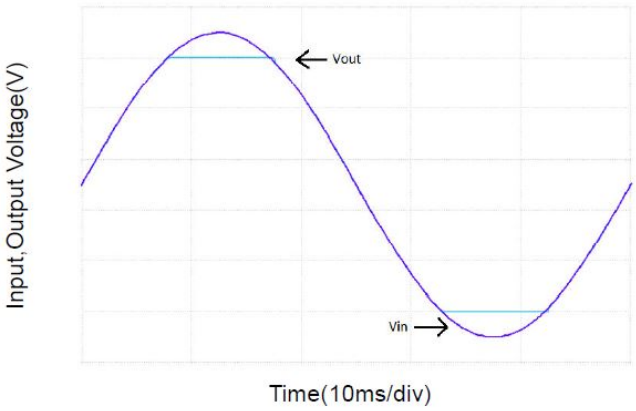
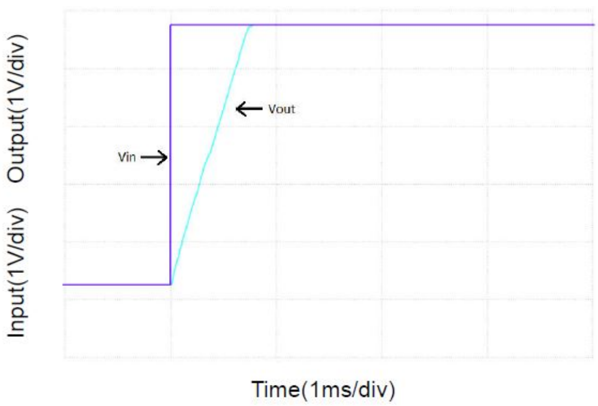
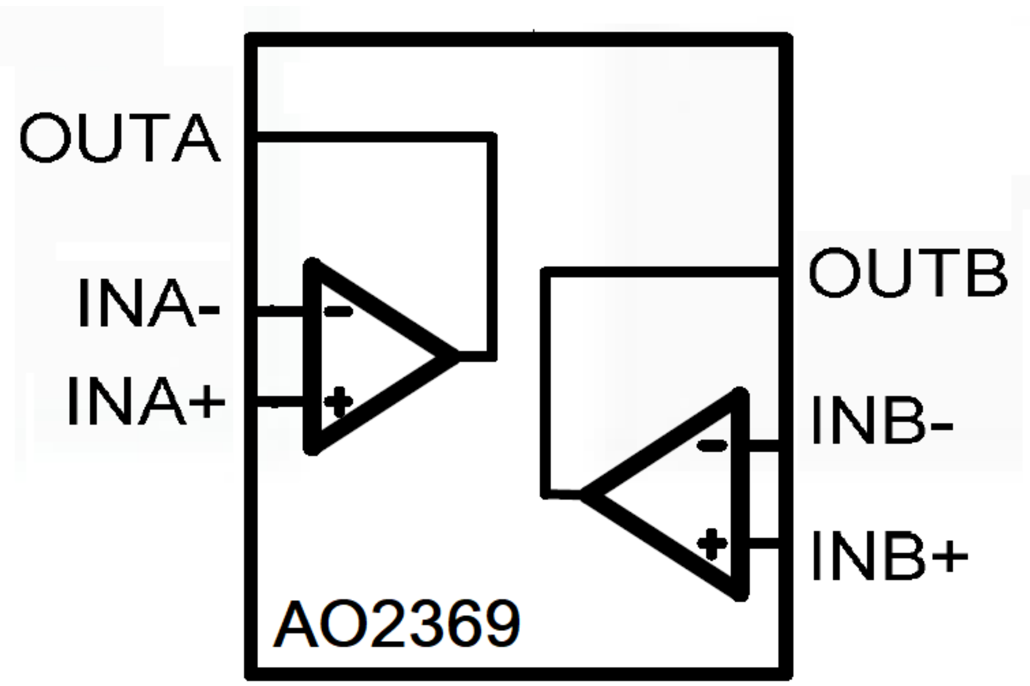


Fig.6 Output Settling Time



BLOCK DIAGRAM



DETAILED INFORMATION

The AO2369 op amp is unity-gain stable and suitable for a wide range of general-purpose applications.
The small footprints of the AO2369 packages save space on printed circuit boards and enable the design of smaller electronic products.

Power Supply Bypassing and Board Layout

The AO2369 operates from a single 1.4V to 5.5V supply or dual ±0.7V 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 600nA per channel) of the AO2369 will help to maximize battery life. AO2369 is ideal for battery powered systems.

Operating Voltage

The AO2369 operates under wide input supply voltage (1.4V to 5.5V). In addition, all temperature specifications apply from -40℃ to +125℃. 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 AO2369 family 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 AO2369 family can typically swing to less than 50mV from supply rail in light resistive loads (>50kΩ).

Capacitive Load Tolerance

The AO2369 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 first, using a small resistor in series with the amplifier's output and the load capacitance and reducing the bandwidth of the amplifier's feedback loop by increasing the overall noise gain. Figure 1. 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.

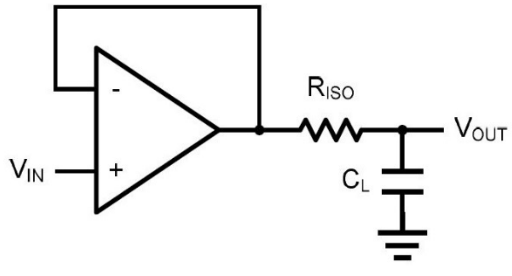


Figure 1. Indirectly Driving a Capacitive Load Using Isolation Resistor

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 2 is an improvement to the one in Figure 1. RF 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.

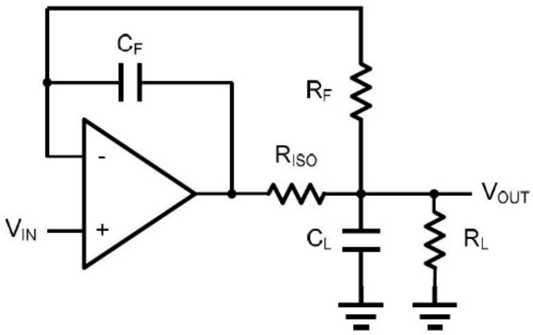


Figure 2. Indirectly Driving a Capacitive Load with DC Accuracy

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 3. shown the differential amplifier using AO2369 family.

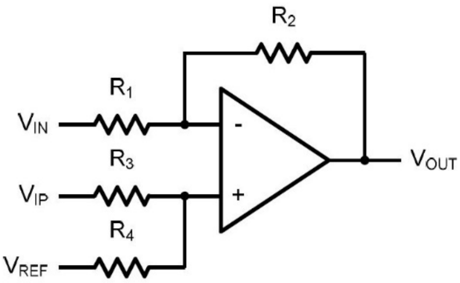


Figure 3. Differential Amplifier

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

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 4. The DC gain is defined by $-R_2/R_1$. The filter has a -20dB/decade roll-off after its corner frequency $f_C=1/(2\pi R_3C_1)$.

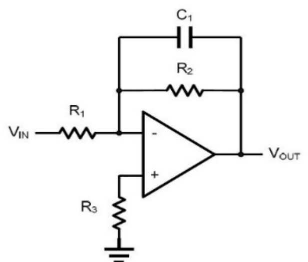


Figure 4. Low Pass Active Filter

Instrumentation Amplifier

The triple AO2369 family can be used to build a three-op-amp instrumentation amplifier as shown in Figure 5. The amplifier in Figure 5 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.

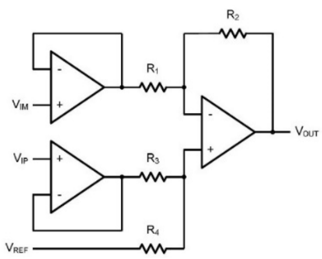
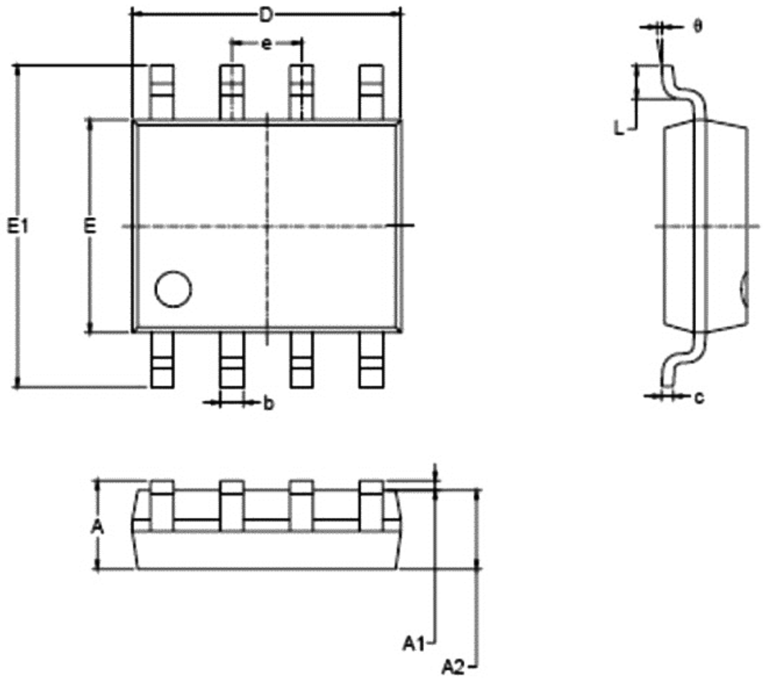


Figure 5. Instrument Amplifier

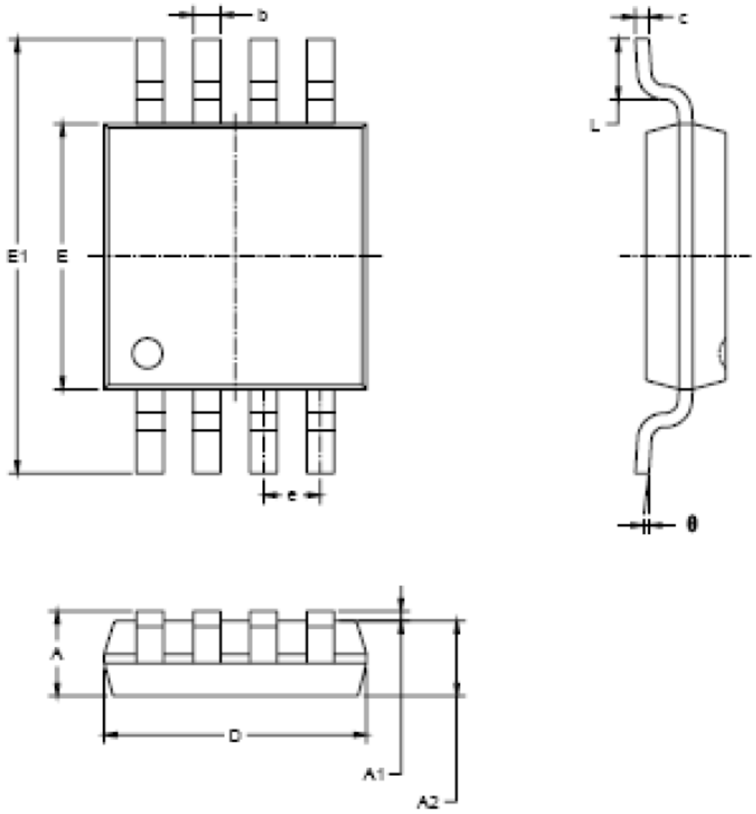
PACKAGE INFORMATION

Dimension in SOP8 (Unit: mm)



Symbol	Millimeters	
	Min	Max
A	1.350	1.750
A1	0.100	0.250
A2	1.350	1.550
b	0.330	0.510
c	0.170	0.250
D	4.700	5.100
E	3.800	4.000
E1	5.800	6.200
e	1.270 BSC	
L	0.400	1.270
θ	0°	8°

Dimension in MSOP8 (Unit: mm)



Symbol	Millimeters	
	Min	Max
A	0.820	1.100
A1	0.020	0.150
A2	0.750	0.950
b	0.250	0.380
c	0.090	0.230
D	2.900	3.100
E	2.900	3.100
E1	4.750	5.050
e	0.650 BSC	
L	0.400	0.800
θ	0°	6°

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