

# SGM2358

# 1MHz, General Purpose CMOS Operational Amplifier

## PRODUCT DESCRIPTION

The SGM2358 has dual rail-to-rail output voltage feedback amplifiers in one package. It takes the minimum operating supply voltage down to 3V and the maximum recommended supply voltage is 5.5 V. SGM2358 is specified over the extended -40°C to +85°C temperature range.

The amplifier in SGM2358 provides 1MHz bandwidth, Very low input bias currents of 10pA, these features enable SGM2358 to be used for integrators, photodiode amplifiers, and piezoelectric sensors. Rail-to-rail output feature is useful for designers to buffer ASIC in single-supply systems.

Applications of SGM2358 include safety monitoring, portable equipment, battery and power supply control, signal conditioning and interfacing for transducers in low power systems.

The SGM2358 comes in SO-8 package.

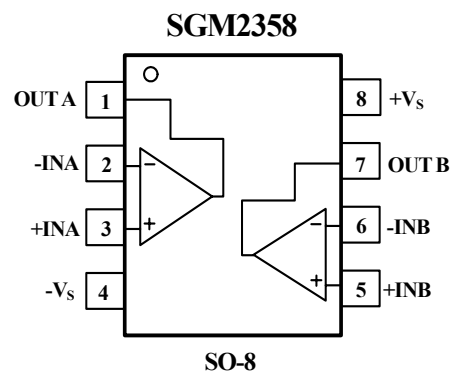
## APPLICATIONS

- ASIC Input or Output Amplifier
- Sensor Interface
- Piezo Electric Transducer Amplifier
- Medical Instrumentation
- Mobile Communication
- Portable Systems
- Smoke Detectors
- Notebook PC
- PCMCIA cards
- Battery -Powered equipment
- DSP interface

## FEATURES

- Low Cost
- Rail-to-Rail Output  
1.7mV Typical  $V_{OS}$
- Unity Gain Stable
- Gain Bandwidth Product: 1MHz
- Very Low Input Bias Currents: 10pA
- Input Common-Mode Voltage Range Includes Ground
- Operates from 3 V to 5.5 V
- Small Packaging: SO-8

## PIN CONFIGURATION (Top View)



# ELECTRICAL CHARACTERISTICS : $V_S = +5V$

(At  $R_L = 100k\Omega$  connected to  $V_S/2$ , and  $V_{OUT} = V_S/2$ , unless otherwise noted)

PARAMETER	CONDITION	SGM2358				
		TYP	MIN/MAX OVER TEMPERATURE			
		+25°C	+25°C	-40°C to +85°C	UNITS	MIN/MAX
<b>INPUT CHARACTERISTICS</b>						
Input Offset Voltage ( $V_{OS}$ )		1.7	7	7.5	mV	MAX
Input Bias Current ( $I_B$ )		10			pA	TYP
Input Offset Current ( $I_{OS}$ )		10			pA	TYP
Common-Mode Rejection Ratio (CMRR)	$V_S = 5V, V_{CM} = -0.1V$ to 3.3 V	88	70	65	dB	MIN
Open-Loop Voltage Gain ( $A_{OL}$ )	$R_L = 2K\Omega, V_O = 0.1V$ to 4.9V	100	85	70	dB	MIN
	$R_L = 10K\Omega, V_O = 0.035V$ to 4.965V	110	100	90	dB	MIN
Input Offset Voltage Drift ( $\Delta V_{OS}/\Delta T$ )		3.5			$\mu V/^\circ C$	TYP
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage Swing from Rail	$R_L = 2K\Omega$	0.8			V	TYP
	$R_L = 10K\Omega$	0.008			V	TYP
Output Current ( $I_{OUT}$ )		43	35	30	mA	MIN
<b>POWER SUPPLY</b>						
Operating Voltage Range			3.0	3.0	V	MIN
			5.5	5.5	V	MAX
Power Supply Rejection Ratio (PSRR)	$V_S = +3V$ to +5.5 V $V_{CM} = (-V_S) + 0.5V$	80	70	65	dB	MIN
Quiescent Current / Amplifier ( $I_Q$ )	$I_{OUT} = 0$	0.4	0.95	1	mA	MAX
<b>DYNAMIC PERFORMANCE</b>						
Gain-Bandwidth Product (GBP)	$C_L = 100pF$	1.0			MHz	TYP
Slew Rate (SR)	$G = +1, 2V$ Output Step	0.65			$V/\mu s$	TYP
Settling Time to 0.1% ( $t_S$ )	$G = +1, 2V$ Output Step	9.0			$\mu s$	TYP
Overload Recovery Time	$V_{IN} \cdot Gain = V_S$	4.0			$\mu s$	TYP
Crosstalk	1KHz	-80			dB	TYP
	1MHz	-65			dB	TYP
<b>NOISE PERFORMANCE</b>						
Voltage Noise Density ( $e_n$ )	$f = 1kHz$	42			$nV/\sqrt{Hz}$	TYP
	$f = 10kHz$	38			$nV/\sqrt{Hz}$	TYP

Specifications subject to change without notice.

## PACKAGE/ORDERING INFORMATION

MODEL	ORDER NUMBER	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	PACKAGE OPTION	MARKING INFORMATION
SGM2358	SGM2358YS/TR	SO-8	-40°C to +85°C	Tape and Reel, 2500	SGM2358YS

### ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V+ to V-	6.0 V
Storage Temperature Range	-65°C to +150°C
Junction Temperature	160°C
Operating Temperature Range	-40°C to +85°C
Package Thermal Resistance @ T <sub>A</sub> = 25°C	
SO-8, θ <sub>JA</sub>	125°C/W
Lead Temperature Range (Soldering 10 sec)	
	260°C
ESD Susceptibility	
HBM	4000V
MM	300V

### NOTES

1. Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

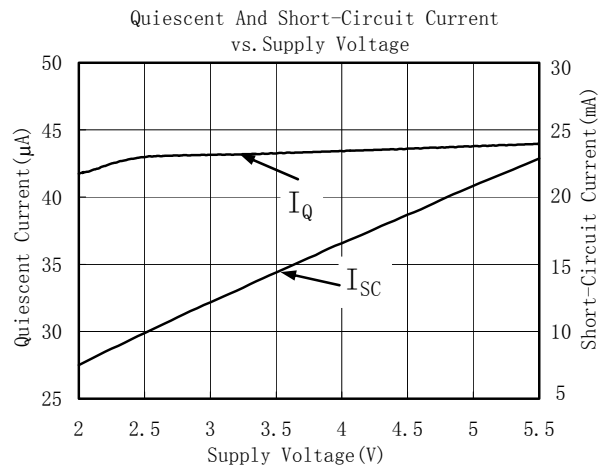
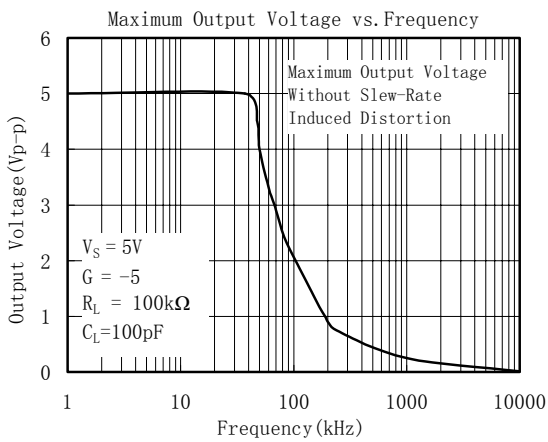
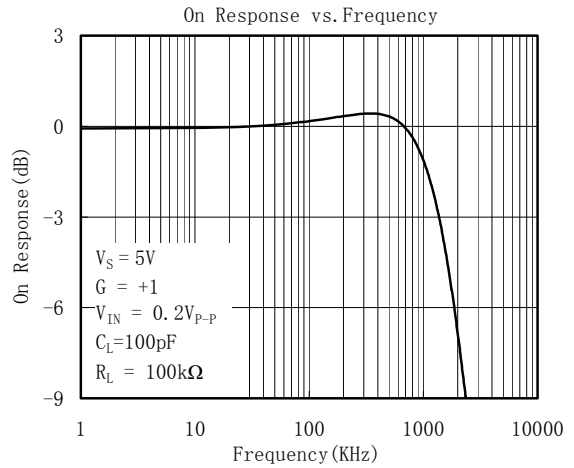
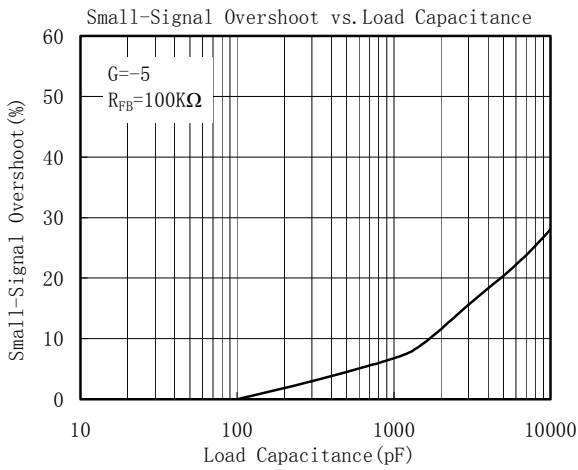
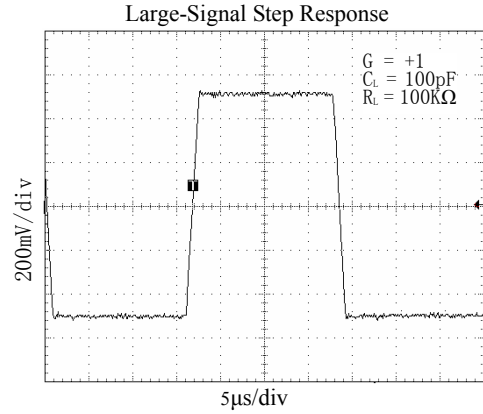
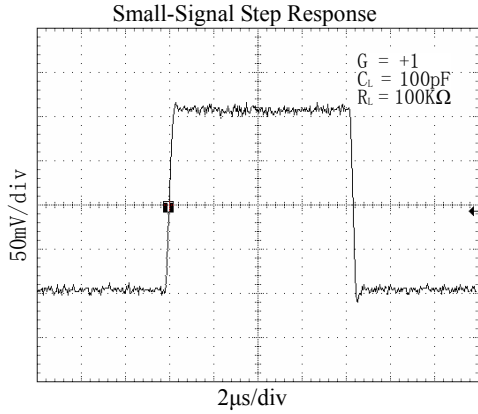
### CAUTION

This integrated circuit can be damaged by ESD. Shengbang Micro-electronics recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

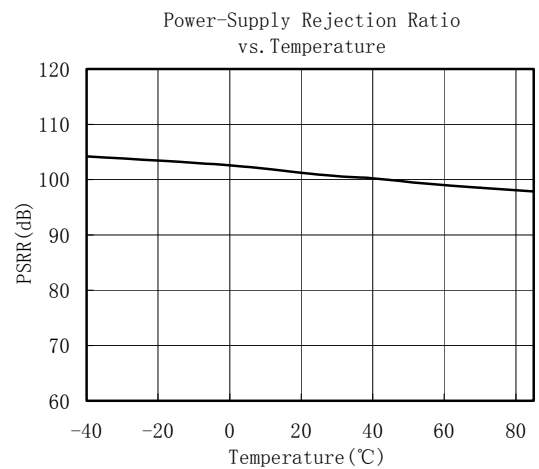
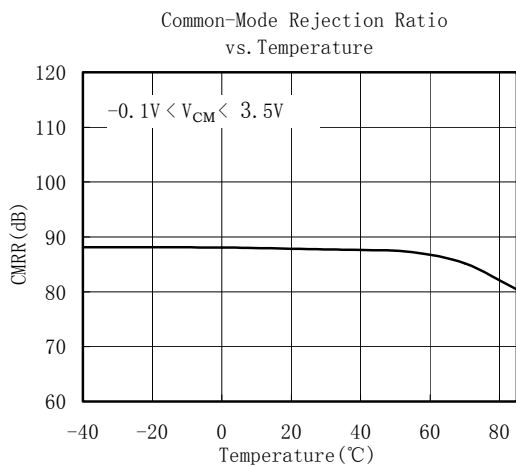
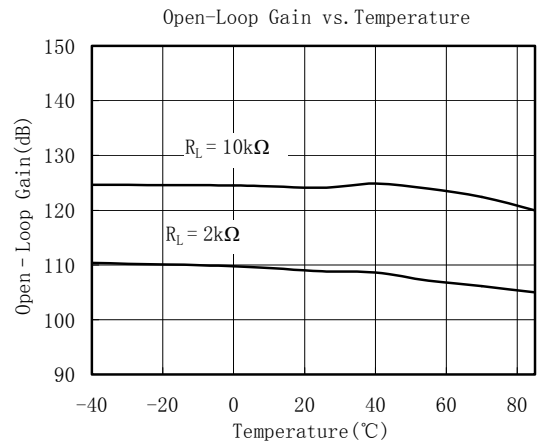
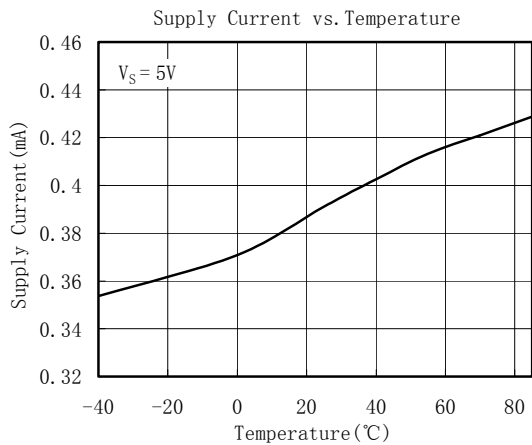
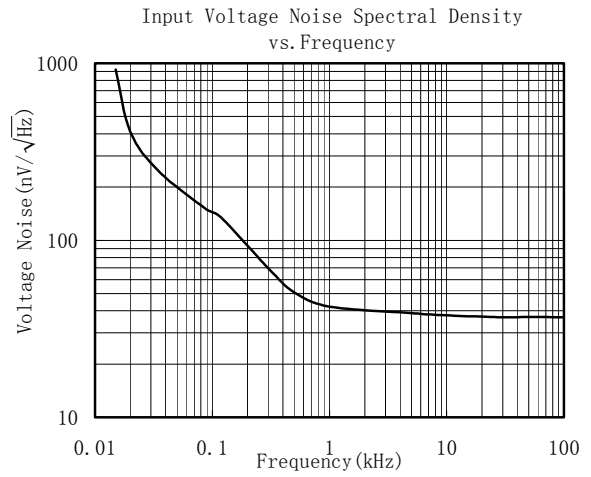
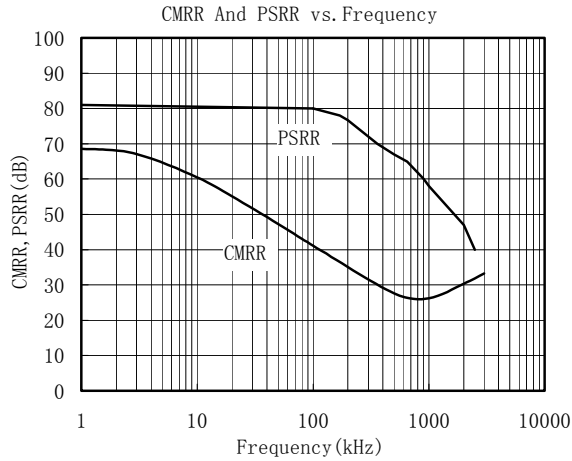
# TYPICAL PERFORMANCE CHARACTERISTICS

At  $T_A = +25^\circ\text{C}$ ,  $V_S = +5\text{V}$ , and  $R_L = 100\text{k}\Omega$  connected to  $V_S/2$ , unless otherwise noted.



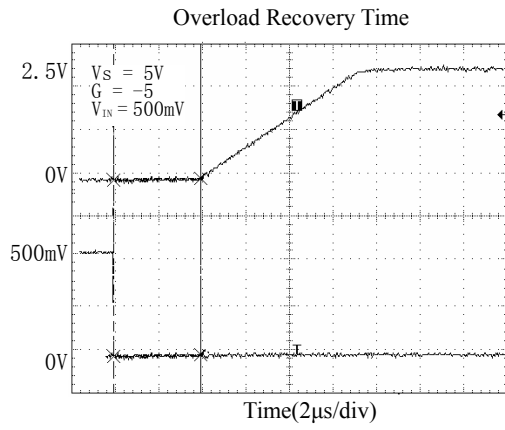
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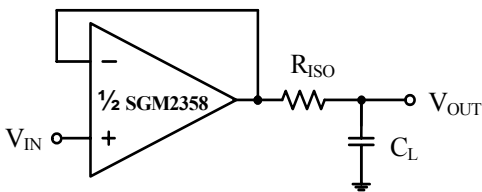
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# APPLICATION NOTES

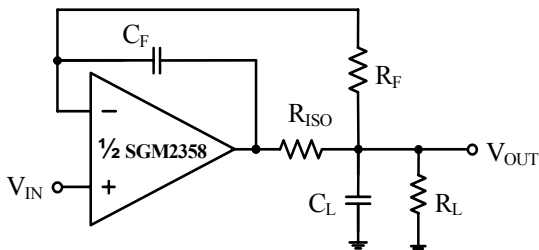
## Driving Capacitive Loads

The SGM2358 can directly drive 250pF in unity-gain without oscillation. The unity-gain follower (buffer) is the most sensitive configuration to capacitive loading. Direct capacitive loading reduces the phase margin of amplifiers and this results in ringing or even oscillation. Applications that require greater capacitive drive capability should use an isolation resistor between the output and the capacitive load like the circuit in Figure 1. The isolation resistor  $R_{ISO}$  and the load capacitor  $C_L$  form a zero to increase stability. The bigger the  $R_{ISO}$  resistor value, the more stable  $V_{OUT}$  will be. Note that this method results in a loss of gain accuracy because  $R_{ISO}$  forms a voltage divider with the  $R_{LOAD}$ .



**Figure 1. Indirectly Driving Heavy Capacitive Load**

An improvement circuit is shown in Figure 2, It provides DC accuracy as well as AC stability.  $R_F$  provides the DC accuracy by connecting the inverting signal with the output,  $C_F$  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 phase margin in the overall feedback loop.

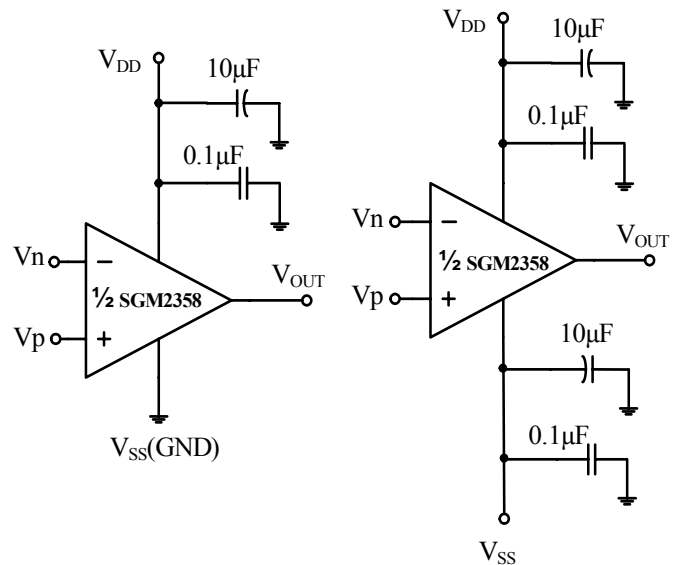


**Figure 2. Indirectly Driving Heavy Capacitive Load with DC Accuracy**

For no-buffer configuration, there are two others ways to increase the phase margin: (a) by increasing the amplifier's gain or (b) by placing a capacitor in parallel with the feedback resistor to counteract the parasitic capacitance associated with inverting node.

## Power-Supply Bypassing and Layout

The SGM2358 operates from either a single +3V to +5.5V supply or dual  $\pm 1.5V$  to  $\pm 2.75V$  supplies. For single-supply operation, bypass the power supply  $V_{DD}$  with a  $0.1\mu F$  ceramic capacitor which should be placed close to the  $V_{DD}$  pin. For dual-supply operation, both the  $V_{DD}$  and the  $V_{SS}$  supplies should be bypassed to ground with separate  $0.1\mu F$  ceramic capacitors.  $2.2\mu F$  tantalum capacitor can be added for better performance.



**Figure 3. Amplifier with Bypass Capacitors**

# Typical Application Circuits

## Differential Amplifier

The circuit shown in Figure 4 performs the difference function. If the resistors ratios are equal ( $R4 / R3 = R2 / R1$ ), then  $V_{OUT} = (Vp - Vn) \times R2 / R1 + Vref$ .

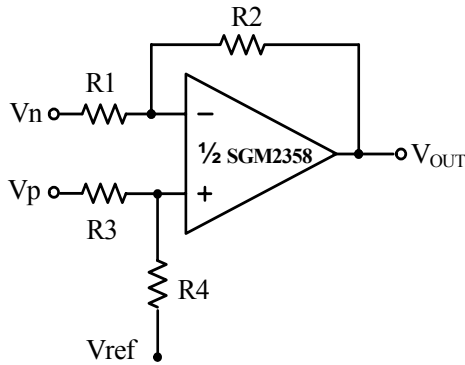


Figure 4. Differential Amplifier

## Instrumentation Amplifier

The circuit in Figure 5 performs the same function as that in Figure 4 but with the high input impedance.

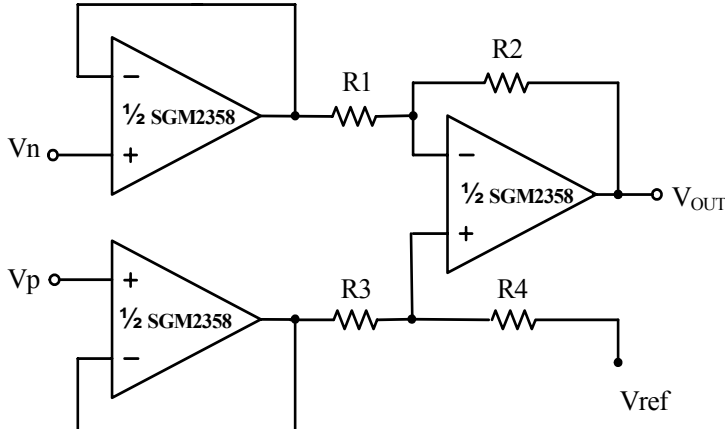


Figure 5. Instrumentation Amplifier

## Low Pass Active Filter

The low pass filter shown in Figure 6 has a DC gain of ( $- R2 / R1$ ) and the  $-3\text{dB}$  corner frequency is  $1/2\pi R2C$ . Make sure the filter is within the bandwidth of the amplifier. The Large values of feedback resistors can couple with parasitic capacitance and cause undesired effects such as ringing or oscillation in high-speed amplifiers. Keep resistors value as low as possible and consistent with output loading consideration.

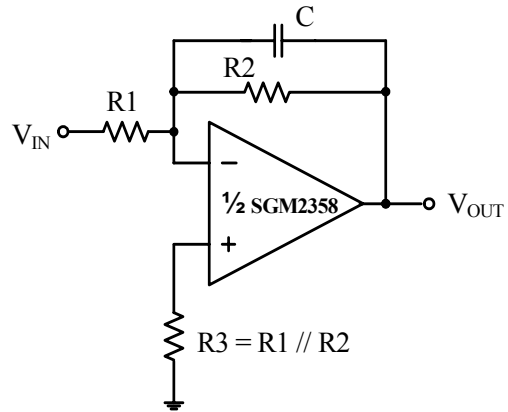
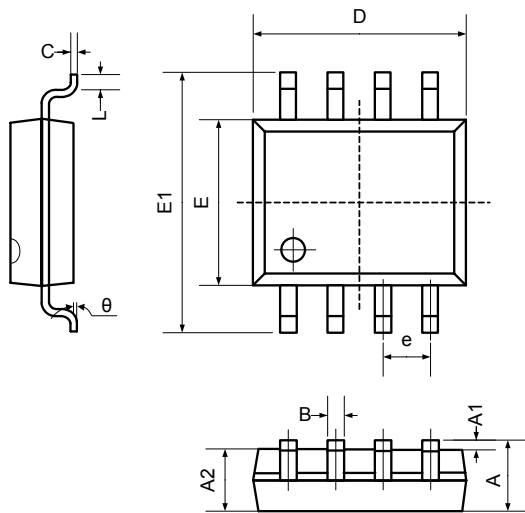


Figure 6. Low Pass Active Filter



# PACKAGE OUTLINE DIMENSIONS

## SO-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	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP	
L	0.400	1.270	0.016	0.050
theta	0°	8°	0°	8°

# REVISION HISTORY

Location	Page
<b>09/07— Data Sheet REV. A</b>	
<b>10/07— Data Sheet changed from REV.A to REV.B</b>	
Changes to ELECTRICAL CHARACTERISTICS about Noise. ....	2
Changes to TYPICAL PERFORMANCE CHARACTERISTICS about Noise. ....	5

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