



SGM8061/2/3

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

PRODUCT DESCRIPTION

The SGM8061 (single), SGM8062 (dual), 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 supplies as low as 2.5V.

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

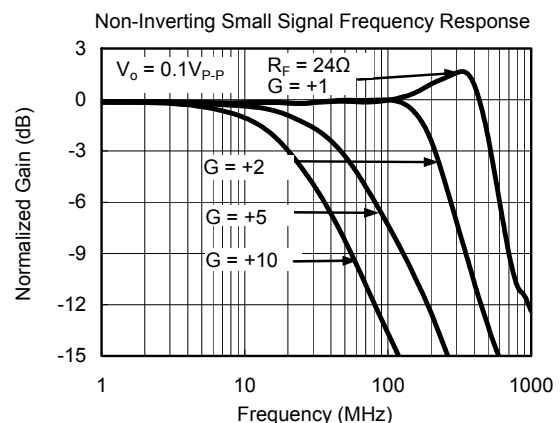
The SGM8061 series is low distortion and fast settling make it ideal for buffering high speed A/D or D/A converters. The SGM8063 has a power-down disable feature that reduces the supply current to 75 μ A. These features make the SGM8063 ideal for portable and battery-powered applications where size and power are critical. All are specified over the extended -40 $^{\circ}$ C to +125 $^{\circ}$ C temperature range.

APPLICATIONS

- Imaging
- Photodiode Preamp
- Professional Video and Cameras
- Hand Sets
- DVD/CD
- Base Stations
- Filters
- A-to-D Driver

FEATURES

- **Low Cost**
- **Rail-to-Rail Output**
2mV Typical V_{OS}
- **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 $V_S = 5V$**
- **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
- **Small Packaging**
SGM8061 Available in SOIC-8 and SOT-23-5
SGM8062 Available in SOIC-8
SGM8063 Available in SOIC-8 and SOT-23-6



PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	ORDER NUMBER	MARKING INFORMATION	PACKAGE OPTION
SGM8061	SOT-23-5	SGM8061XN5/TR	8061	Tape and Reel, 3000
	SOIC-8	SGM8061XS/TR	SGM8061XS	Tape and Reel, 2500
SGM8062	SOIC-8	SGM8062XS/TR	SGM8062XS	Tape and Reel, 2500
SGM8063	SOT-23-6	SGM8063XN6/TR	8063	Tape and Reel, 3000
	SOIC-8	SGM8063XS/TR	SGM8063XS	Tape and Reel, 2500

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, +V _S to -V _S	7.5V
Common Mode Input Voltage.....(-V _S) - 0.5V to (+V _S) + 0.5V	
Storage Temperature Range	-65°C to +150°C
Junction Temperature	160°C
Operating Temperature Range	-55°C to +150°C
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
Lead Temperature (Soldering 10sec).....	260°C
ESD Susceptibility	
HBM.....	1000V
MM.....	400V

NOTE:

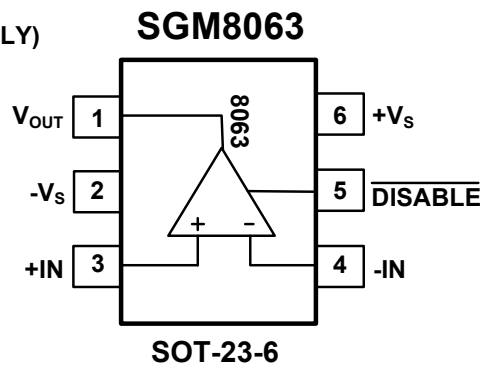
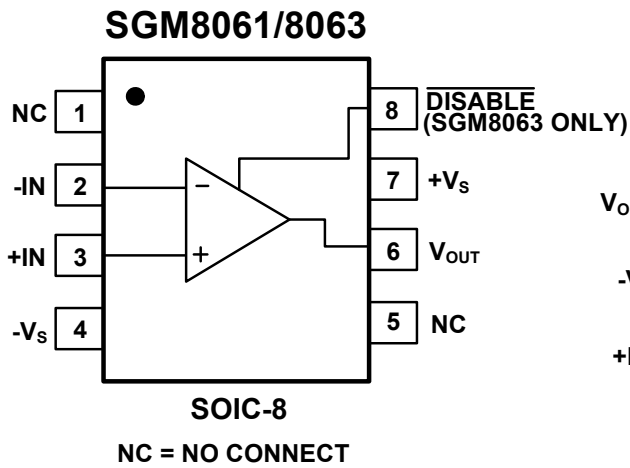
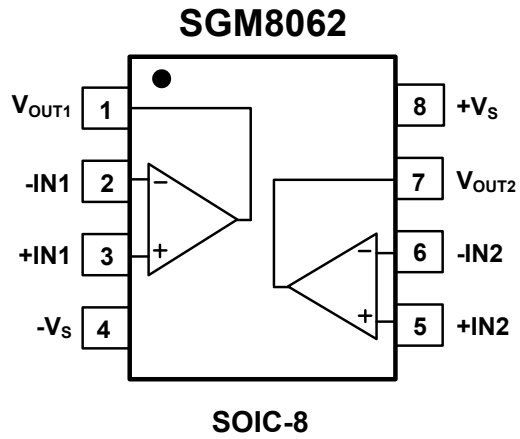
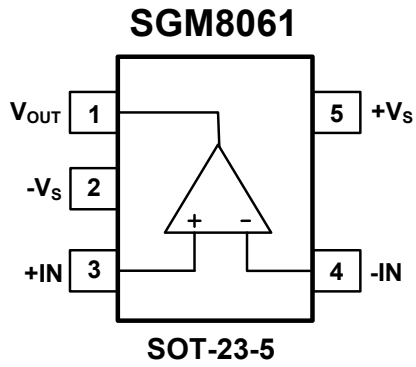
Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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.

SGMICRO reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact SGMICRO sales office to get the latest datasheet.

PIN CONFIGURATIONS (TOP VIEW)

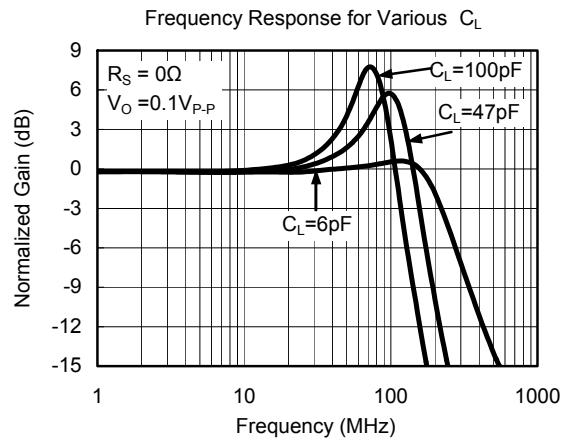
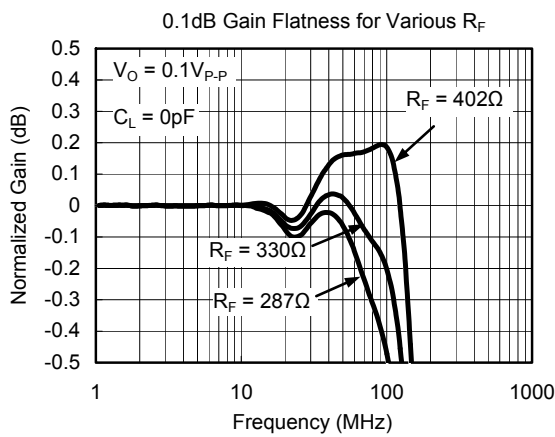
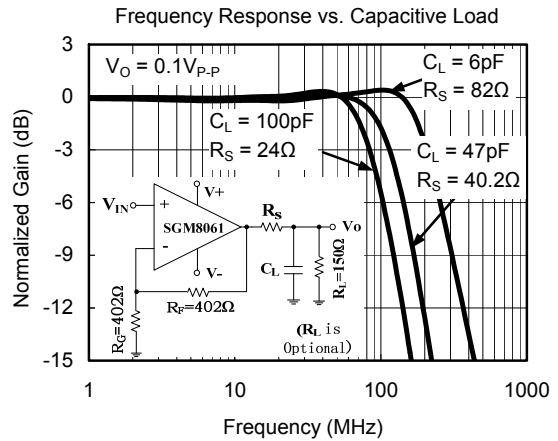
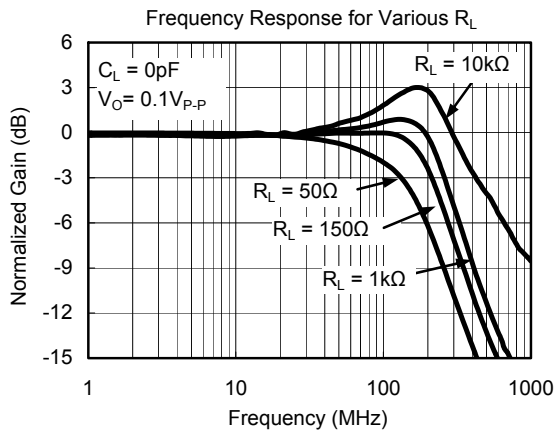
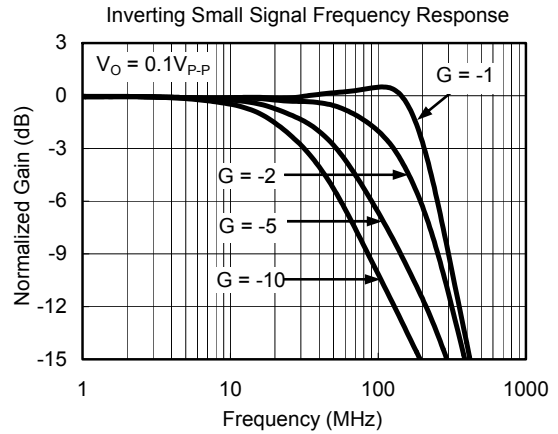
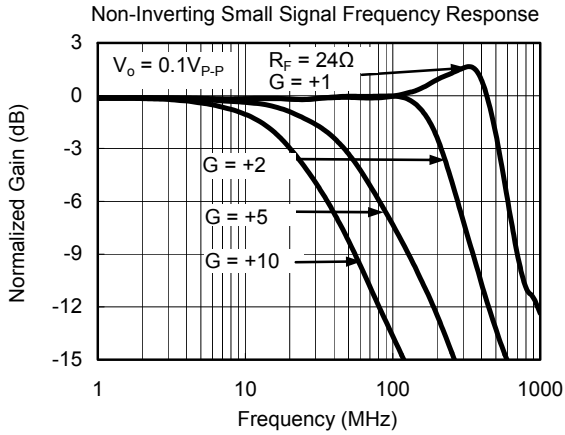


ELECTRICAL CHARACTERISTICS: $V_S = +5V$ (G = +2, $R_F = 402\Omega$, $R_L = 150\Omega$, unless otherwise noted.)

PARAMETER	CONDITIONS	SGM8061/2/3							
		TYP	MIN/MAX OVER TEMPERATURE					UNITS	MIN/ MAX
		+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, $V_O = 0.1V_{p-p}$, $R_F = 24\Omega$, G = +1, $V_O = 0.1V_{p-p}$, $R_F = 24\Omega$, $R_L = 1k\Omega$ G = +2, $V_O = 0.1V_{p-p}$, $R_L = 50\Omega$ G = +2, $V_O = 0.1V_{p-p}$, $R_L = 150\Omega$ G = +2, $V_O = 0.1V_{p-p}$, $R_L = 1k\Omega$ G = +2, $V_O = 0.1V_{p-p}$, $R_L = 10k\Omega$	500 550 130 210 250 420					MHz MHz MHz MHz MHz MHz	TYP TYP TYP TYP TYP TYP	
Gain-Bandwidth Product	G = +10, $R_L = 150\Omega$ G = +10, $R_L = 1k\Omega$	200 230					MHz MHz	TYP TYP	
Bandwidth for 0.1dB Flatness	G = +1, $V_O = 0.1V_{p-p}$, $R_F = 24\Omega$ G = +2, $V_O = 0.1V_{p-p}$, $R_F = 330\Omega$	130 80					MHz MHz	TYP TYP	
Slew Rate	G = +1, 2V Output Step G = +2, 2V Output Step G = +2, 4V Output Step	320/-370 350/-320 420/-390					V/ μ s V/ μ s V/ μ s	TYP TYP TYP	
Rise-and-Fall Time	G = +2, $V_O = 0.2V_{p-p}$, 10% to 90% G = +2, $V_O = 2V_{p-p}$, 10% to 90%	4 4.5					ns ns	TYP TYP	
Settling Time to 0.1%	G = +2, 2V Output Step	16					ns	TYP	
Overload Recovery Time	$V_{IN} \cdot G = +V_S$	6.2					ns	TYP	
NOISE/DISTORTION PERFORMANCE									
Input Voltage Noise	f = 1MHz	5.6					nV/ \sqrt{Hz}	TYP	
Differential Gain Error (NTSC)	G = +2, $R_L = 150\Omega$	0.015					%	TYP	
Differential Phase Error (NTSC)	G = +2, $R_L = 150\Omega$	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					$\mu V/^\circ C$	TYP	
Input Bias Current (I_B)		6					pA	TYP	
Input offset Current (I_{OS})		2					pA	TYP	
Open-Loop Gain (A_{OL})	$V_O = 0.3V$ to $4.7V$, $R_L = 150\Omega$ $V_O = 0.2V$ to $4.8V$, $R_L = 1k\Omega$	80 104	75 90	75 90	74 89	70 80	dB dB	MIN 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	$R_L = 150\Omega$ $R_L = 1k\Omega$	0.12 0.03					V V	TYP 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	
$\overline{DISABLE}$ Voltage-Off			0.8				V	MAX	
$\overline{DISABLE}$ Voltage-On			2				V	MIN	
POWER SUPPLY									
Operating Voltage Range			2.5 5.5	2.7 5.5	2.7 5.5	2.7 5.5	V V	MIN MAX	
Quiescent Current (per 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)	$\Delta V_S = +2.7V$ to $+5.5V$, $V_{CM} = (-V_S) + 0.5$	80	66	66	65	63	dB	MIN	

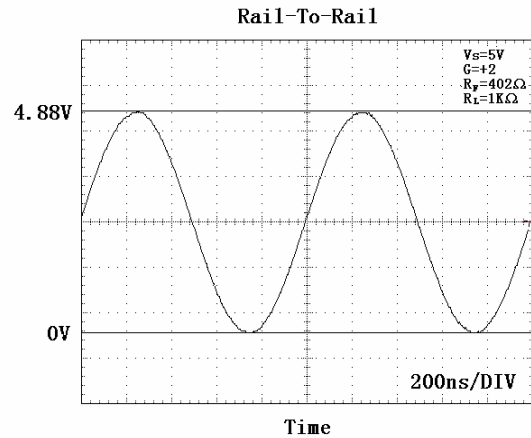
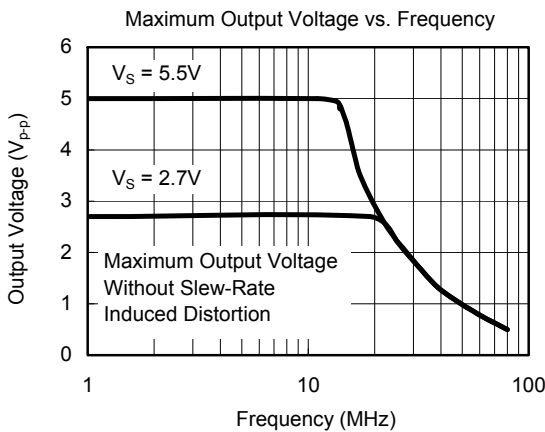
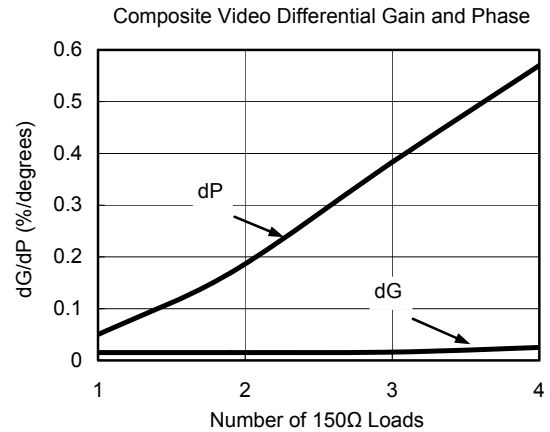
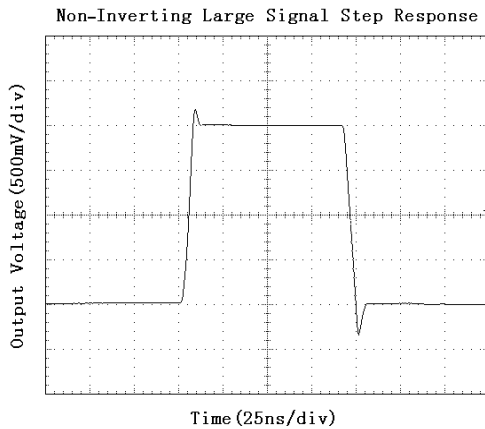
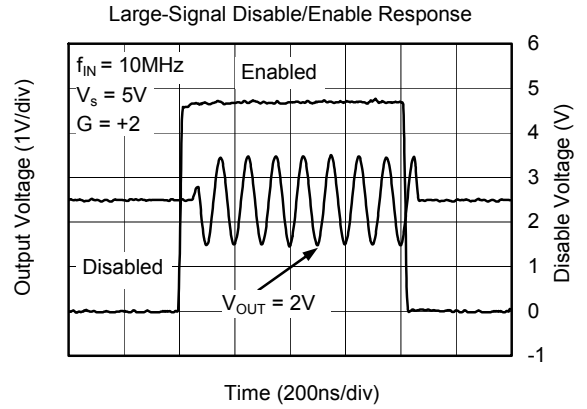
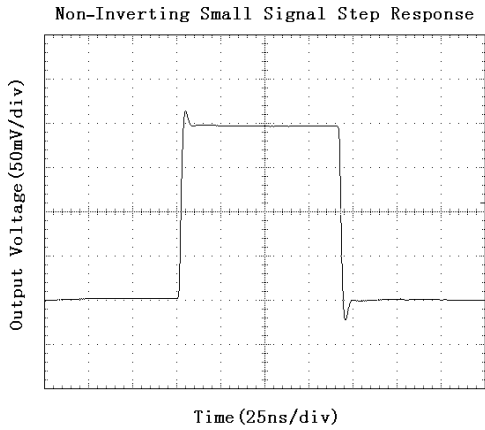
TYPICAL PERFORMANCE CHARACTERISTICS

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.



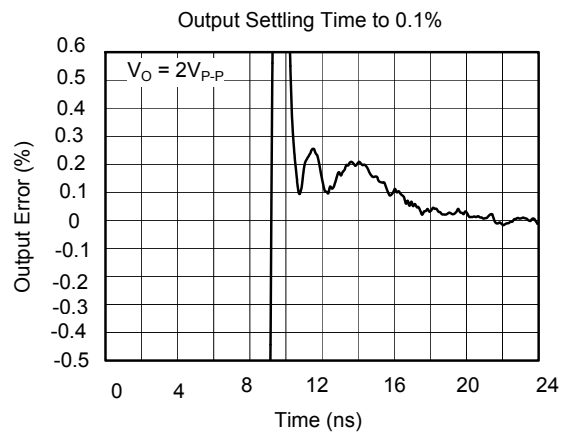
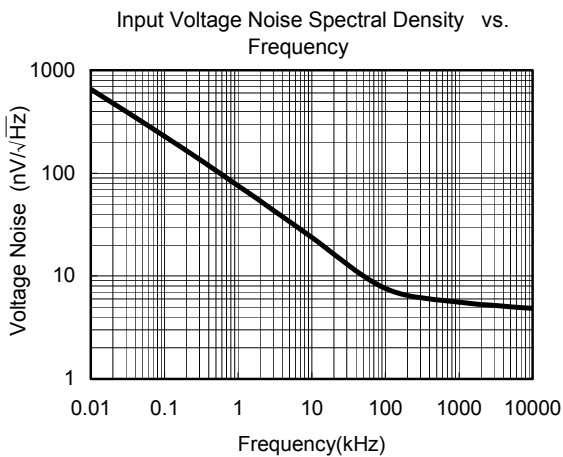
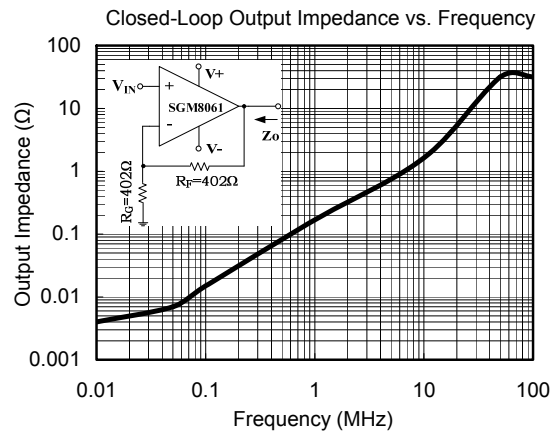
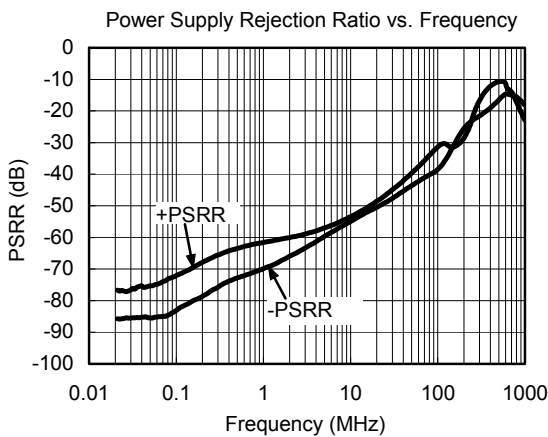
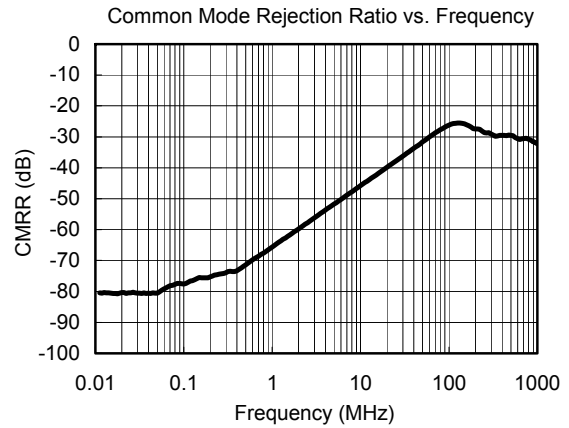
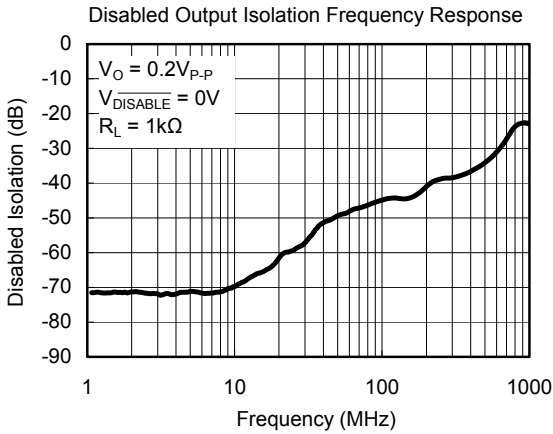
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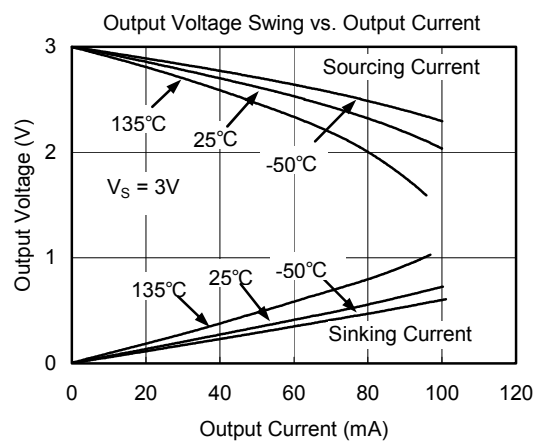
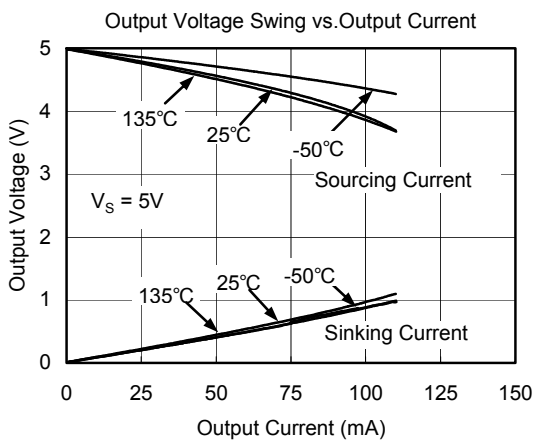
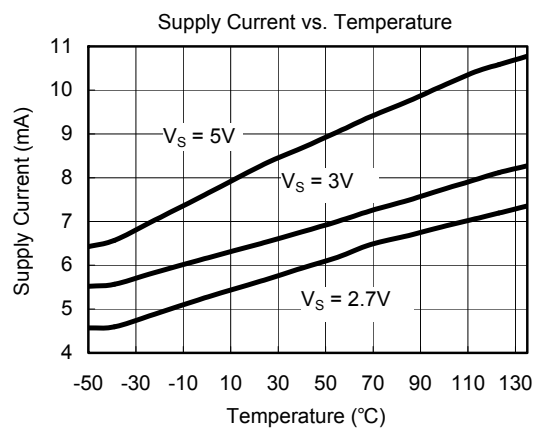
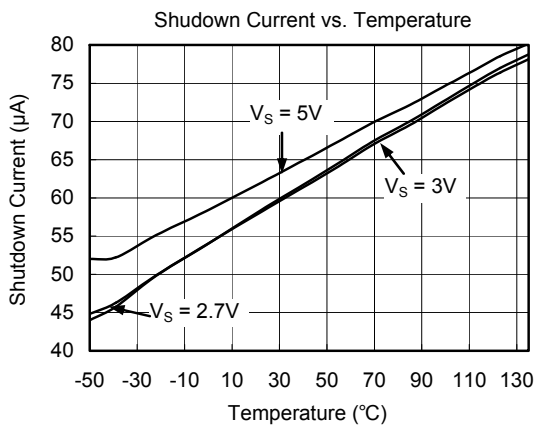
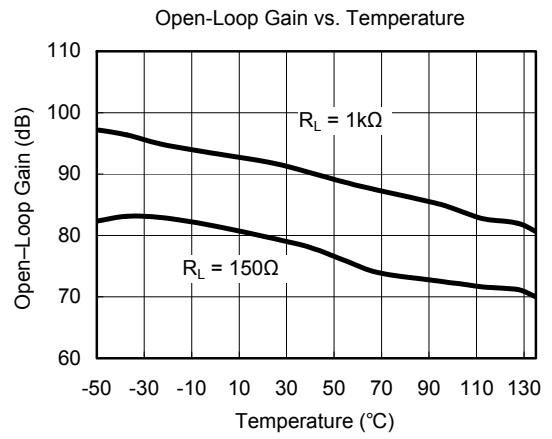
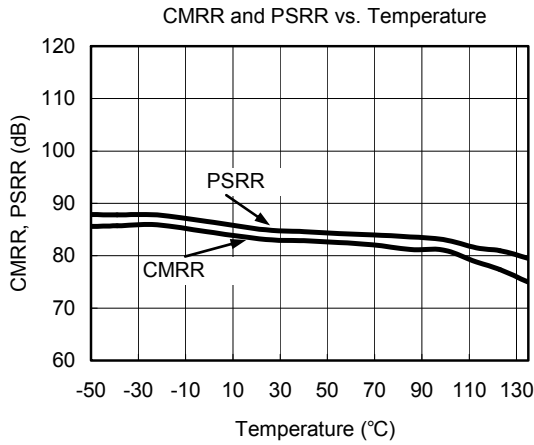
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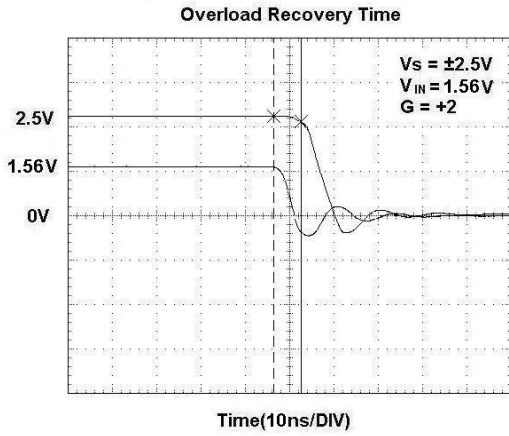
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APPLICATION NOTES

Driving Capacitive Loads

The SGM806x family is optimized for bandwidth and speed, not for driving capacitive loads. Output capacitance will create a pole in the amplifier's feedback path, leading to excessive peaking and potential oscillation. If dealing with load capacitance is a requirement of the application, the two strategies to consider are (1) using a small resistor in series with the amplifier's output and the load capacitance and (2) reducing the bandwidth of the amplifier's feedback loop by increasing the overall noise gain.

Figure 1 shows a unity gain follower using the series resistor strategy. The resistor isolates the output from the capacitance and, more importantly, creates a zero in the feedback path that compensates for the pole created by the output capacitance.

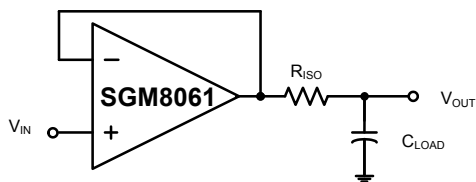


Figure 1. Series Resistor Isolating Capacitive Load

Power-Supply Bypassing and Layout

The SGM806x family operates from either a single +2.7V to +5.5V supply or dual $\pm 1.35\text{V}$ to $\pm 2.75\text{V}$ supplies. For single-supply operation, bypass the power supply $+V_S$ with a $0.1\mu\text{F}$ 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 $0.1\mu\text{F}$ ceramic capacitors. $2.2\mu\text{F}$ tantalum capacitor can be added for better performance.

Good PC board layout techniques optimize performance by decreasing the amount of stray capacitance at the op amp'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 high speed operational amplifier, soldering the part to the board directly is strongly recommended. Try to keep the high frequency big current loop area small to minimize the EMI (electromagnetic interfacing).

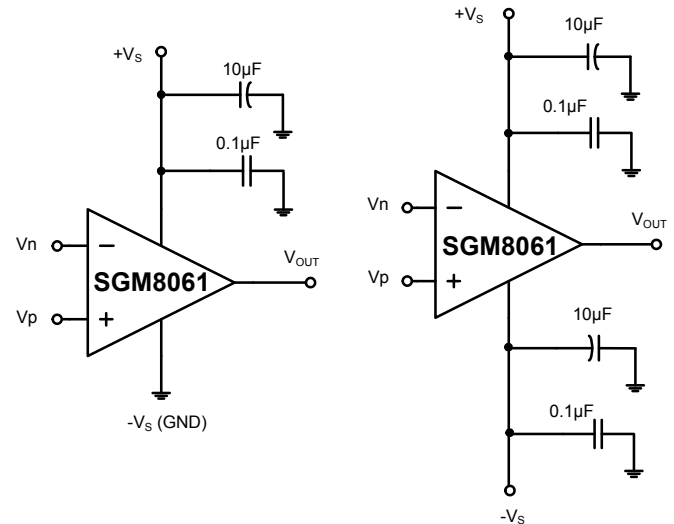


Figure 2. Amplifier with Bypass Capacitors

Grounding

A ground plane layer is important for high speed circuit design. The length of the current path speed currents 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 parallel. This helps reduce unwanted positive feedback.

TYPICAL APPLICATION CIRCUITS

Differential Amplifier

The circuit shown in Figure 3 performs the difference function. If the resistors ratios are equal ($R_4/R_3 = R_2/R_1$), then $V_{OUT} = (V_p - V_n) \times R_2/R_1 + V_{REF}$.

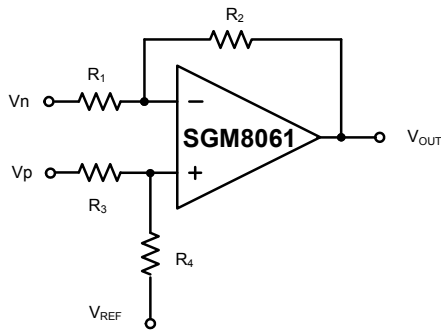


Figure 3. Differential Amplifier

Low Pass Active Filter

The low pass filter shown in Figure 4 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. The large values of feedback resistors 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.

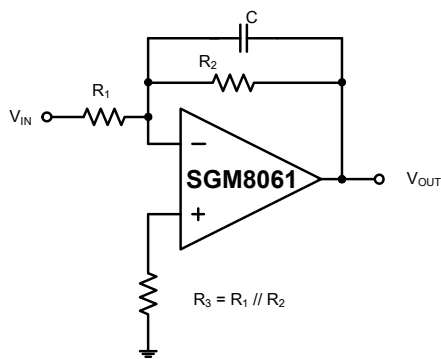
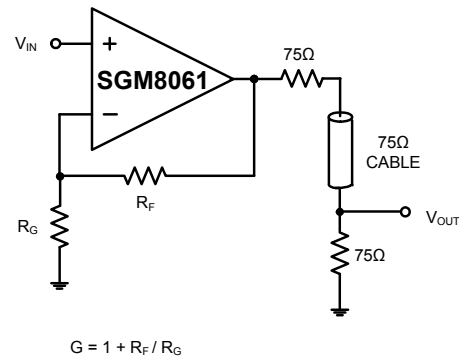


Figure 4. Low Pass Active Filter

Driving Video

The SGM806x can be used in video applications like in Figure 5.

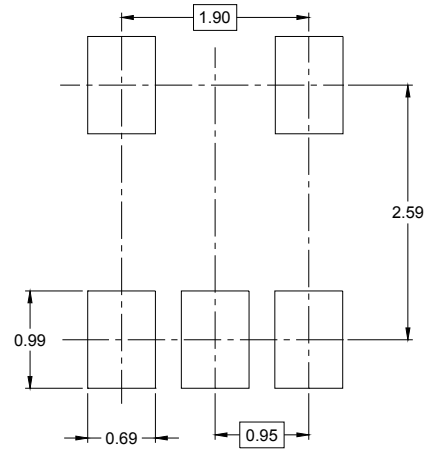
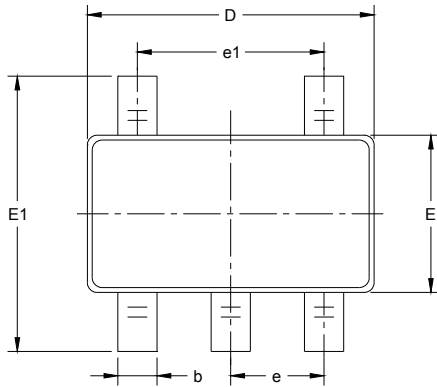


$$G = 1 + R_F / R_G$$

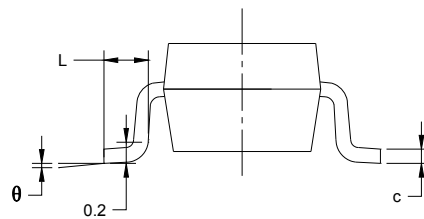
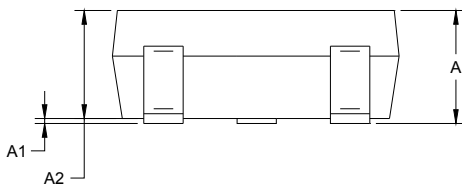
Figure 5. Typical Video Driving

PACKAGE OUTLINE DIMENSIONS

SOT-23-5



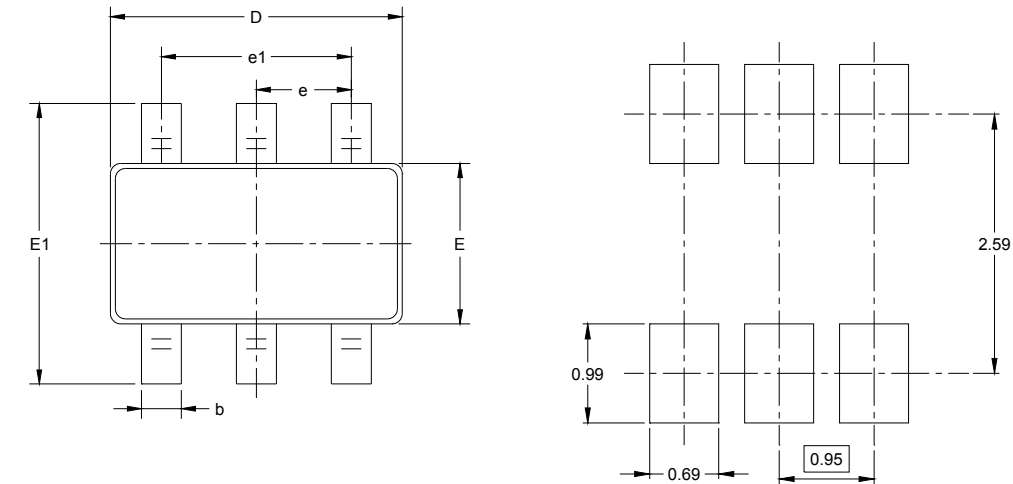
RECOMMENDED LAND PATTERN (Unit: mm)



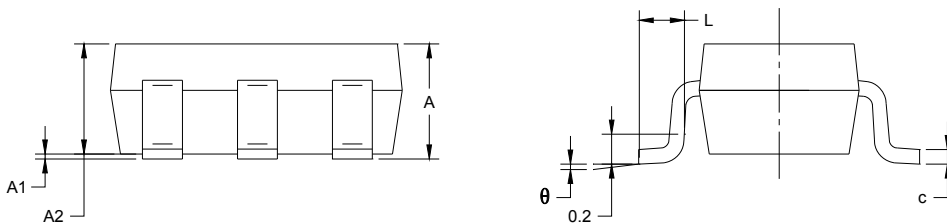
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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

PACKAGE OUTLINE DIMENSIONS

SOT-23-6



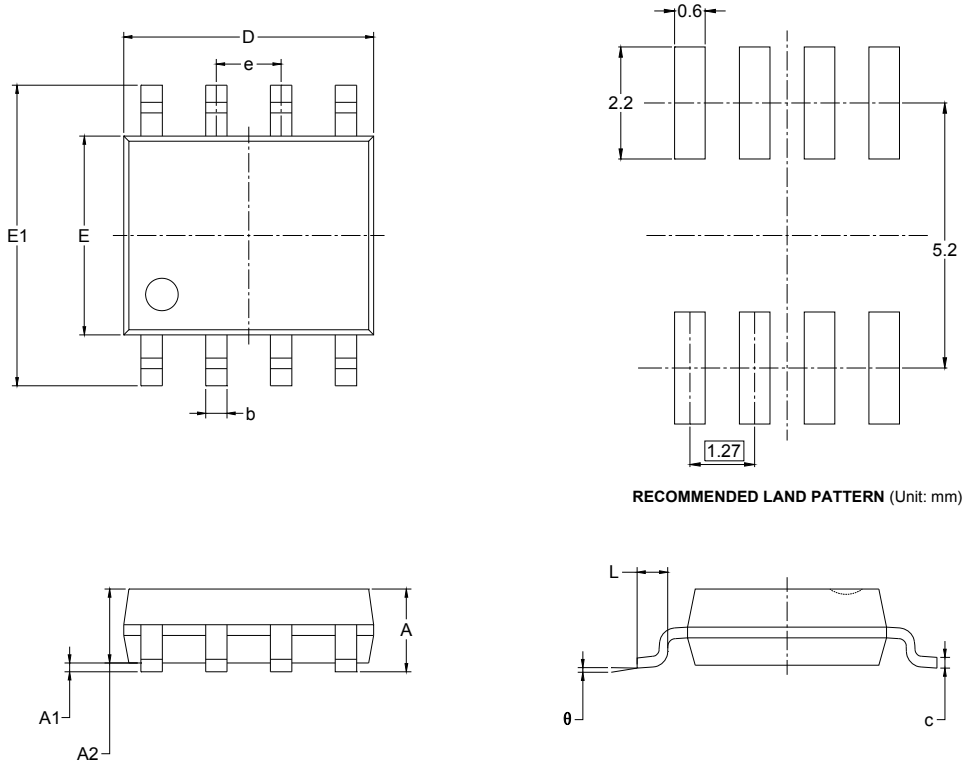
RECOMMENDED LAND PATTERN (Unit: mm)



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

SOIC-8

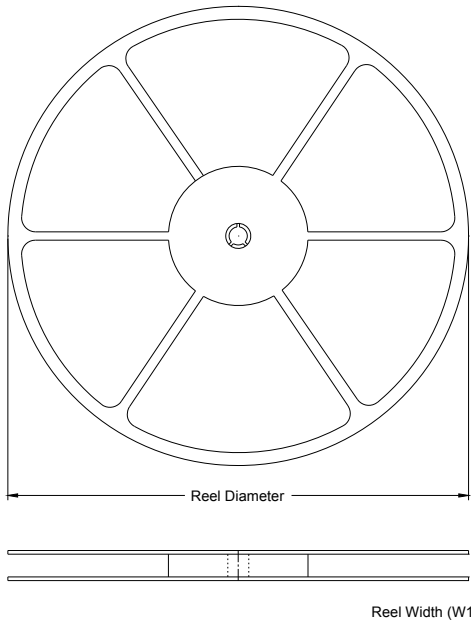


RECOMMENDED LAND PATTERN (Unit: mm)

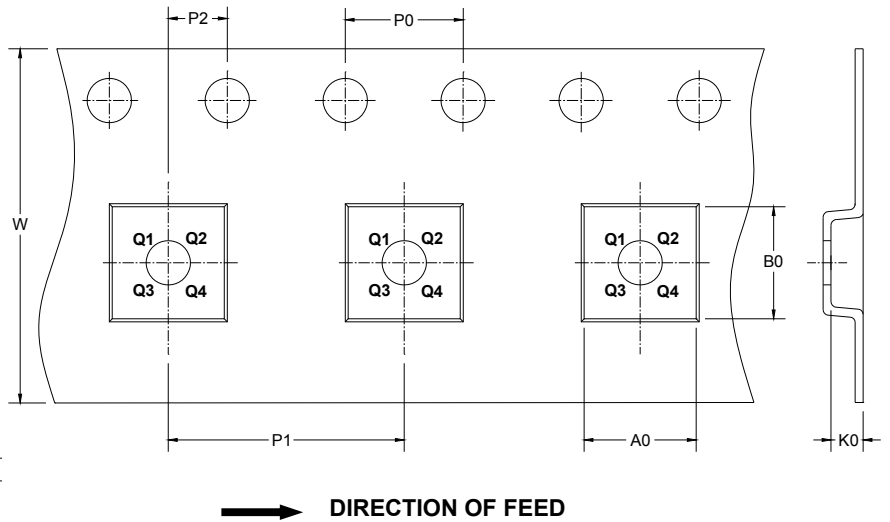
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

TAPE AND REEL INFORMATION

REEL DIMENSIONS



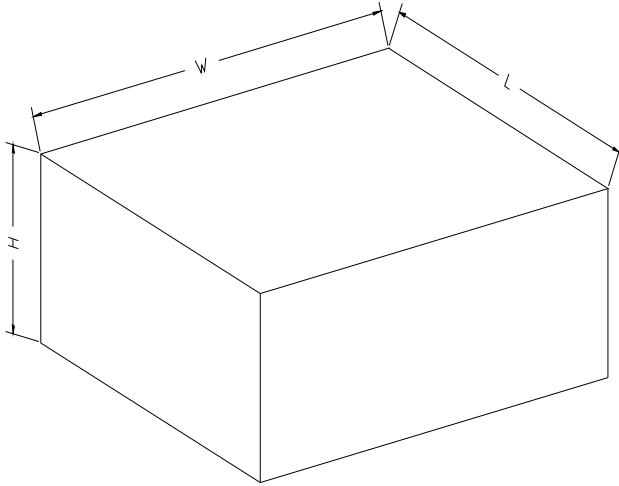
TAPE DIMENSIONS



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	3.17	3.23	1.37	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
SOIC-8	13"	12.4	6.4	5.4	2.1	4.0	8.0	2.0	12.0	Q1

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