



SGM8594

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

GENERAL DESCRIPTION

The SGM8594 is a quad, precision operational amplifier which can operate from 2.5V to 5.5V single supply. The device provides rail-to-rail input and output operation.

The SGM8594 offers a low offset voltage less than 450 μ V and an ultra-low bias current of 60pA. The combination of characteristics makes the SGM8594 a good choice for temperature measurements, pressure and position sensors, strain gauge amplifiers and medical instrumentation, or any other 2.5V to 5.5V applications requiring precision and long-term stability.

The SGM8594 is available in Green SOIC-14 and TSSOP-14 packages. It is specified over the extended industrial temperature range (-40°C to +125°C).

FEATURES

- **Low Offset Voltage: 150 μ V (TYP)**
- **Ultra-Low Input Bias Current: 60pA**
- **Large-Signal Voltage Gain: 118dB (TYP) at 5V**
- **PSRR: 98dB (TYP)**
- **EMIRR at 1.8GHz: 118dB**
- **CMRR: 92dB (TYP)**
- **Overload Recovery Time: 30 μ s (at $V_S = 5V$)**
- **Rail-to-Rail Input and Output**
- **Supply Voltage Range: 2.5V to 5.5V**
- **Low Supply Current: 480 μ A/Amplifier**
- **No External Capacitors Required**
- **-40°C to +85°C Operating Temperature Range**
- **Available in Green SOIC-14 and TSSOP-14 Packages**

APPLICATIONS

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

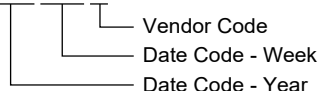
PACKAGE/ORDERING INFORMATION

| MODEL | PACKAGE DESCRIPTION | SPECIFIED TEMPERATURE RANGE | ORDERING NUMBER | PACKAGE MARKING | PACKING OPTION |
|---------|---------------------|-----------------------------|------------------|---------------------------|---------------------|
| SGM8594 | SOIC-14 | -40°C to +85°C | SGM8594YS14G/TR | SGM8594YS14 XXXXX | Tape and Reel, 2500 |
| | TSSOP-14 | -40°C to +85°C | SGM8594YTS14G/TR | SGM8594 YTS14 XXXXX | Tape and Reel, 3000 |

MARKING INFORMATION

NOTE: XXXXX = Date Code and Vendor Code.

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 | 6V |
| Input Voltage Range | -Vs to (+Vs) + 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 (SOIC-14) | 7000V |
| HBM (TSSOP-14) | 8000V |
| MM | 400V |

RECOMMENDED OPERATING CONDITIONS

| | |
|-----------------------------------|----------------|
| Operating Temperature Range | -40°C to +85°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.

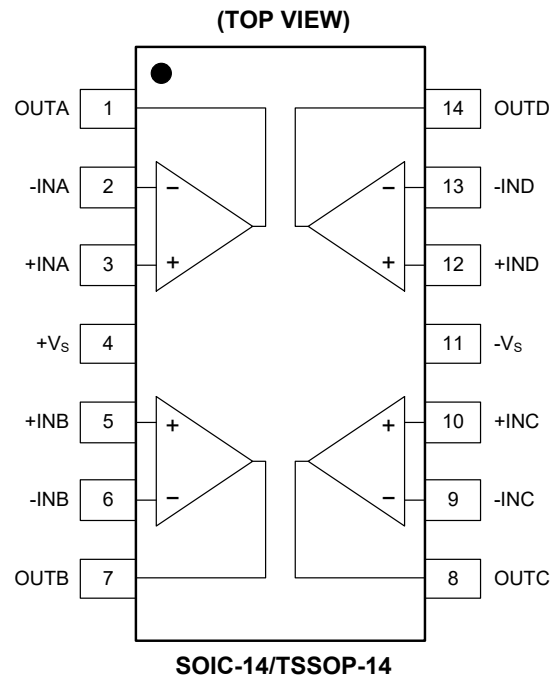
ESD SENSITIVITY CAUTION

This integrated circuit can be damaged 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



ELECTRICAL CHARACTERISTICS(V_S = 5V, V_{CM} = 2.5V, V_{OUT} = 2.5V, Full = -40°C to +85°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 | | 150 | 450 | μV |
| | | Full | | | 550 | |
| Input Offset Voltage Drift (ΔV _{OS} /ΔT) | | Full | | 200 | | nV/°C |
| Input Bias Current (I _B) | | +25°C | | 60 | | pA |
| Input Offset Current (I _{OS}) | | +25°C | | 50 | | pA |
| Input Voltage Range | | +25°C | 0 | | 5 | V |
| Common Mode Rejection Ratio ⁽¹⁾ (CMRR) | V _{CM} = 0V to 5V | +25°C | 80 | 92 | | dB |
| | | Full | 77 | | | |
| Large-Signal Voltage Gain (A _{VO}) | R _L = 10kΩ, V _{OUT} = 0.3V to 4.7V | +25°C | 98 | 118 | | dB |
| | | Full | 75 | | | |
| Output Characteristics | | | | | | |
| Output Voltage High (V _{OH}) | R _L = 100kΩ to -V _S | +25°C | 4.985 | 4.995 | | V |
| | | Full | 4.96 | | | |
| | R _L = 10kΩ to -V _S | +25°C | 4.98 | 4.99 | | V |
| | | Full | 4.95 | | | |
| Output Voltage Low (V _{OL}) | R _L = 100kΩ to +V _S | +25°C | | 5 | 15 | mV |
| | | Full | | | 20 | |
| | R _L = 10kΩ to +V _S | +25°C | | 10 | 20 | mV |
| | | Full | | | 30 | |
| Output Short-Circuit Limit (I _{SC}) | V _{OUT} = 2.5V, R _L = 10Ω to GND | +25°C | 34 | 46 | | mA |
| | | Full | 14 | | | |
| Power Supply | | | | | | |
| Power Supply Rejection Ratio ⁽¹⁾ (PSRR) | V _S = 2.5V to 5.5V | +25°C | 83 | 98 | | dB |
| | | Full | 78 | | | |
| Quiescent Current/Amplifier (I _Q) | V _{OUT} = V _S /2 | +25°C | | 480 | 620 | μA |
| | | Full | | | 760 | |
| 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 | | 0.9 | | V/μs |
| Overload Recovery Time | A _V = -100, R _L = 10kΩ, V _{IN} = 200mV (RET to GND) | +25°C | | 0.03 | | ms |
| Noise Performance | | | | | | |
| Input Voltage Noise | 0.1Hz to 10Hz | +25°C | | 1.4 | | μV _{P-P} |
| Input Voltage Noise Density (e _n) | f = 1kHz | +25°C | | 78 | | nV/√Hz |

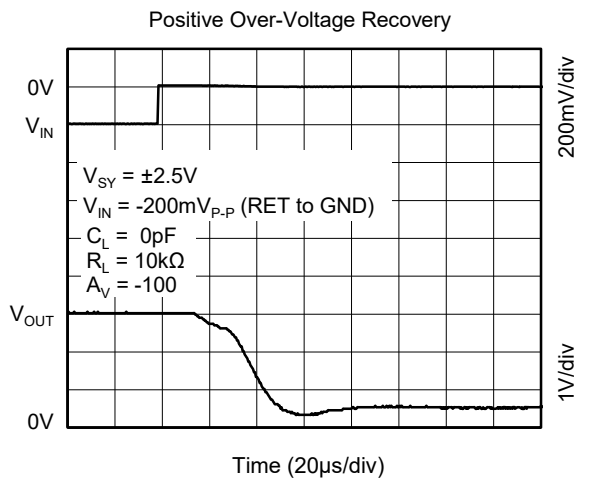
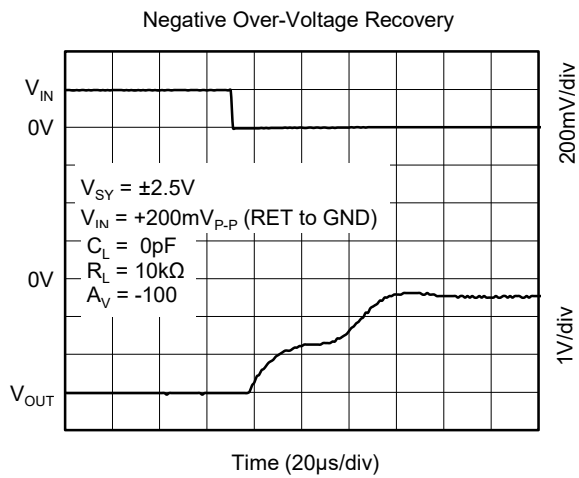
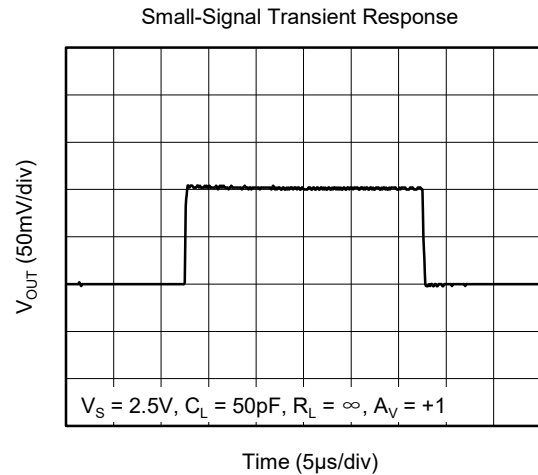
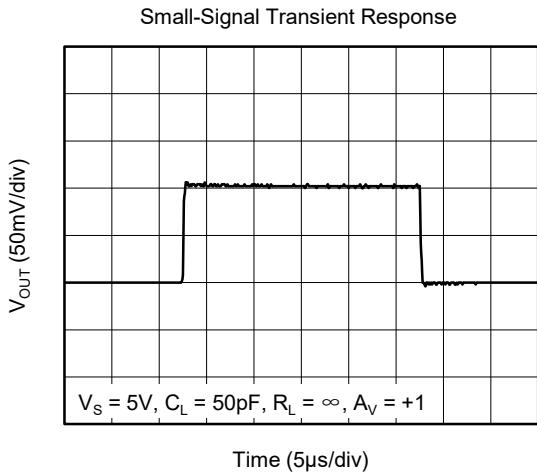
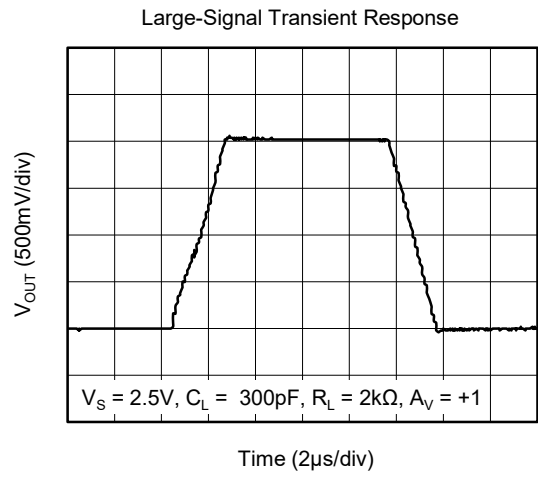
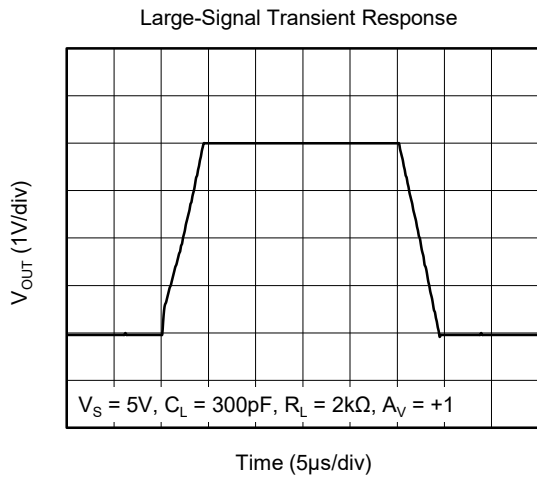
NOTE: 1. PSRR and CMRR are affected by the matching between external gain-setting resistor ratios.

ELECTRICAL CHARACTERISTICS (continued)(V_S = 2.5V, V_{CM} = 1.25V, V_{OUT} = 1.25V, Full = -40°C to +85°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 | | 150 | 450 | μV |
| | | Full | | | 550 | |
| Input Offset Voltage Drift (ΔV _{OS} /ΔT) | | Full | | 200 | | nV/°C |
| Input Bias Current (I _B) | | +25°C | | 60 | | pA |
| Input Offset Current (I _{OS}) | | +25°C | | 50 | | pA |
| Input Voltage Range | | +25°C | 0 | | 2.5 | V |
| Common Mode Rejection Ratio ⁽¹⁾ (CMRR) | V _{CM} = 0V to 2.5V | +25°C | 72 | 80 | | dB |
| | | Full | 69 | | | |
| Large-Signal Voltage Gain (A _{VO}) | R _L = 10kΩ, V _{OUT} = 0.3V to 2.4V | +25°C | 98 | 124 | | dB |
| | | Full | 75 | | | |
| Output Characteristics | | | | | | |
| Output Voltage High (V _{OH}) | R _L = 100kΩ to -V _S | +25°C | 2.485 | 2.495 | | V |
| | | Full | 2.46 | | | |
| | R _L = 10kΩ to -V _S | +25°C | 2.48 | 2.49 | | V |
| | | Full | 2.45 | | | |
| Output Voltage Low (V _{OL}) | R _L = 100kΩ to +V _S | +25°C | | 5 | 15 | mV |
| | | Full | | | 20 | |
| | R _L = 10kΩ to +V _S | +25°C | | 10 | 20 | mV |
| | | Full | | | 30 | |
| Output Short-Circuit Limit (I _{SC}) | V _{OUT} = 1.25V, R _L = 10Ω to GND | +25°C | 15 | 25 | | mA |
| Power Supply | | | | | | |
| Power Supply Rejection Ratio ⁽¹⁾ (PSRR) | V _S = 2.5V to 5.5V | +25°C | 83 | 98 | | dB |
| | | Full | 78 | | | |
| Quiescent Current/Amplifier (I _Q) | V _{OUT} = V _S /2 | +25°C | | 480 | 620 | μA |
| | | Full | | | 760 | |
| 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 | | 1.0 | | V/μs |
| Overload Recovery Time | A _V = -100, R _L = 10kΩ, V _{IN} = 200mV (RET to GND) | +25°C | | 0.02 | | ms |
| Noise Performance | | | | | | |
| Input Voltage Noise | 0.1Hz to 10Hz | +25°C | | 1.7 | | μV _{P-P} |
| Input Voltage Noise Density (e _n) | f = 1kHz | +25°C | | 108 | | nV/√Hz |

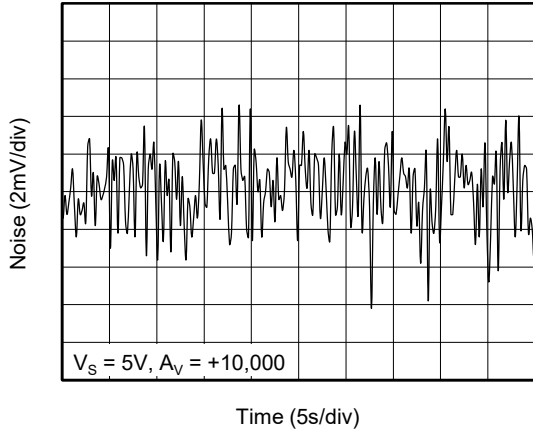
NOTE: 1. PSRR and CMRR are affected by the matching between external gain-setting resistor ratios.

TYPICAL PERFORMANCE CHARACTERISTICS

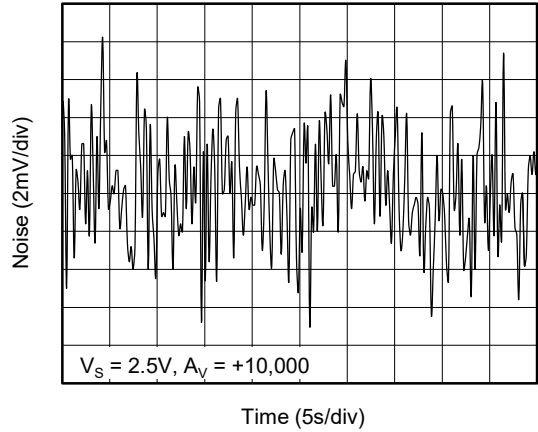


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

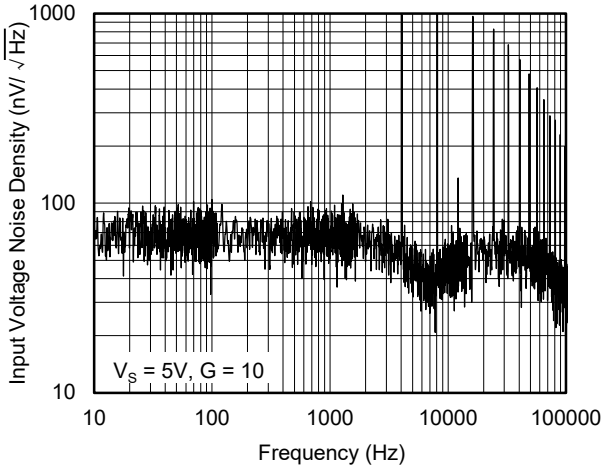
0.1Hz to 10Hz Input Voltage Noise



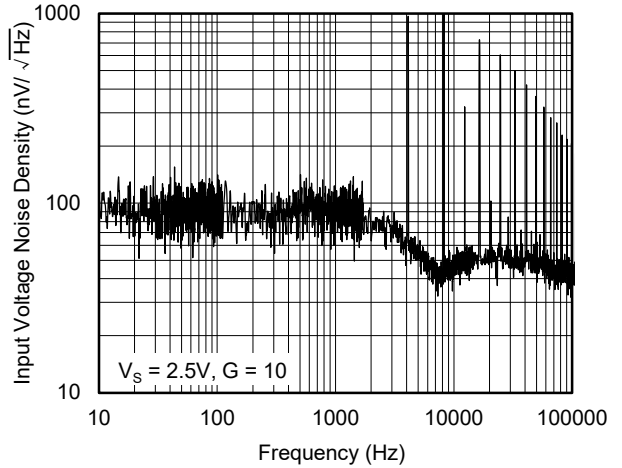
0.1Hz to 10Hz Input Voltage Noise



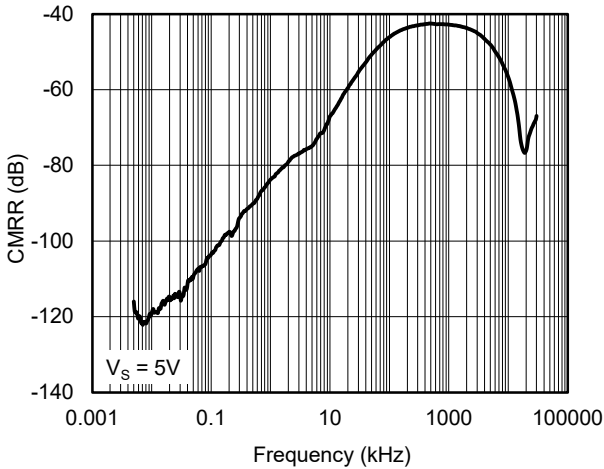
Input Voltage Noise Density vs. Frequency



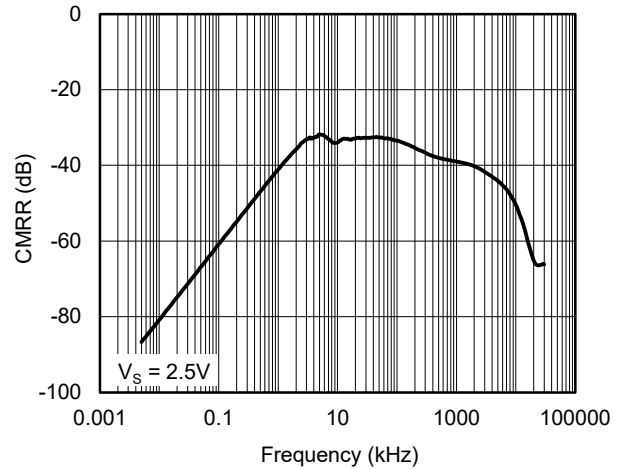
Input Voltage Noise Density vs. Frequency



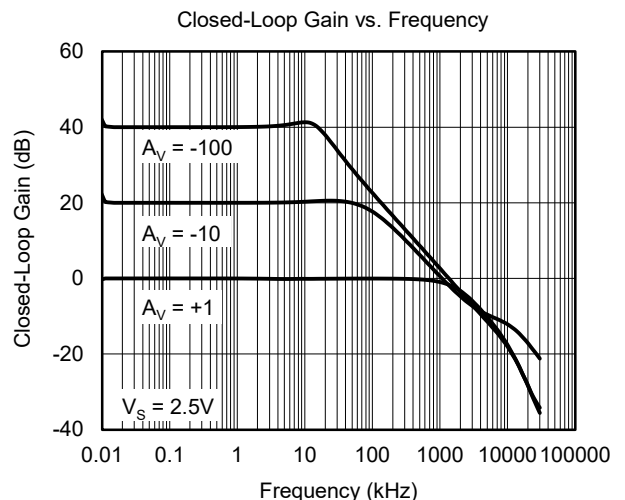
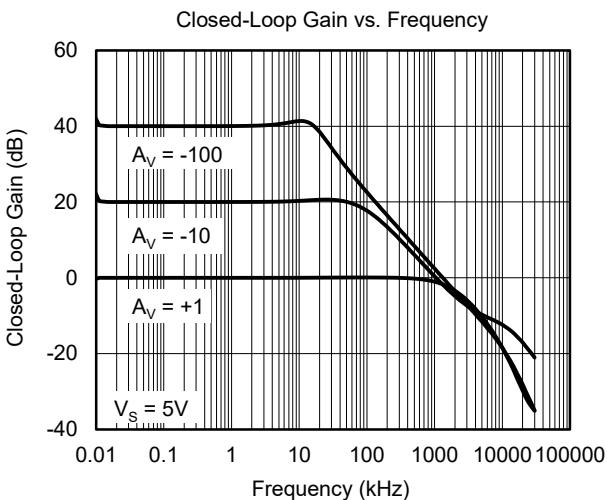
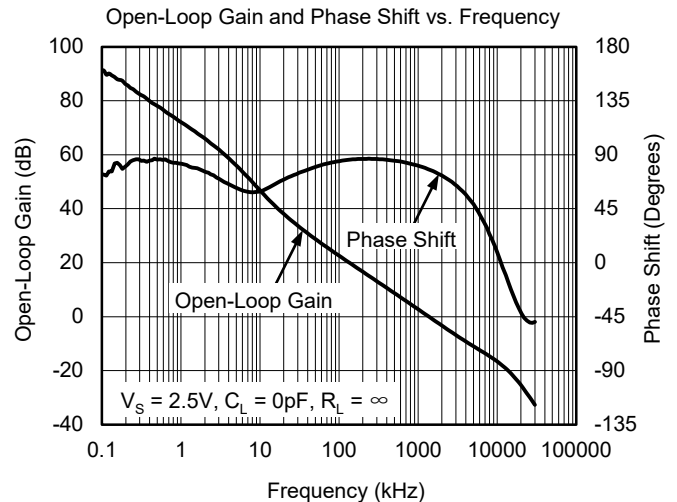
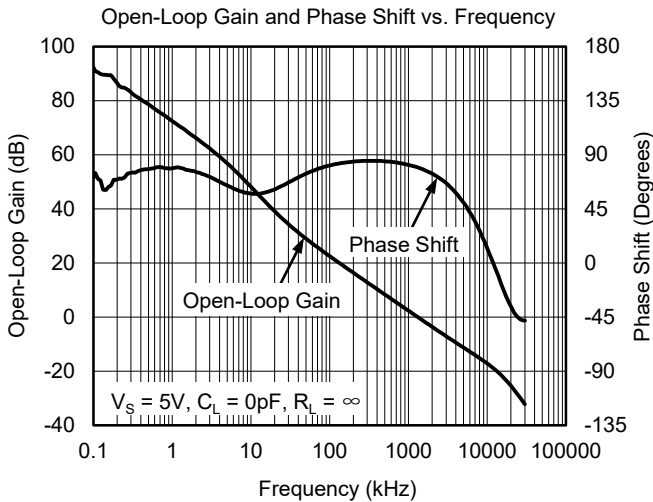
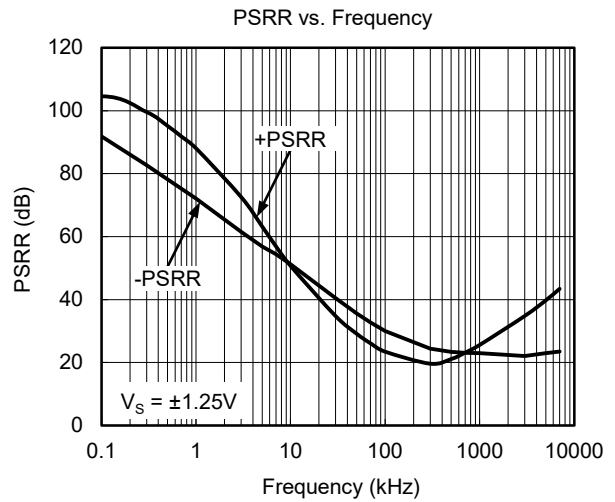
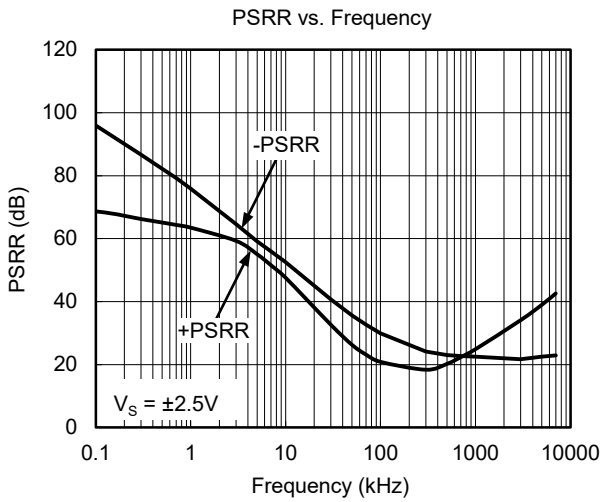
CMRR vs. Frequency



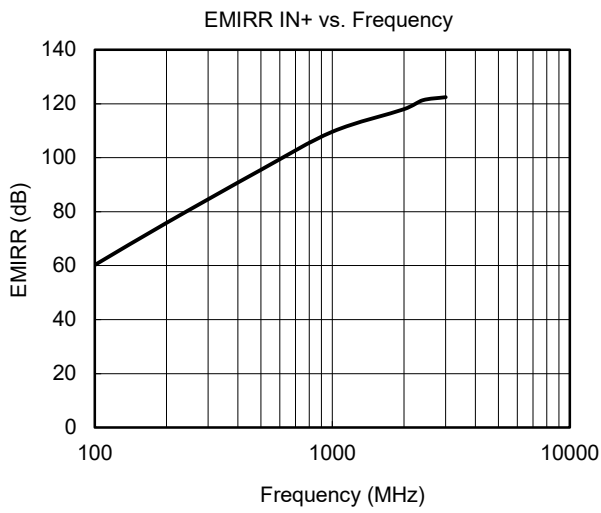
CMRR vs. Frequency



TYPICAL PERFORMANCE CHARACTERISTICS (continued)



TYPICAL PERFORMANCE CHARACTERISTICS (continued)



REVISION HISTORY

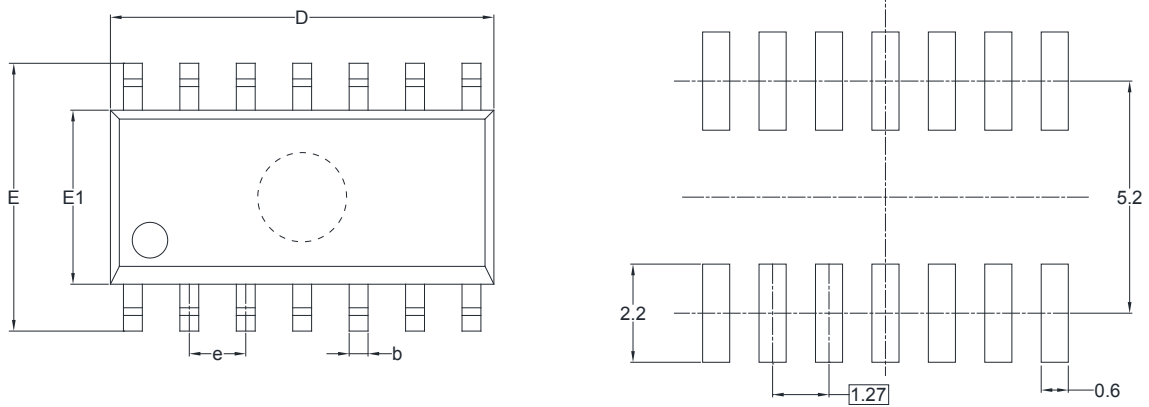
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| SEPTEMBER 2020 – REV.A to REV.A.1 | Page |
|---|-------------|
| Updated Electrical Characteristics section | 3, 4 |
| Updated Typical Performance Characteristics section | 6, 7 |

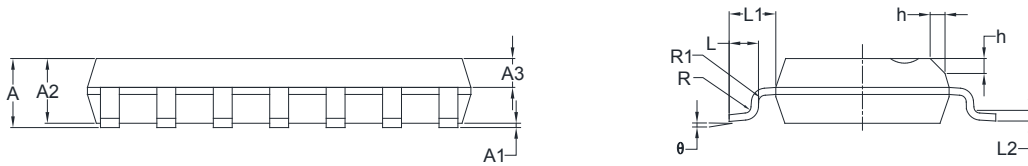
| Changes from Original (JULY 2015) to REV.A | Page |
|--|-------------|
| Changed from product preview to production data..... | All |

PACKAGE OUTLINE DIMENSIONS

SOIC-14



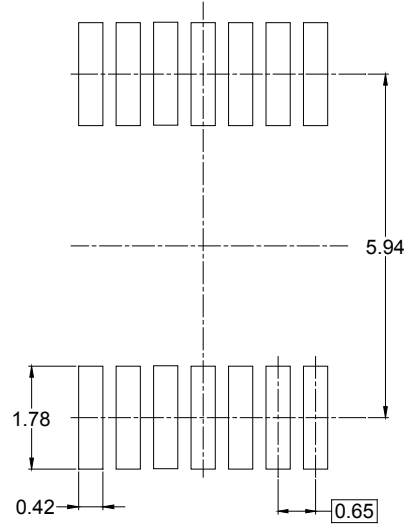
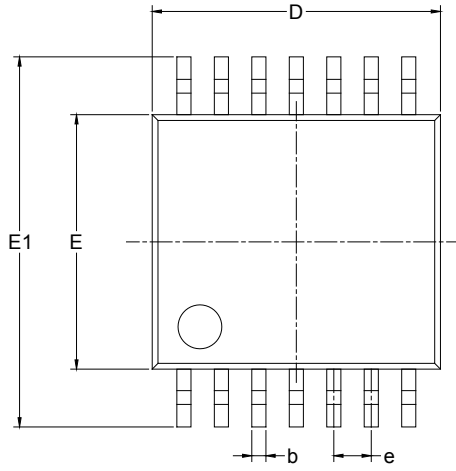
RECOMMENDED LAND PATTERN (Unit: mm)



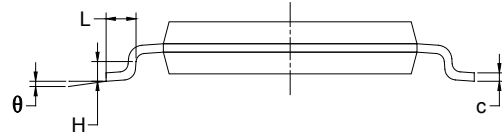
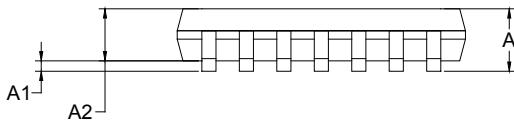
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|------------------------------|------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.35 | 1.75 | 0.053 | 0.069 |
| A1 | 0.10 | 0.25 | 0.004 | 0.010 |
| A2 | 1.25 | 1.65 | 0.049 | 0.065 |
| A3 | 0.55 | 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° |

PACKAGE OUTLINE DIMENSIONS

TSSOP-14



RECOMMENDED LAND PATTERN (Unit: mm)



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | | 1.200 | | 0.047 |
| A1 | 0.050 | 0.150 | 0.002 | 0.006 |
| A2 | 0.800 | 1.050 | 0.031 | 0.041 |
| b | 0.190 | 0.300 | 0.007 | 0.012 |
| c | 0.090 | 0.200 | 0.004 | 0.008 |
| D | 4.860 | 5.100 | 0.191 | 0.201 |
| E | 4.300 | 4.500 | 0.169 | 0.177 |
| E1 | 6.250 | 6.550 | 0.246 | 0.258 |
| e | 0.650 BSC | | 0.026 BSC | |
| L | 0.500 | 0.700 | 0.02 | 0.028 |
| H | 0.25 TYP | | 0.01 TYP | |
| θ | 1° | 7° | 1° | 7° |

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 |
|--------------|---------------|--------------------|---------|---------|---------|---------|---------|---------|--------|---------------|
| SOIC-14 | 13" | 16.4 | 6.60 | 9.30 | 2.10 | 4.0 | 8.0 | 2.0 | 16.0 | Q1 |
| TSSOP-14 | 13" | 12.4 | 6.95 | 5.60 | 1.20 | 4.0 | 8.0 | 2.0 | 12.0 | Q1 |

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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 |
|-----------|-------------|------------|-------------|--------------|
| 13" | 386 | 280 | 370 | 5 |

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