

SGM8061/SGM8062/SGM8063

500MHz, Rail-to-Rail Output, CMOS Operational Amplifiers

GENERAL DESCRIPTION

The SGM8061 (single), SGM8062 (dual) and SGM8063 (single with shutdown) are rail-to-rail output voltage feedback amplifiers offering ease of use and low cost. They have bandwidth and slew rate typically found in current feedback amplifiers. All have a wide input common mode voltage range and output voltage swing, making them easy to use on single supply as low as 2.5V.

Despite being low cost, the SGM8061 series provide excellent overall performance. They offer 500MHz ($G = +1$) wide bandwidth, and 130MHz ($G = +1$) bandwidth along with 0.1dB flatness. They offer a typical low power of 8.2mA/amplifier.

The SGM8061 series have low distortion and fast settling time, making them ideal for buffering high speed A/D or D/A converters. The SGM8063 has a power-down disable feature that reduces the supply current to 75 μ A. These features make the SGM8063 ideal for portable and battery-powered applications where size and power are critical.

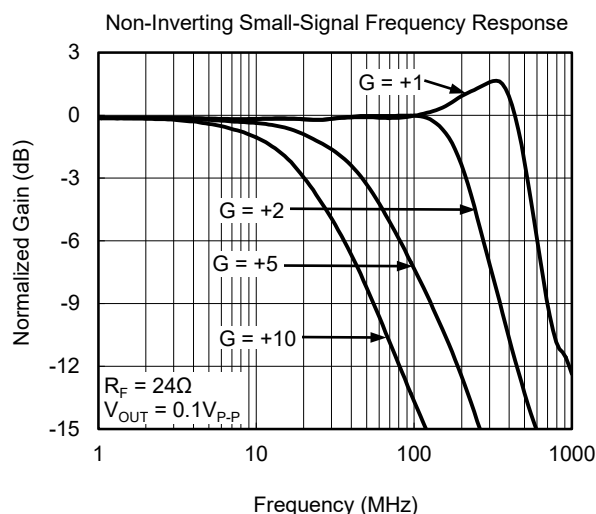
The single SGM8061 is available in Green SOT-23-5 and SOIC-8 packages. The dual SGM8062 is available in Green SOIC-8 and MSOP-8 packages. The single with shutdown SGM8063 is available in Green SOT-23-6 and SOIC-8 packages. They are specified over the extended -40°C to $+125^{\circ}\text{C}$ temperature range.

APPLICATIONS

Imaging
Photodiode Preamp
Professional Video and Camera
Hand Set
DVD/CD
Base Station
Filter
A-to-D Driver

FEATURES

- **Low Cost**
- **Rail-to-Rail Output**
- **Input Offset Voltage: 8mV (MAX)**
- **High Speed:**
 - **500MHz, -3dB Bandwidth ($G = +1$)**
 - **420V/ μ s, Slew Rate**
 - **16ns Settling Time to 0.1% with 2V Step**
- **Supply Voltage Range: 2.5V to 5.5V**
- **Input Voltage Range: -0.2V to 3.8V with $V_S = 5\text{V}$**
- **Excellent Video Specs ($R_L = 150\Omega$, $G = +2$):**
 - **Gain Flatness: 0.1dB to 80MHz**
 - **Diff Gain: 0.015%, Diff Phase: 0.05 Degree**
- **Low Supply Current:**
 - **8.2mA/Amplifier (TYP)**
 - **75 μ A Shutdown Current for SGM8063**
- **-40°C to $+125^{\circ}\text{C}$ Operating Temperature Range**
- **Small Packaging:**
 - **SGM8061 Available in Green SOT-23-5 and SOIC-8 Packages**
 - **SGM8062 Available in Green MSOP-8 and SOIC-8 Packages**
 - **SGM8063 Available in Green SOT-23-6 and SOIC-8 Packages**



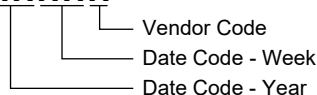
PACKAGE/ORDERING INFORMATION

| MODEL | PACKAGE DESCRIPTION | SPECIFIED TEMPERATURE RANGE | ORDERING NUMBER | PACKAGE MARKING | PACKING OPTION |
|---------|---------------------|-----------------------------|-----------------|-------------------------|---------------------|
| SGM8061 | SOT-23-5 | -40°C to +125°C | SGM8061XN5/TR | 8061 | Tape and Reel, 3000 |
| | SOIC-8 | -40°C to +125°C | SGM8061XS/TR | SGM8061XS XXXXX | Tape and Reel, 2500 |
| SGM8062 | MSOP-8 | -40°C to +125°C | SGM8062XMS/TR | SGM8062 XMS XXXXX | Tape and Reel, 3000 |
| | SOIC-8 | -40°C to +125°C | SGM8062XS/TR | SGM8062XS XXXXX | Tape and Reel, 2500 |
| SGM8063 | SOT-23-6 | -40°C to +125°C | SGM8063XN6/TR | 8063 | Tape and Reel, 3000 |
| | SOIC-8 | -40°C to +125°C | SGM8063XS/TR | SGM8063XS XXXXX | Tape and Reel, 2500 |

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, +V_S to -V_S.....6V
- Input Common Mode Voltage Range
..... (-V_S) - 0.3V to (+V_S) + 0.3V
- Package Thermal Resistance @ T_A = +25°C
- SOT-23-5, θ_{JA} 190°C/W
- SOT-23-6, θ_{JA} 190°C/W
- SOIC-8, θ_{JA} 125°C/W
- MSOP-8, θ_{JA} 155°C/W
- Junction Temperature+150°C
- Storage Temperature Range.....-65°C to +150°C
- Lead Temperature (Soldering, 10s)+260°C
- ESD Susceptibility
- HBM..... 1000V
- MM..... 400V

RECOMMENDED OPERATING CONDITIONS

- Operating Voltage Range.....2.5V to 5.5V
- 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.

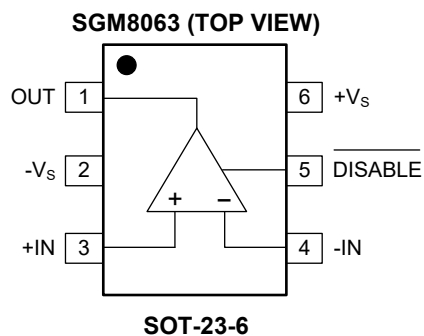
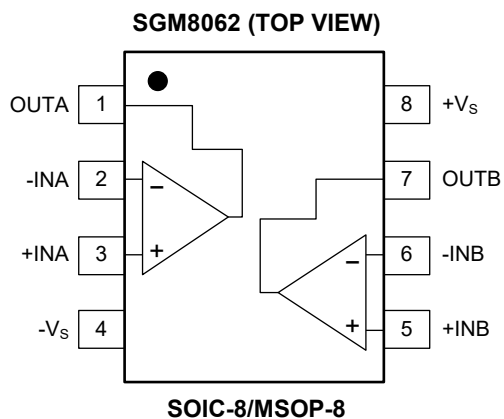
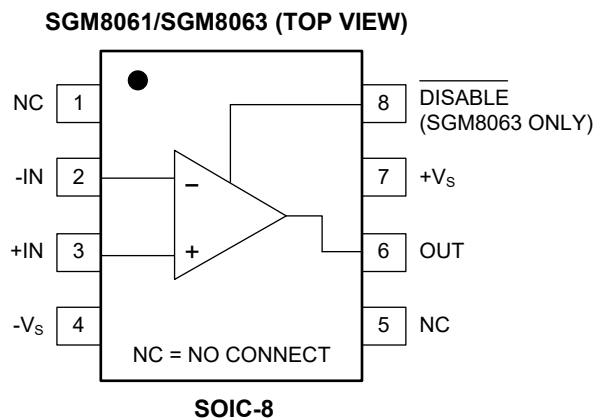
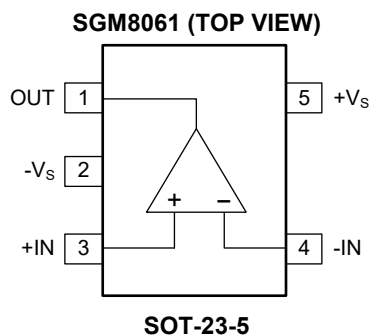
ESD SENSITIVITY CAUTION

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.

PIN CONFIGURATIONS



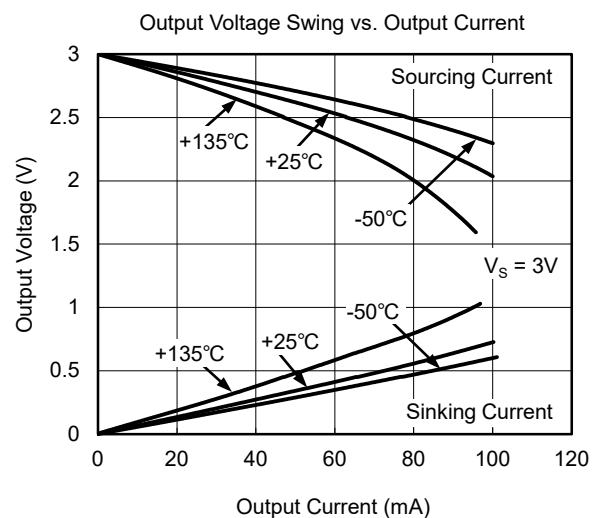
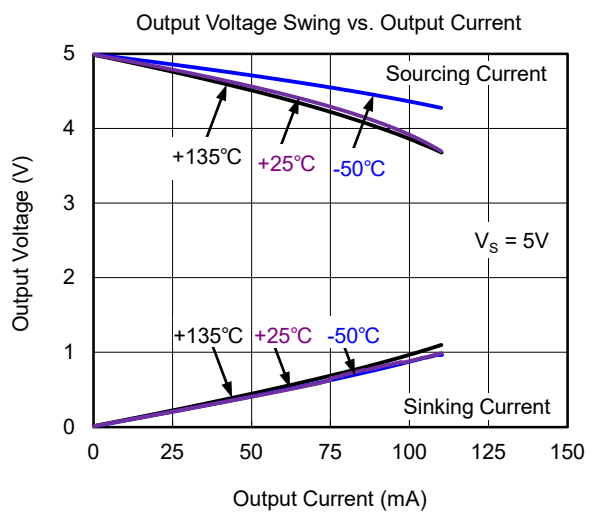
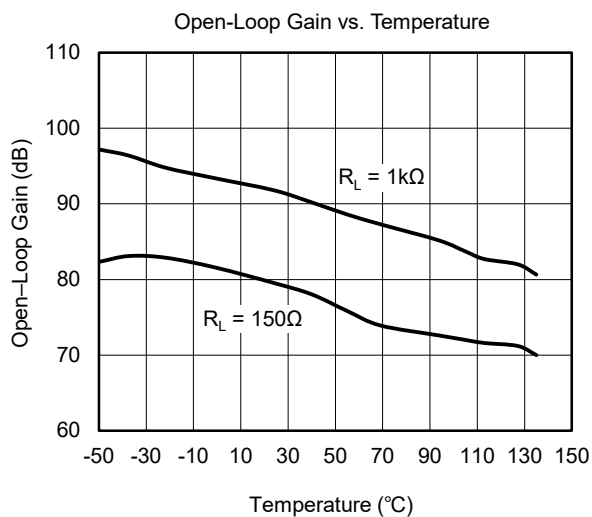
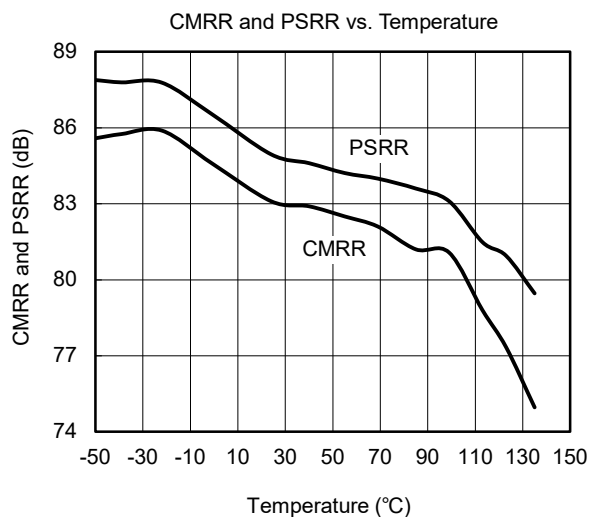
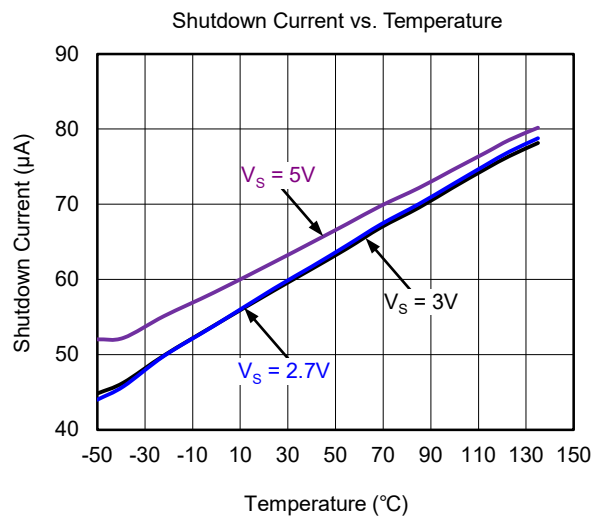
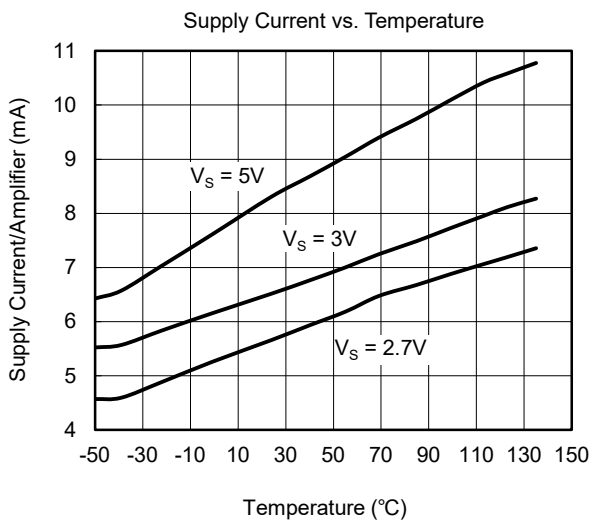
ELECTRICAL CHARACTERISTICS

(G = +2, R_F = 402Ω, R_L = 150Ω, unless otherwise noted.)

| PARAMETER | CONDITIONS | SGM8061/2/3 | | | | | | UNITS | MIN /MAX |
|--|---|-------------|--------------------------|--------------------|----------------------|-----------------------|--|--------|-------------|
| | | TYP | MIN/MAX OVER TEMPERATURE | | | | | | |
| | | +25°C | +25°C | 0°C to +70°C | -40°C to +85°C | -40°C to +125°C | | | |
| DYNAMIC PERFORMANCE | | | | | | | | | |
| -3dB Small-Signal Bandwidth | G = +1, V _{OUT} = 0.1V _{P-P} , R _F = 24Ω | 500 | | | | | | MHz | TYP |
| | G = +1, V _{OUT} = 0.1V _{P-P} , R _F = 24Ω, R _L = 1kΩ | 550 | | | | | | MHz | TYP |
| | G = +2, V _{OUT} = 0.1V _{P-P} , R _L = 50Ω | 130 | | | | | | MHz | TYP |
| | G = +2, V _{OUT} = 0.1V _{P-P} , R _L = 150Ω | 210 | | | | | | MHz | TYP |
| | G = +2, V _{OUT} = 0.1V _{P-P} , R _L = 1kΩ | 250 | | | | | | MHz | TYP |
| | G = +2, V _{OUT} = 0.1V _{P-P} , R _L = 10kΩ | 420 | | | | | | MHz | TYP |
| Gain-Bandwidth Product | G = +10, R _L = 150Ω | 200 | | | | | | MHz | TYP |
| | G = +10, R _L = 1kΩ | 230 | | | | | | MHz | TYP |
| Bandwidth for 0.1dB Flatness | G = +1, V _{OUT} = 0.1V _{P-P} , R _F = 24Ω | 130 | | | | | | MHz | TYP |
| | G = +2, V _{OUT} = 0.1V _{P-P} , R _F = 330Ω | 80 | | | | | | MHz | TYP |
| Slew Rate | G = +1, 2V Output Step | 320/370 | | | | | | V/μs | TYP |
| | G = +2, 2V Output Step | 350/320 | | | | | | V/μs | TYP |
| | G = +2, 4V Output Step | 420/390 | | | | | | V/μs | TYP |
| Rise-and-Fall Time | G = +2, V _{OUT} = 0.2V _{P-P} , 10% to 90% | 4 | | | | | | ns | TYP |
| | G = +2, V _{OUT} = 2V _{P-P} , 10% to 90% | 4.5 | | | | | | ns | TYP |
| Settling Time to 0.1% | G = +2, 2V Output Step | 16 | | | | | | ns | TYP |
| Overload Recovery Time | V _{IN} G = +V _S | 6.2 | | | | | | ns | TYP |
| NOISE/DISTORTION PERFORMANCE | | | | | | | | | |
| Input Voltage Noise Density | f = 1MHz | 5.6 | | | | | | nV/√Hz | TYP |
| Differential Gain Error (NTSC) | G = +2, R _L = 150Ω | 0.015 | | | | | | % | TYP |
| Differential Phase Error (NTSC) | G = +2, R _L = 150Ω | 0.05 | | | | | | degree | TYP |
| DC PERFORMANCE | | | | | | | | | |
| Input Offset Voltage (V _{OS}) | | ±2 | ±8 | ±8.5 | ±9 | ±9.3 | | mV | MAX |
| Input Offset Voltage Drift | | 3 | | | | | | μV/°C | TYP |
| Input Bias Current (I _B) | | 6 | | | | | | pA | TYP |
| Input Offset Current (I _{OS}) | | 2 | | | | | | pA | TYP |
| Open-Loop Gain (A _{OL}) | V _{OUT} = 0.3V to 4.7V, R _L = 150Ω | 80 | 75 | 75 | 74 | 70 | | dB | MIN |
| | V _{OUT} = 0.2V to 4.8V, R _L = 1kΩ | 104 | 90 | 90 | 89 | 80 | | dB | MIN |
| INPUT CHARACTERISTICS | | | | | | | | | |
| Input Common Mode Voltage Range (V _{CM}) | | -0.2 to 3.8 | | | | | | V | TYP |
| Common Mode Rejection Ratio (CMRR) | V _{CM} = -0.1V to 3.5V | 80 | 66 | 65 | 64 | 62 | | dB | MIN |
| OUTPUT CHARACTERISTICS | | | | | | | | | |
| Output Voltage Swing from Rail | R _L = 150Ω | 0.12 | | | | | | V | TYP |
| | R _L = 1kΩ | 0.03 | | | | | | V | TYP |
| Output Current | | 120 | 100 | 98 | 93 | 87 | | mA | MIN |
| Closed-Loop Output Impedance | f < 100kHz | 0.015 | | | | | | Ω | TYP |
| POWER-DOWN DISABLE (SGM8063 ONLY) | | | | | | | | | |
| Turn-On Time | | 50 | | | | | | ns | TYP |
| Turn-Off Time | | 44 | | | | | | ns | TYP |
| DISABLE Voltage-Off | | | 0.8 | | | | | V | MAX |
| DISABLE Voltage-On | | | 2 | | | | | V | MIN |
| POWER SUPPLY | | | | | | | | | |
| Operating Voltage Range | | | 2.5 | 2.7 | 2.7 | 2.7 | | V | MIN |
| | | | 5.5 | 5.5 | 5.5 | 5.5 | | V | MAX |
| Quiescent Current/Amplifier | | 8.2 | 10 | 10.3 | 10.5 | 11 | | mA | MAX |
| Supply Current when Disabled (SGM8063 only) | | 75 | 120 | 127 | 130 | 139 | | μA | MAX |
| Power Supply Rejection Ratio (PSRR) | ΔV _S = 2.7V to 5.5V, V _{CM} = (-V _S) + 0.5V | 80 | 66 | 66 | 65 | 63 | | dB | MIN |

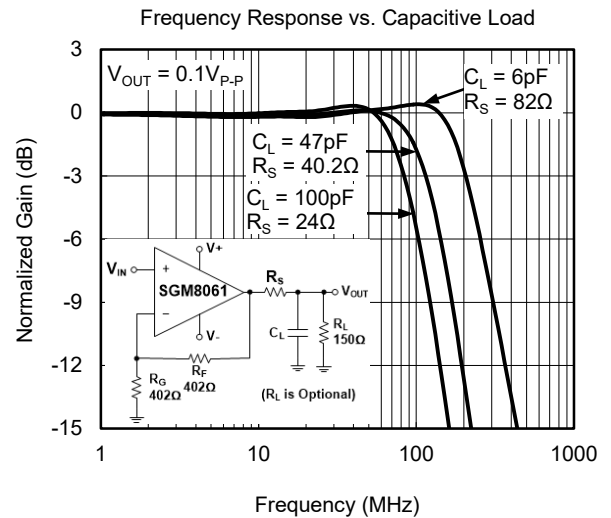
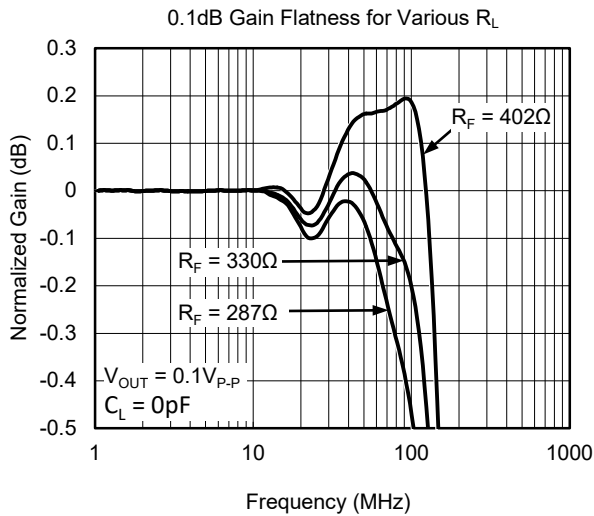
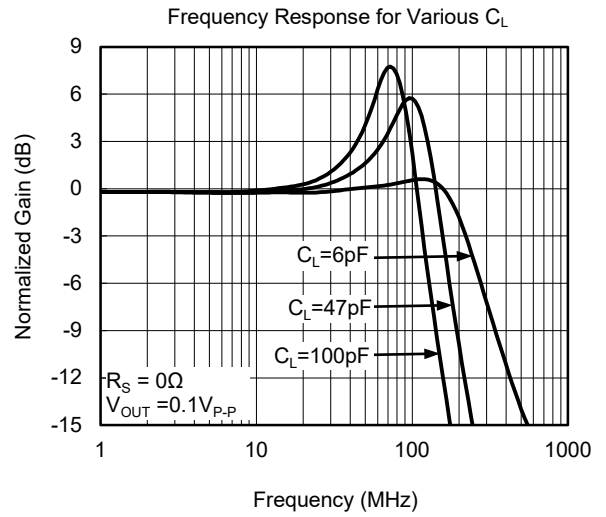
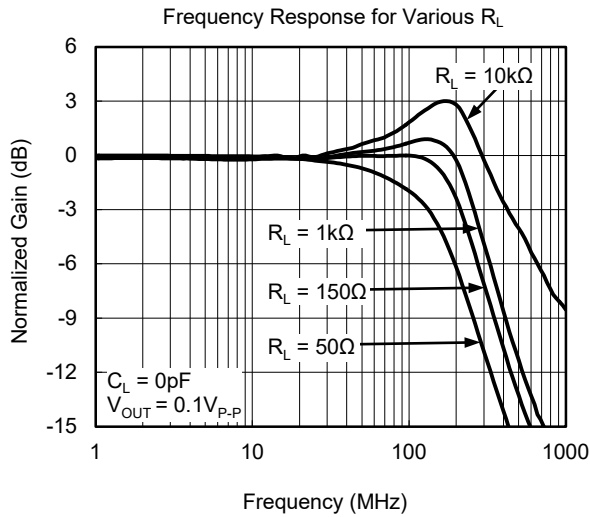
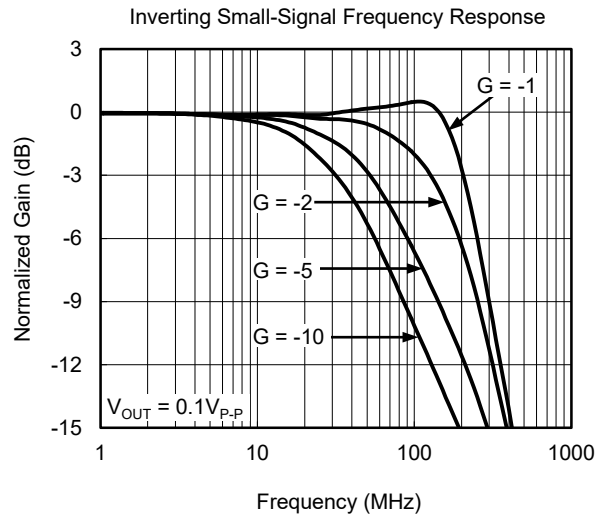
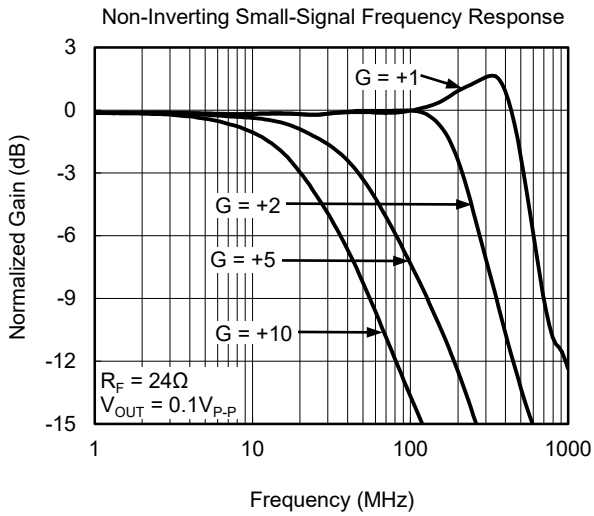
TYPICAL PERFORMANCE CHARACTERISTICS

At $T_A = +25^\circ\text{C}$, $V_S = 5\text{V}$, $G = +2$, $R_F = 402\Omega$, $R_G = 402\Omega$, and $R_L = 150\Omega$ connected to $V_S/2$, unless otherwise noted.



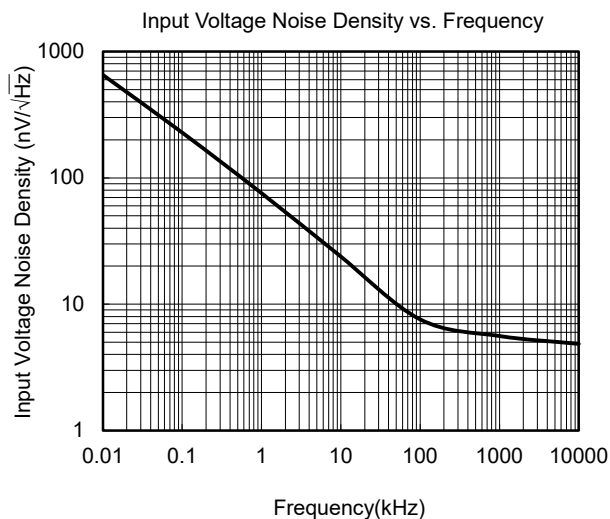
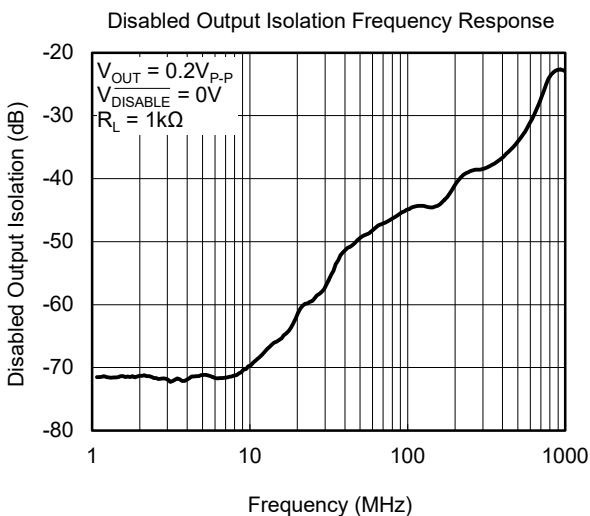
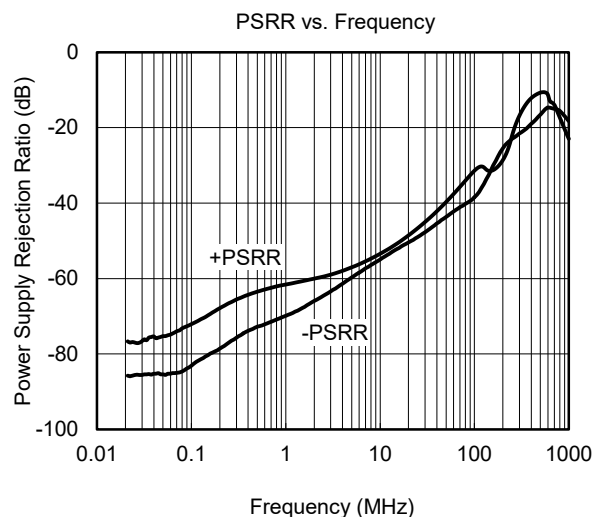
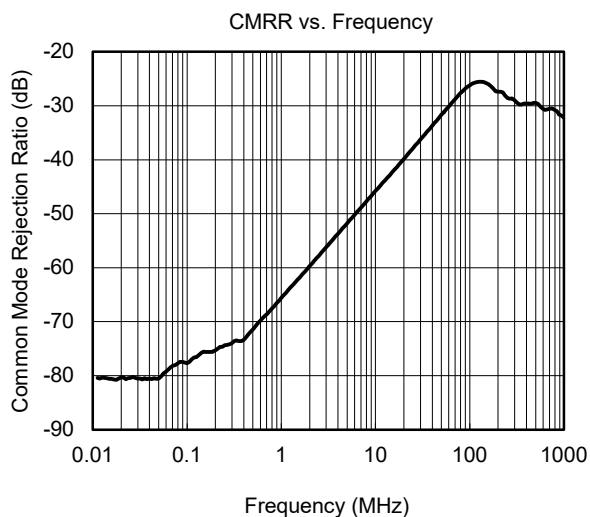
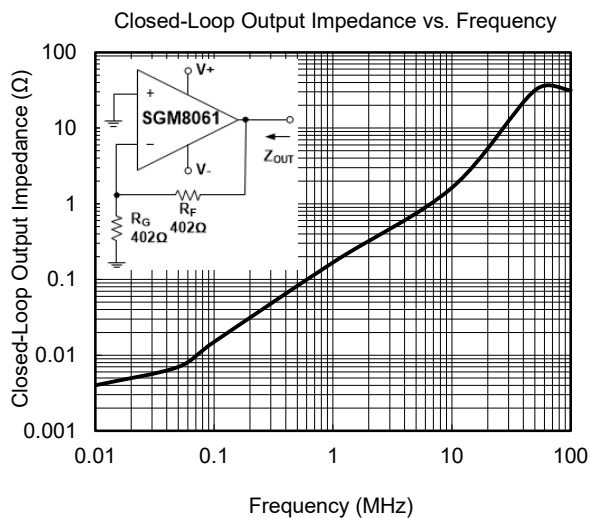
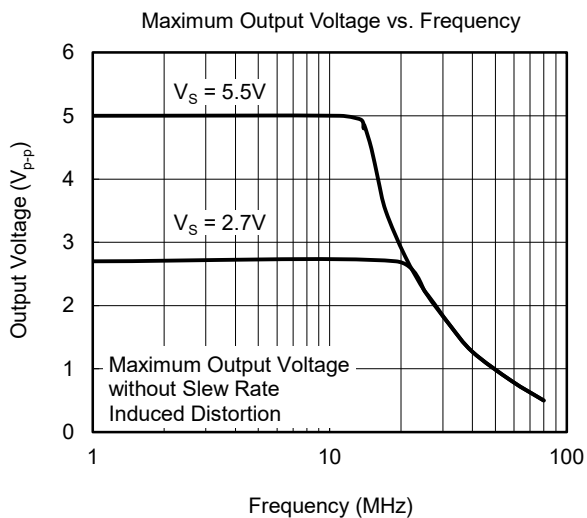
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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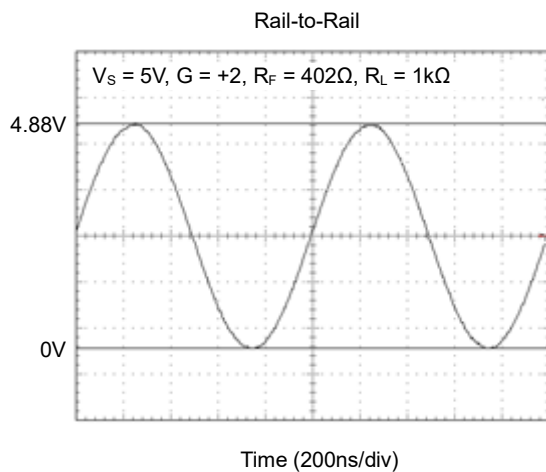
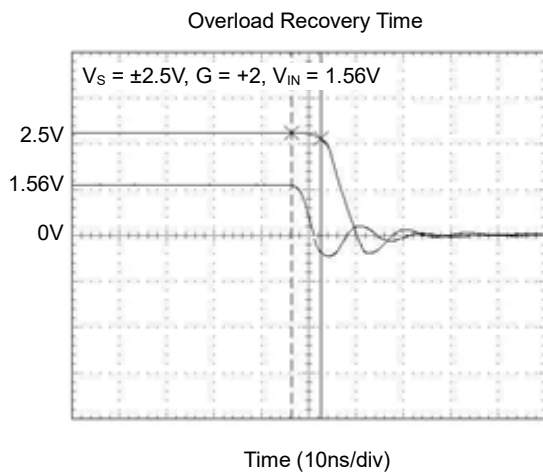
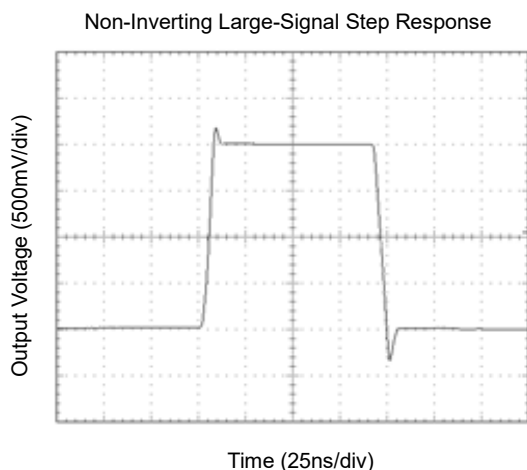
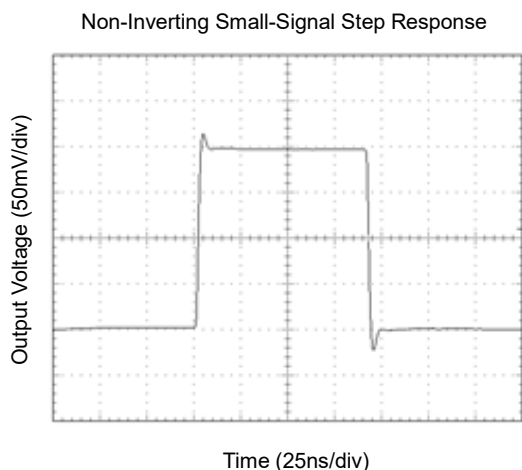
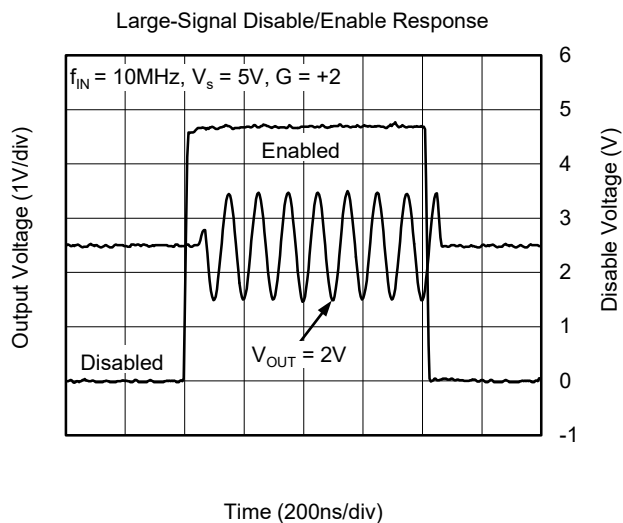
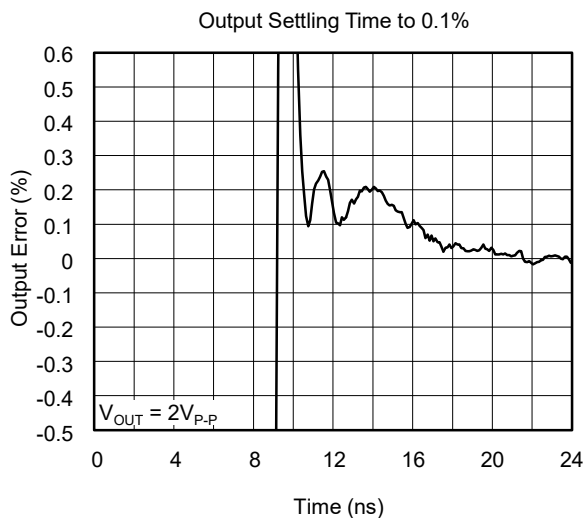
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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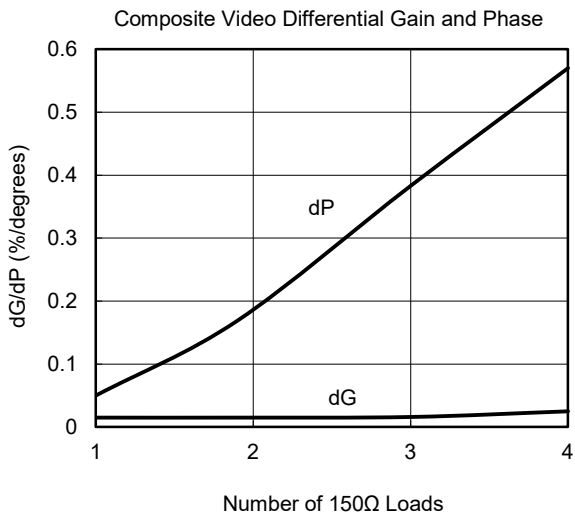
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At $T_A = +25^\circ\text{C}$, $V_S = 5\text{V}$, $G = +2$, $R_F = 402\Omega$, $R_G = 402\Omega$, and $R_L = 150\Omega$ connected to $V_S/2$, unless otherwise noted.



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At $T_A = +25^\circ\text{C}$, $V_S = 5\text{V}$, $G = +2$, $R_F = 402\Omega$, $R_G = 402\Omega$, and $R_L = 150\Omega$ connected to $V_S/2$, unless otherwise noted.



APPLICATION NOTES

Driving Capacitive Loads

The unity-gain follower (buffer) is the most sensitive configuration to capacitive loading. Direct capacitive loading reduces the phase margin of amplifiers and this results in ringing or even oscillation. Applications that require greater capacitive driving capability should use an isolation resistor between the output and the capacitive load like the circuit in Figure 1. The isolation resistor R_{ISO} and the load capacitor C_L form a zero to increase stability. The bigger the R_{ISO} resistor value, the more stable V_{OUT} will be. Note that this method results in a loss of gain accuracy because R_{ISO} forms a voltage divider with the R_{LOAD} .

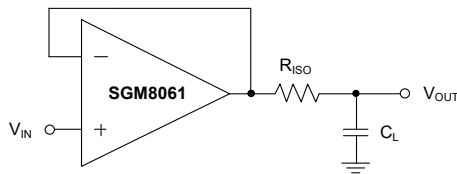


Figure 1. Series Resistor Isolating Capacitive Load

An improved circuit is shown in Figure 2. It provides DC accuracy as well as AC stability. R_F provides the DC accuracy by connecting the inverting input with the output. C_F and R_{ISO} serve to counteract the loss of phase margin by feeding the high frequency component of the output signal back to the amplifier's inverting input, thereby preserving phase margin in the overall feedback loop.

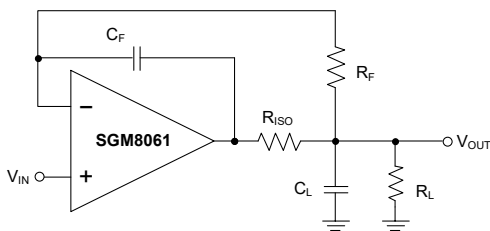


Figure 2. Indirectly Driving Heavy Capacitive Load with DC Accuracy

For non-buffer configuration, there are two other ways to increase the phase margin: (a) by increasing the amplifier's closed-loop gain or (b) by placing a capacitor in parallel with the feedback resistor to counteract the parasitic capacitance associated with inverting node.

Power Supply Bypassing and Layout

The SGM806x family operates from either a single 2.7V to 5.5V supply or dual $\pm 1.35V$ to $\pm 2.75V$ supplies. For single-supply operation, bypass the power supply $+V_S$ with a $0.1\mu F$ ceramic capacitor which should be placed close to the $+V_S$ pin. For dual-supply operation, both the $+V_S$ and the $-V_S$ supplies should be bypassed to ground with separate $0.1\mu F$ ceramic capacitors. $2.2\mu F$ tantalum capacitor can be added for better performance.

Good PC board layout techniques optimize performance by decreasing the amount of stray capacitance at the operational amplifier's inputs and output. To decrease stray capacitance, minimize trace lengths and widths by placing external components as close to the device as possible. Use surface-mount components whenever possible.

For the operational amplifier, soldering the part to the board directly is strongly recommended. Try to keep the high frequency current loop area small to minimize the EMI (electromagnetic interference).

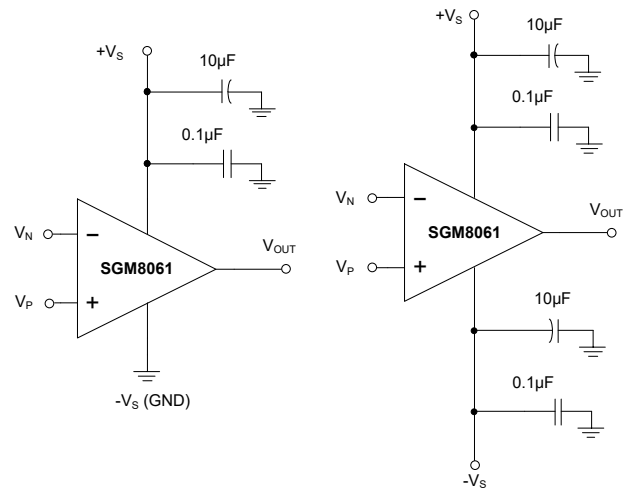


Figure 3. Amplifier with Bypass Capacitors

Grounding

A ground plane layer is important for circuit design. The length of the current path in an inductive ground return will create an unwanted voltage noise. Broad ground plane areas will reduce the parasitic inductance.

Input-to-Output Coupling

To minimize capacitive coupling, the input and output signal traces should not be in parallel. This helps reduce unwanted positive feedback.

TYPICAL APPLICATION CIRCUITS

Differential Amplifier

The circuit shown in Figure 4 performs the difference function. If the resistor ratios are equal ($R_4/R_3 = R_2/R_1$), then $V_{OUT} = (V_P - V_N) \times R_2/R_1 + V_{REF}$.

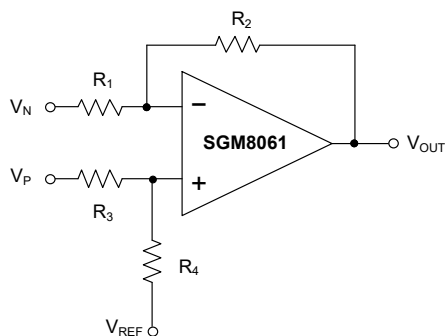


Figure 4. Differential Amplifier

Active Low-Pass Filter

The low-pass filter shown in Figure 5 has a DC gain of $(-R_2/R_1)$ and the -3dB corner frequency is $1/2\pi R_2 C$. Make sure the filter bandwidth is within the bandwidth of the amplifier. Feedback resistors with large values can couple with parasitic capacitance and cause undesired effects such as ringing or oscillation in high-speed amplifiers. Keep resistor values as low as possible and consistent with output loading consideration.

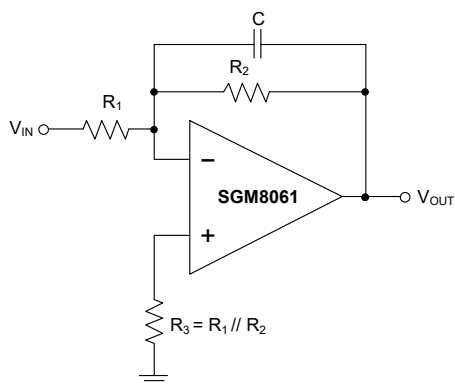


Figure 5. Active Low-Pass Filter

Driving Video

The SGM806x can be used in video applications like in Figure 6.

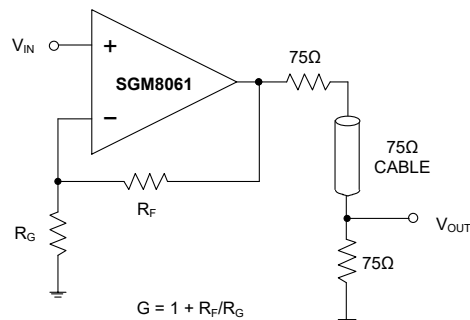


Figure 6. Typical Video Driving

REVISION HISTORY

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

JANUARY 2019 – REV.A.1 to REV.A.2

| | |
|---|-----|
| Added MSOP-8 Package..... | All |
| Changed Absolute Maximum Ratings section..... | 2 |
| Changed Driving Capacitive Loads section..... | 10 |

MAY 2011 – REV.A to REV.A.1

| | |
|----------------------------|-----|
| Changed Package name | All |
|----------------------------|-----|

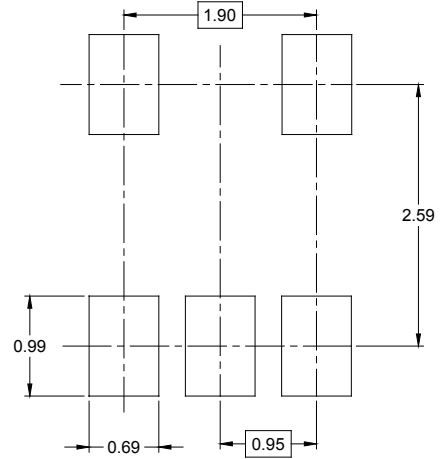
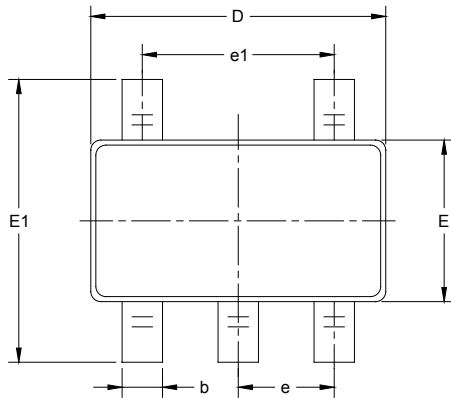
Changes from Original (NOVEMBER 2006) to REV.A

| | |
|--|-----|
| Changed from product preview to production data..... | All |
|--|-----|

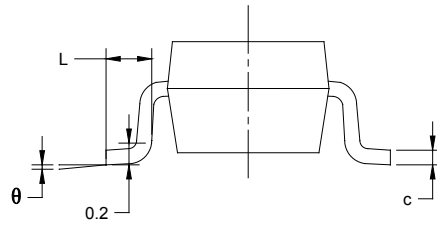
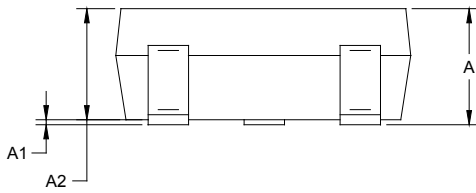
PACKAGE INFORMATION

PACKAGE OUTLINE DIMENSIONS

SOT-23-5



RECOMMENDED LAND PATTERN (Unit: mm)

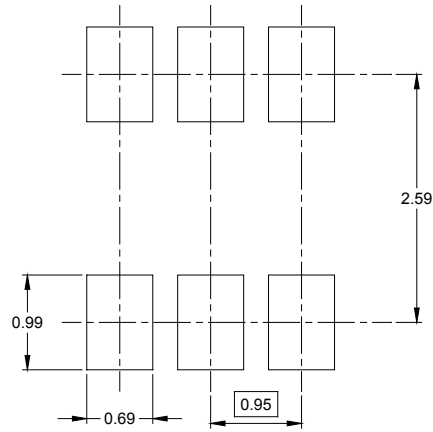
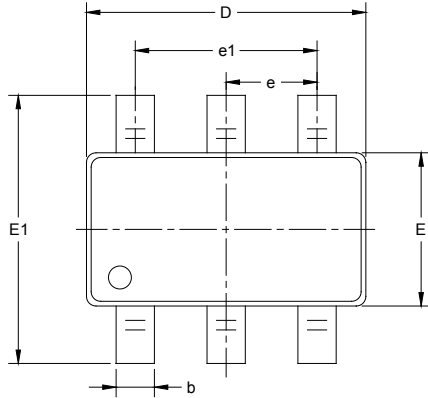


| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|----------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b |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

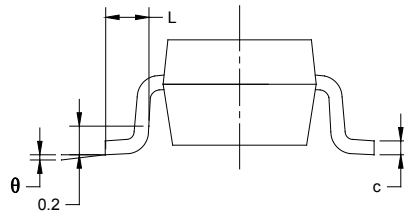
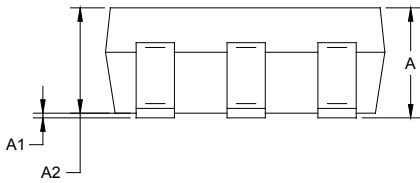
PACKAGE INFORMATION

PACKAGE OUTLINE DIMENSIONS

SOT-23-6



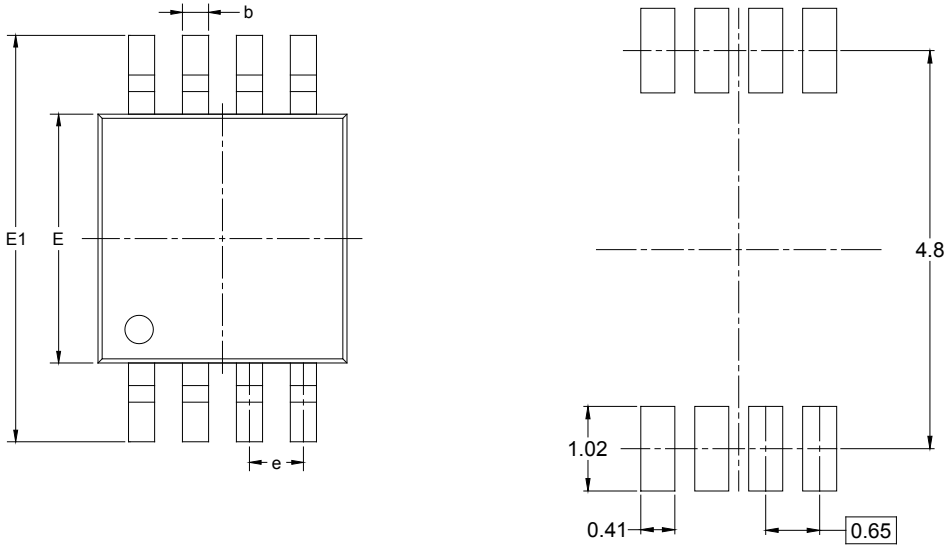
RECOMMENDED LAND PATTERN (Unit: mm)



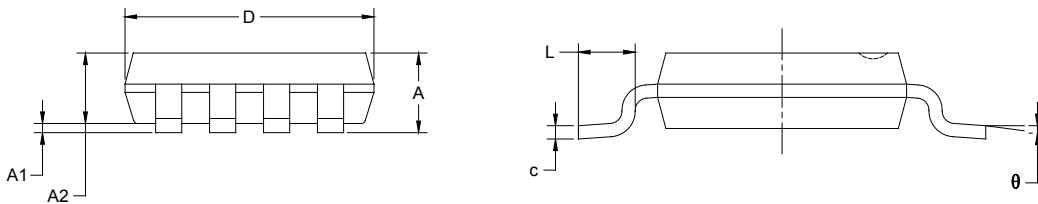
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|----------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b |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

PACKAGE OUTLINE DIMENSIONS

MSOP-8



RECOMMENDED LAND PATTERN (Unit: mm)

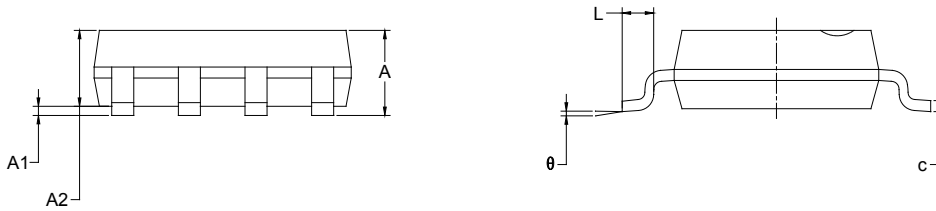
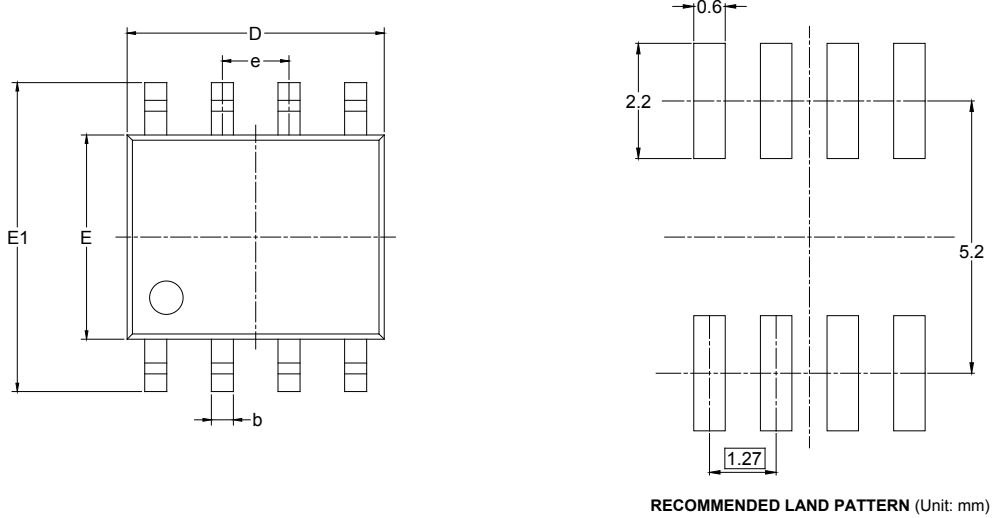


| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.820 | 1.100 | 0.032 | 0.043 |
| A1 | 0.020 | 0.150 | 0.001 | 0.006 |
| A2 | 0.750 | 0.950 | 0.030 | 0.037 |
| b | 0.250 | 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

PACKAGE OUTLINE DIMENSIONS

SOIC-8

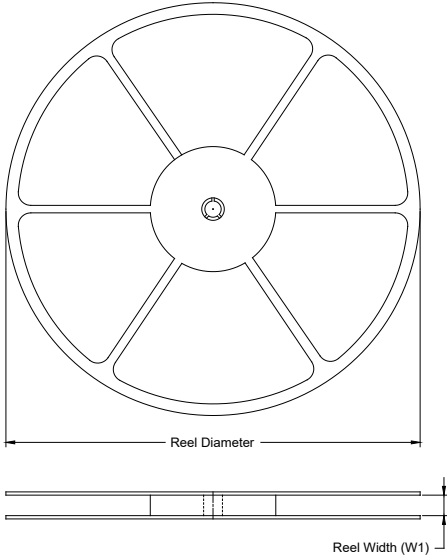


| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|----------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.350 | 1.750 | 0.053 | 0.069 |
| A1 | 0.100 | 0.250 | 0.004 | 0.010 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| b |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

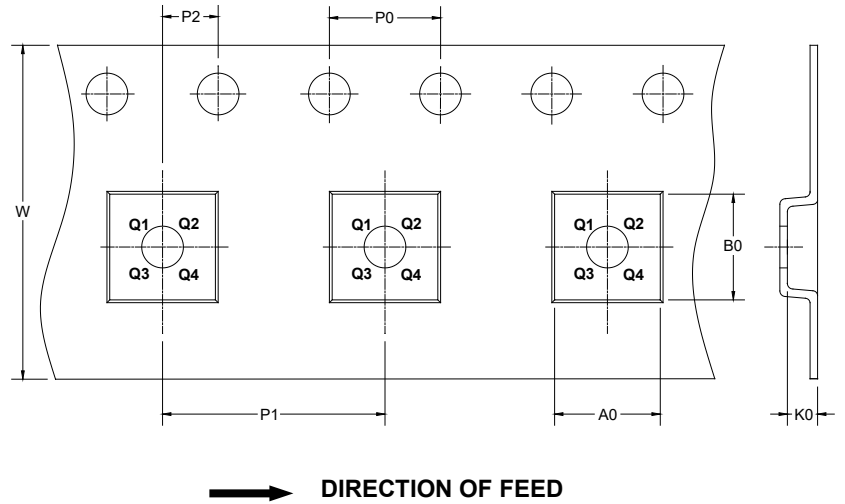
PACKAGE INFORMATION

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 | 3.17 | 3.23 | 1.37 | 4.0 | 4.0 | 2.0 | 8.0 | Q3 |
| MSOP-8 | 13" | 12.4 | 5.20 | 3.30 | 1.50 | 4.0 | 8.0 | 2.0 | 12.0 | Q1 |
| SOIC-8 | 13" | 12.4 | 6.40 | 5.40 | 2.10 | 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