

SGM8581

Single-Supply, Single Rail-to-Rail I/O Precision Operational Amplifier

GENERAL DESCRIPTION

The SGM8581 is a single rail-to-rail input and output precision operational amplifier which has low input offset voltage and bias current. It is guaranteed to operate from 2.5V to 5.5V single supply.

The rail-to-rail input and output swings provided by the SGM8581 make both high-side and low-side sensing easy. The combination of characteristics makes the SGM8581 a good choice for temperature, position and pressure sensors, medical equipment and strain gauge amplifiers, or any other 2.5V to 5.5V applications requiring precision and long term stability.

The SGM8581 is specified for the extended industrial/automotive (-40°C to +125°C) temperature range. The SGM8581 is available in Green SOT-23-5, SOIC-8 and MSOP-8 packages.

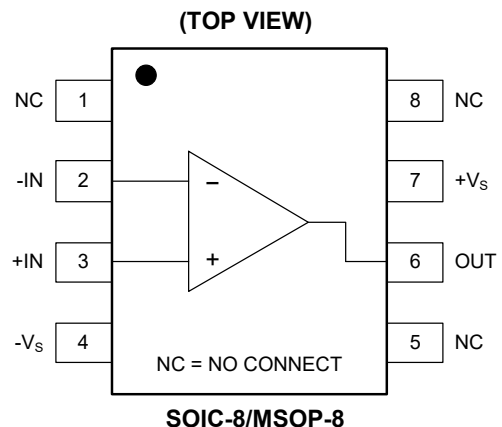
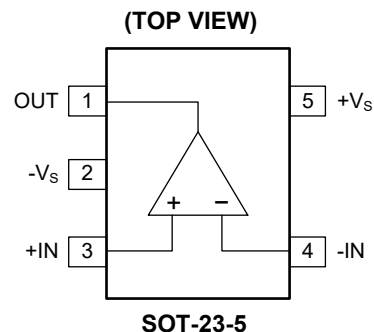
APPLICATIONS

Temperature Measurements
Pressure Sensors
Precision Current Sensings
Electronic Scales
Strain Gage Amplifiers
Medical Instrumentation
Thermocouple Amplifiers
Handheld Test Equipment

FEATURES

- **Low Offset Voltage: 100 μ V (MAX)**
- **Rail-to-Rail Input and Output Swings**
- **2.5V to 5.5V Single-Supply Operation**
- **Voltage Gain: 145dB (TYP) at 5V**
- **PSRR: 120dB (TYP)**
- **CMRR: 90dB (TYP)**
- **Ultra Low Input Bias Current: 15pA**
- **Low Supply Current: 445 μ A at 5V**
- **Overload Recovery Time: 70 μ s (at $V_S = 5V$)**
- **No External Capacitors Required**
- **-40°C to +125°C Operating Temperature Range**
- **Available in Green SOT-23-5, SOIC-8 and MSOP-8 Packages**

PIN CONFIGURATIONS



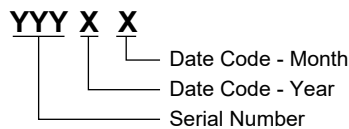
PACKAGE/ORDERING INFORMATION

| MODEL | PACKAGE DESCRIPTION | SPECIFIED TEMPERATURE RANGE | ORDERING NUMBER | PACKAGE MARKING | PACKING OPTION |
|---------|---------------------|-----------------------------|-----------------|--------------------------|---------------------|
| SGM8581 | SOT-23-5 | -40°C to +125°C | SGM8581XN5G/TR | S0BXX | Tape and Reel, 3000 |
| | SOIC-8 | -40°C to +125°C | SGM8581XS8G/TR | SGM8581XS8 XXXXX | Tape and Reel, 2500 |
| | MSOP-8 | -40°C to +125°C | SGM8581XMS8G/TR | SGM8581 XMS8 XXXXX | Tape and Reel, 3000 |

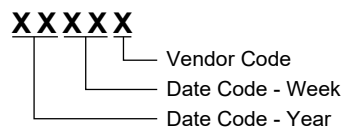
MARKING INFORMATION

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

SOT-23-5



SOIC-8/MSOP-8



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.....6V
- Input Voltage Range-V_S to (+V_S) + 0.1V
- Differential Input Voltage Range -5V to 5V
- Junction Temperature+150°C
- Storage Temperature Range.....-65°C to +150°C
- Lead Temperature (Soldering, 10s)+260°C
- ESD Susceptibility
- HBM (SOT-23-5).....6000V
- HBM (SOIC-8)7000V
- HBM (MSOP-8).....6000V
- MM.....400V

RECOMMENDED OPERATING CONDITIONS

- Operating Temperature Range-40°C to +125°C

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 by ESD if you don't pay attention to ESD protection. 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 very small parametric changes could cause the device not to meet its published specifications.

DISCLAIMER

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

ELECTRICAL CHARACTERISTICS(V_S = 5V, V_{CM} = 2.5V, V_{OUT} = 2.5V, Full = -40°C to +125°C, typical values are at T_A = +25°C, unless otherwise noted.)

| PARAMETER | CONDITIONS | TEMP | MIN | TYP | MAX | UNITS |
|----------------------------------------------------|------------------------------------------------------------------------------------|-------|-------|-------|-----|-------------------|
| Input Characteristics | | | | | | |
| Input Offset Voltage (V _{OS}) | | +25°C | | 25 | 100 | μV |
| | | Full | | | 106 | |
| Input Offset Voltage Drift (ΔV _{OS} /ΔT) | | Full | | 100 | | nV/°C |
| Input Bias Current (I _B) | | +25°C | | 15 | | pA |
| Input Offset Current (I _{OS}) | | +25°C | | 10 | | pA |
| Input Voltage Range | | +25°C | 0 | | 5 | V |
| Common Mode Rejection Ratio ⁽¹⁾ (CMRR) | V _{CM} = 0V to 5V | +25°C | 80 | 90 | | dB |
| | | Full | 62 | | | |
| Large-Signal Voltage Gain (A _{VO}) | R _L = 10kΩ, V _{OUT} = 0.3V to 4.7V | +25°C | 95 | 145 | | dB |
| | | Full | 91 | | | |
| Output Characteristics | | | | | | |
| Output Voltage High (V _{OH}) | R _L = 100kΩ to -V _S | +25°C | 4.99 | 4.998 | | V |
| | | Full | 4.979 | | | |
| | R _L = 10kΩ to -V _S | +25°C | 4.98 | 4.994 | | |
| | | Full | 4.96 | | | |
| Output Voltage Low (V _{OL}) | R _L = 100kΩ to +V _S | +25°C | | 2 | 10 | mV |
| | | Full | | | 11 | |
| | R _L = 10kΩ to +V _S | +25°C | | 6 | 15 | |
| | | Full | | | 18 | |
| Short-Circuit Limit (I _{SC}) | V _{OUT} = 2.5V, R _L = 10Ω to GND | +25°C | 40 | 45 | | mA |
| | | Full | 26 | | | |
| Power Supply | | | | | | |
| Power Supply Rejection Ratio ⁽¹⁾ (PSRR) | V _S = 2.5V to 5.5V | +25°C | 90 | 120 | | dB |
| | | Full | 73 | | | |
| Quiescent Current (I _Q) | V _{OUT} = V _S /2 | +25°C | | 445 | 700 | μA |
| | | Full | | | 845 | |
| Dynamic Performance | | | | | | |
| Gain-Bandwidth Product (GBP) | A _V = +100 | +25°C | | 1.5 | | MHz |
| Slew Rate (SR) | A _V = +1, R _L = 10kΩ, 2V output step | +25°C | | 0.75 | | V/μs |
| Overload Recovery Time | A _V = -100, R _L = 10kΩ, V _{IN} = 200mV (RET to GND) | +25°C | | 0.07 | | ms |
| Noise | | | | | | |
| Input Voltage Noise (e _{n P-P}) | 0.1Hz to 10Hz | +25°C | | 0.85 | | μV _{P-P} |
| Input Voltage Noise Density (e _n) | f = 1kHz | +25°C | | 47.5 | | nV/√Hz |

NOTE: 1. PSRR and CMRR are affected by the matching between external gain-setting resistor ratios.

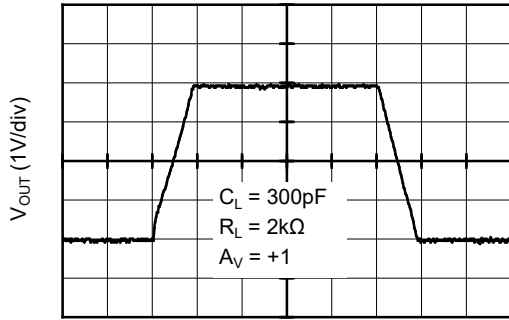
ELECTRICAL CHARACTERISTICS (continued)(V_S = 2.5V, V_{CM} = 1.25V, V_{OUT} = 1.25V, Full = -40°C to +125°C, typical values are at T_A = +25°C, unless otherwise noted.)

| PARAMETER | CONDITIONS | TEMP | MIN | TYP | MAX | UNITS |
|----------------------------------------------------|------------------------------------------------------------------------------------|-------|-------|-------|-----|-------------------|
| Input Characteristics | | | | | | |
| Input Offset Voltage (V _{OS}) | | +25°C | | 25 | 100 | μV |
| | | Full | | | 127 | |
| Input Offset Voltage Drift (ΔV _{OS} /ΔT) | | Full | | 150 | | nV/°C |
| Input Bias Current (I _B) | | +25°C | | 15 | | pA |
| Input Offset Current (I _{OS}) | | +25°C | | 10 | | pA |
| Input Voltage Range | | +25°C | 0 | | 2.5 | V |
| Common Mode Rejection Ratio ⁽¹⁾ (CMRR) | V _{CM} = 0V to 2.5V | +25°C | 75 | 90 | | dB |
| | | Full | 61 | | | |
| Large-Signal Voltage Gain (A _{VO}) | R _L = 10kΩ, V _{OUT} = 0.3V to 2.4V | +25°C | 95 | 140 | | dB |
| | | Full | 91 | | | |
| Output Characteristics | | | | | | |
| Output Voltage High (V _{OH}) | R _L = 100kΩ to -V _S | +25°C | 2.49 | 2.498 | | V |
| | | Full | 2.473 | | | |
| | R _L = 10kΩ to -V _S | +25°C | 2.48 | 2.497 | | |
| | | Full | 2.46 | | | |
| Output Voltage Low (V _{OL}) | R _L = 100kΩ to +V _S | +25°C | | 1 | 10 | mV |
| | | Full | | | 11 | |
| | R _L = 10kΩ to +V _S | +25°C | | 3 | 15 | |
| | | Full | | | 16 | |
| Short-Circuit Limit (I _{SC}) | V _{OUT} = 1.25V, R _L = 10Ω to GND | +25°C | 20 | 27 | | mA |
| | | Full | 14 | | | |
| Power Supply | | | | | | |
| Power Supply Rejection Ratio ⁽¹⁾ (PSRR) | V _S = 2.5V to 5.5V | +25°C | 90 | 120 | | dB |
| | | Full | 73 | | | |
| Quiescent Current (I _Q) | V _{OUT} = V _S /2 | +25°C | | 440 | 700 | μA |
| | | Full | | | 786 | |
| Dynamic Performance | | | | | | |
| Gain-Bandwidth Product (GBP) | A _V = +100 | +25°C | | 1.45 | | MHz |
| Slew Rate (SR) | A _V = +1, R _L = 10kΩ, 2V output step | +25°C | | 0.75 | | V/μs |
| Overload Recovery Time | A _V = -100, R _L = 10kΩ, V _{IN} = 200mV (RET to GND) | +25°C | | 0.04 | | ms |
| Noise | | | | | | |
| Input Voltage Noise (e _{n P-P}) | 0.1Hz to 10Hz | +25°C | | 0.9 | | μV _{P-P} |
| Input Voltage Noise Density (e _n) | f = 1kHz | +25°C | | 77 | | nV/√Hz |

NOTE: 1. PSRR and CMRR are affected by the matching between external gain-setting resistor ratios.

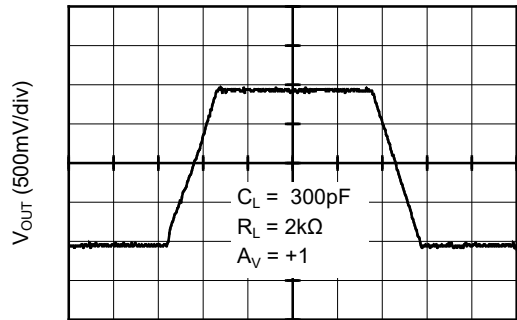
TYPICAL PERFORMANCE CHARACTERISTICS

Large Signal Transient Response at +5V



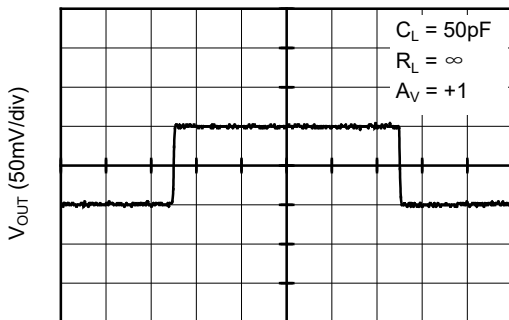
Time (5µs/div)

Large Signal Transient Response at +2.5V



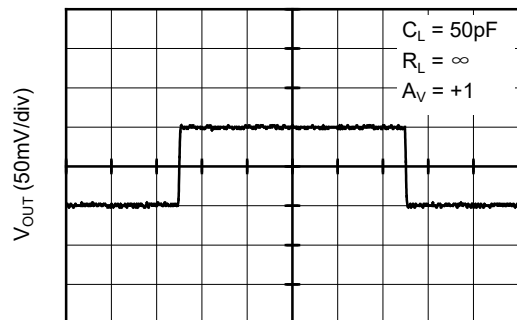
Time (2µs/div)

Small Signal Transient Response at +5V



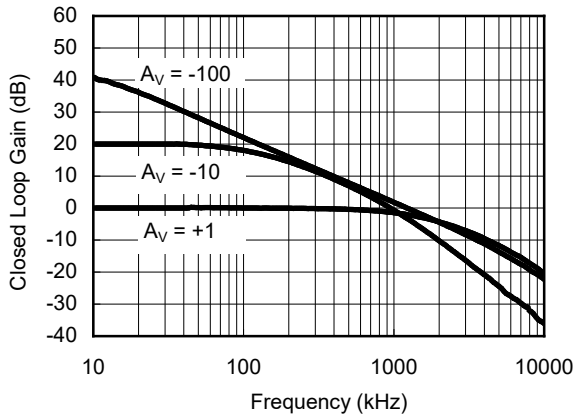
Time (5µs/div)

Small Signal Transient Response at +2.5V

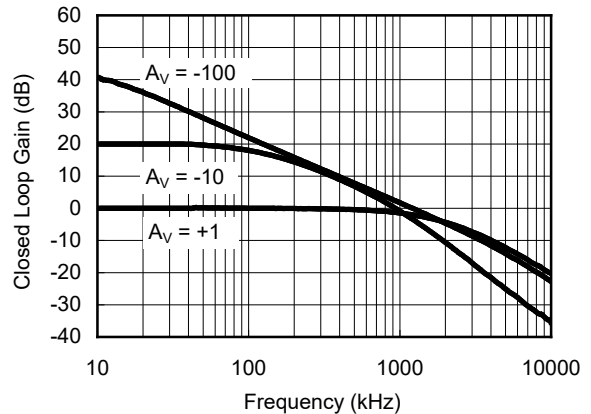


Time (5µs/div)

Closed Loop Gain vs. Frequency at +5V

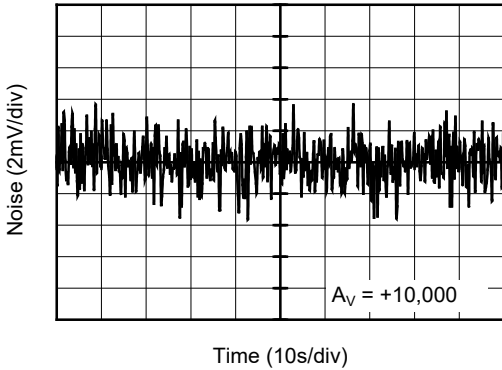


Closed Loop Gain vs. Frequency at +2.5V

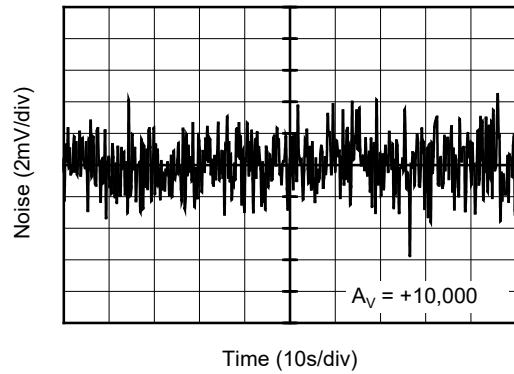


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

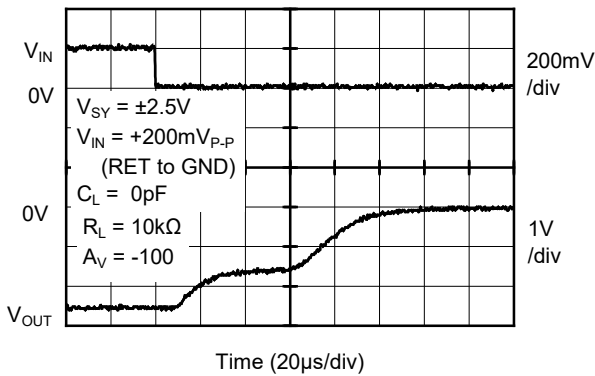
0.1Hz to 10Hz Noise at +5V



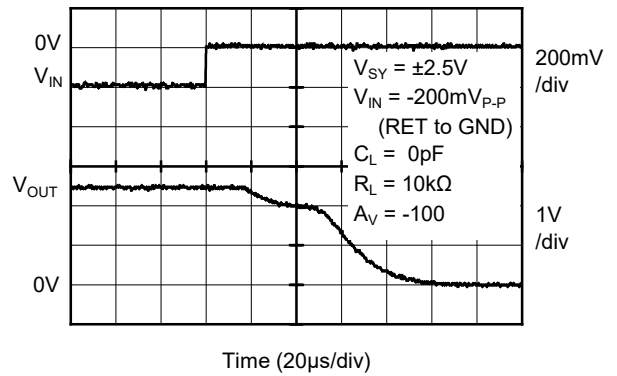
0.1Hz to 10Hz Noise at +2.5V



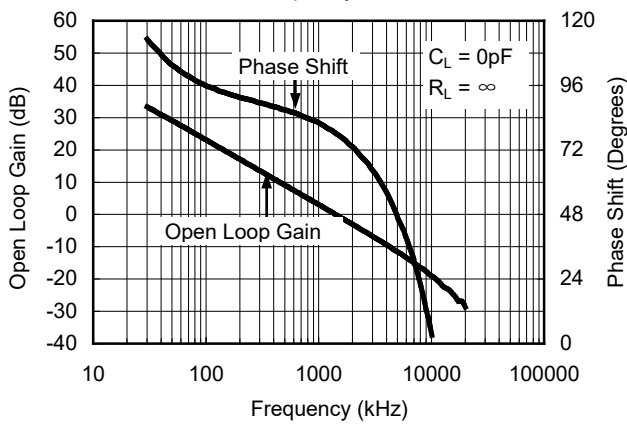
Negative Overvoltage Recovery



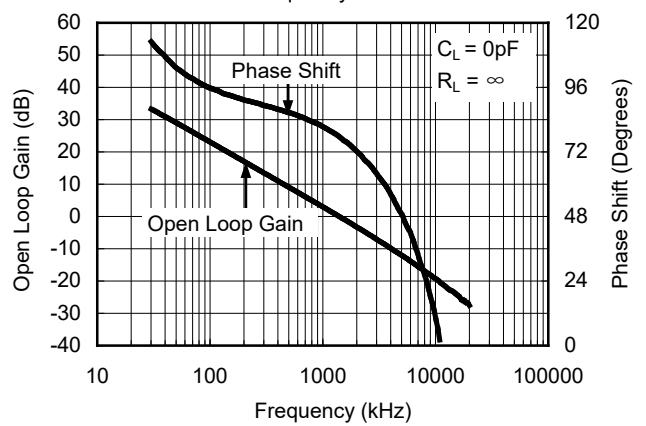
Positive Overvoltage Recovery



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

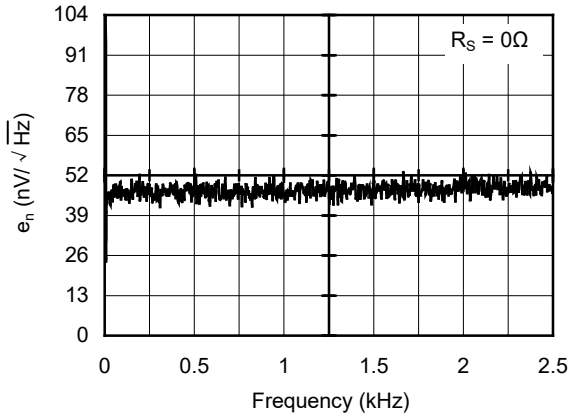


Open Loop Gain, Phase Shift vs. Frequency at +2.5V

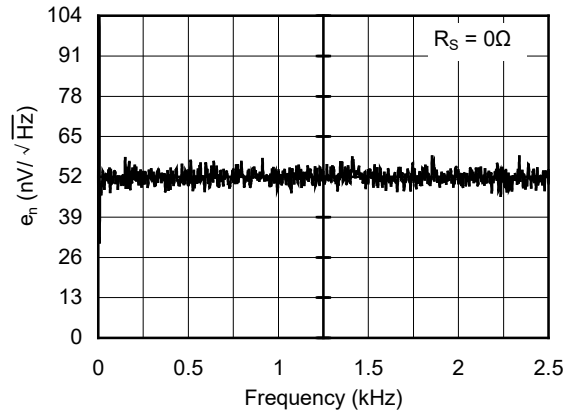


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

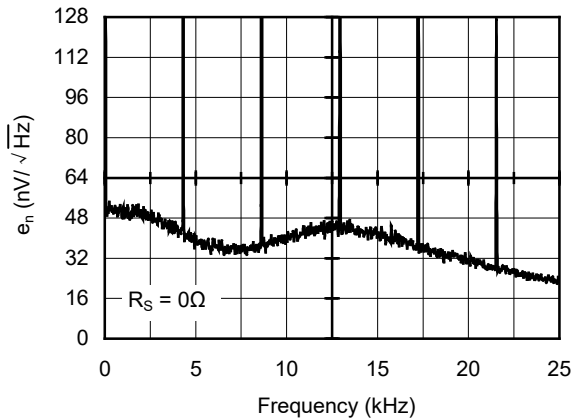
Voltage Noise Density at +5V
from 0.1Hz to 2.5kHz



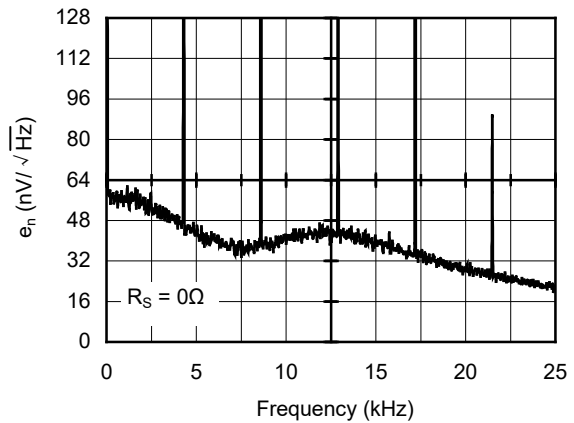
Voltage Noise Density at +2.5V
from 0.1Hz to 2.5kHz



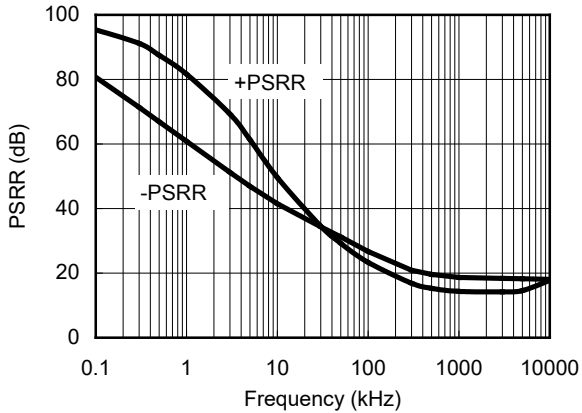
Voltage Noise Density at +5V
from 0.1Hz to 25kHz



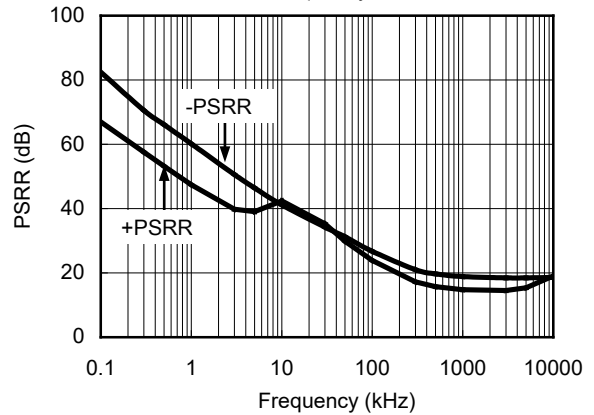
Voltage Noise Density at +2.5V
from 0.1Hz to 25kHz



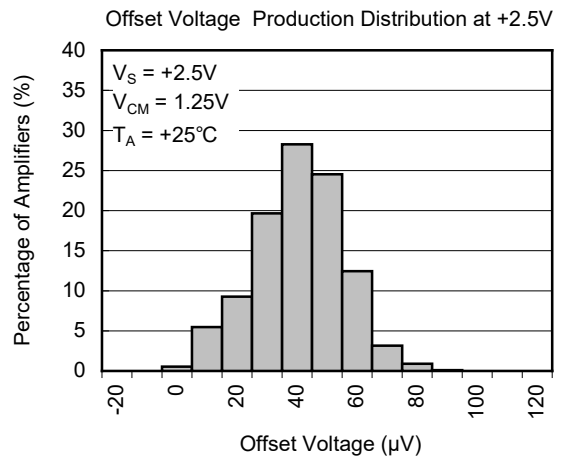
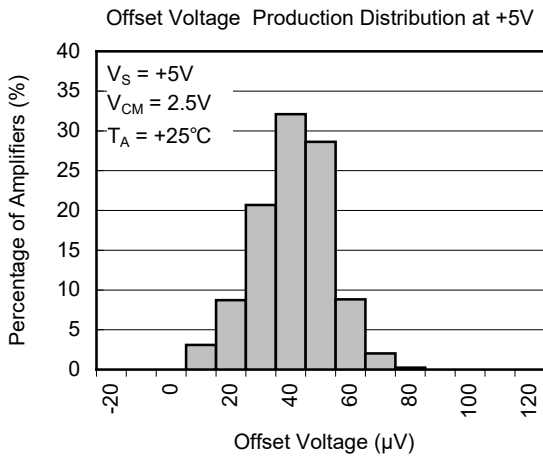
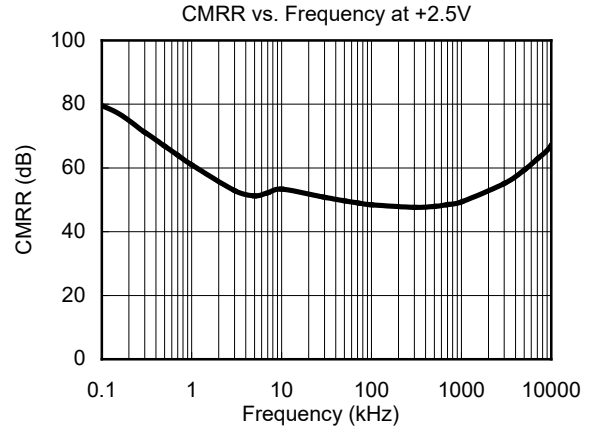
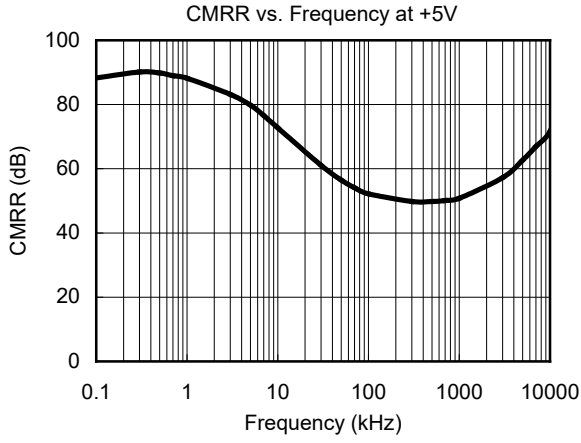
PSRR vs. Frequency at ±2.5V



PSRR vs. Frequency at ±1.25V



TYPICAL PERFORMANCE CHARACTERISTICS (continued)



REVISION HISTORY

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

| JANUARY 2013 – REV.A.2 to REV.A.3 | Page |
|-----------------------------------------------|-------------|
| Added Tape and Reel Information section | 15, 16 |

| DECEMBER 2011 – REV.A.1 to REV.A.2 | Page |
|-----------------------------------------------------------|-------------|
| Updated Electrical Characteristics section | 3, 4 |
| Updated Typical Performance Characteristics section | 7 |
| Updated Package Outline Dimensions section | 9~11 |

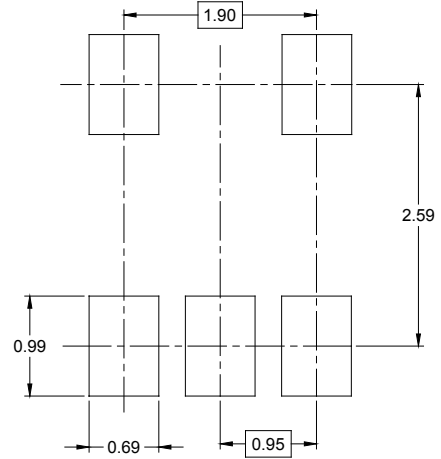
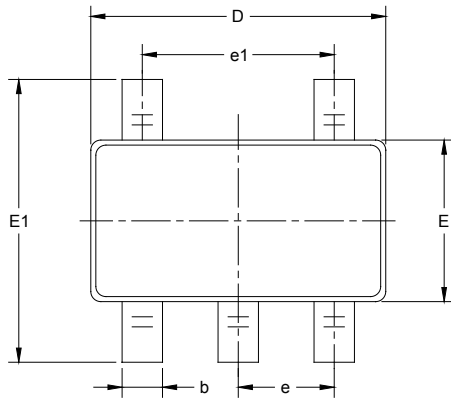
| MAY 2011 – REV.A to REV.A.1 | Page |
|------------------------------------|-------------|
| Changed packages' name | All |

| Changes from Original (MARCH 2010) to REV.A | Page |
|-------------------------------------------------------|-------------|
| Changed from product preview to production data | All |

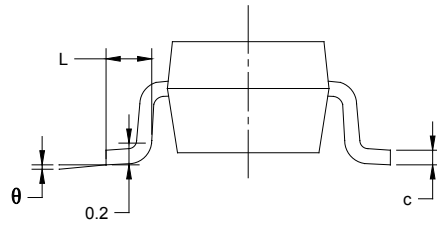
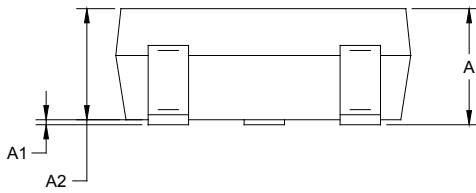
PACKAGE INFORMATION

PACKAGE OUTLINE DIMENSIONS

SOT-23-5



RECOMMENDED LAND PATTERN (Unit: mm)

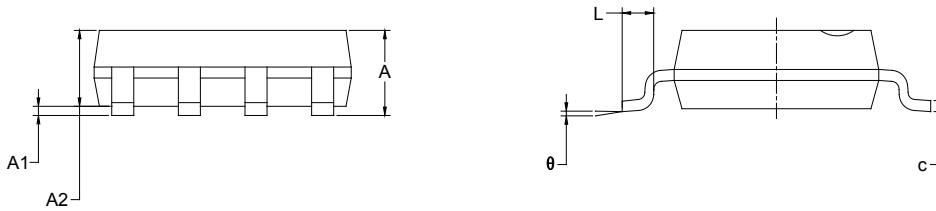
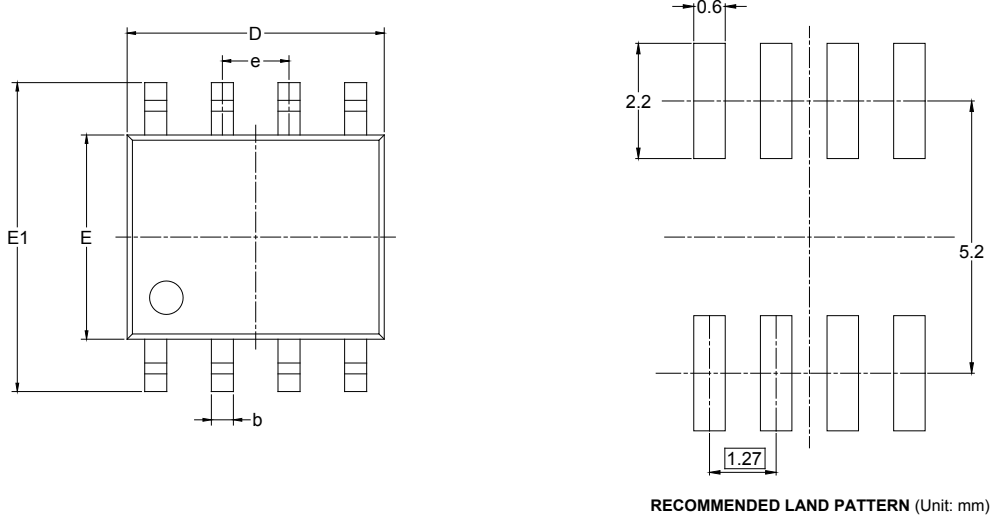


| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|----------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 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° |

PACKAGE INFORMATION

PACKAGE OUTLINE DIMENSIONS

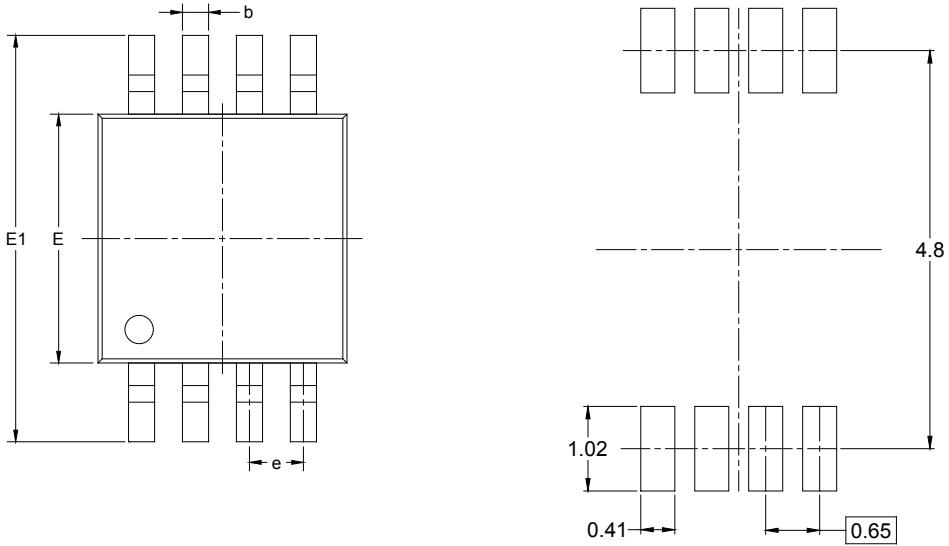
SOIC-8



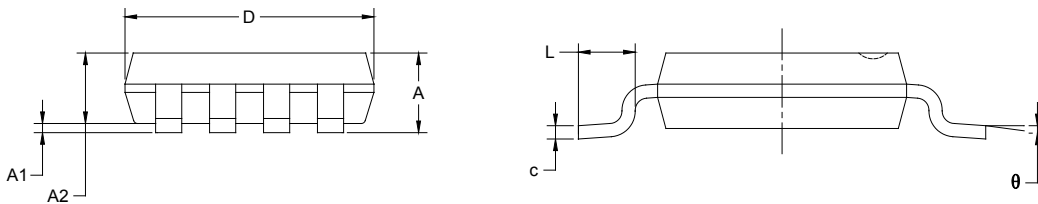
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|----------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.350 | 1.750 | 0.053 | 0.069 |
| A1 | 0.100 | 0.250 | 0.004 | 0.010 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| b | 0.330 | 0.510 | 0.013 | 0.020 |
| c | 0.170 | 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° |

PACKAGE OUTLINE DIMENSIONS

MSOP-8



RECOMMENDED LAND PATTERN (Unit: mm)

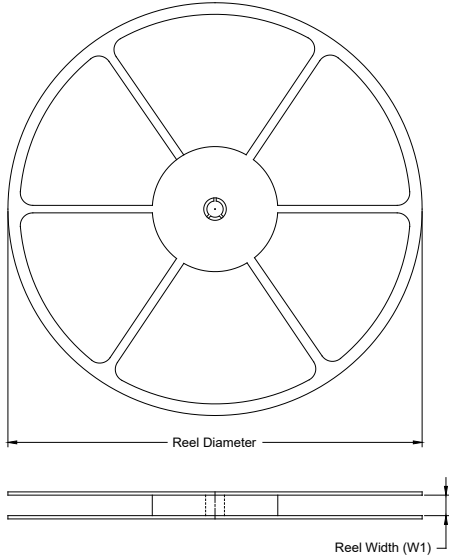


| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.820 | 1.100 | 0.032 | 0.043 |
| A1 | 0.020 | 0.150 | 0.001 | 0.006 |
| A2 | 0.750 | 0.950 | 0.030 | 0.037 |
| b | 0.250 | 0.380 | 0.010 | 0.015 |
| c | 0.090 | 0.230 | 0.004 | 0.009 |
| D | 2.900 | 3.100 | 0.114 | 0.122 |
| E | 2.900 | 3.100 | 0.114 | 0.122 |
| E1 | 4.750 | 5.050 | 0.187 | 0.199 |
| e | 0.650 BSC | | 0.026 BSC | |
| L | 0.400 | 0.800 | 0.016 | 0.031 |
| θ | 0° | 6° | 0° | 6° |

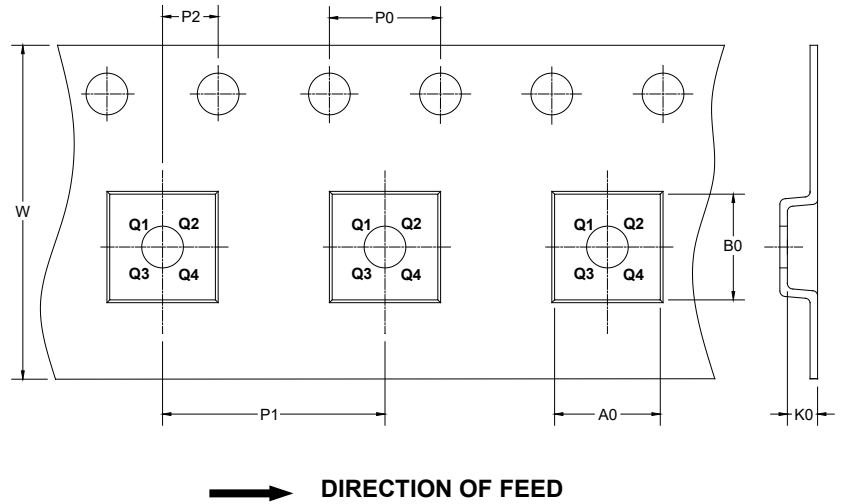
PACKAGE INFORMATION

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 |
| SOIC-8 | 13" | 12.4 | 6.40 | 5.40 | 2.10 | 4.0 | 8.0 | 2.0 | 12.0 | Q1 |
| MSOP-8 | 13" | 12.4 | 5.20 | 3.30 | 1.50 | 4.0 | 8.0 | 2.0 | 12.0 | Q1 |

DD0001

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