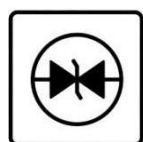


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SGM855X-MS

Product specification

**Ultra Low Noise Rail-to-Rail I/O CMOS
Precision OPERATIONAL AMPLIFIERS**

GENERAL DESCRIPTION

The SGM855X-MS family represents a new generation of low-noise operational amplifiers, offering outstanding dc precision and ac performance. Rail-to-Rail input and output, low offset (2μV), low noise (6 nV/√Hz), quiescent current of 600 μA, and a 6-MHz bandwidth make this part very attractive for a variety of precision and portable applications.

In addition, this device has a reasonably wide supply range (2V to 5.5V) with excellent PSRR, making it attractive for applications that run directly from batteries without regulation.

The SGM8551-MS (single), SGM8552-MS (dual) and SGM8554-MS (quad) families of operational amplifiers are specified for operation from -25°C to +125°C.







FEATURES

- Input Offset Voltage: 2μV (Typical)
- Zero Drift: 0.03μV/°C (Typical)
- Ultra Low Noise: 6nV/√Hz at 1kHz
- Supply Range: 2V to 5.5V
- Gain Bandwidth: 6 MHz
- Slew rate: 5V/μs
- Quiescent current: 600μA (Vs=5V)
- Rail-to-Rail Input and Output
- Micro size Packages:
SGM8551-MS: SOT-23-5
SGM8552-MS: SOP-8
SGM8554-MS: SOP-14

APPLICATIONS

- ADC Buffer
- Audio Equipment
- Medical Instrumentation
- Handheld Test Equipment
- Active Filtering
- Sensor Signal Conditioning

Reference News

| MODEL | Op Temp(°C) | PACKAGE OUTLINE | | Marking | Minimum packaging (PCS) |
|------------|-------------|-----------------|--|---|-------------------------|
| SGM8551-MS | -25°C~125°C | SOT-23-5 |  |  | 3000 |
| SGM8552-MS | -25°C~125°C | SOP-8 |  |  | 2500 |
| SGM8554-MS | -25°C~125°C | SOP-14 |  |  | 2500 |

TYPICAL APPLICATION

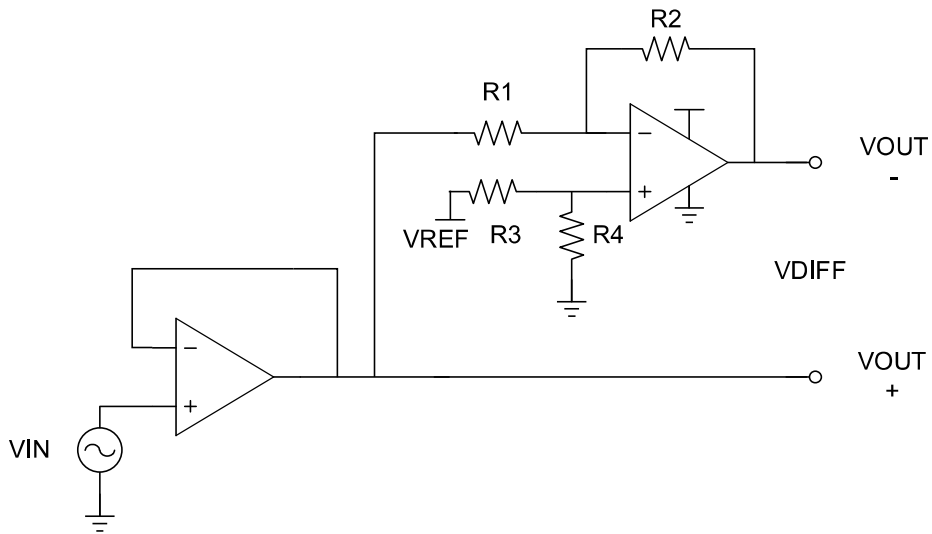
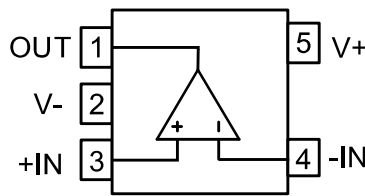


Figure 1. Typical Application

Pin Configuration and Functions (Top View)

Pin Description

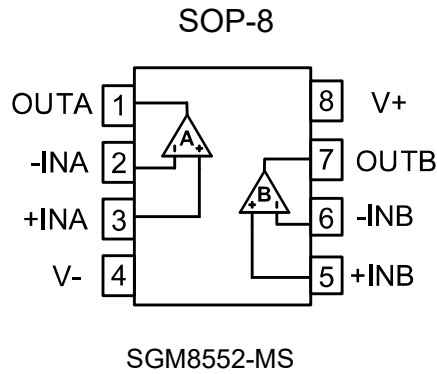
SOT-23-5



SGM8551-MS

| PIN | | I/O | DESCRIPTION |
|------|--------|-----|---------------------------------|
| NAME | Number | | |
| +IN | 3 | I | Positive (noninverting) input |
| -IN | 4 | I | Negative (inverting) input |
| OUT | 1 | O | Output |
| V- | 2 | - | Positive (highest) power supply |
| V+ | 5 | - | Negative (lowest) power supply |

Pin Configuration and Functions (Top View)
Pin Description

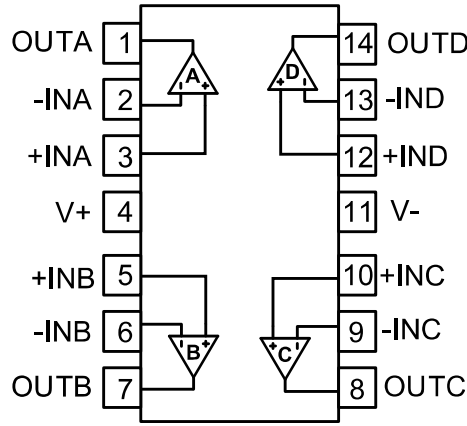


| PIN | | I/O | DESCRIPTION |
|------|--------|-----|---------------------------------|
| NAME | Number | | |
| +INA | 3 | | Noninverting input, channel A |
| +INB | 5 | | Noninverting input, channel B |
| -INA | 2 | | Inverting input, channel A |
| -INB | 6 | | Inverting input, channel B |
| OUTA | 1 | 0 | Output, channel A |
| OUTB | 7 | 0 | Output, channel B |
| V- | 4 | — | Negative (lowest) power supply |
| V+ | 8 | — | Positive (highest) power supply |

Pin Configuration and Functions (Top View)

Pin Description

SOP-14



SGM8554-MS

| PIN | | I/O | DESCRIPTION |
|------|--------|-----|---------------------------------|
| NAME | Number | | |
| +INA | 3 | | Noninverting input, channel A |
| +INB | 5 | | Noninverting input, channel B |
| +INC | 10 | | Noninverting input, channel C |
| +IND | 12 | | Noninverting input, channel D |
| -INA | 2 | | Inverting input, channel A |
| -INB | 6 | | Inverting input, channel B |
| -INC | 9 | | Inverting input, channel C |
| -IND | 13 | | Inverting input, channel D |
| OUTA | 1 | 0 | Output, channel A |
| OUTB | 7 | 0 | Output, channel B |
| OUTC | 8 | 0 | Output, channel C |
| OUTD | 14 | 0 | Output, channel D |
| V- | 4 | | Negative (lowest) power supply |
| V+ | 11 | — | Positive (highest) power supply |

SPECIFICATIONS

Absolute Maximum Ratings⁽¹⁾

| | | MIN | MAX | UNIT |
|---------------|--|------------|------------|------|
| Voltage | Supply Voltage | | 6 | V |
| | Signal Input Terminals Voltage ⁽²⁾ | (V-) - 0.5 | (V+) + 0.5 | V |
| | Signal Input Terminals Voltage ⁽³⁾ | (V-) - 0.5 | (V+) + 0.5 | V |
| Current | Signal Input Terminals Current ⁽²⁾ | -10 | 10 | mA |
| | Signal output Terminals Current ⁽³⁾ | -200 | 200 | mA |
| | Output Short-Circuit ⁽⁴⁾ | Continuous | | |
| θ_{JA} | Operating Temperature Range | -25 | 125 | °C |
| | Storage Temperature Range | -65 | 150 | °C |
| | Junction Temperature | -40 | 150 | °C |

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.

(2) Input terminals are diode clamped to the power-supply rails. Input signals that can swing more than 0.5V beyond the supply rails should be current limited to 10mA or less.

(3) Output terminals are diode-clamped to the power-supply rails. Output signals that can swing more than 0.5V beyond the supply rails should be current-limited to ± 200 mA or less.

(4) Short-circuit to ground, one amplifier per package.

ESD Ratings

| | | | VALUE | UNIT |
|-------------|-------------------------|----------------------------|------------|------|
| $V_{(ESD)}$ | Electrostatic discharge | Human-Body Model (HBM) | ± 4000 | V |
| | | Charged-Device Model (CDM) | ± 500 | V |
| | | Machine Model | 100 | V |

Recommended Operating Conditions

| | | MIN | MAX | UNIT |
|--|---------------|---------|------------|------|
| Supply voltage, $V_S = (V+) - (V-)$ | Single-supply | 2 | 5.5 | V |
| | Dual-supply | ± 1 | ± 2.75 | V |

ELECTRICAL CHARACTERISTICS($V_S = +5V$)

 At $T_A = 25^\circ C$, $V_{CM}=V_{OUT}=V_S/2$, unless otherwise noted.

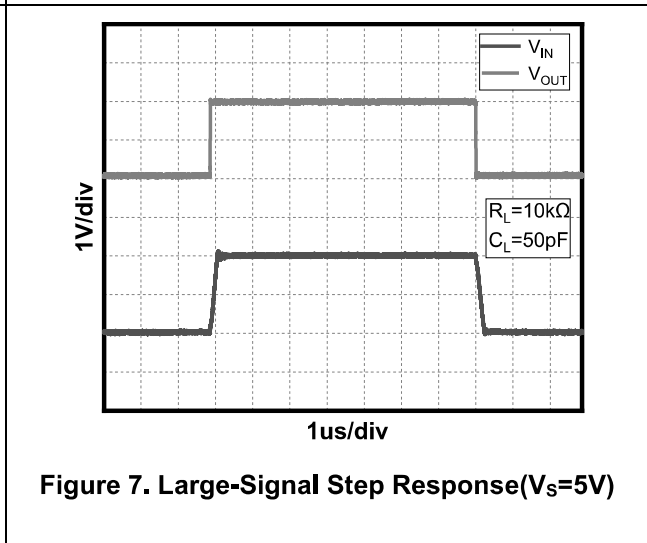
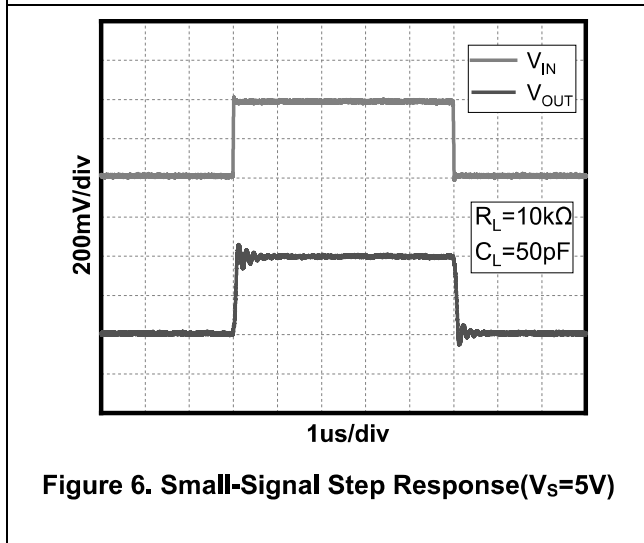
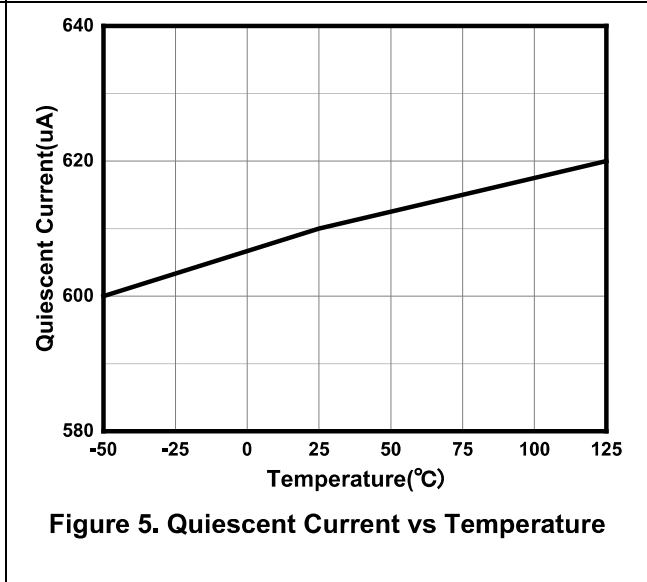
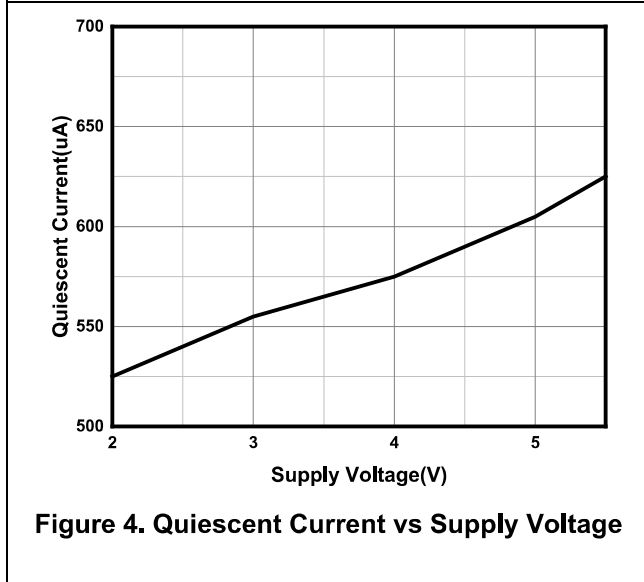
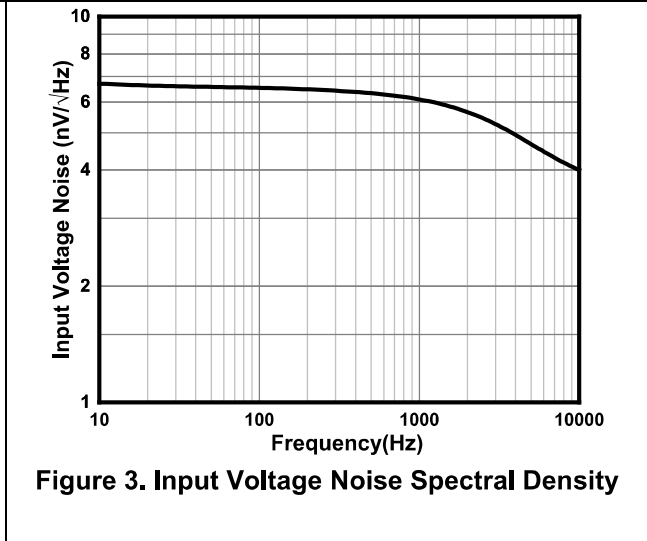
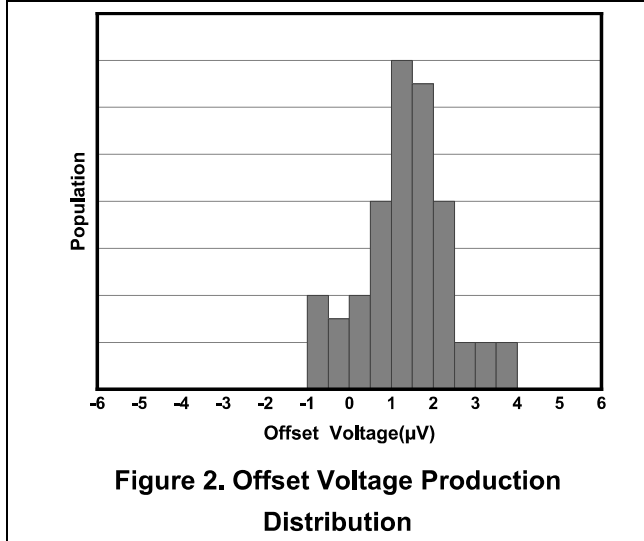
| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNIT |
|---------------------------|------------------------------------|--|-----------|-----------|------------------|
| OFFSET VOLTAGE | | | | | |
| V_{OS} | Input Offset Voltage | | 2 | 10 | μV |
| dV_{OS}/dT | Input Offset Voltage Average Drift | $T_A = -25^\circ C$ to $125^\circ C$ | 0.03 | | $\mu V/^\circ C$ |
| INPUT CURRENT | | | | | |
| I_B | Input Bias Current | | 500 | | pA |
| I_{OS} | Input Offset Current | | 50 | | pA |
| NOISE | | | | | |
| V_N | Input Voltage Noise | $f=0.1Hz$ to $10Hz$ | 0.3 | | μV_{PP} |
| e_n | Input Voltage Noise Density | $f=1kHz$ | 6 | | nV/\sqrt{Hz} |
| INPUT VOLTAGE | | | | | |
| V_{CM} | Common-Mode Voltage Range | | $V_S-0.1$ | $V_S+0.1$ | V |
| CMRR | Common-Mode Rejection Ratio | $V_{CM}=0.1V$ to $4V$ | 110 | 130 | dB |
| FREQUENCY RESPONSE | | | | | |
| GBW | Gain-Bandwidth Product | $C_L=100pF$ | 6 | | MHz |
| SR | Slew Rate | $G = +1$, $V_{IN}=2V$ Step | 5 | | V/us |
| t_s | Settling Time to 0.1% | $G = +1$, $V_{IN}=2V$ Step | 0.7 | | us |
| THD+N | Total Harmonic Distortion +Noise | $G=1, V_O=1V_{RMS}$, $f=1kHz, R_L=10k\Omega$ | 0.0004 | | % |
| OUTPUT | | | | | |
| A_V | Open-Loop Voltage Gain | $V_{OUT}=0.1V$ to $4.9V$ $R_L=10k\Omega$ | 135 | 150 | dB |
| V_{OH} | High output voltage swing | $R_L=10k\Omega$ | 10 | 20 | mV |
| | | $R_L=2k\Omega$ | 50 | 60 | mV |

| | | | | | | |
|-------------------------------|------------------------------|---------------------------------------|-----|-----|-----|----|
| V _{OL} | Low output voltage swing | R _L =10kΩ | | 10 | 20 | mV |
| | | R _L =2kΩ | | 35 | 45 | mV |
| I _{sc} | Output Short-Circuit Current | Source current | | 30 | | mA |
| | | Sink current | | 65 | | mA |
| C _L ⁽¹⁾ | Capacitive Load Drive | G = +1, V _{IN} =0.2V Step | | | 560 | pF |
| POWER SUPPLY | | | | | | |
| PSRR | Power-Supply Rejection Ratio | V _S =1.5V to 5.5V | 110 | 130 | | dB |
| V _S | Operating Voltage Range | | 2 | | 5.5 | V |
| I _Q | Quiescent Current/Amplifier | I _O =0A | | 600 | 700 | uA |

(1) Capacitive load drive means that above a given maximum value, the output waveform will oscillate under the step response.

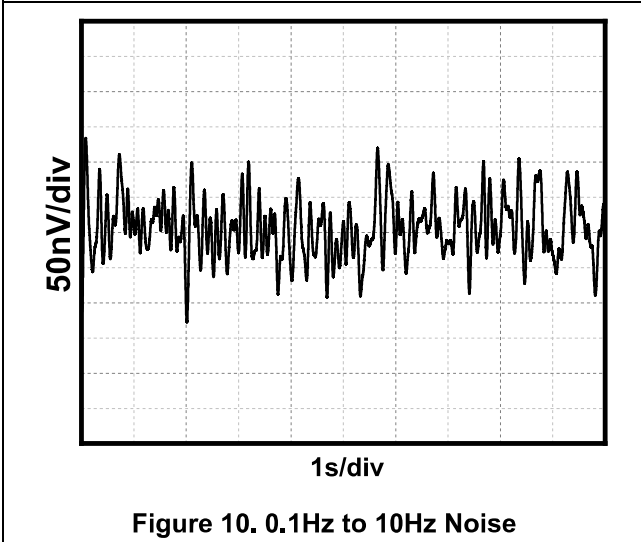
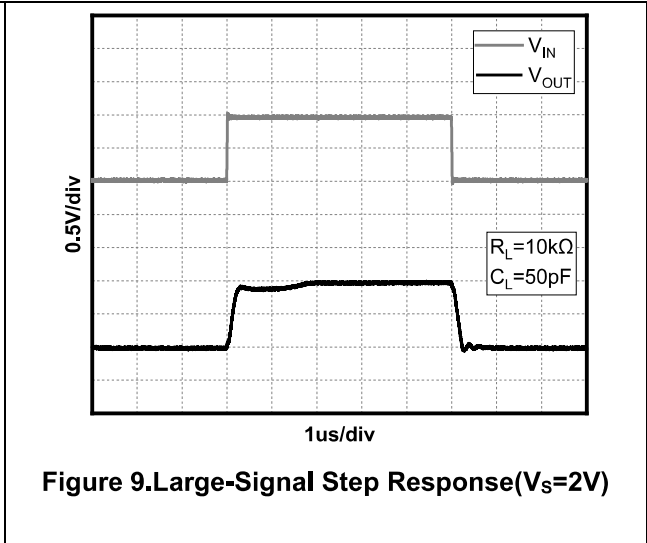
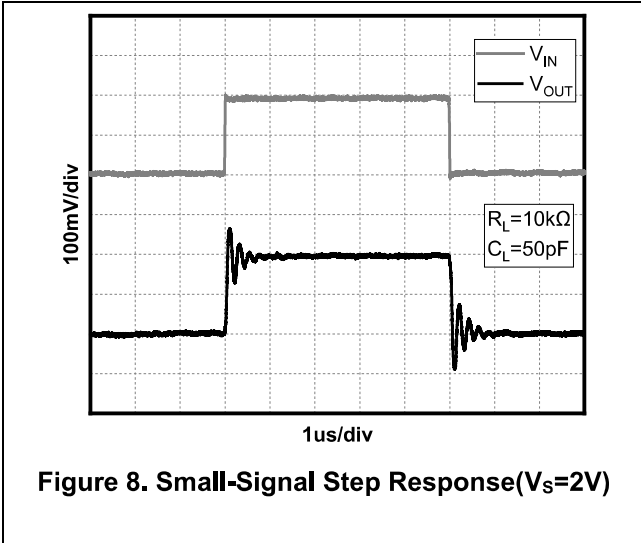
TYPICAL CHARACTERISTICS

At $T_A = 25^\circ\text{C}$, $V_S = +5\text{V}$, $G=+1$, $V_{IN}=V_{OUT}= V_S / 2$, unless otherwise noted.



TYPICAL CHARACTERISTICS

At $T_A = 25^\circ\text{C}$, $V_S = +5\text{V}$, $G=+1$, $V_{IN}=V_{OUT}= V_S / 2$, unless otherwise noted.



Detailed Description

Overview

The SGM8551-MS/SGM8552-MS/SGM8554-MS devices are a low noise, unity-gain stable, rail-to-rail precision operational amplifier that operate in a single-supply voltage range of 2V to 5.5V ($\pm 1V$ to $\pm 2.75V$). A high supply voltage of 6V (absolute maximum) can permanently damage the amplifier. Rail-to-rail input and output wobbles significantly increase the dynamic range, especially in low-supply applications. Good layout practices require that a 0.1 μF capacitor be used where it is tightly threaded through the power supply pin.

Phase Reversal Protection

The SGM8551-MS/SGM8552-MS/SGM8554-MS devices have internal phase-reversal protection. Many

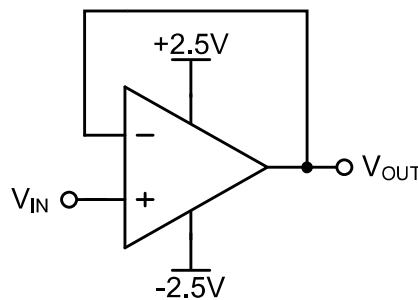
op amps exhibit phase reversal when the input is driven beyond the linear common-mode range. This condition is most often encountered in noninverting circuits when the input is driven beyond the specified common-mode voltage range, causing the output to reverse into the opposite rail. The input of the SGM8551-MS/SGM8552-MS/SGM8554-MS prevents phase reversal with excessive common-mode voltage. Instead, the appropriate rail limits the output voltage.

Typical Applications

1 Voltage Follower

As shown in Figure 11, the voltage gain is 1. With this circuit, the output voltage V_{OUT} is configured to be equal to the input voltage V_{IN} . Due to the high input impedance and low output impedance, the circuit can also stabilize the output voltage, the output voltage expression is

$$V_{OUT} = V_{IN} \quad (1)$$



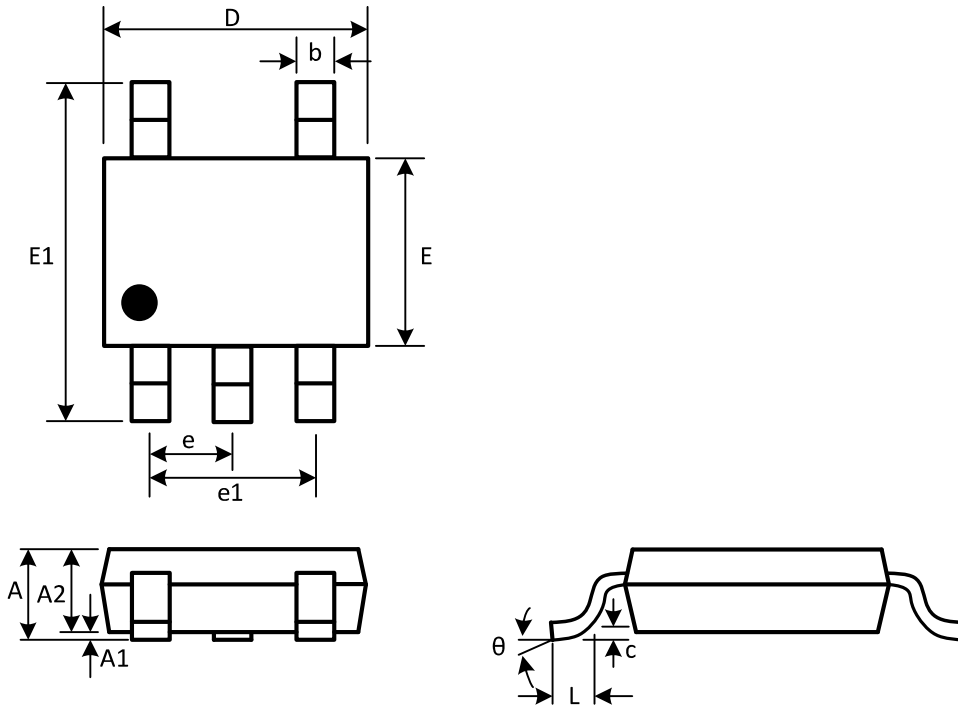
2 Inverting Proportional Amplifier

As shown in Figure 12, for a reverse-phase proportional amplifier, the input voltage V_{IN} is amplified by a voltage gain that depends on the ratio of R_1 to R_2 . The output voltage V_{OUT} is inversely with the input voltage V_{IN} . The input impedance of the circuit is equal to R_1 , and the output voltage expression is

$$V_{OUT} = -\frac{R_2}{R_1} V_{IN} \quad (2)$$

PACKAGE DESCRIPTION

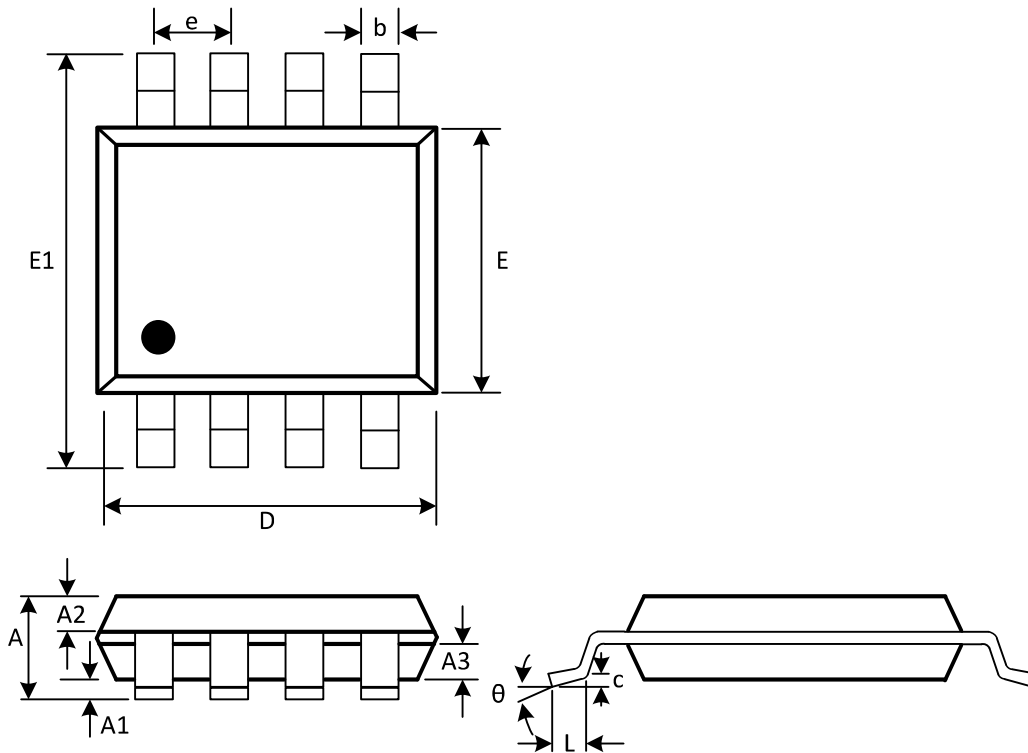
SOT23-5



(Unit: mm)

| Symbol | Min | Max |
|----------|------------|-------|
| A | 1.050 | 1.250 |
| A1 | 0.000 | 0.100 |
| A2 | 1.050 | 1.150 |
| b | 0.300 | 0.500 |
| c | 0.100 | 0.200 |
| D | 2.820 | 3.020 |
| e | 0.950(BSC) | |
| e1 | 1.800 | 2.000 |
| E | 1.500 | 1.700 |
| E1 | 2.650 | 2.950 |
| L | 0.300 | 0.600 |
| θ | 0° | 8° |

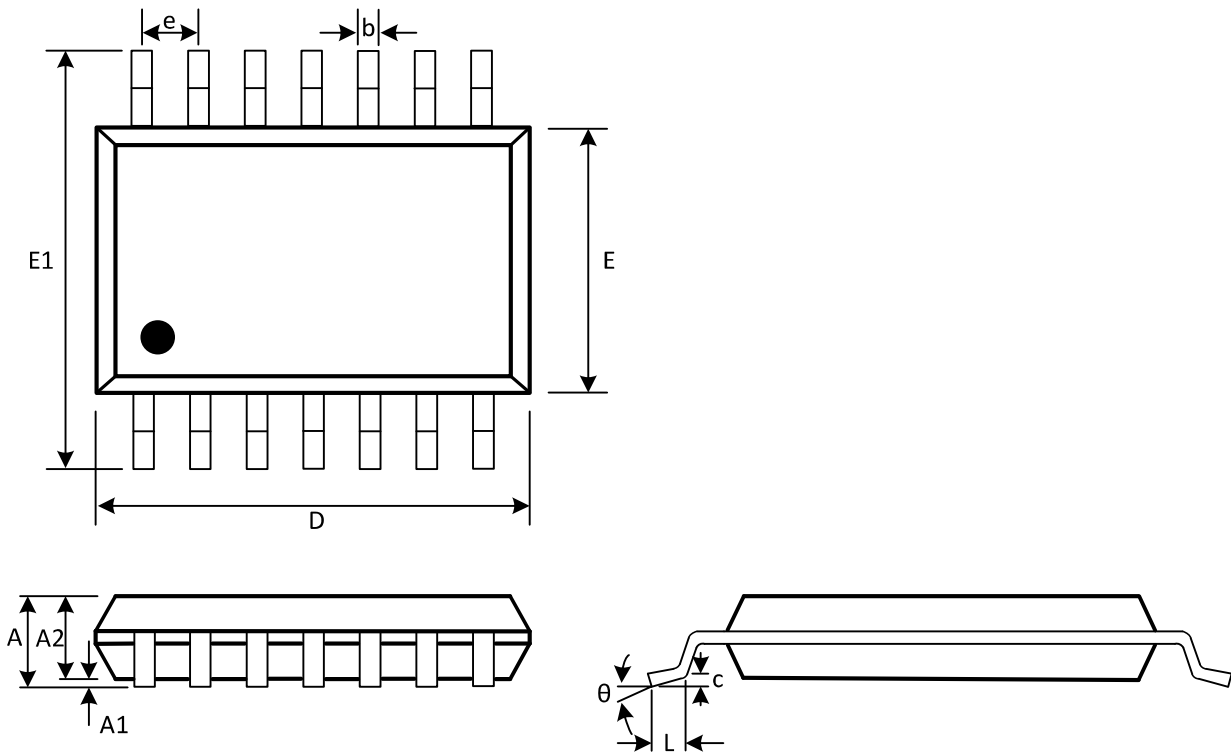
SOP-8



(Unit: mm)

| Symbol | Min | Max |
|----------|------------|-------|
| A | 1.300 | 1.600 |
| A1 | 0.050 | 0.200 |
| A2 | 0.550 | 0.650 |
| A3 | 0.550 | 0.650 |
| b | 0.356 | 0.456 |
| c | 0.203 | 0.233 |
| D | 4.800 | 5.000 |
| e | 1.270(BSC) | |
| E | 3.800 | 4.000 |
| E1 | 5.800 | 6.200 |
| L | 0.400 | 0.800 |
| θ | 0° | 8° |

SOP-14



(Unit: mm)

| Symbol | Min | Max |
|----------|------------|-------|
| A | 1.350 | 1.750 |
| A1 | 0.100 | 0.250 |
| A2 | 1.350 | 1.550 |
| b | 0.310 | 0.510 |
| c | 0.100 | 0.250 |
| D | 8.450 | 8.850 |
| e | 1.270(BSC) | |
| E | 5.800 | 6.200 |
| E1 | 3.800 | 4.000 |
| L | 0.400 | 1.270 |
| θ | 0° | 8° |

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