



SGM8051/2/3/4/5 250MHz, Rail-to-Rail Output CMOS Operational Amplifiers

PRODUCT DESCRIPTION

The SGM8051/3 (single), SGM8052/5 (dual) and SGM8054 (quad) 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 SGM8051 series provide excellent overall performance. They offer wide bandwidth to 250MHz ($G = +1$) along with 0.1dB flatness out to 37MHz ($G = +2$) and offer a typical low power of 2.3mA/amplifier.

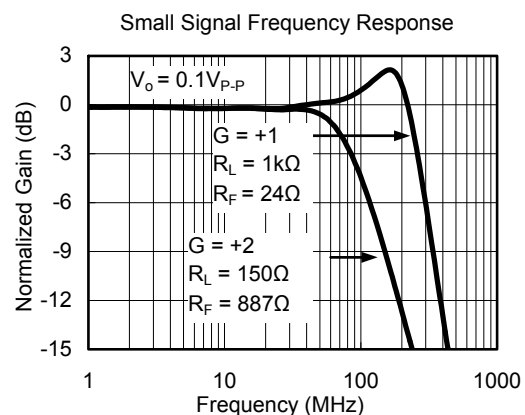
The SGM8051 series is low distortion and fast settling make it ideal for buffering high speed A/D or D/A converters. The SGM8053/5 has a power-down disable feature that reduces the supply current to 75 μ A. These features make the SGM8053/5 ideal for portable and battery-powered applications where size and power are critical. All are specified over the extended -40°C to $+125^{\circ}\text{C}$ 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
250MHz, -3dB Bandwidth ($G = +1$)
130V/ μ s, Slew Rate
58ns Settling Time to 0.1% with 2V Step
- Supply Voltage Range: 2.5V to 5.5V
- Input Voltage Range: -0.2V to $+3.8\text{V}$ with $V_S = 5\text{V}$
- Excellent Video Specs ($R_L = 150\Omega$, $G = +2$)
Gain Flatness 0.1dB to 37MHz
Diff Gain: 0.03%, Diff Phase: 0.08 Degree
- Low Supply Current
2.3mA/Amplifier (TYP)
75 μ A Shutdown Current for SGM8053/5
- Small Packaging
SGM8051 Available in SOT-23-5 and SOIC-8
SGM8052 Available in MSOP-8 and SOIC-8
SGM8053 Available in SOT-23-6 and SOIC-8
SGM8054 Available in TSSOP-14 and SOIC-14
SGM8055 Available in MSOP-10



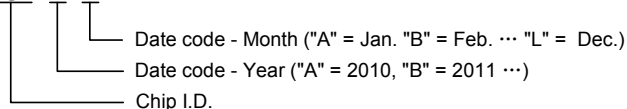
PACKAGE/ORDERING INFORMATION

MODEL	CHANNEL	PACKAGE DESCRIPTION	ORDER NUMBER	MARKING INFORMATION	PACKAGE OPTION
SGM8051	Single	SOT-23-5	SGM8051XN5/TR	8051	Tape and Reel, 3000
		SOIC-8	SGM8051XS/TR	SGM8051XS	Tape and Reel, 2500
SGM8052	Dual	MSOP-8	SGM8052XMS/TR	SGM8052XMS	Tape and Reel, 3000
		SOIC-8	SGM8052XS/TR	SGM8052XS	Tape and Reel, 2500
SGM8053	Single with Shutdown	SOT-23-6	SGM8053XN6/TR	SOFXX	Tape and Reel, 3000
		SOIC-8	SGM8053XS/TR	SGM8053XS	Tape and Reel, 2500
SGM8054	Quad	SOIC-14	SGM8054XS14/TR	SGM8054XS14	Tape and Reel, 2500
		TSSOP-14	SGM8054XTS14/TR	SGM8054XTS14	Tape and Reel, 3000
SGM8055	Dual with Shutdown	MSOP-10	SGM8055XMS/TR	SGM8055XMS	Tape and Reel, 3000

NOTE: XX = Date Code.

MARKING INFORMATION

SOF X X



For example: SOFAA (2010, January)

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, +V _S to -V _S	7.5V
Input Common Mode 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
MSOP-8, θ _{JA}	216°C/W
MSOP-10, θ _{JA}	216°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

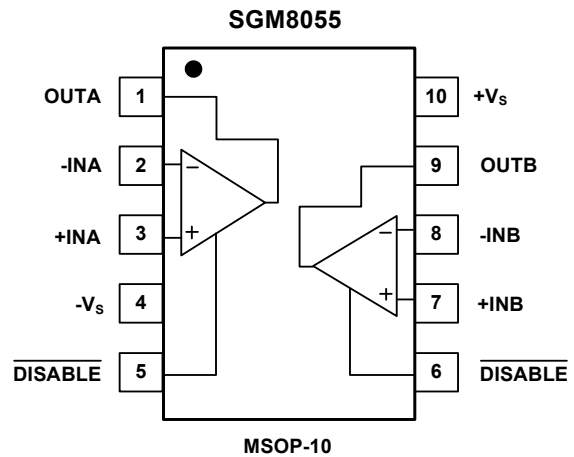
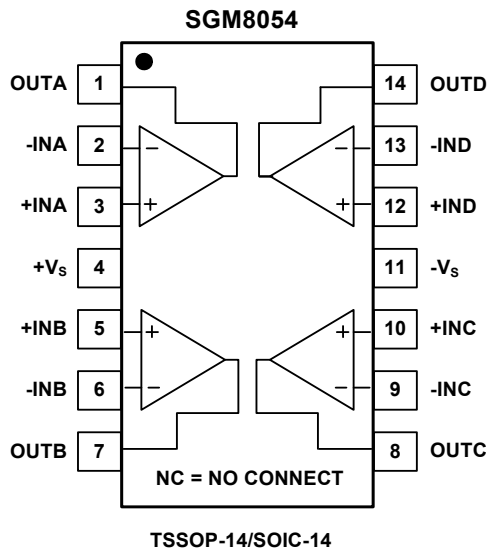
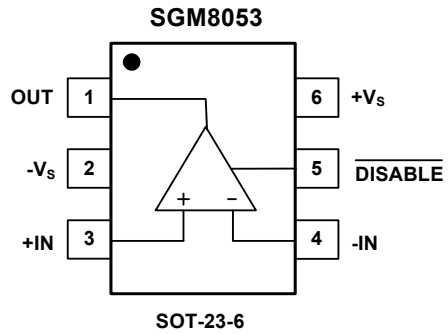
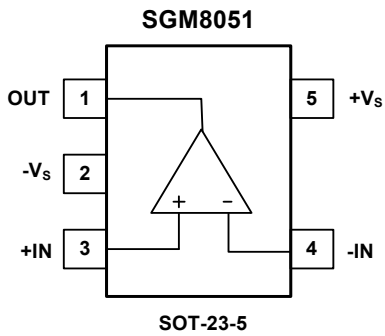
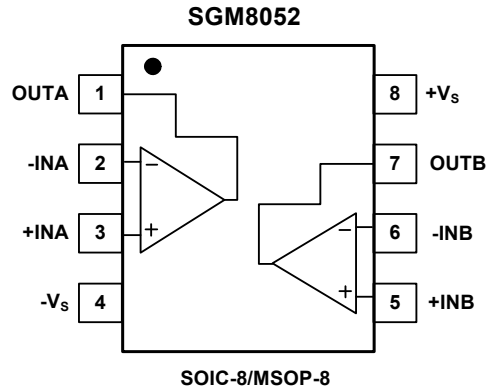
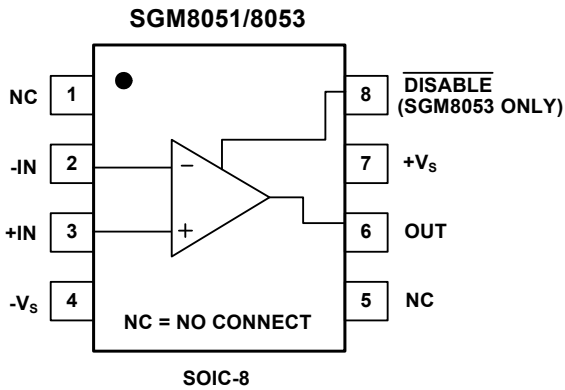
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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.

SGM8051/2/3/4/5

250MHz, Rail-to-Rail Output CMOS Operational Amplifiers

PIN CONFIGURATIONS (TOP VIEW)

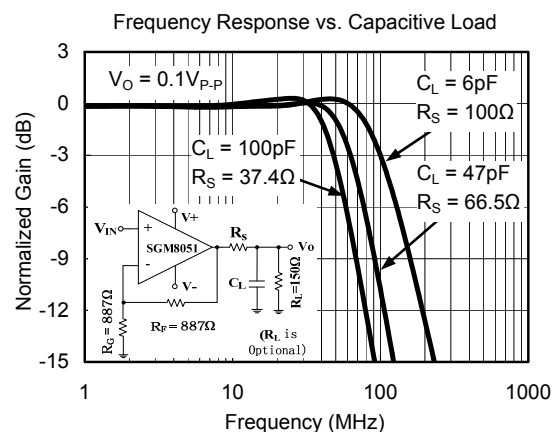
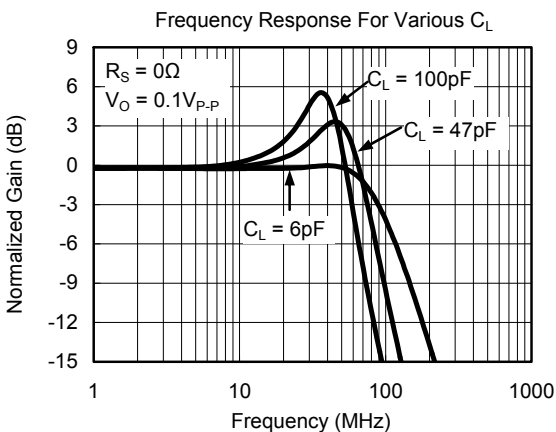
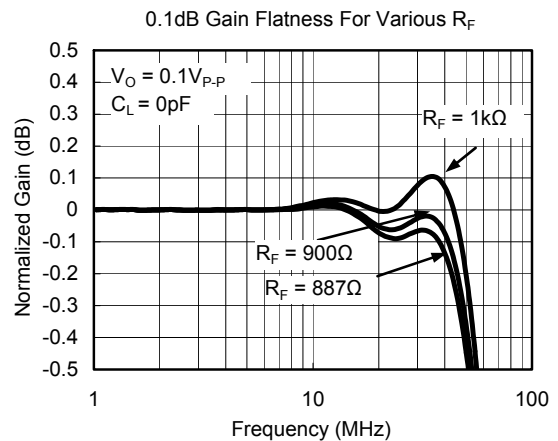
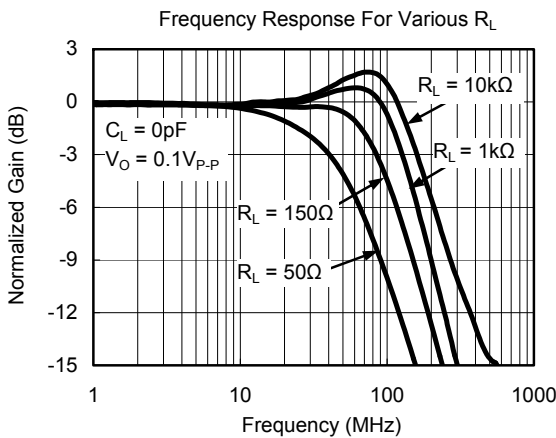
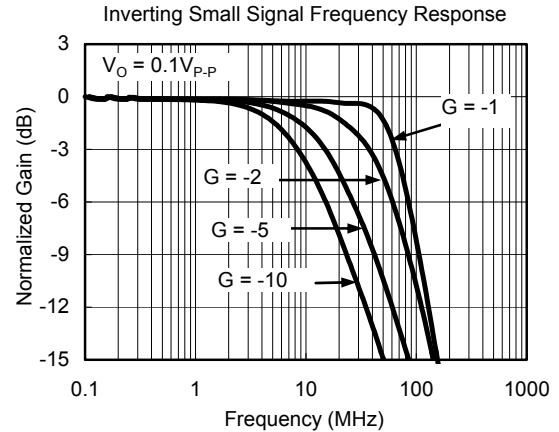
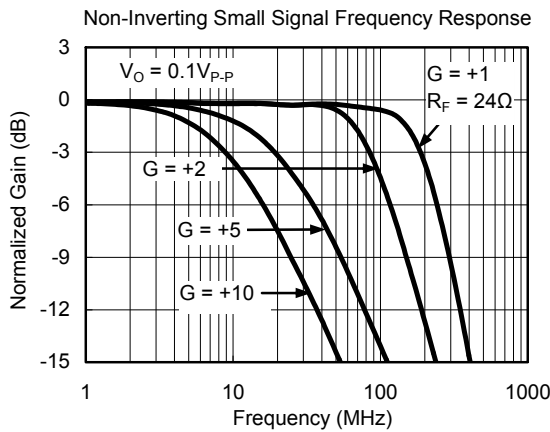


ELECTRICAL CHARACTERISTICS: $V_S = +5V$ (G = +2, $R_F = 887\Omega$, $R_L = 150\Omega$, unless otherwise noted.)

PARAMETER	CONDITIONS	SGM8051/2/3/4/5							
		TYP	MIN/MAX OVER TEMPERATURE					UNITS	MIN/ MAX
		+25°C	+25°C	0°C to70°C	-40°C to 85°C	-40°C to125°C			
DYNAMIC PERFORMANCE									
-3dB Small Signal Bandwidth	G = +1, $V_o = 0.1V_{p-p}$, $R_F = 24\Omega$, $R_L = 150\Omega$ 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, $V_o = 0.1V_{p-p}$, $R_L = 10k\Omega$	180 250 40 80 130 160					MHz MHz MHz MHz MHz MHz	TYP TYP TYP TYP TYP TYP	
Gain-Bandwidth Product	G = +10, $R_L = 150\Omega$ G = +10, $R_L = 1k\Omega$	90 120					MHz MHz	TYP TYP	
Bandwidth for 0.1dB Flatness	G = +2, $V_o = 0.1V_{p-p}$, $R_L = 150\Omega$, $R_F = 887\Omega$	37					MHz	TYP	
Slew Rate	G = +1, 2V Output Step G = +2, 2V Output Step G = +2, 4V Output Step	93/-118 116/-103 130/-130					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 14					ns ns	TYP TYP	
Settling Time to 0.1%	G = +2, 2V Output Step	58					ns	TYP	
Overload Recovery Time	$V_{IN} \cdot G = +V_S$	18					ns	TYP	
NOISE/DISTORTION PERFORMANCE									
Input Voltage Noise	f = 1MHz	8.1					nV/ \sqrt{Hz}	TYP	
Differential Gain Error (NTSC)	G = +2, $R_L = 150\Omega$	0.03					%	TYP	
Differential Phase Error (NTSC)	G = +2, $R_L = 150\Omega$	0.08					degree	TYP	
DC PERFORMANCE									
Input Offset Voltage (V_{OS})		± 2	± 8	± 8.9	± 9.5	± 9.8	mV	MAX	
Input Offset Voltage Drift		4.4					$\mu V/^\circ C$	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 92	74 91	74 91	73 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	65	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		130	100	95	90	84	mA	MIN	
Closed-Loop Output Impedance	f < 100kHz	0.08					Ω	TYP	
POWER-DOWN DISABLE (SGM8053/5 ONLY)									
Turn-On Time		236					ns	TYP	
Turn-Off Time		52					ns	TYP	
DISABLE Voltage-Off			0.8				V	MAX	
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)		2.3	3.2	3.4	3.8	4	mA	MAX	
Supply Current when Disabled per Amplifier (SGM8053/5 only)		75	120	127	130	137	μA	MAX	
Power Supply Rejection Ratio (PSRR)	$\Delta V_S = +2.7V$ to $+5.5V$, $V_{CM} = (-V_S) + 0.5$	80	67	67	65	62	dB	MIN	

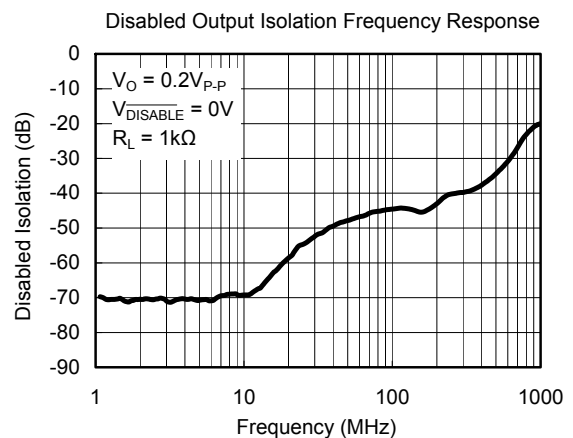
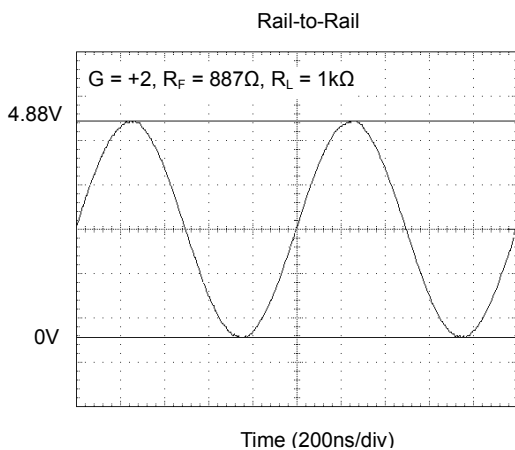
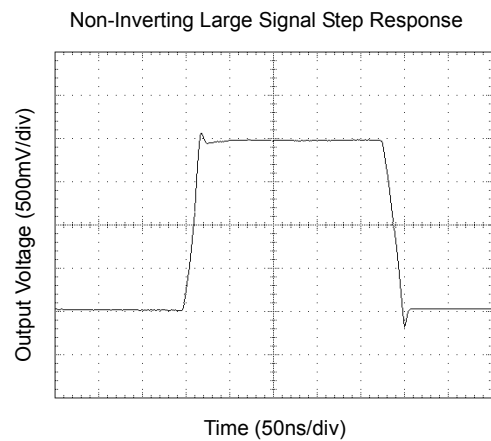
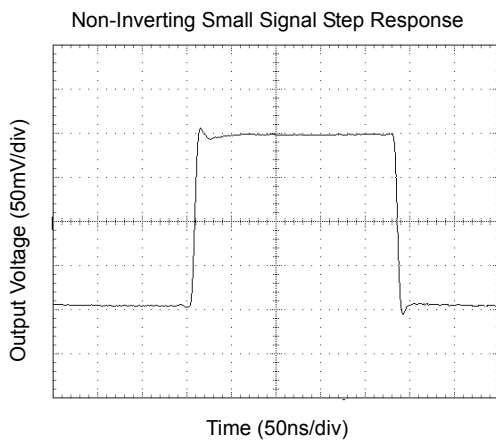
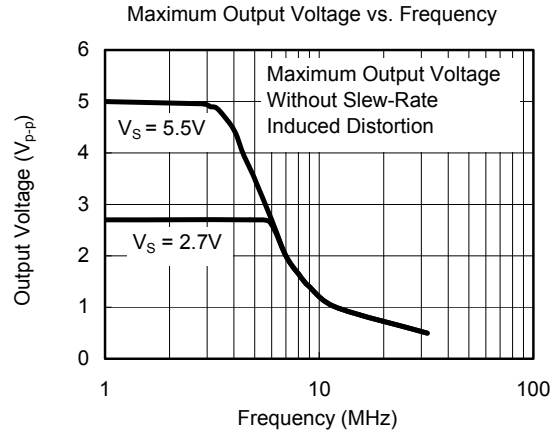
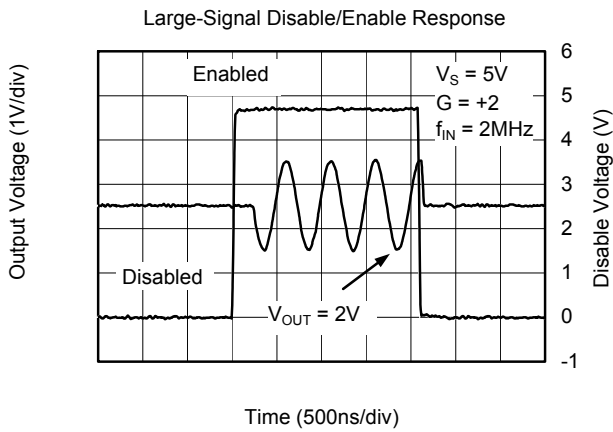
TYPICAL PERFORMANCE CHARACTERISTICS

At $T_A = +25^\circ\text{C}$, $V_S = +5\text{V}$, $G = +2$, $R_F = 887\Omega$, $R_G = 887\Omega$, and $R_L = 150\Omega$ connected to $V_S/2$, unless otherwise noted.



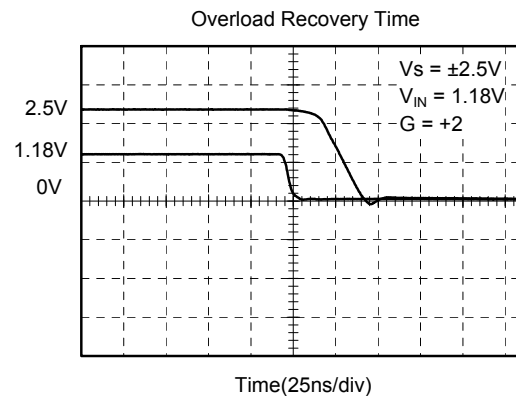
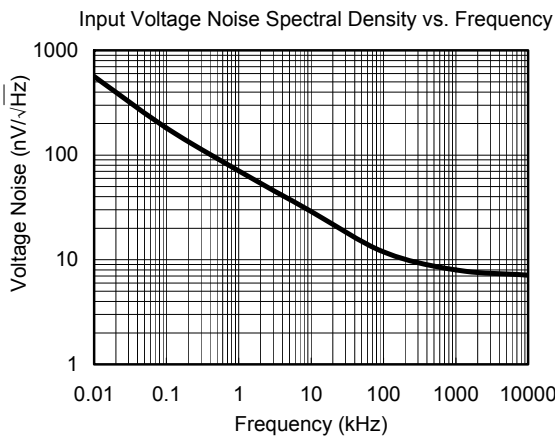
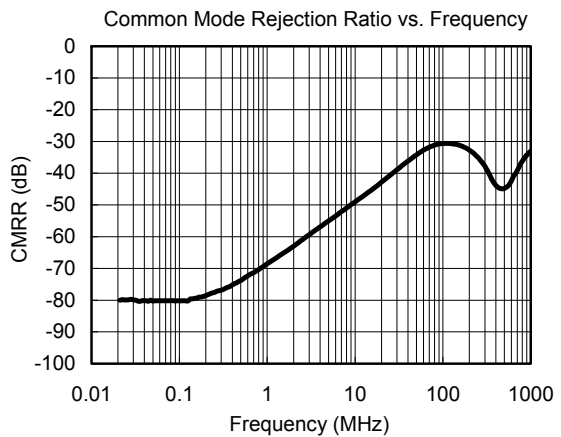
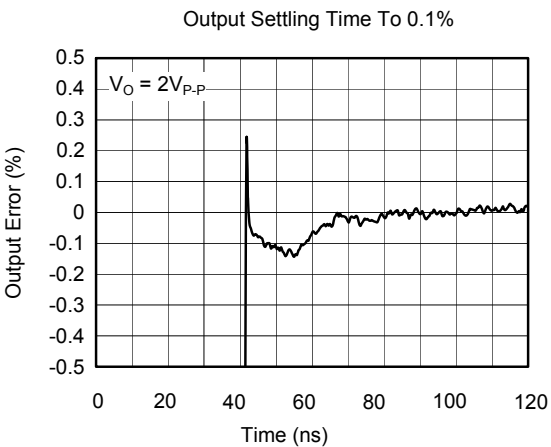
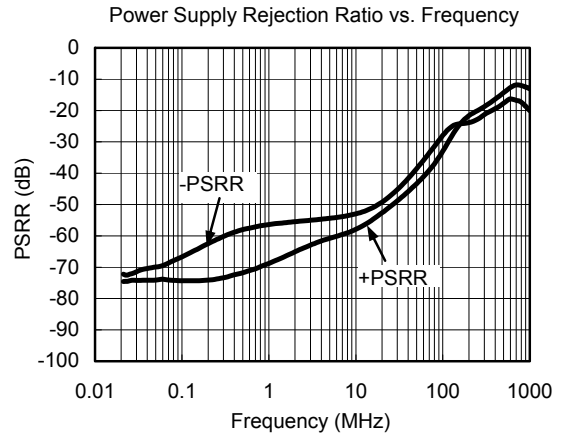
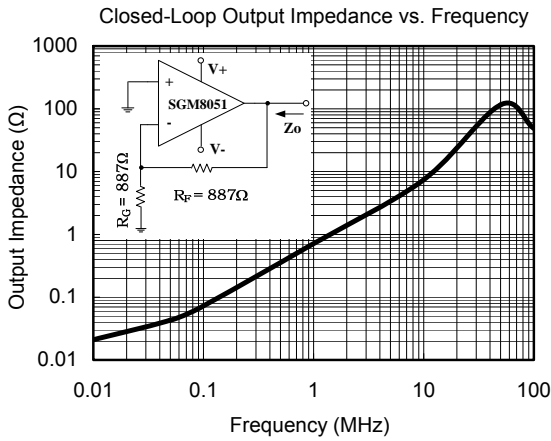
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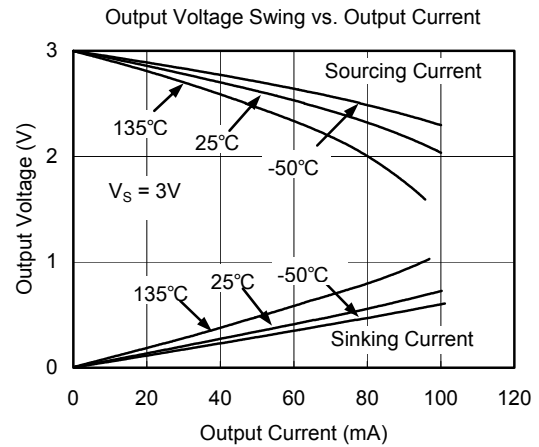
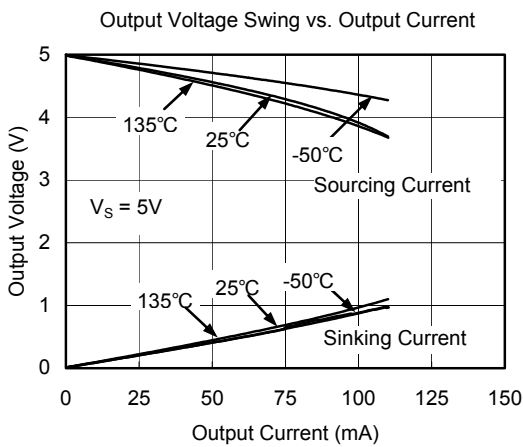
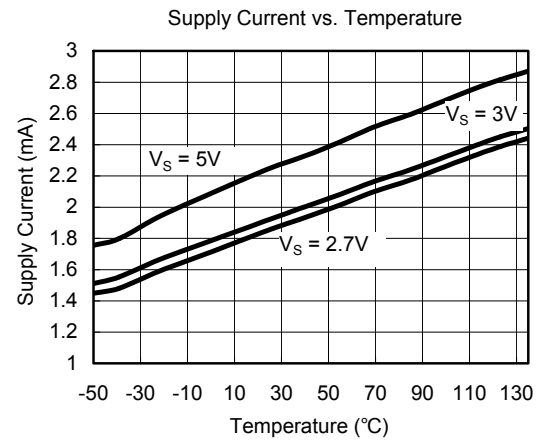
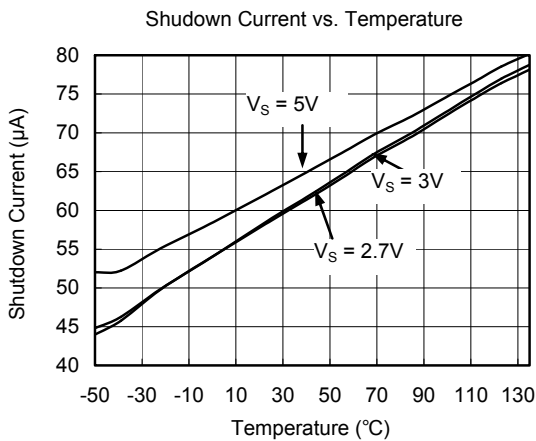
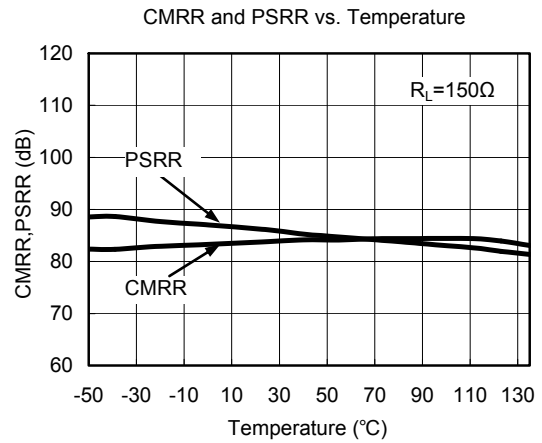
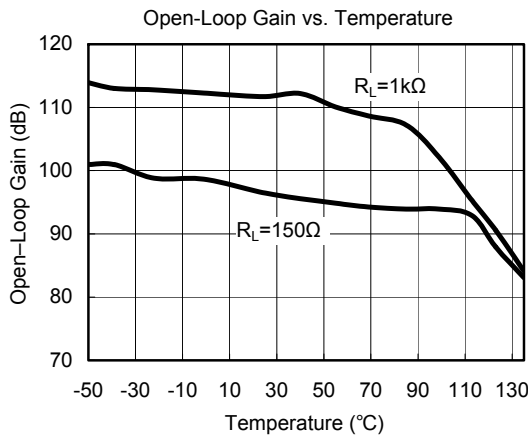
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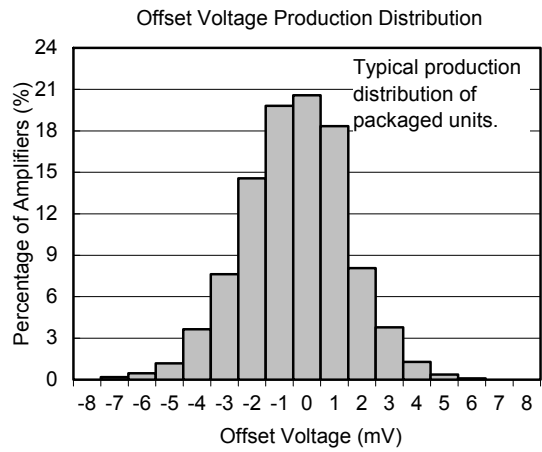
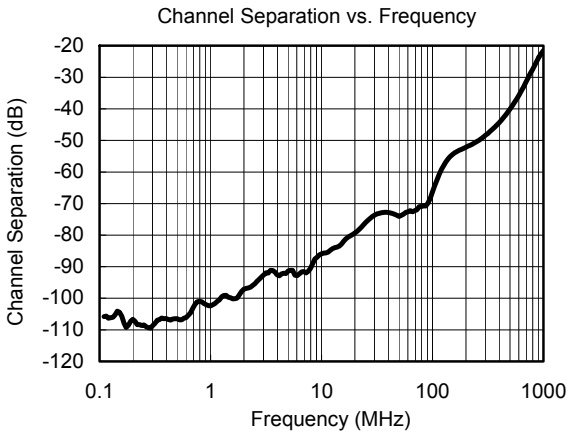
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APPLICATION NOTES

Driving Capacitive Loads

The SGM805x 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.

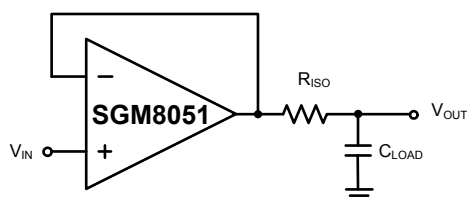


Figure 1. Series Resistor Isolating Capacitive Load

Power-Supply Bypassing and Layout

The SGM805x 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 μF 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 μF ceramic capacitors. 2.2 μF 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).

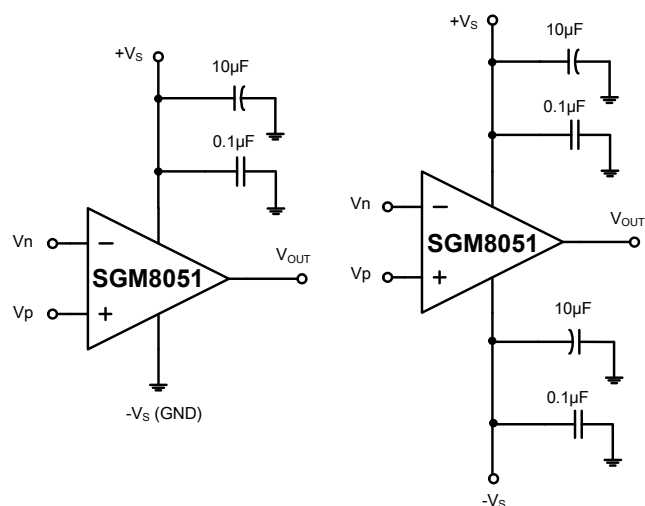


Figure 2. Amplifier with Bypass Capacitors

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 $V_{OUT} = (V_p - V_n) \times R_2/R_1 + V_{REF}$.

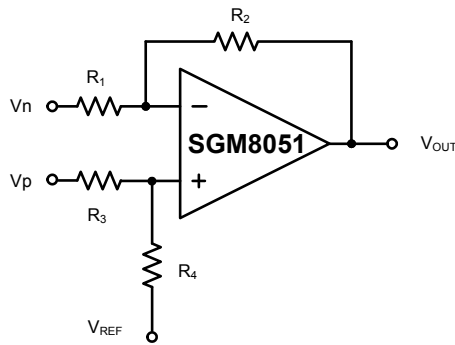


Figure 3. Differential Amplifier

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.

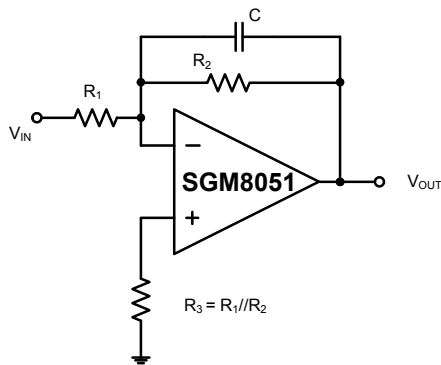


Figure 4. Low Pass Active Filter

Driving Video

The SGM805x can be used in video applications like in Figure 5.

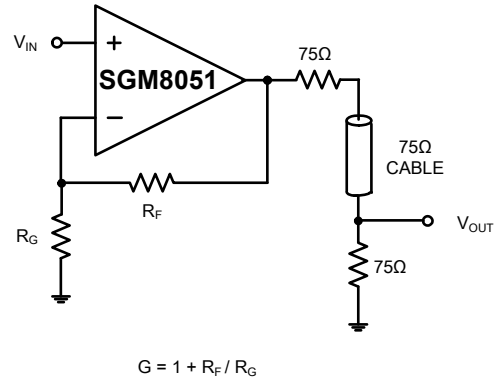
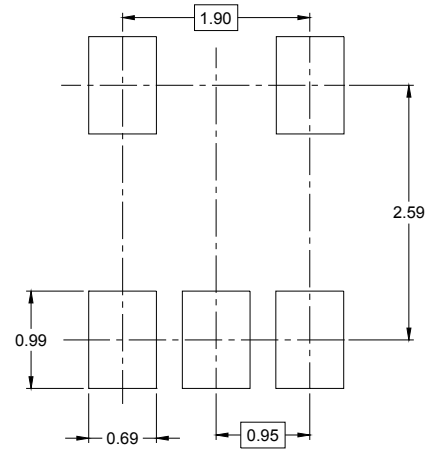
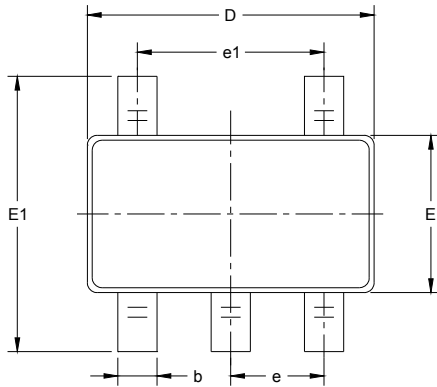


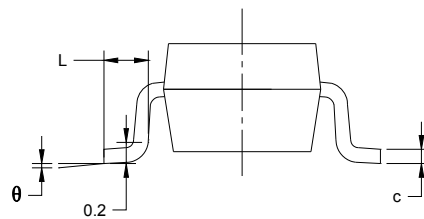
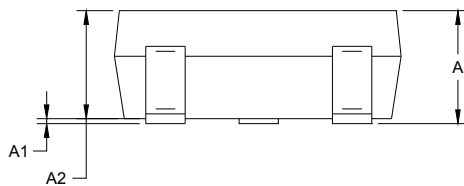
Figure 5. Typical Video Driving

PACKAGE OUTLINE DIMENSIONS

SOT-23-5



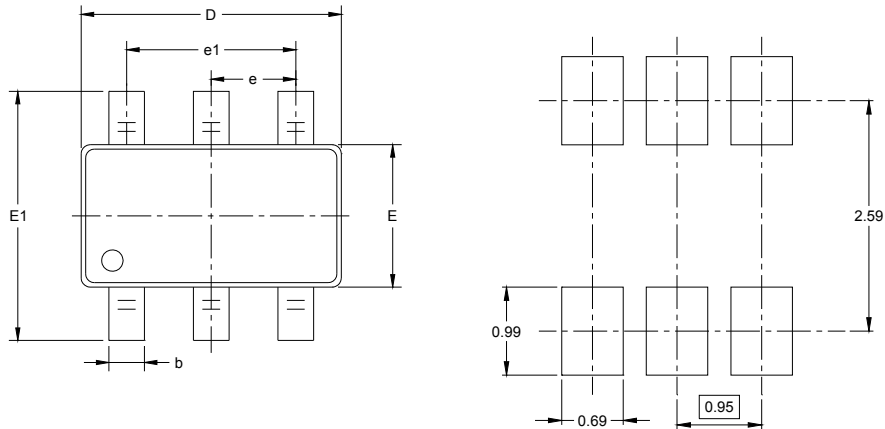
RECOMMENDED LAND PATTERN (Unit: mm)



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

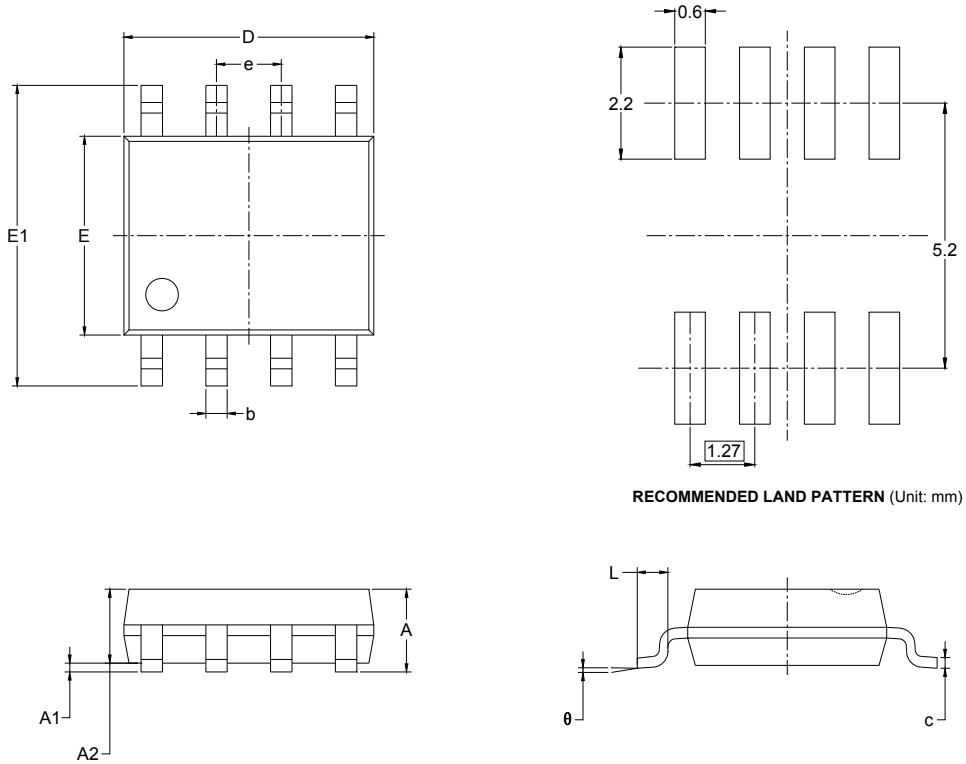


RECOMMENDED LAND PATTERN (Unit: mm)

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

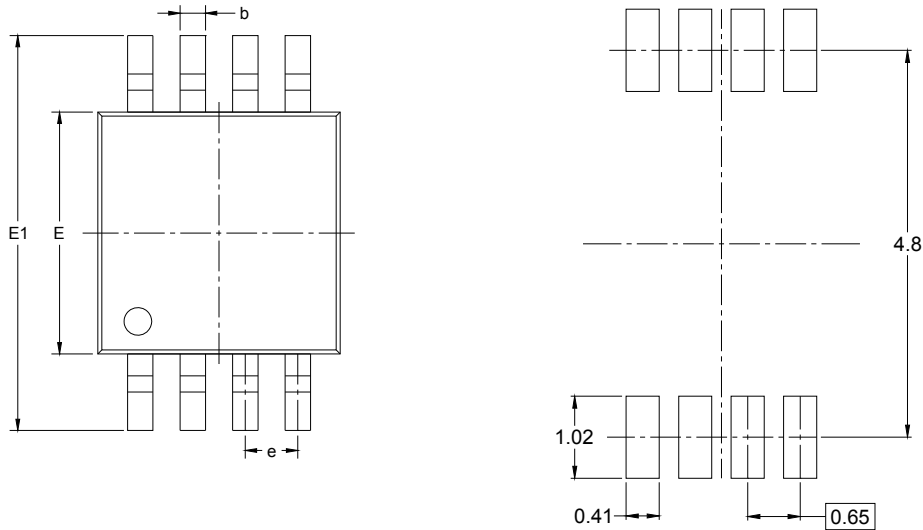


RECOMMENDED LAND PATTERN (Unit: mm)

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°

PACKAGE OUTLINE DIMENSIONS

MSOP-8

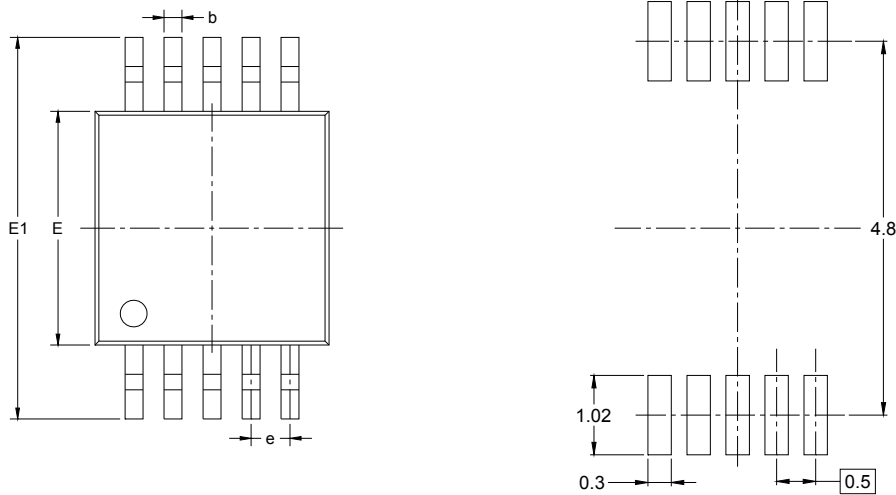


RECOMMENDED LAND PATTERN (Unit: mm)

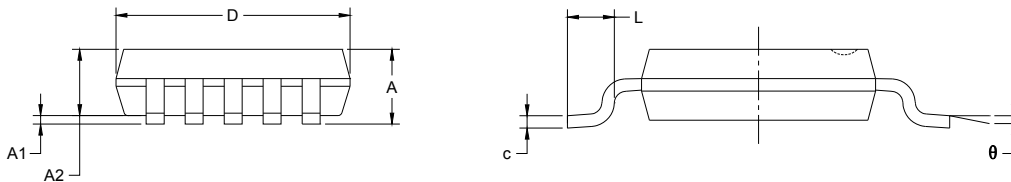
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026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

PACKAGE OUTLINE DIMENSIONS

MSOP-10



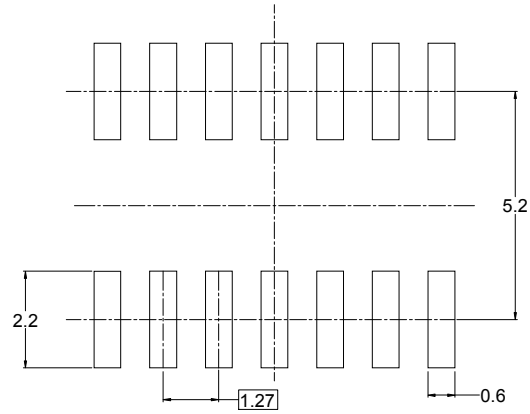
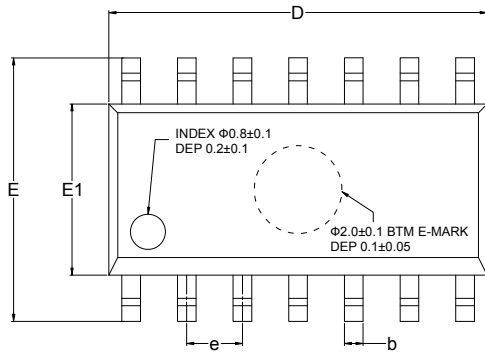
RECOMMENDED LAND PATTERN (Unit: mm)



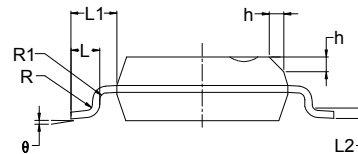
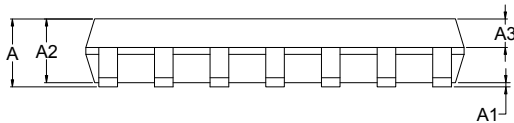
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.500 BSC		0.020 BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

PACKAGE OUTLINE DIMENSIONS

SOIC-14



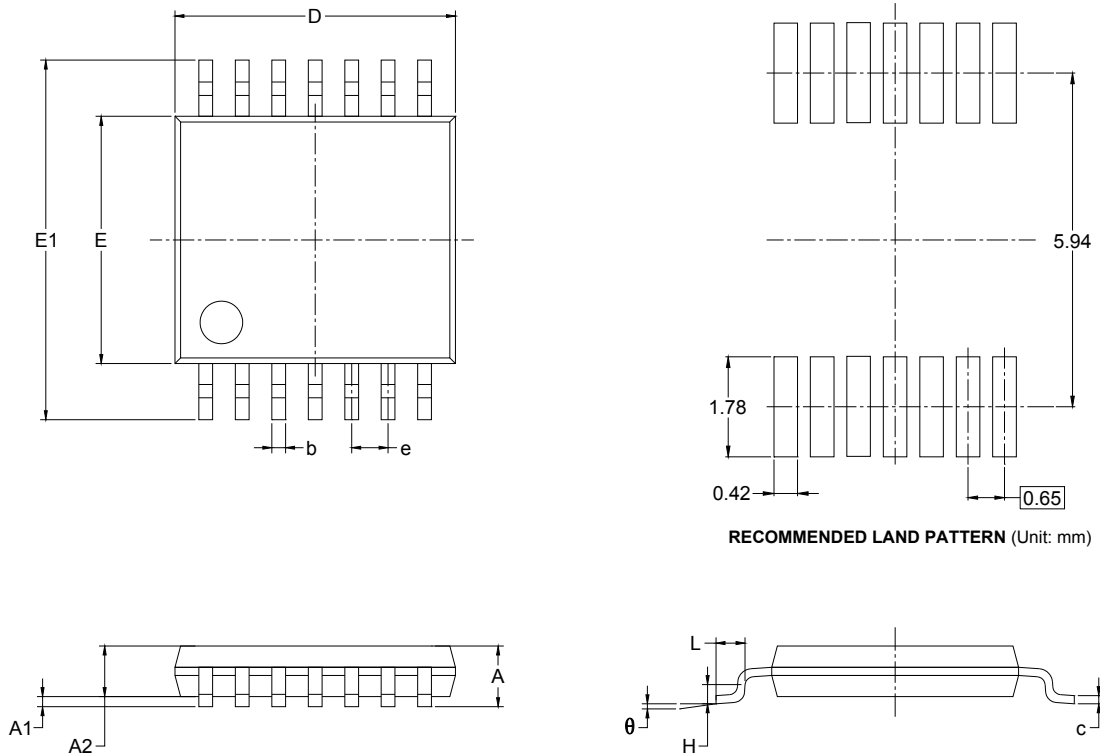
RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	MIN	MOD	MAX	MIN	MOD	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

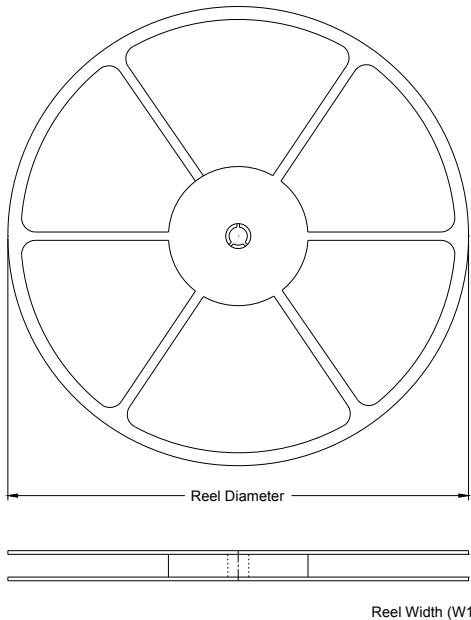


RECOMMENDED LAND PATTERN (Unit: mm)

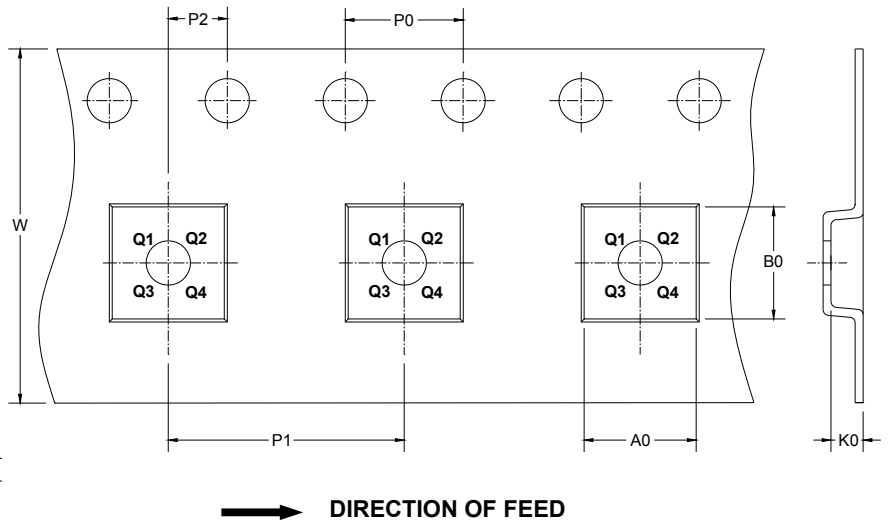
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A		1.100		0.043
A1	0.050	0.150	0.002	0.006
A2	0.800	1.000	0.031	0.039
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.900	5.100	0.193	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650 BSC		0.026 BSC	
L	0.500	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.

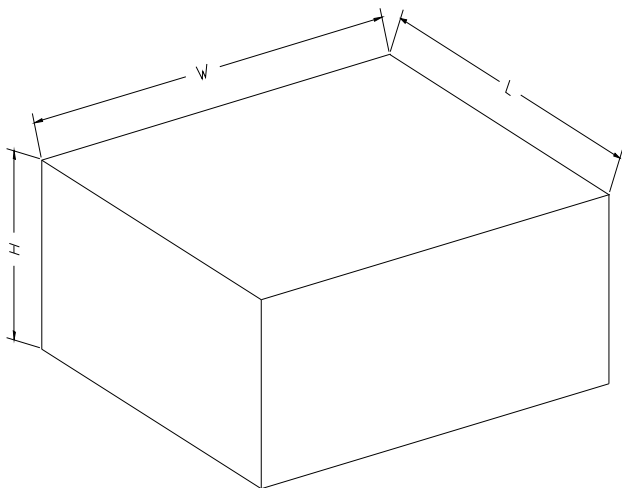
KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOT-23-5	7"	9.5	3.2	3.2	1.4	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
MSOP-8	13"	12.4	5.2	3.3	1.5	4.0	8.0	2.0	12.0	Q1
MSOP-10	13"	12.4	5.2	3.3	1.2	4.0	8.0	2.0	12.0	Q1
SOIC-14	13"	16.4	6.6	9.3	2.1	4.0	8.0	2.0	16.0	Q1
TSSOP-14	13"	12.4	6.95	5.6	1.2	4.0	8.0	2.0	12.0	Q1

SGM8051/2/3/4/5

250MHz, Rail-to-Rail Output CMOS Operational Amplifiers

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