



# SGM8558-1/SGM8558-2/SGM8558-3/SGM8558-4

## 15MHz, 8V/ $\mu$ s, High Output Drive, High Precision, Low Noise Operational Amplifiers

### GENERAL DESCRIPTION

The SGM8558-1 (single), SGM8558-2 (dual), SGM8558-3 (single with shutdown), and SGM8558-4 (quad) are low noise, high precision CMOS operational amplifiers that provide a high output current of 230mA, rail-to-rail output operation from a range of 2.8V to 5.5V single supply. The SGM8558-3 is available with shutdown pins that drive the output voltage low.

The SGM8558-1/2/3/4 offer low input offset voltage, low input offset voltage drift and high output current drive. These devices also can achieve a high 15MHz gain-bandwidth product and a high 8V/ $\mu$ s slew rate.

The SGM8558-1/2/3/4 are specifically designed to drive high current load, such as 32 $\Omega$  headset,  $V_{BIAS}$  of RF power amplifier, etc.

The SGM8558-1 is available in Green SOIC-8 and SOT-23-5 packages. The SGM8558-2 is available in Green TDFN-3 $\times$ 3-8L and SOIC-8 packages. The SGM8558-3 is available in a Green SOT-23-6 package. The SGM8558-4 is available in a Green SOIC-14 package. They operate over an ambient temperature range of -40 $^{\circ}$ C to +125 $^{\circ}$ C.

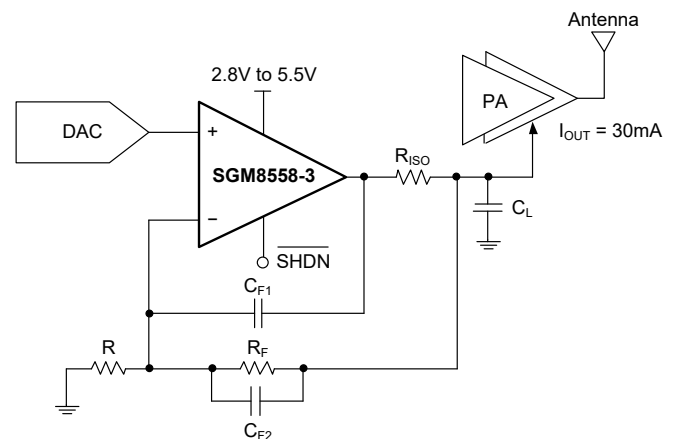
### APPLICATIONS

- Battery-Powered Equipment
- Audio System
- Optical Module
- DAC Buffer
- Industrial Equipment

### FEATURES

- **Output Drive Capability: 230mA**
- **Low Input Offset Voltage: 15 $\mu$ V (MAX)**
- **Low Noise: 8nV/ $\sqrt{\text{Hz}}$  at 1kHz**
- **Unity-Gain Stable for Capacitive Loads to 780pF**
- **Gain-Bandwidth Product: 15MHz**
- **High Slew Rate: 8V/ $\mu$ s**
- **Open-Loop Voltage Gain ( $R_L = 2\text{k}\Omega$ ): 139dB**
- **Power Supply Rejection Ratio: 130dB**
- **Current Limitation: 230mA**
- **Over-Temperature Protection**
- **No Phase Reversal for Overdriven Inputs**
- **Supply Voltage Range: 2.8V to 5.5V**
- **Supply Current:**
  - **0.86mA/Amplifier (TYP)**
  - **0.2 $\mu$ A (TYP) Shutdown Current for SGM8558-3**
- **-40 $^{\circ}$ C to +125 $^{\circ}$ C Operating Temperature Range**
- **Small Packaging:**
  - **SGM8558-1 Available in Green SOIC-8 and SOT-23-5 Packages**
  - **SGM8558-2 Available in Green TDFN-3 $\times$ 3-8L and SOIC-8 Packages**
  - **SGM8558-3 Available in a Green SOT-23-6 Package**
  - **SGM8558-4 Available in a Green SOIC-14 Package**

### TYPICAL APPLICATION



**PACKAGE/ORDERING INFORMATION**

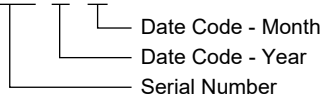
| MODEL     | PACKAGE DESCRIPTION | SPECIFIED TEMPERATURE RANGE | ORDERING NUMBER    | PACKAGE MARKING          | PACKING OPTION      |
|-----------|---------------------|-----------------------------|--------------------|--------------------------|---------------------|
| SGM8558-1 | SOIC-8              | -40°C to +125°C             | SGM8558-1XS8G/TR   | SGM<br>85581XS8<br>XXXXX | Tape and Reel, 2500 |
|           | SOT-23-5            | -40°C to +125°C             | SGM8558-1XN5G/TR   | GFBXX                    | Tape and Reel, 3000 |
| SGM8558-2 | TDFN-3x3-8L         | -40°C to +125°C             | SGM8558-2XTDB8G/TR | SGM<br>85582DB<br>XXXXX  | Tape and Reel, 4000 |
|           | SOIC-8              | -40°C to +125°C             | SGM8558-2XS8G/TR   | SGM<br>85582XS8<br>XXXXX | Tape and Reel, 2500 |
| SGM8558-3 | SOT-23-6            | -40°C to +125°C             | SGM8558-3XN6G/TR   | GFCXX                    | Tape and Reel, 3000 |
| SGM8558-4 | SOIC-14             | -40°C to +125°C             | SGM8558-4XS14G/TR  | SGM85584XS14<br>XXXXX    | Tape and Reel, 2500 |

**MARKING INFORMATION**

NOTE: XX = Date Code. XXXXX = Date Code and Vendor Code.

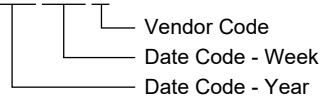
**SOT-23-5/SOT-23-6**

**YYY X X**



**SOIC-8/TDFN-3x3-8L/SOIC-14**

**XXXXX**



Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

**ABSOLUTE MAXIMUM RATINGS**

- Supply Voltage, +V<sub>s</sub> to -V<sub>s</sub>.....6V
- All Other Pins..... (-V<sub>s</sub>) - 0.3V to (+V<sub>s</sub>) + 0.3V
- Junction Temperature .....+150°C
- Storage Temperature Range.....-65°C to +150°C
- Lead Temperature (Soldering, 10s) .....+260°C
- ESD Susceptibility
- HBM..... 8000V
- MM..... 400V
- CDM ..... 1000V

**RECOMMENDED OPERATING CONDITIONS**

- Operating Temperature Range .....-40°C to +125°C
- Operating Supply Voltage Range.....2.8V to 5.5V

**OVERSTRESS CAUTION**

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods

may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

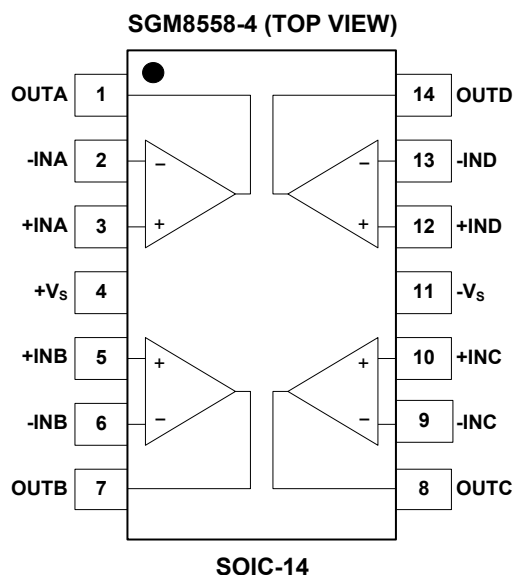
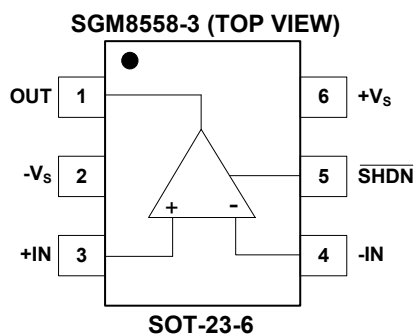
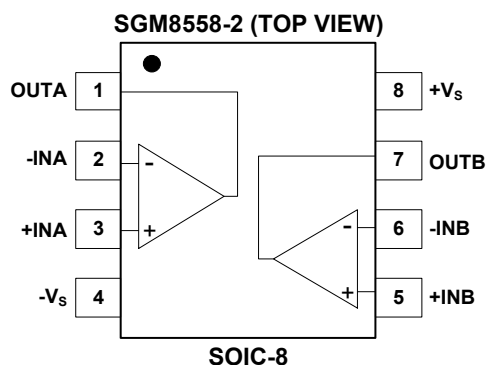
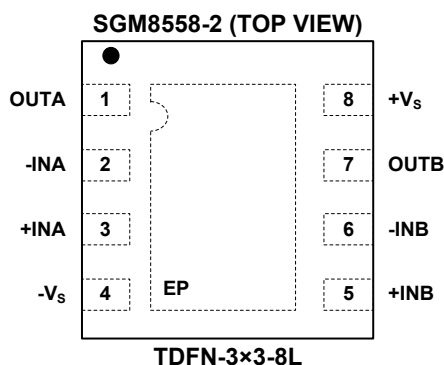
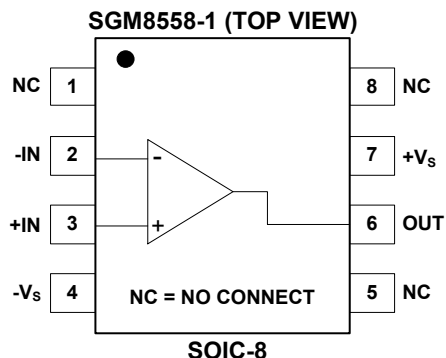
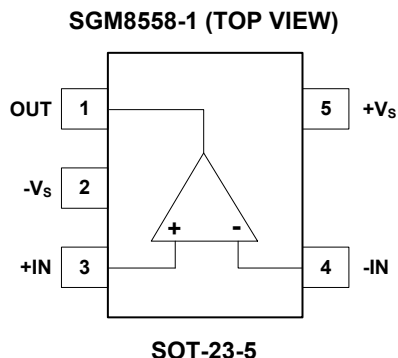
**ESD SENSITIVITY CAUTION**

This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO 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 even small parametric changes could cause the device not to meet the published specifications.

**DISCLAIMER**

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

## PIN CONFIGURATIONS



NOTE: For the TDFN-3x3-8L package, the exposed pad must be connected to  $-V_s$  or left floating. Connect it to  $-V_s$  plane can maximize thermal performance.

## ELECTRICAL CHARACTERISTICS

( $+V_S = 2.8V$ ,  $-V_S = 0V$ ,  $V_{CM} = +V_S/2$ ,  $V_{OUT} = +V_S/2$ , Full =  $-40^\circ C$  to  $+125^\circ C$ , typical values are at  $T_A = +25^\circ C$ , unless otherwise noted.)

| PARAMETER                                    | CONDITIONS  | TEMP          | MIN            | TYP | MAX            | UNITS          |
|--|---|---------------|----------------|-----|----------------|----------------|
| <b>Input Characteristics</b>                 |   |               |                |     |                |                |
| Input Offset Voltage ( $V_{OS}$ )            |   | $+25^\circ C$ |                | 1.5 | 15             | $\mu V$        |
| Input Common Mode Voltage Range ( $V_{CM}$ ) |   | Full          | $(-V_S) - 0.1$ |     | $(+V_S) + 0.1$ | V              |
| Common Mode Rejection Ratio (CMRR)           | $(-V_S) - 0.1V < V_{CM} < (+V_S) + 0.1V$                      | $+25^\circ C$ | 96             | 118 |                | dB             |
|  |   | Full          | 90             |     |                |                |
| Open-Loop Voltage Gain ( $A_{OL}$ )          | $(-V_S) + 0.3V < V_{OUT} < (+V_S) - 0.3V$ , $R_L = 2k\Omega$  | $+25^\circ C$ | 108            | 131 |                | dB             |
|  |   | Full          | 105            |     |                |                |
|  | $(-V_S) + 0.3V < V_{OUT} < (+V_S) - 0.3V$ , $R_L = 200\Omega$ | $+25^\circ C$ | 106            | 130 |                |                |
|  |   | Full          | 103            |     |                |                |
| <b>Output Characteristics</b>                |   |               |                |     |                |                |
| Output Voltage Swing from Rail               | $R_L = 2k\Omega$  | $+25^\circ C$ |                | 5   | 11             | mV             |
|  |   | Full          |                |     | 12             |                |
|  | $R_L = 200\Omega$   | $+25^\circ C$ |                | 45  | 55             |                |
|  |   | Full          |                |     | 66             |                |
| Output Short-Circuit Current ( $I_{SC}$ )    |   | $+25^\circ C$ | 96             | 120 |                | mA             |
|  |   | Full          | 75             |     |                |                |
| <b>Power Supply</b>                          |   |               |                |     |                |                |
| Specified Voltage Range ( $V_S$ )            |   | Full          | 2.8            |     | 5.5            | V              |
| Quiescent Current/Amplifier ( $I_Q$ )        | $I_{OUT} = 0A$  | $+25^\circ C$ |                | 827 | 1250           | $\mu A$        |
|  |   | Full          |                |     | 1450           |                |
| Power Supply Rejection Ratio (PSRR)          | $V_S = 2.8V$ to $5.5V$ , $V_{CM} = 0.2V$                      | $+25^\circ C$ | 102            | 130 |                | dB             |
|  |   | Full          | 100            |     |                |                |
| <b>Dynamic Performance</b>                   |   |               |                |     |                |                |
| Gain-Bandwidth Product                       | $G = +100$  | $+25^\circ C$ |                | 14  |                | MHz            |
| Slew Rate                                    | $G = +1$ , $V_{OUT} = 2V_{P-P}$                               | $+25^\circ C$ |                | 8   |                | V/ $\mu s$     |
| <b>Noise</b>                                 |   |               |                |     |                |                |
| Input Voltage Noise                          | $f = 0.1Hz$ to $10Hz$   | $+25^\circ C$ |                | 0.3 |                | $\mu V_{P-P}$  |
| Input Voltage Noise Density                  | $f = 1kHz$  | $+25^\circ C$ |                | 11  |                | $nV/\sqrt{Hz}$ |
|  | $f = 10kHz$   | $+25^\circ C$ |                | 11  |                |                |

## ELECTRICAL CHARACTERISTICS (continued)

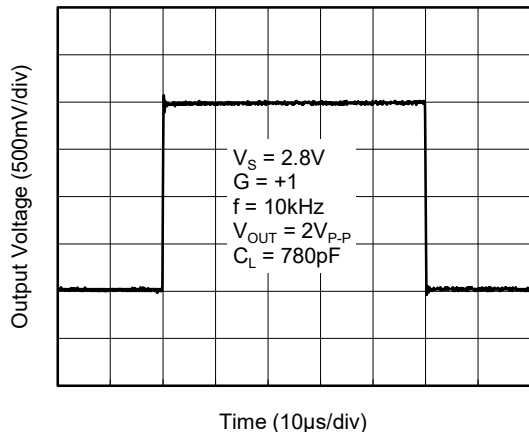
( $+V_S = 5V$ ,  $-V_S = 0V$ ,  $V_{CM} = +V_S/2$ ,  $V_{OUT} = +V_S/2$ , Full =  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ , typical values are at  $T_A = +25^\circ\text{C}$ , unless otherwise noted.)

| PARAMETER   | CONDITIONS  | TEMP                | MIN                 | TYP | MAX            | UNITS                        |
|---|---|---------------------|---------------------|-----|----------------|------------------------------|
| <b>Input Characteristics</b>                            |   |                     |                     |     |                |                              |
| Input Offset Voltage ( $V_{OS}$ )                       |   | $+25^\circ\text{C}$ |                     | 1.5 | 15             | $\mu\text{V}$                |
| Input Offset Voltage Drift ( $\Delta V_{OS}/\Delta T$ ) |   | Full                |                     | 13  | 66             | $\text{nV}/^\circ\text{C}$   |
| Input Bias Current ( $I_B$ )                            |   | $+25^\circ\text{C}$ |                     | 0.6 | 3              | $\text{nA}$                  |
| Input Offset Current ( $I_{OS}$ )                       |   | $+25^\circ\text{C}$ |                     | 1.2 | 5.2            | $\text{nA}$                  |
| Input Common Mode Voltage Range ( $V_{CM}$ )            |   | Full                | $(-V_S) - 0.1$      |     | $(+V_S) + 0.1$ | V                            |
| Common Mode Rejection Ratio (CMRR)                      | $(-V_S) - 0.1V < V_{CM} < (+V_S) + 0.1V$                            | $+25^\circ\text{C}$ | 102                 | 126 |                | dB                           |
|   |   | Full                | 97                  |     |                |                              |
| Open-Loop Voltage Gain ( $A_{OL}$ )                     | $(-V_S) + 0.3V < V_{OUT} < (+V_S) - 0.3V$ , $R_L = 2\text{k}\Omega$ | $+25^\circ\text{C}$ | 116                 | 139 |                | dB                           |
|   |   | Full                | 113                 |     |                |                              |
|   | $(-V_S) + 0.3V < V_{OUT} < (+V_S) - 0.3V$ , $R_L = 200\Omega$       | $+25^\circ\text{C}$ | 114                 | 136 |                |                              |
|   |   | Full                | 110                 |     |                |                              |
| <b>Output Characteristics</b>                           |   |                     |                     |     |                |                              |
| Output Voltage Swing from Rail                          | $R_L = 2\text{k}\Omega$   | $+25^\circ\text{C}$ |                     | 7   | 16             | mV                           |
|   |   | Full                |                     |     | 18             |                              |
|   | $R_L = 200\Omega$   | $+25^\circ\text{C}$ |                     | 63  | 88             |                              |
|   |   | Full                |                     |     | 104            |                              |
| Output Short-Circuit Current ( $I_{SC}$ )               |   | $+25^\circ\text{C}$ | 193                 | 230 |                | mA                           |
|   |   | Full                | 173                 |     |                |                              |
| <b>Power-Down Disable (SGM8558-3 Only)</b>              |   |                     |                     |     |                |                              |
| Logic Threshold   | $V_{IH}$  | Normal mode         | $+25^\circ\text{C}$ | 2.0 |                | V                            |
|   | $V_{IL}$  | Shutdown mode       | $+25^\circ\text{C}$ |     | 0.8            |                              |
| Shutdown Supply Current                                 | $V_{EN} = 0V$   | $+25^\circ\text{C}$ |                     | 0.2 | 1.5            | $\mu\text{A}$                |
| <b>Power Supply</b>                                     |   |                     |                     |     |                |                              |
| Specified Voltage Range ( $V_S$ )                       |   | Full                | 2.8                 |     | 5.5            | V                            |
| Quiescent Current/Amplifier ( $I_Q$ )                   | $I_{OUT} = 0A$  | $+25^\circ\text{C}$ |                     | 860 | 1280           | $\mu\text{A}$                |
|   |   | Full                |                     |     | 1500           |                              |
| <b>Dynamic Performance</b>                              |   |                     |                     |     |                |                              |
| Gain-Bandwidth Product                                  | $G = +100$  | $+25^\circ\text{C}$ |                     | 15  |                | MHz                          |
| Slew Rate   | $G = +1$ , $V_{OUT} = 2V_{P-P}$                                     | $+25^\circ\text{C}$ |                     | 8   |                | $\text{V}/\mu\text{s}$       |
| <b>Noise</b>  |   |                     |                     |     |                |                              |
| Input Voltage Noise                                     | $f = 0.1\text{Hz}$ to $10\text{Hz}$                                 | $+25^\circ\text{C}$ |                     | 0.2 |                | $\mu\text{V}_{P-P}$          |
| Input Voltage Noise Density                             | $f = 1\text{kHz}$   | $+25^\circ\text{C}$ |                     | 8   |                | $\text{nV}/\sqrt{\text{Hz}}$ |
|   | $f = 10\text{kHz}$  | $+25^\circ\text{C}$ |                     | 8   |                |                              |

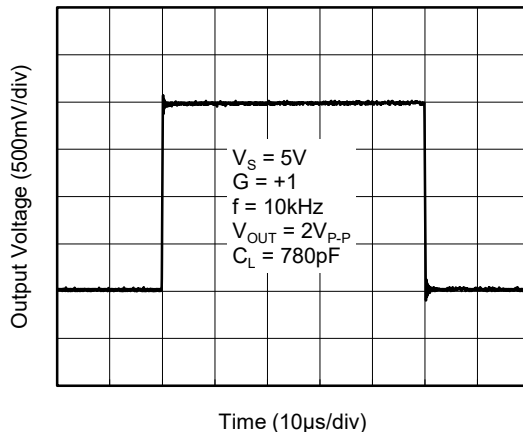
## TYPICAL PERFORMANCE CHARACTERISTICS

At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ , unless otherwise noted.

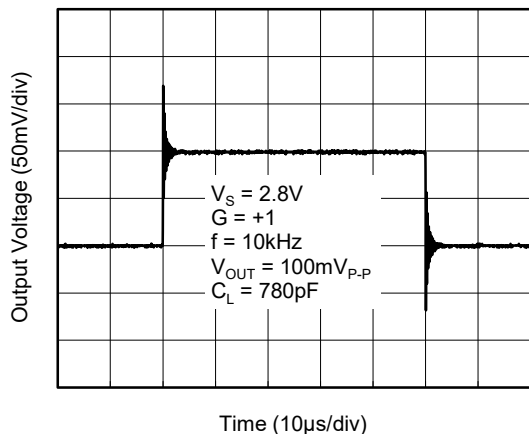
Large-Signal Transient Response with Capacitive Load



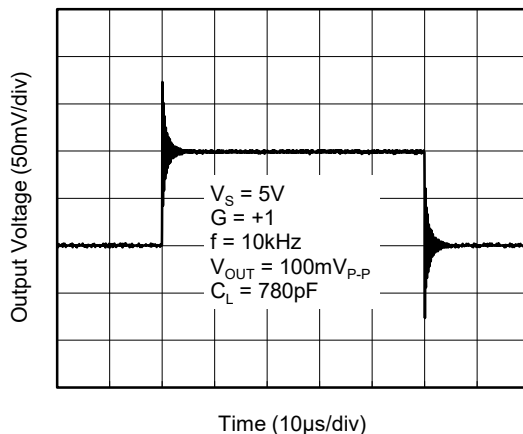
Large-Signal Transient Response with Capacitive Load



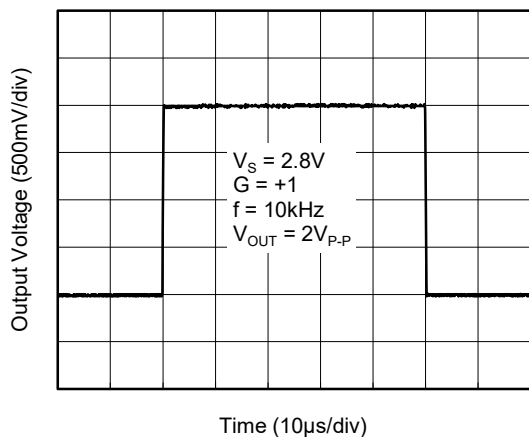
Small-Signal Transient Response with Capacitive Load



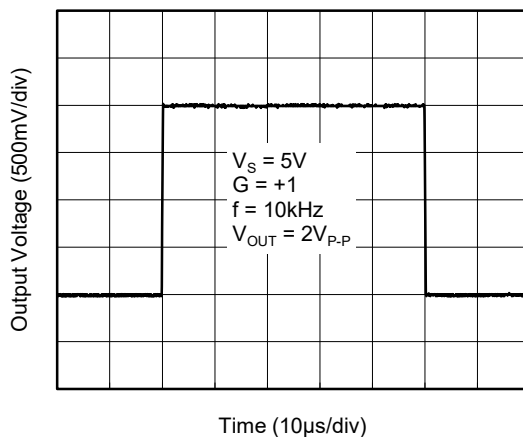
Small-Signal Transient Response with Capacitive Load



Large-Signal Step Response



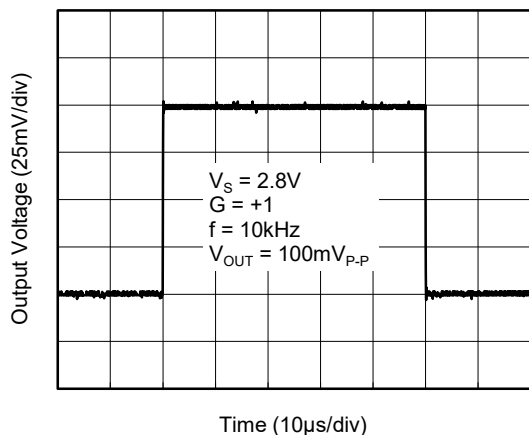
Large-Signal Step Response



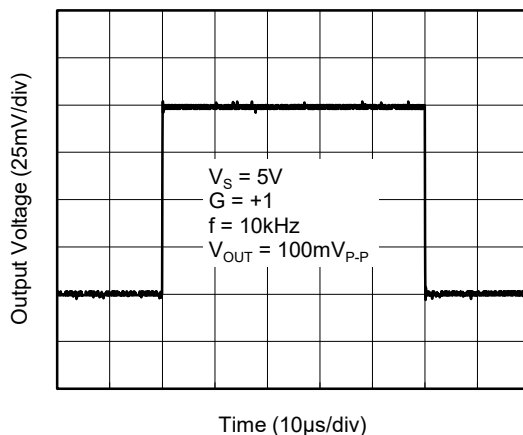
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ , unless otherwise noted.

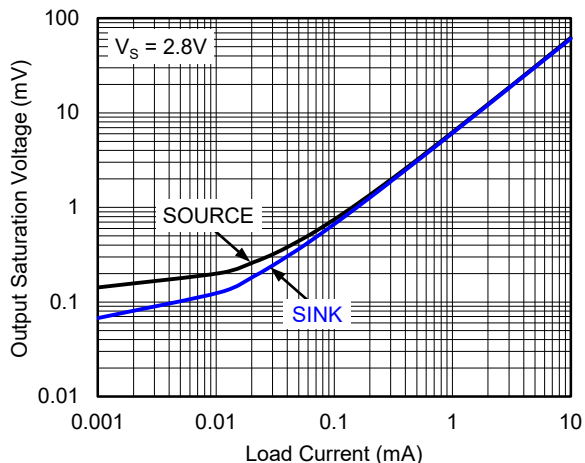
Small-Signal Step Response



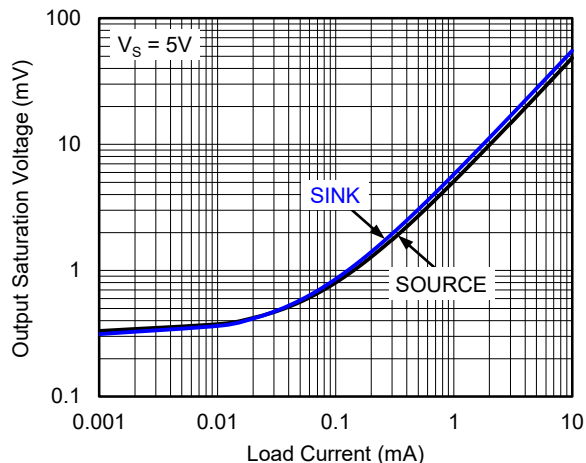
Small-Signal Step Response



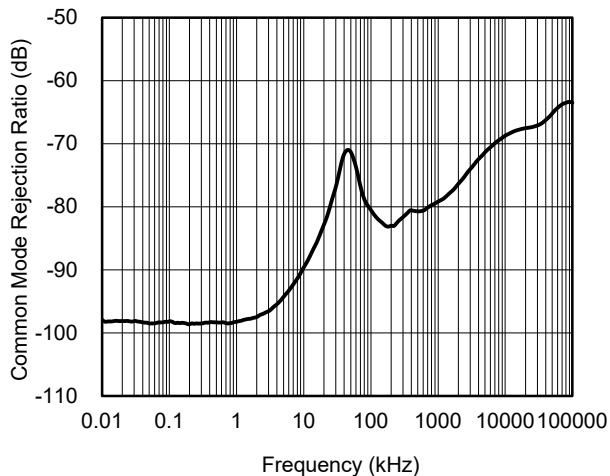
Output Saturation Voltage vs. Load Current



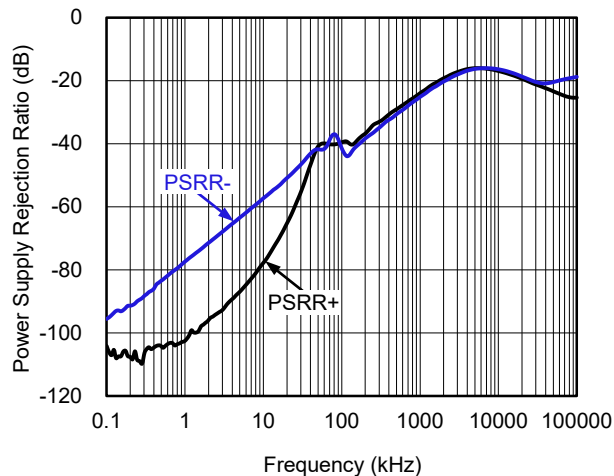
Output Saturation Voltage vs. Load Current



CMRR vs. Frequency

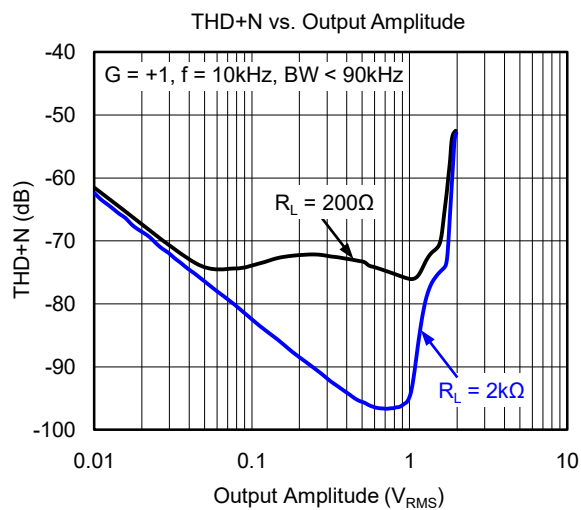
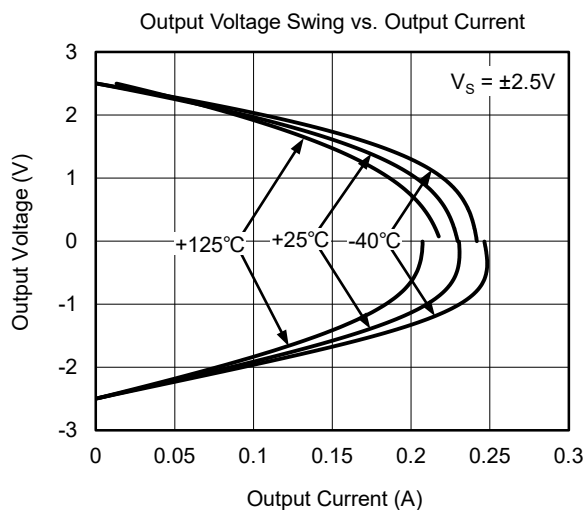
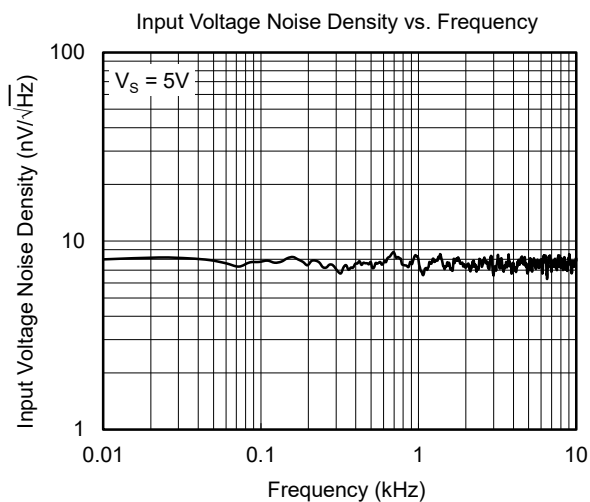
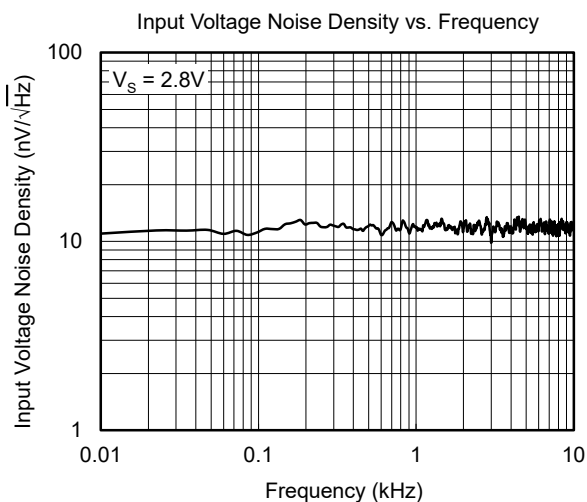
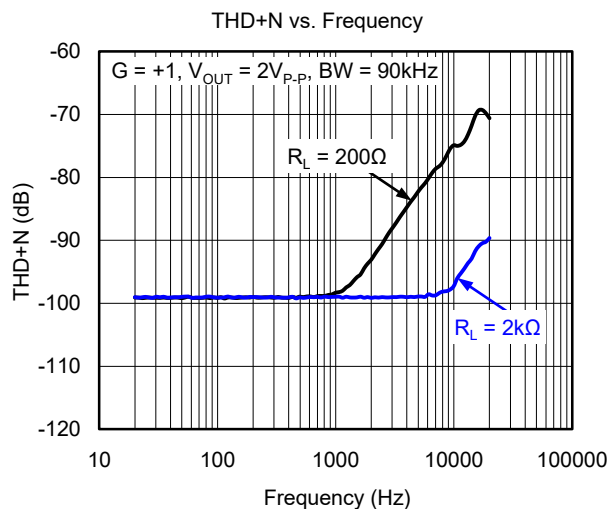
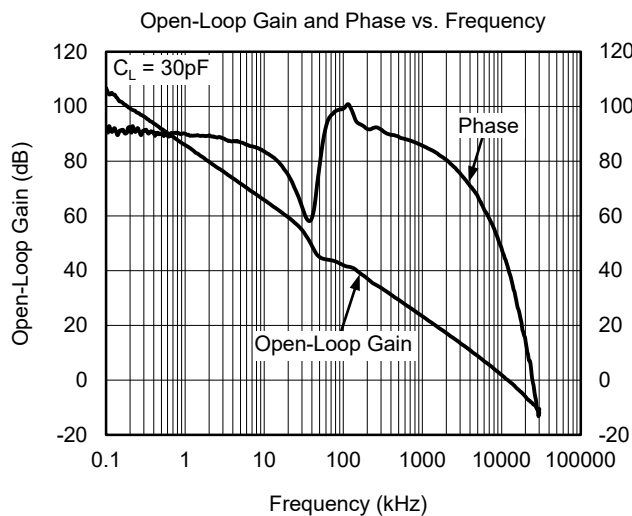


PSRR vs. Frequency



## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

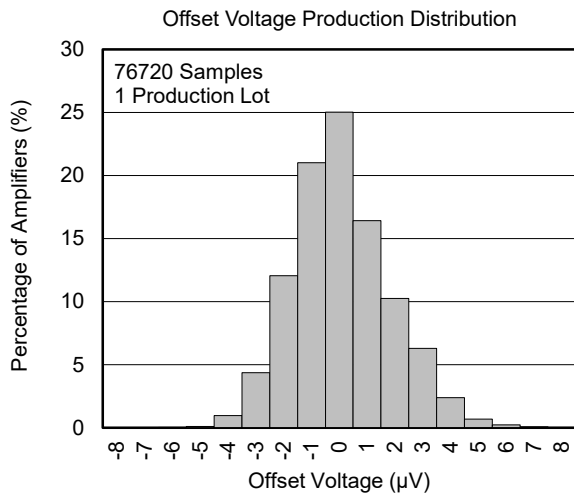
At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ , unless otherwise noted.





## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ , unless otherwise noted.



## APPLICATION INFORMATION

### Single-Supply Stereo Headphone Driver

A single-supply stereo headphone driver is shown in Figure 1 as an example to explain the simplified design procedure.

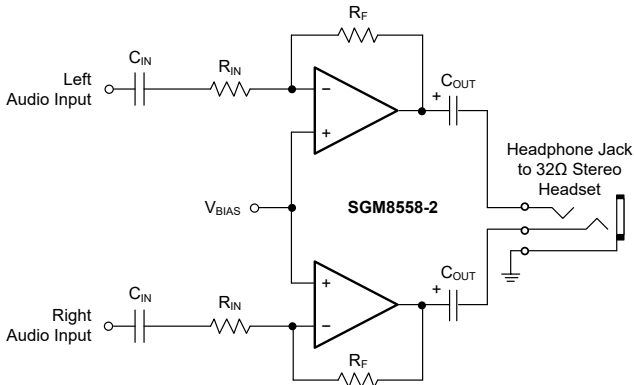


Figure 1. Stereo Headphone Driver

In this circuit,  $C_{IN}$  and  $R_{IN}$  form a high-pass filter, the DC bias is removed from the incoming signal. The -3dB point of the high-pass filter is using Equation 1:

$$f_{-3dB} = \frac{1}{2\pi R_{IN} C_{IN}} \quad (1)$$

The gain of driver is  $-R_F/R_{IN}$ . The  $C_{OUT}$  and the load impedance form a high-pass filter with the -3dB point determined by Equation 2:

$$f_{-3dB} = \frac{1}{2\pi R_L C_{OUT}} \quad (2)$$

### Bridge Amplifier

A bridge amplifier circuit which can provide 200mW at 3V is shown in Figure 2. Due to differential output, this structure eliminates the large coupling capacitors in Figure 1. The voltage gain is 10V/V and the gain can be changed by changing  $R_2$ .

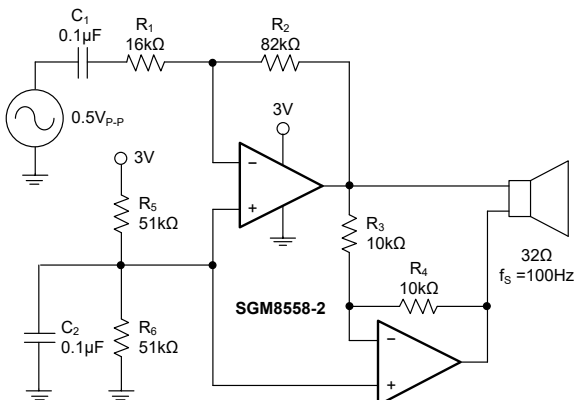


Figure 2. 200mW Bridge Amplifier at 3V

### Cancel Input Capacitance

The  $C_{IN}$  (20pF TYP) at inverting input pin will generate a pole at frequency  $(2\pi R' C_{IN})^{-1}$ , where  $R'$  is the parallel combination of the gain-setting resistor for the inverting or non-inverting amplifier in Figure 3. If the pole-frequency is less than or comparable to the unity-gain bandwidth (15MHz), the phase margin will be reduced, ringing in the step response or sustained oscillation will be generated. To cancel this pole,  $C_F$  is used to compensate  $C_{IN}$  in Figure 3. Equation 3 gives the  $C_F$  feedback capacitance.

$$C_F = 8 \times (R/R_F) \text{ pF} \quad (3)$$

where:

$R_F$  is the feedback resistor.

$R$  is the gain-setting resistor.

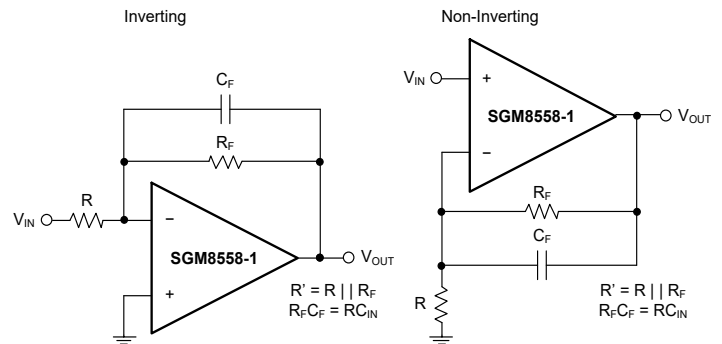


Figure 3. Inverting and Non-Inverting Amplifiers with  $C_F$  to Compensate  $C_{IN}$

### Input Current-Limit Protection

For ESD diode clamping protection, when the current flowing through ESD diode exceeds the maximum rating value, the ESD diode and amplifier will be damaged, so current-limit protection will be added in some applications. One resistor is selected to limit the current not to exceed the maximum rating value. In Figure 4, a series input resistor is used to limit the input current to less than 10mA, but the drawback of this current-limit resistor is to contribute thermal noise at the amplifier input. If this resistor must be added, its value must be selected as small as possible.

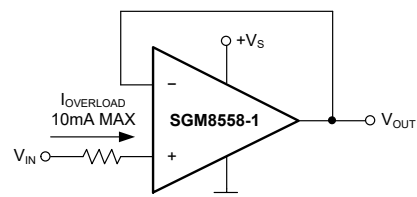


Figure 4. Input Current-Limit Protection

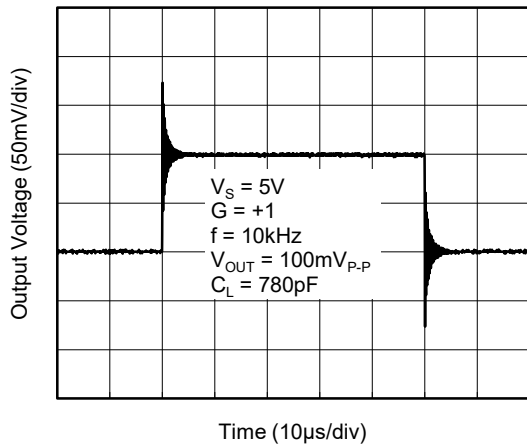
**APPLICATIONS INFORMATION (continued)**

**Rail-to-Rail Output**

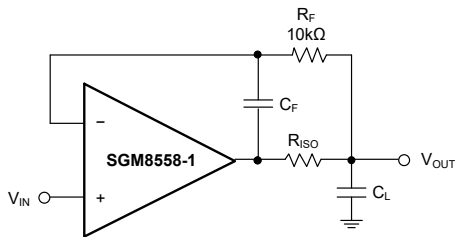
The SGM8558-1/2/3/4 support rail-to-rail output operation. In single power supply application, for example, when  $+V_S = 5V$ ,  $-V_S = GND$ ,  $2k\Omega$  load resistor is tied from OUT pin to  $V_S/2$ , the typical output swing range is from 0.007V to 4.993V.

**Driving Capacitive Loads**

The SGM8558-1/2/3/4 are designed for unity-gain stable for capacitive load up to 780pF. In Figure 5, it shows the transient response with capacitive load ( $C_L$ ). If greater capacitive load must be driven in application, the circuit in Figure 6 can be used. In this circuit, the IR drop voltage generated by  $R_{ISO}$  is compensated by feedback loop.



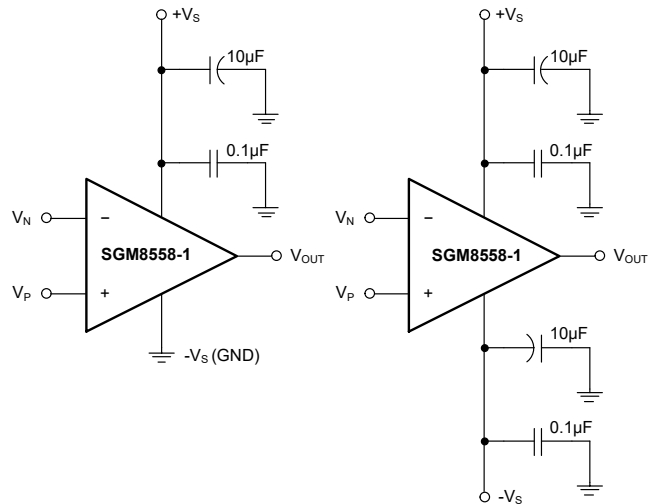
**Figure 5. Small-Signal Transient Response (Capacitive Load)**



**Figure 6. Circuit to Drive Capacitive Load**

**Power Supply Decoupling and Layout**

A clean and low noise power supply is very important in amplifier circuit design, besides of input signal noise, the power supply is one of important source of noise to the amplifiers through  $+V_S$  and  $-V_S$  pins. Power supply bypassing is an effective method to clear up the noise at power supply, and the low impedance path to ground of decoupling capacitor will bypass the noise to GND. In application,  $10\mu F$  ceramic capacitor paralleled with  $0.1\mu F$  or  $0.01\mu F$  ceramic capacitor is used in Figure 7. The ceramic capacitors should be placed as close as possible to  $+V_S$  and  $-V_S$  power supply pins.



**Figure 7. Amplifier Power Supply Bypassing**

## REVISION HISTORY

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| <b>AUGUST 2022 – REV.A.2 to REV.A.3</b>                   | <b>Page</b> |
|---|-------------|
| Updated Electrical Characteristics section .....          | 4, 5        |
| Updated Typical Performance Characteristics section ..... | 7, 8        |

---

| <b>MARCH 2022 – REV.A.1 to REV.A.2</b>                    | <b>Page</b> |
|---|-------------|
| Updated Typical Performance Characteristics section ..... | 8           |

---

| <b>JANUARY 2019 – REV.A to REV.A.1</b> | <b>Page</b> |
|--|-------------|
| Changed Figure 2.....                  | 10          |

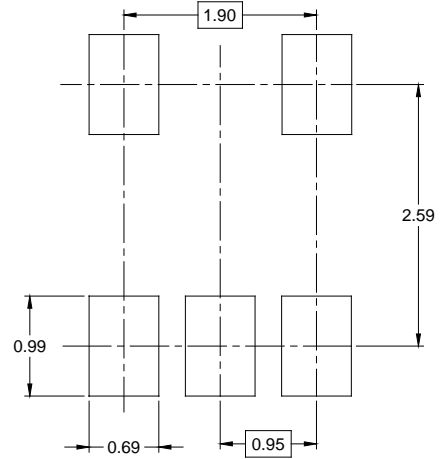
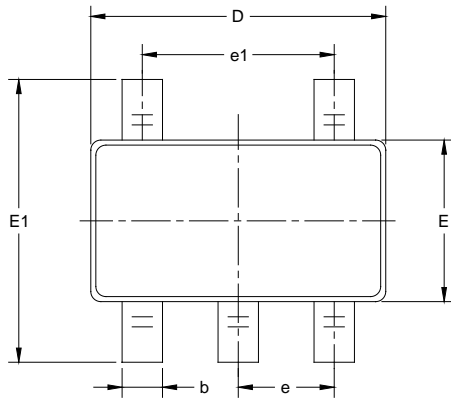
---

| <b>Changes from Original (SEPTEMBER 2018) to REV.A</b> | <b>Page</b> |
|--|-------------|
| Changed from product preview to production data.....   | All         |

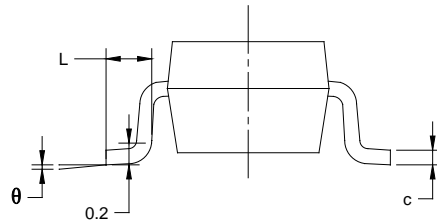
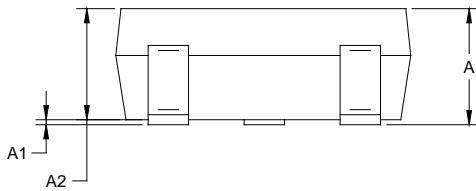
---

PACKAGE OUTLINE DIMENSIONS

SOT-23-5



RECOMMENDED LAND PATTERN (Unit: mm)



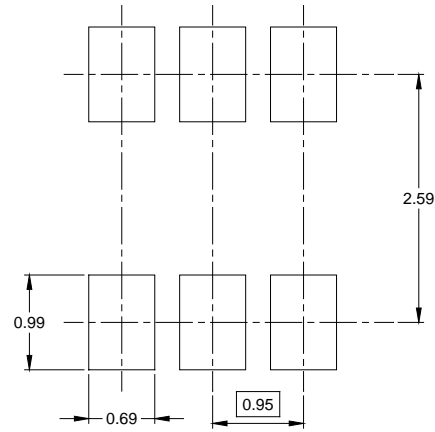
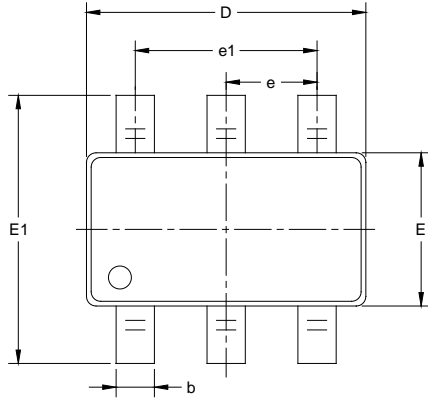
| Symbol   | Dimensions<br>In Millimeters |       | Dimensions<br>In Inches |       |
|----------|------------------------------|-------|-------------------------|-------|
|          | MIN                          | MAX   | MIN                     | MAX   |
| A        | 1.050                        | 1.250 | 0.041                   | 0.049 |
| A1       | 0.000                        | 0.100 | 0.000                   | 0.004 |
| A2       | 1.050                        | 1.150 | 0.041                   | 0.045 |
| b        | 0.300                        | 0.500 | 0.012                   | 0.020 |
| c        | 0.100                        | 0.200 | 0.004                   | 0.008 |
| D        | 2.820                        | 3.020 | 0.111                   | 0.119 |
| E        | 1.500                        | 1.700 | 0.059                   | 0.067 |
| E1       | 2.650                        | 2.950 | 0.104                   | 0.116 |
| e        | 0.950 BSC                    |       | 0.037 BSC               |       |
| e1       | 1.900 BSC                    |       | 0.075 BSC               |       |
| L        | 0.300                        | 0.600 | 0.012                   | 0.024 |
| $\theta$ | 0°                           | 8°    | 0°                      | 8°    |

NOTES:

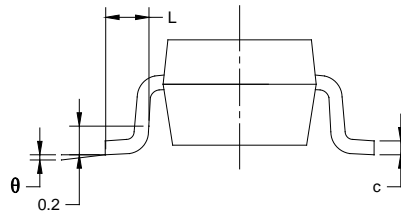
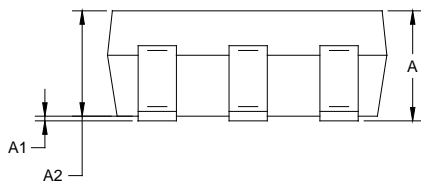
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS

SOT-23-6



RECOMMENDED LAND PATTERN (Unit: mm)

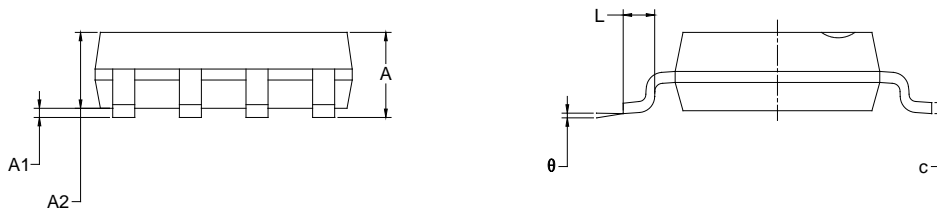
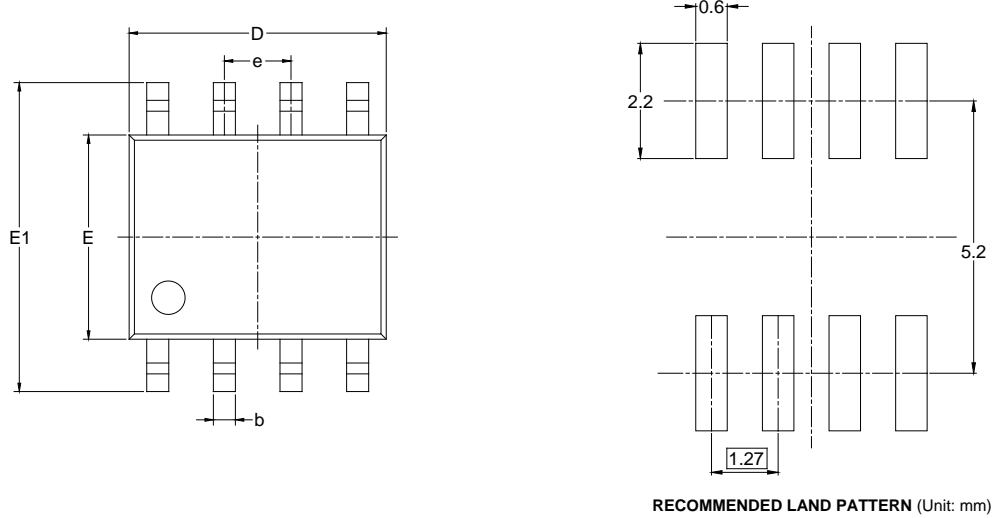


| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | MIN                       | MAX   | MIN                  | MAX   |
| A      | 1.050                     | 1.250 | 0.041                | 0.049 |
| A1     | 0.000                     | 0.100 | 0.000                | 0.004 |
| A2     | 1.050                     | 1.150 | 0.041                | 0.045 |
| b      | 0.300                     | 0.500 | 0.012                | 0.020 |
| c      | 0.100                     | 0.200 | 0.004                | 0.008 |
| D      | 2.820                     | 3.020 | 0.111                | 0.119 |
| E      | 1.500                     | 1.700 | 0.059                | 0.067 |
| E1     | 2.650                     | 2.950 | 0.104                | 0.116 |
| e      | 0.950 BSC                 |       | 0.037 BSC            |       |
| e1     | 1.900 BSC                 |       | 0.075 BSC            |       |
| L      | 0.300                     | 0.600 | 0.012                | 0.024 |
| θ      | 0°                        | 8°    | 0°                   | 8°    |

- NOTES:  
 1. Body dimensions do not include mode flash or protrusion.  
 2. This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS

SOIC-8

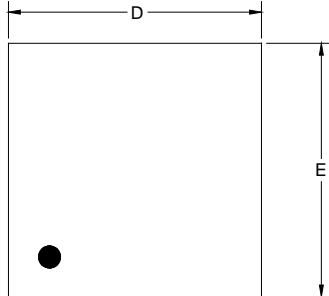


| Symbol | Dimensions<br>In Millimeters |       | Dimensions<br>In Inches |       |
|--------|------------------------------|-------|-------------------------|-------|
|        | MIN                          | MAX   | MIN                     | MAX   |
| A      | 1.350                        | 1.750 | 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      | 0.170                        | 0.250 | 0.006                   | 0.010 |
| D      | 4.700                        | 5.100 | 0.185                   | 0.200 |
| E      | 3.800                        | 4.000 | 0.150                   | 0.157 |
| E1     | 5.800                        | 6.200 | 0.228                   | 0.244 |
| e      | 1.27 BSC                     |       | 0.050 BSC               |       |
| L      | 0.400                        | 1.270 | 0.016                   | 0.050 |
| θ      | 0°                           | 8°    | 0°                      | 8°    |

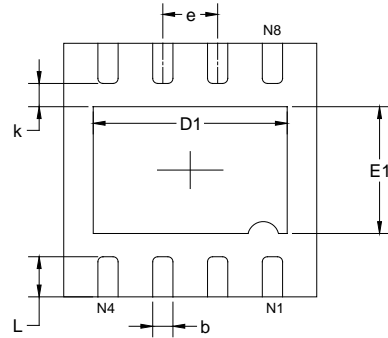
NOTES:  
 1. Body dimensions do not include mode flash or protrusion.  
 2. This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS

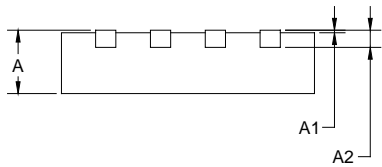
TDFN-3x3-8L



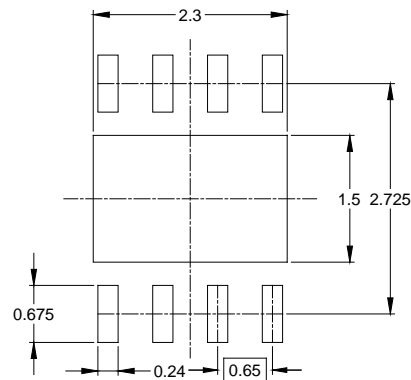
TOP VIEW



BOTTOM VIEW



SIDE VIEW



RECOMMENDED LAND PATTERN (Unit: mm)

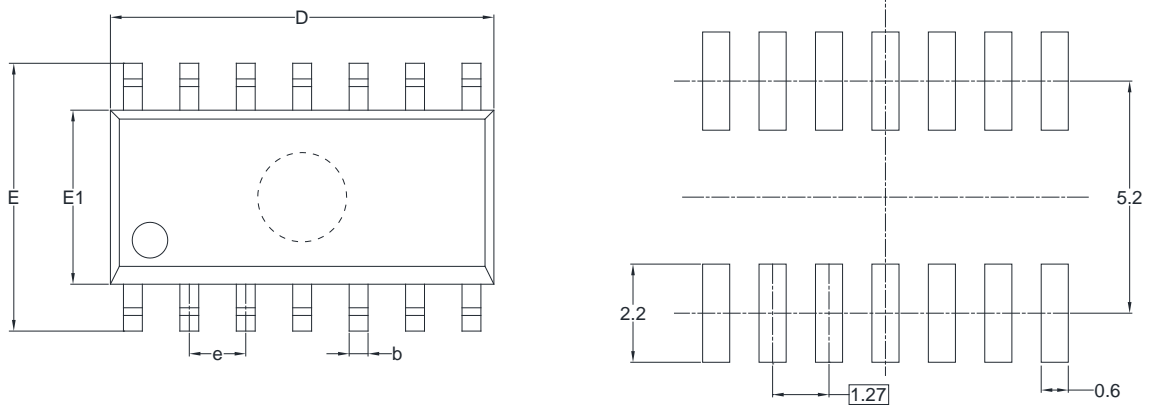
| Symbol | Dimensions<br>In Millimeters |       | Dimensions<br>In Inches |       |
|--------|------------------------------|-------|-------------------------|-------|
|        | MIN                          | MAX   | MIN                     | MAX   |
| A      | 0.700                        | 0.800 | 0.028                   | 0.031 |
| A1     | 0.000                        | 0.050 | 0.000                   | 0.002 |
| A2     | 0.203 REF                    |       | 0.008 REF               |       |
| D      | 2.900                        | 3.100 | 0.114                   | 0.122 |
| D1     | 2.200                        | 2.400 | 0.087                   | 0.094 |
| E      | 2.900                        | 3.100 | 0.114                   | 0.122 |
| E1     | 1.400                        | 1.600 | 0.055                   | 0.063 |
| k      | 0.200 MIN                    |       | 0.008 MIN               |       |
| b      | 0.180                        | 0.300 | 0.007                   | 0.012 |
| e      | 0.650 TYP                    |       | 0.026 TYP               |       |
| L      | 0.375                        | 0.575 | 0.015                   | 0.023 |

NOTE: This drawing is subject to change without notice.

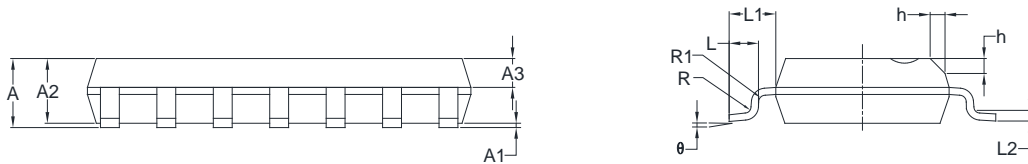


PACKAGE OUTLINE DIMENSIONS

SOIC-14



RECOMMENDED LAND PATTERN (Unit: mm)



| Symbol | Dimensions<br>In Millimeters |      | Dimensions<br>In Inches |       |
|--------|------------------------------|------|-------------------------|-------|
|        | MIN                          | MAX  | MIN                     | MAX   |
| A      | 1.35                         | 1.75 | 0.053                   | 0.069 |
| A1     | 0.10                         | 0.25 | 0.004                   | 0.010 |
| A2     | 1.25                         | 1.65 | 0.049                   | 0.065 |
| A3     | 0.55                         | 0.75 | 0.022                   | 0.030 |
| b      | 0.36                         | 0.49 | 0.014                   | 0.019 |
| D      | 8.53                         | 8.73 | 0.336                   | 0.344 |
| E      | 5.80                         | 6.20 | 0.228                   | 0.244 |
| E1     | 3.80                         | 4.00 | 0.150                   | 0.157 |
| e      | 1.27 BSC                     |      | 0.050 BSC               |       |
| L      | 0.45                         | 0.80 | 0.018                   | 0.032 |
| L1     | 1.04 REF                     |      | 0.040 REF               |       |
| L2     | 0.25 BSC                     |      | 0.01 BSC                |       |
| R      | 0.07                         |      | 0.003                   |       |
| R1     | 0.07                         |      | 0.003                   |       |
| h      | 0.30                         | 0.50 | 0.012                   | 0.020 |
| θ      | 0°                           | 8°   | 0°                      | 8°    |

NOTES:

1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

# PACKAGE INFORMATION

## TAPE AND REEL INFORMATION

### REEL DIMENSIONS



### TAPE DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

### KEY PARAMETER LIST OF TAPE AND REEL

| Package Type | Reel Diameter | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P0 (mm) | P1 (mm) | P2 (mm) | W (mm) | Pin1 Quadrant |
|--------------|---------------|--------------------|---------|---------|---------|---------|---------|---------|--------|---------------|
| SOT-23-5     | 7"            | 9.5                | 3.20    | 3.20    | 1.40    | 4.0     | 4.0     | 2.0     | 8.0    | Q3            |
| SOT-23-6     | 7"            | 9.5                | 3.23    | 3.17    | 1.37    | 4.0     | 4.0     | 2.0     | 8.0    | Q3            |
| SOIC-8       | 13"           | 12.4               | 6.40    | 5.40    | 2.10    | 4.0     | 8.0     | 2.0     | 12.0   | Q1            |
| TDFN-3×3-8L  | 13"           | 12.4               | 3.35    | 3.35    | 1.13    | 4.0     | 8.0     | 2.0     | 12.0   | Q1            |
| SOIC-14      | 13"           | 16.4               | 6.60    | 9.30    | 2.10    | 4.0     | 8.0     | 2.0     | 16.0   | Q1            |

D20001

# PACKAGE INFORMATION

## CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

## KEY PARAMETER LIST OF CARTON BOX

| Reel Type   | Length (mm) | Width (mm) | Height (mm) | Pizza/Carton |
|-------------|-------------|------------|-------------|--------------|
| 7" (Option) | 368         | 227        | 224         | 8            |
| 7"          | 442         | 410        | 224         | 18           |
| 13"         | 386         | 280        | 370         | 5            |

DD0002