



# SGM8051/2/4 SGM8053/5 250MHz, Rail-to-Rail Output CMOS Operational Amplifiers

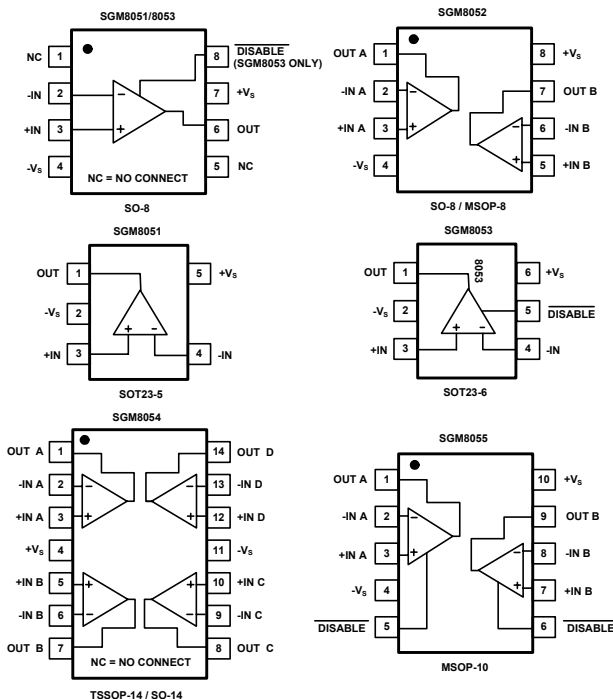
## PRODUCT DESCRIPTION

The SGM8051/3(single), SGM8052/5(dual), 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 $\mu$ 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  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  temperature range.

## PIN CONFIGURATIONS (Top View)

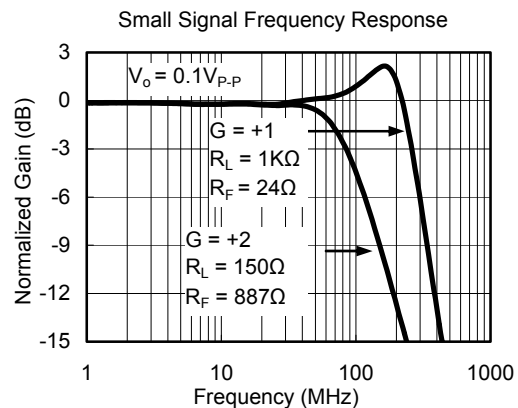


## FEATURES

- Low Cost
- Rail-to-Rail Output  
2mV Typical  $V_{OS}$
- High Speed  
250MHz, -3dB Bandwidth ( $G = +1$ )  
130V/ $\mu$ s, Slew Rate  
58ns Settling Time to 0.1% with 2V Step
- Operates on 2.5V to 5.5V Supplies
- Input Voltage Range =  $-0.2\text{V}$  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 Power  
2.3mA/Amplifier Typical Supply Current  
75 $\mu$ A/Amplifier when Disabled (SGM8053/5 Only)
- Small Packaging  
SGM8051 Available in SOT23-5 and SO-8  
SGM8052 Available in MSOP-8 and SO-8  
SGM8053 Available in SOT23-6 and SO-8  
SGM8054 Available in TSSOP-14 and SO-14  
SGM8055 Available in MSOP-10

## APPLICATIONS

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



**PACKAGE/ORDERING INFORMATION**

MODEL	CHANNEL	ORDER NUMBER	PACKAGE DESCRIPTION	PACKAGE OPTION	MARKING INFORMATION
SGM8051	Single	SGM8051XN5/TR	SOT23-5	Tape and Reel, 3000	8051
		SGM8051XS/TR	SO-8	Tape and Reel, 2500	SGM8051XS
SGM8052	Dual	SGM8052XMS/TR	MSOP-8	Tape and Reel, 3000	SGM8052XMS
		SGM8052XS/TR	SO-8	Tape and Reel, 2500	SGM8052XS
SGM8053	Single With shutdown	SGM8053XN6/TR	SOT23-6	Tape and Reel, 3000	8053
		SGM8053XS/TR	SO-8	Tape and Reel, 2500	SGM8053XS
SGM8054	Quad	SGM8054XS14/TR	SO-14	Tape and Reel, 2500	SGM8054XS14
		SGM8054XTS14/TR	TSSOP-14	Tape and Reel, 3000	SGM8054XTS14
SGM8055	Dual with shutdown	SGM8055XMS/TR	MSOP-10	Tape and Reel, 3000	SGM8055XMS

**ABSOLUTE MAXIMUM RATINGS**

Supply Voltage, V+ to V- .....	7.5V	SO-8, $\theta_{JA}$ .....	125°C/W
Common-Mode Input Voltage .....	(-V <sub>S</sub> ) - 0.5V to (+V <sub>S</sub> ) + 0.5V	MSOP-8, $\theta_{JA}$ .....	216°C/W
Storage Temperature Range .....	-65°C to +150°C	MSOP-10, $\theta_{JA}$ .....	216°C/W
Junction Temperature .....	160°C	Lead Temperature Range (Soldering 10 sec).....	260°C
Operating Temperature Range .....	-55°C to +150°C	ESD Susceptibility	
Package Thermal Resistance @ T <sub>A</sub> = 25°C		HBM.....	1000V
SOT23-5, $\theta_{JA}$ .....	190°C/W	MM.....	400V
SOT23-6, $\theta_{JA}$ .....	190°C/W		

**NOTES:**

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification 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.

**ELECTRICAL CHARACTERISTICS:  $V_S = +5V$**

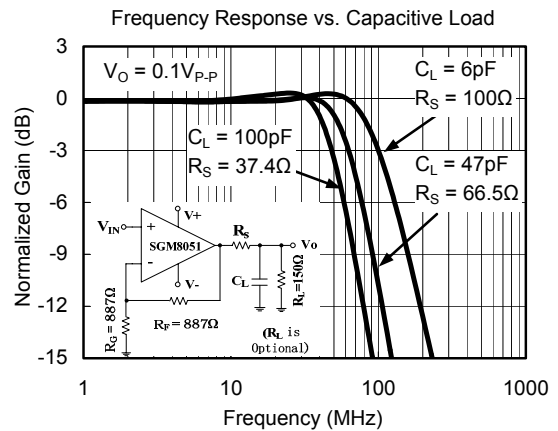
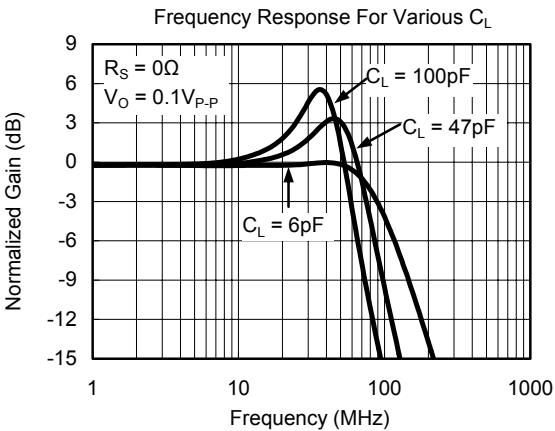
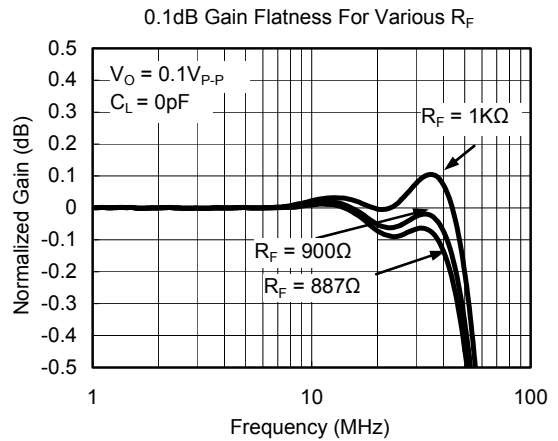
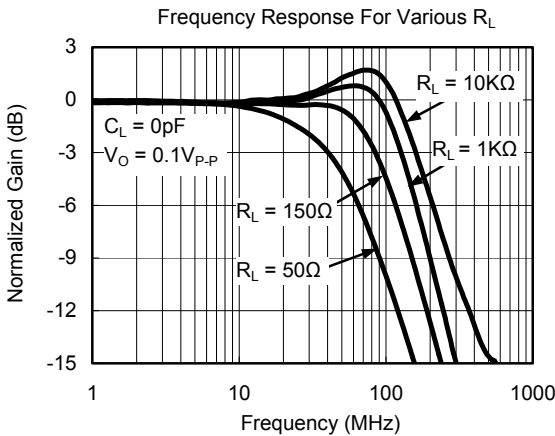
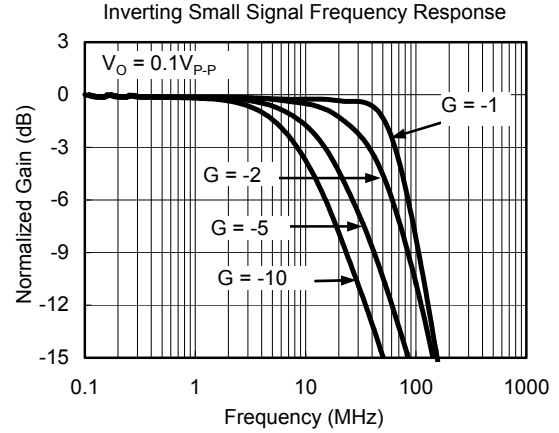
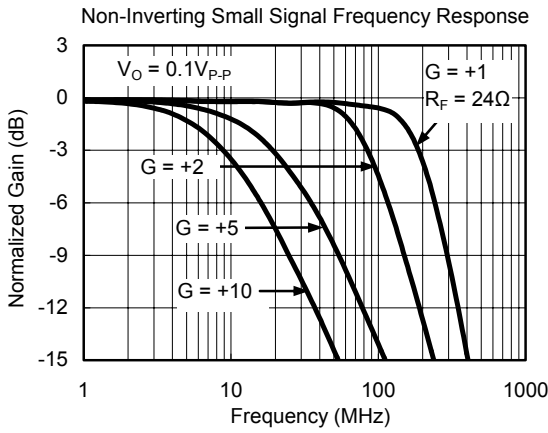
(G = +2,  $R_F = 887\Omega$ ,  $R_L = 150\Omega$ , unless otherwise noted.)

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			
<b>DYNAMIC PERFORMANCE</b>									
-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/ $\mu$ s V/ $\mu$ s V/ $\mu$ 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, 2 V Output Step	58					ns	TYP	
Overload Recovery Time	$V_{IN} \cdot G = +V_S$	18					ns	TYP	
<b>NOISE/DISTORTION PERFORMANCE</b>									
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	
<b>DC PERFORMANCE</b>									
Input Offset Voltage ( $V_{OS}$ )		$\pm 2$	$\pm 8$	$\pm 8.9$	$\pm 9.5$	$\pm 9.8$	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	
<b>INPUT CHARACTERISTICS</b>									
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	
<b>OUTPUT CHARACTERISTICS</b>									
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					$\Omega$	TYP	
<b>POWER-DOWN DISABLE</b> (SGM8053/5 only)									
Turn-On Time		236					ns	TYP	
Turn-Off Time		52					ns	TYP	
$\overline{DISABLE}$ Voltage-Off			0.8				V	MAX	
$\overline{DISABLE}$ Voltage-On			2				V	MIN	
<b>POWER SUPPLY</b>									
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	2.9	3.4	3.8	4	mA	MAX	
Supply Current when Disabled per amplifier (SGM8053/5 only)		75	120	127	130	137	$\mu A$	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	

Specifications subject to changes without notice.

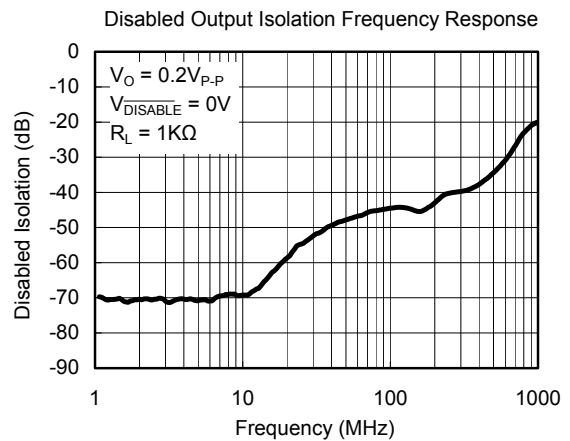
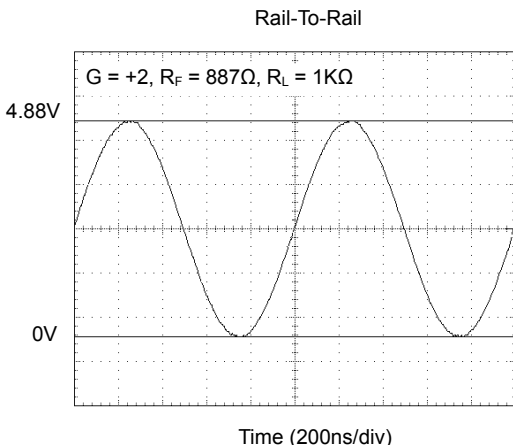
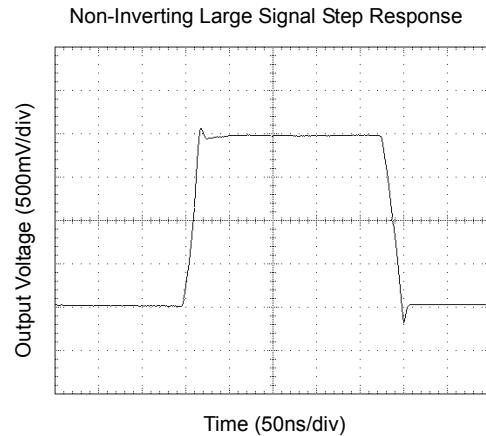
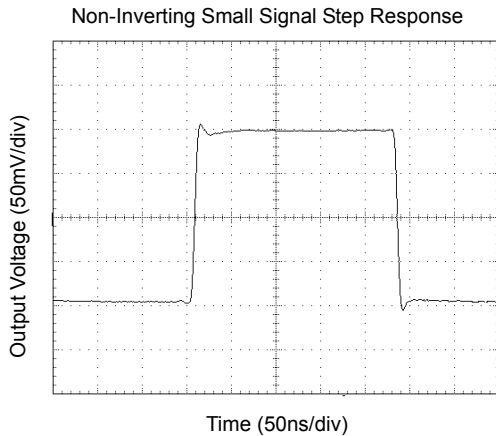
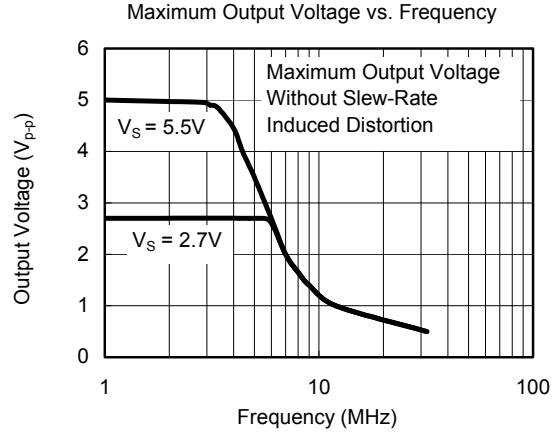
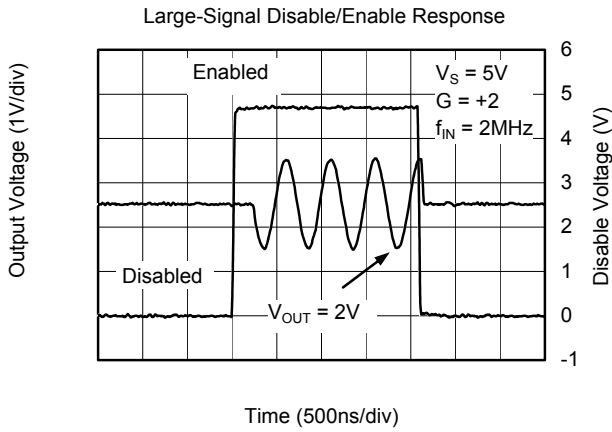
**TYPICAL PERFORMANCE CHARACTERISTICS**

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.



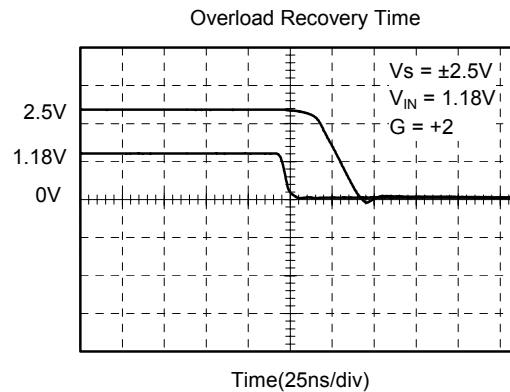
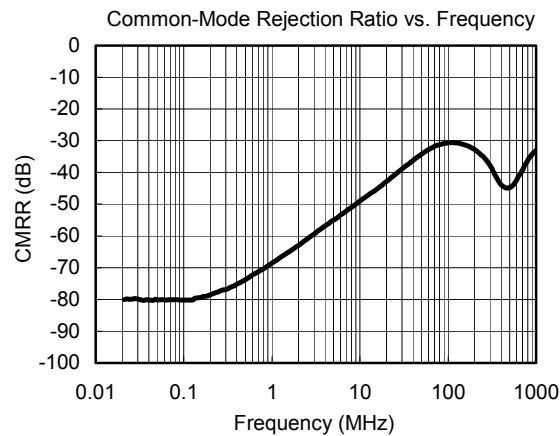
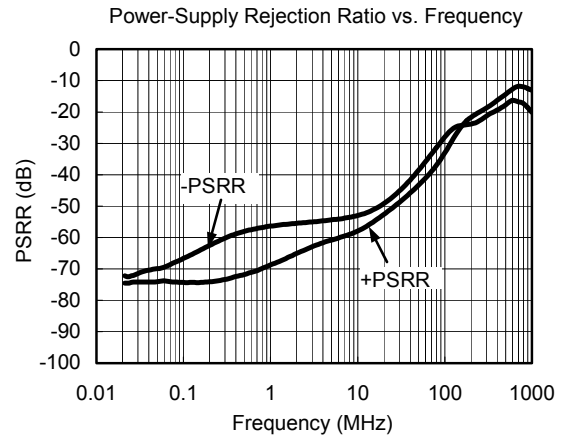
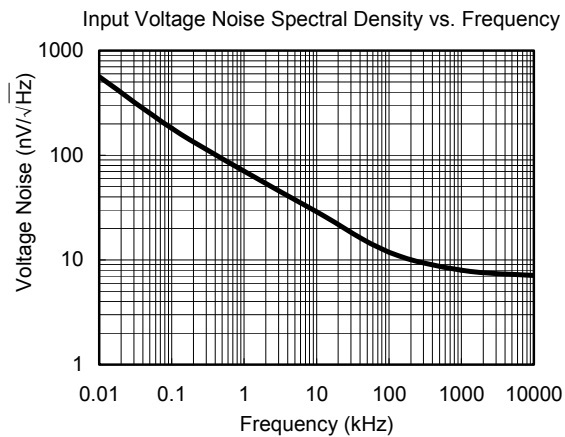
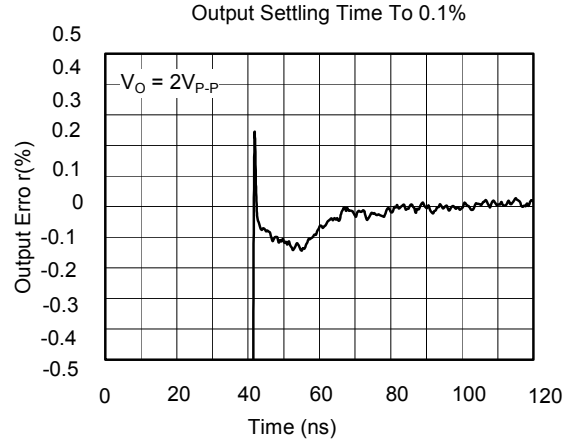
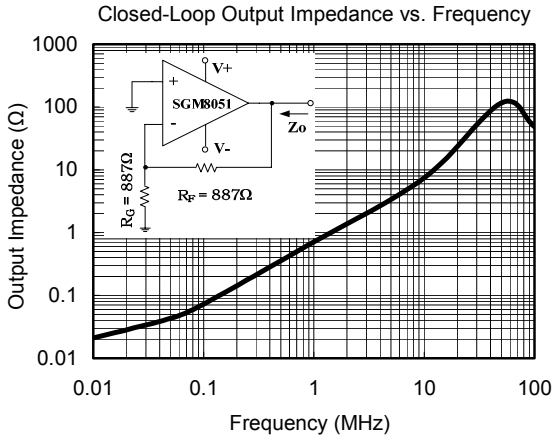
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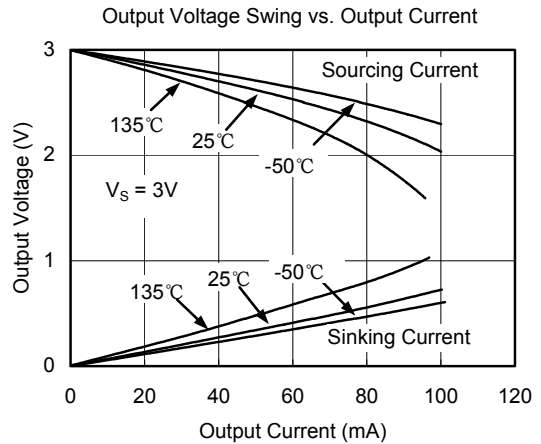
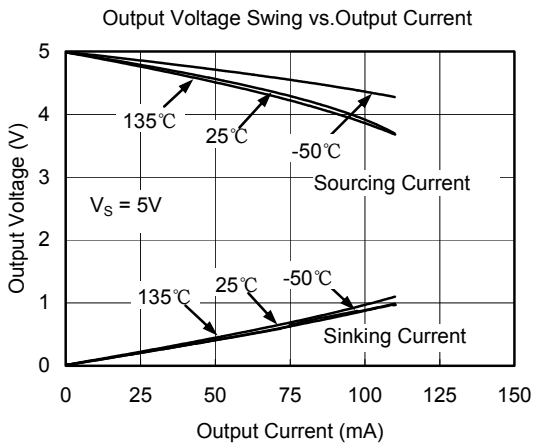
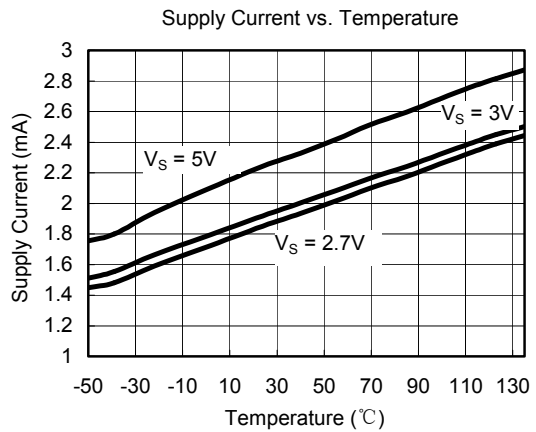
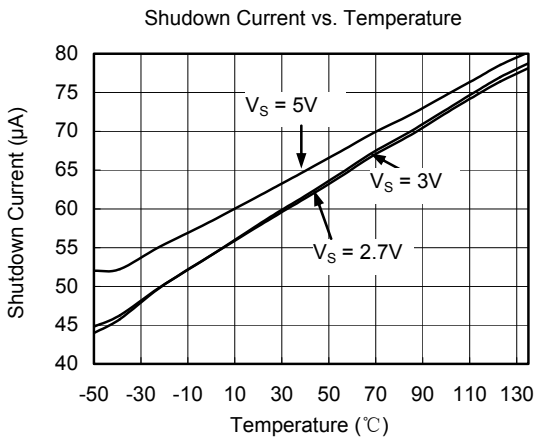
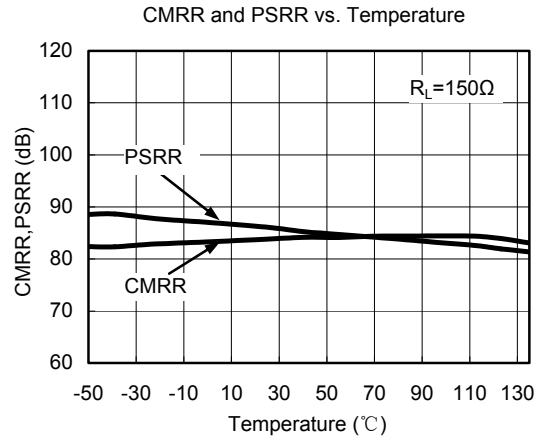
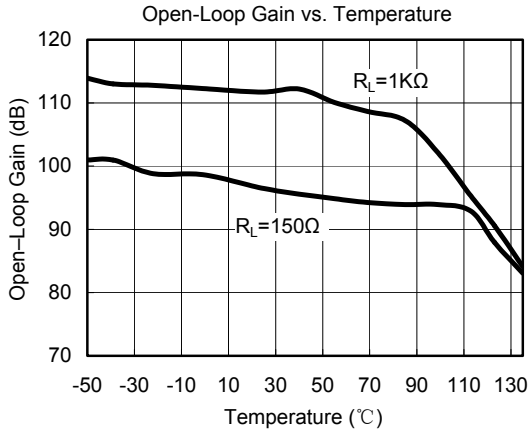
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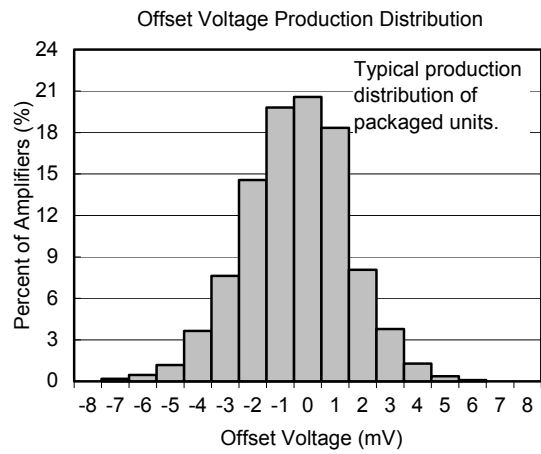
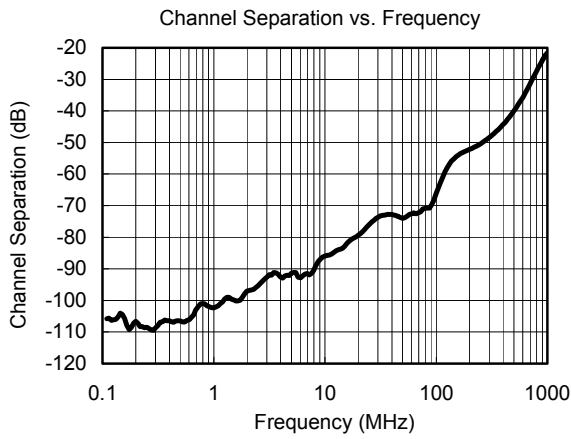
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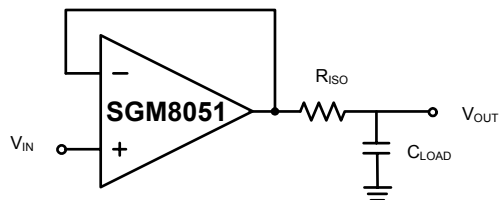


## APPLICATION NOTES

### 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.



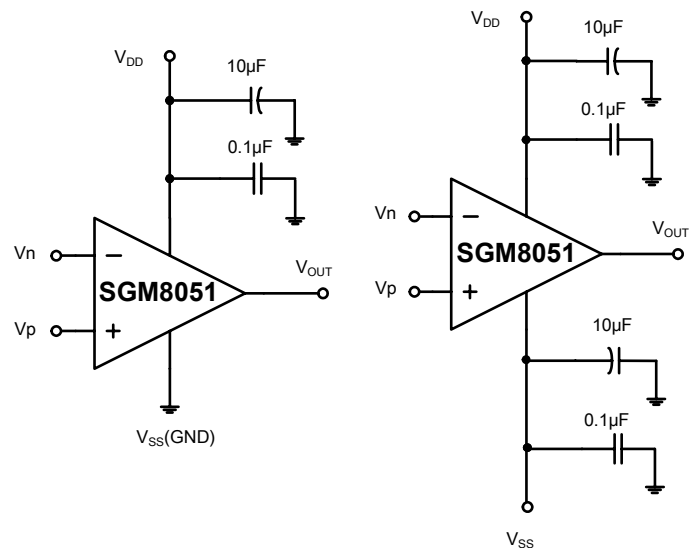
**Figure 1. Series Resistor Isolating Capacitive Load**

### 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  $V_{DD}$  with a 0.1 $\mu F$  ceramic capacitor which should be placed close to the  $V_{DD}$  pin. For dual-supply operation, both the  $V_{DD}$  and the  $V_{SS}$  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 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.

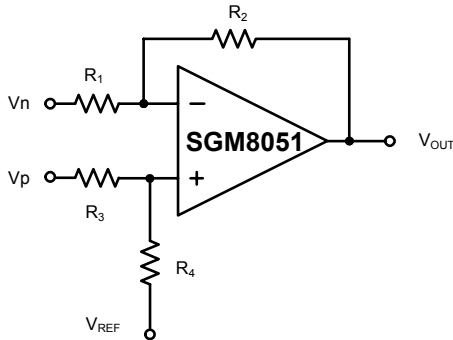
### Input-to-Output Coupling

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**

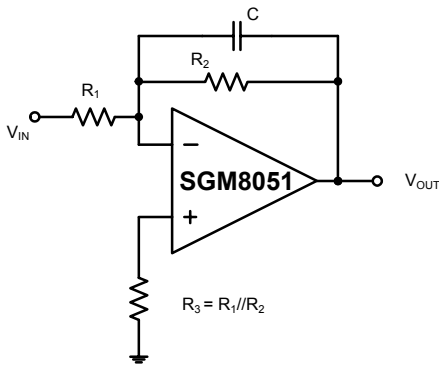
The circuit shown in Figure 3 performs the difference function. If the resistors ratios are equal ( $R_4 / R_3 = R_2 / R_1$ ), then  $V_{OUT} = (V_p - V_n) \times R_2 / R_1 + V_{REF}$ .



**Figure 3. Differential Amplifier**

**Low Pass Active Filter**

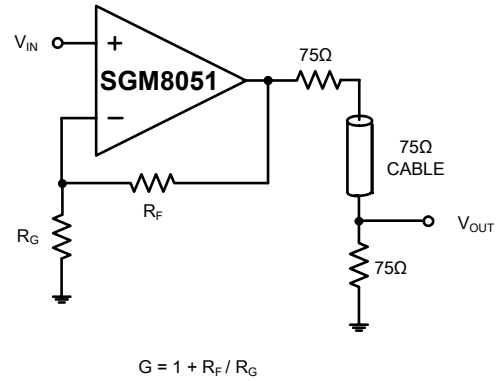
The low pass filter shown in Figure 4 has a DC gain of  $(-R_2/R_1)$  and the  $-3\text{dB}$  corner frequency is  $1/2\pi R_2 C$ . Make sure the filter is within the bandwidth of the amplifier. The Large values of feedback resistors can couple with parasitic capacitance and cause undesired effects such as ringing or oscillation in high-speed amplifiers. Keep resistors value 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.

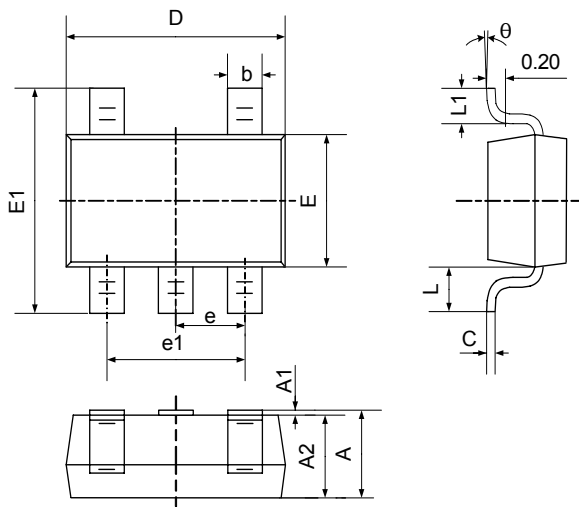


$$G = 1 + R_F / R_G$$

**Figure 5. Typical Video Driving**

PACKAGE OUTLINE DIMENSIONS

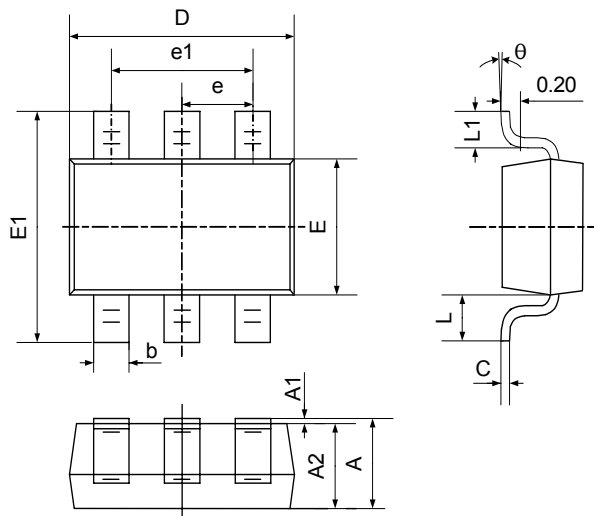
SOT23-5



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	0.400	0.012	0.016
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	0.950TYP		0.037TYP	
e1	1.800	2.000	0.071	0.079
L	0.700REF		0.028REF	
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

PACKAGE OUTLINE DIMENSIONS

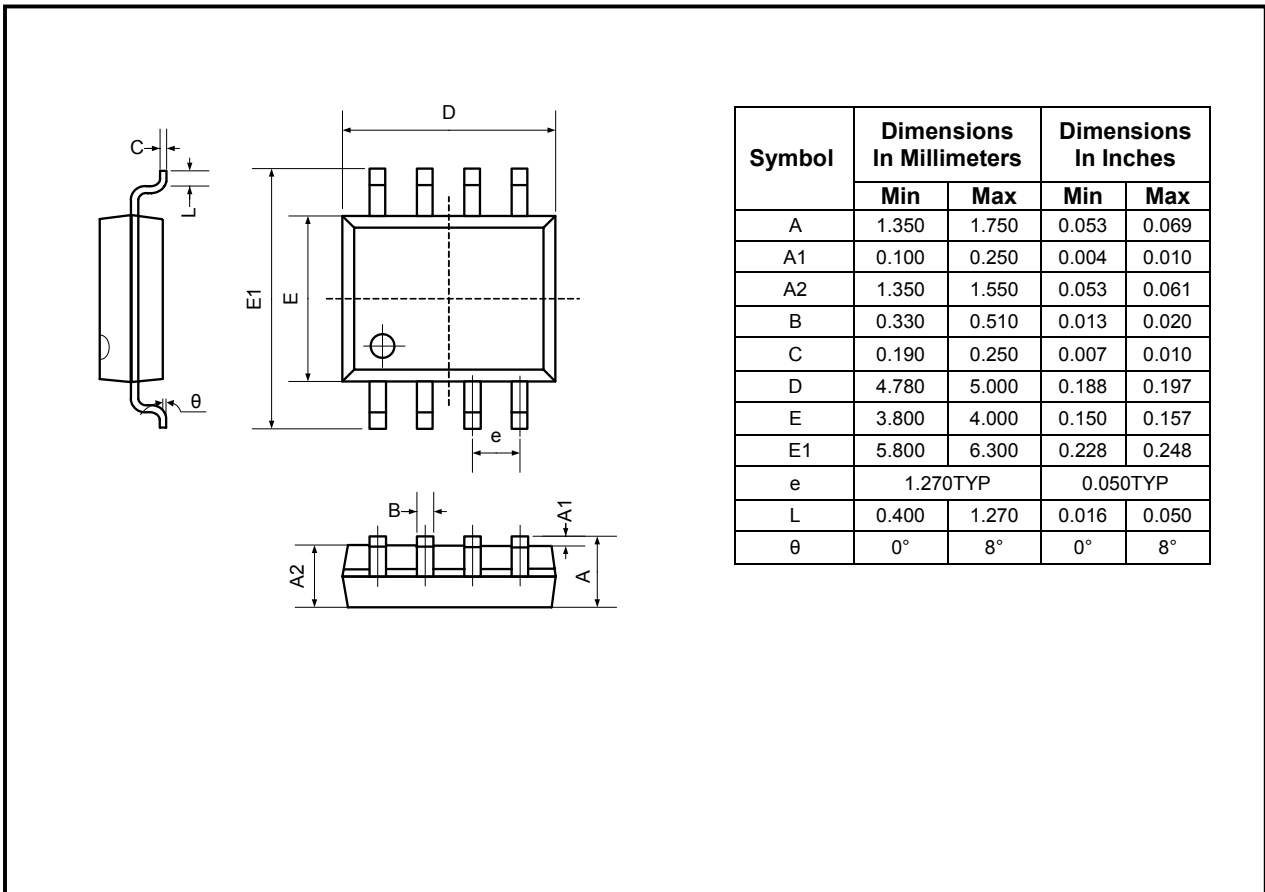
SOT23-6



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	0.400	0.012	0.016
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	0.950TYP		0.037TYP	
e1	1.800	2.000	0.071	0.079
L	0.700REF		0.028REF	
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

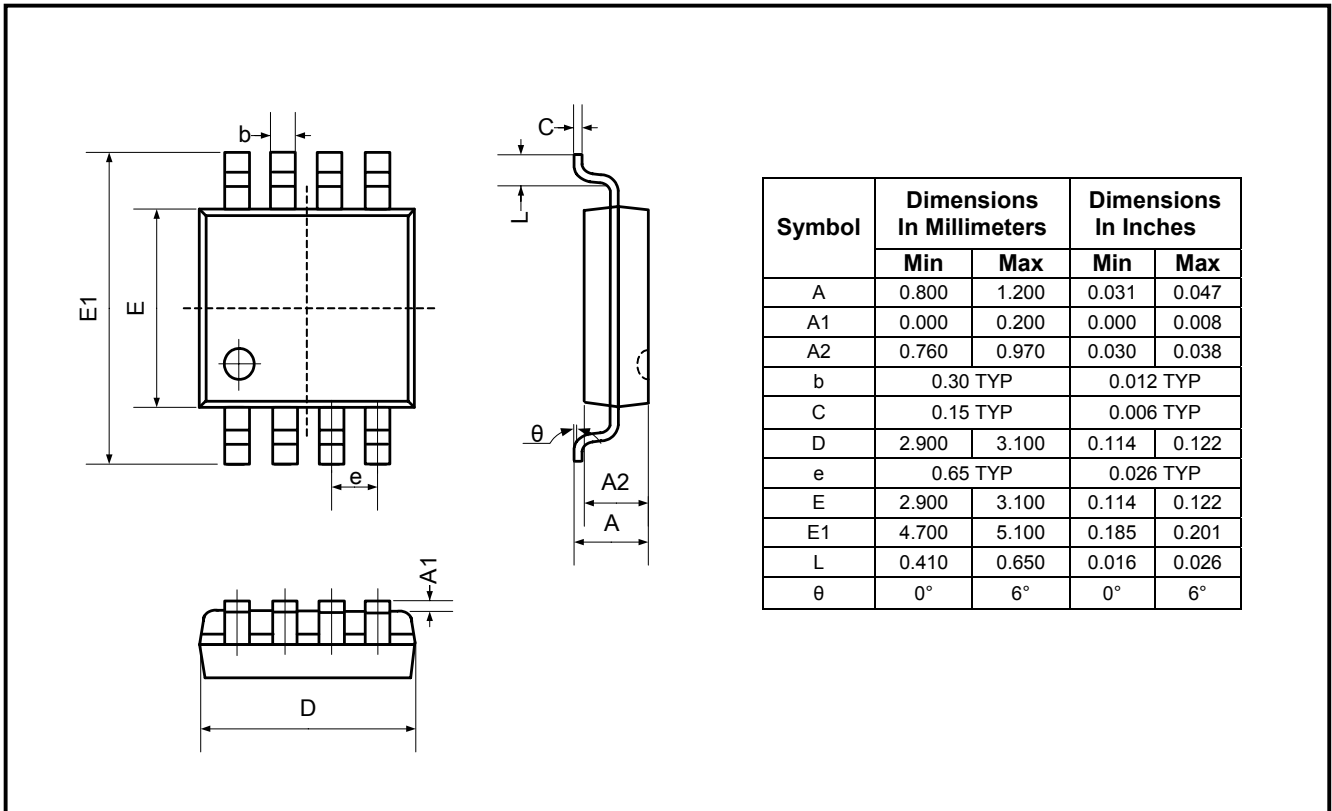
PACKAGE OUTLINE DIMENSIONS

SO-8



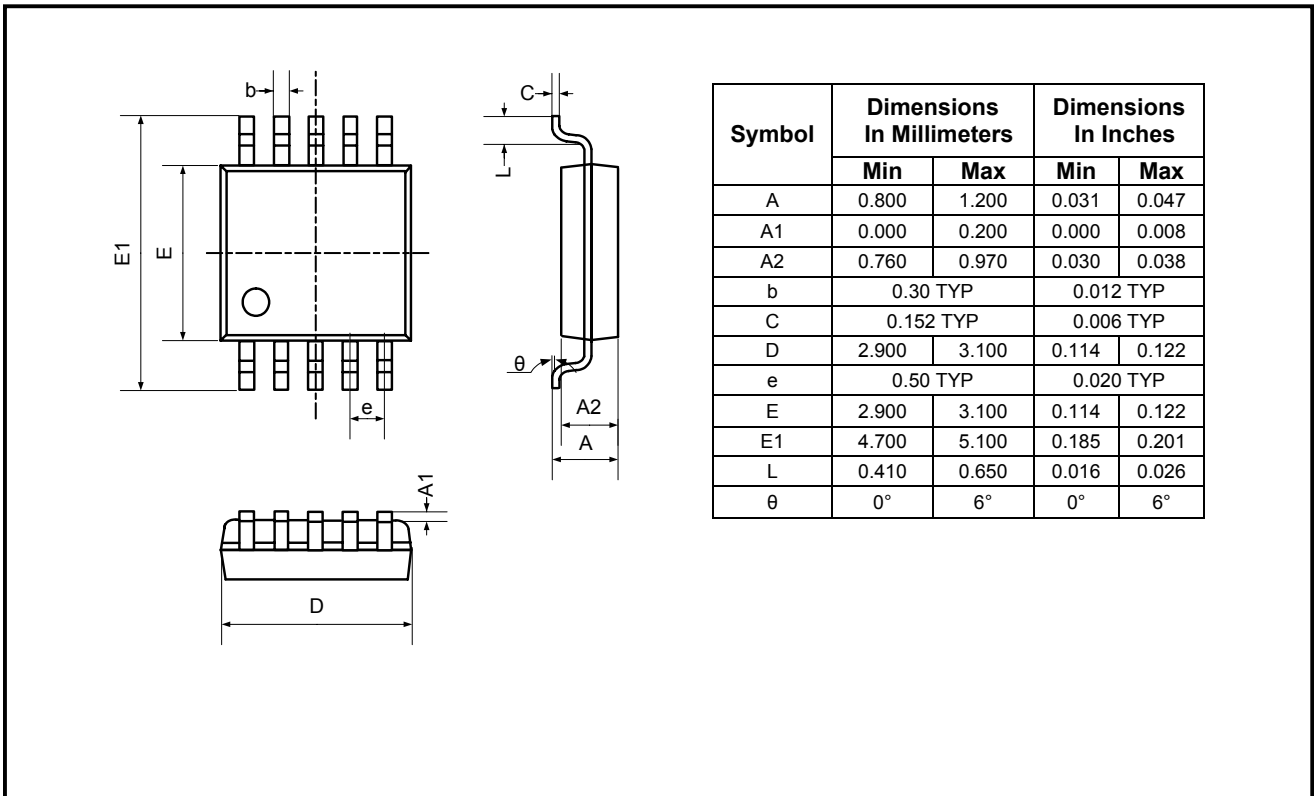
PACKAGE OUTLINE DIMENSIONS

MSOP-8



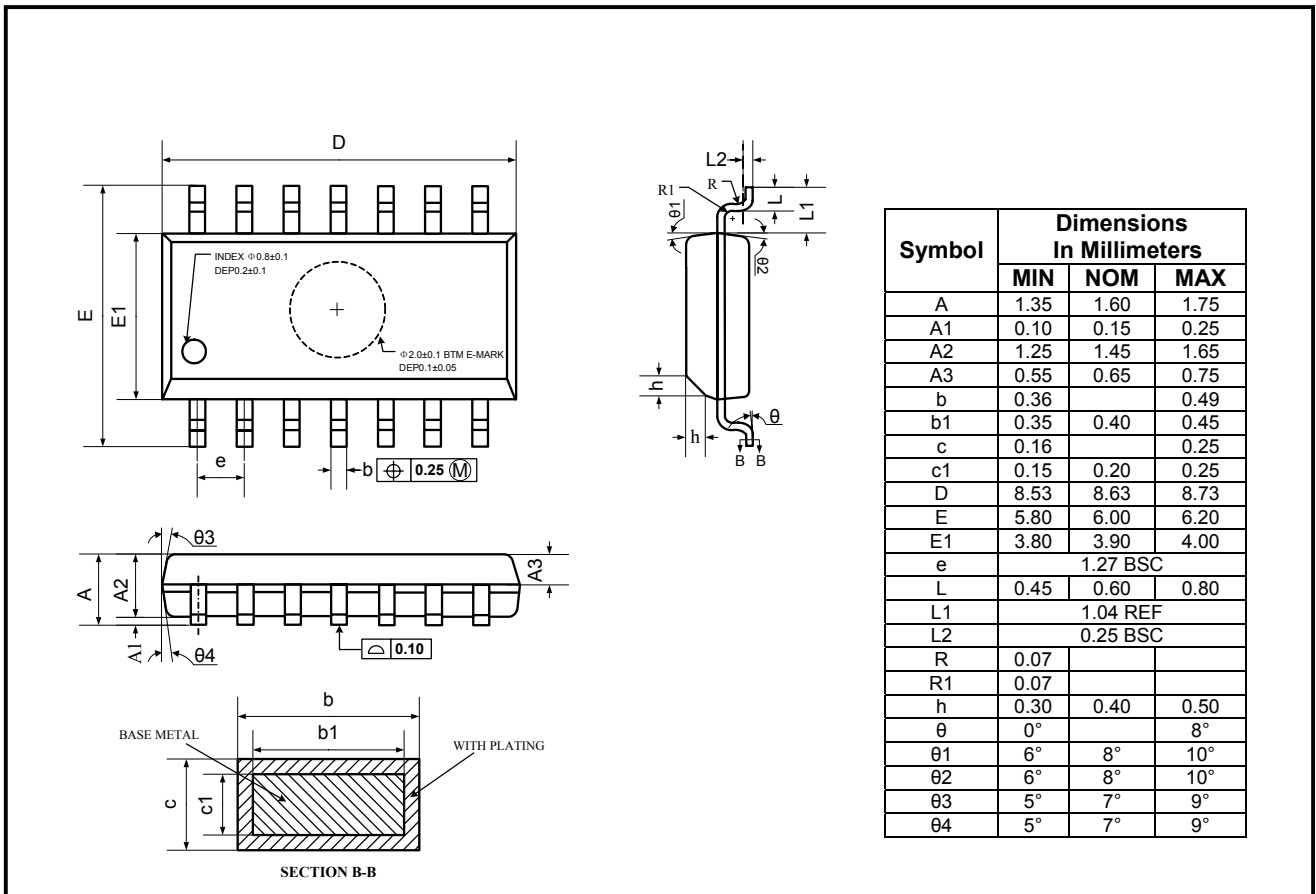
PACKAGE OUTLINE DIMENSIONS

MSOP-10



PACKAGE OUTLINE DIMENSIONS

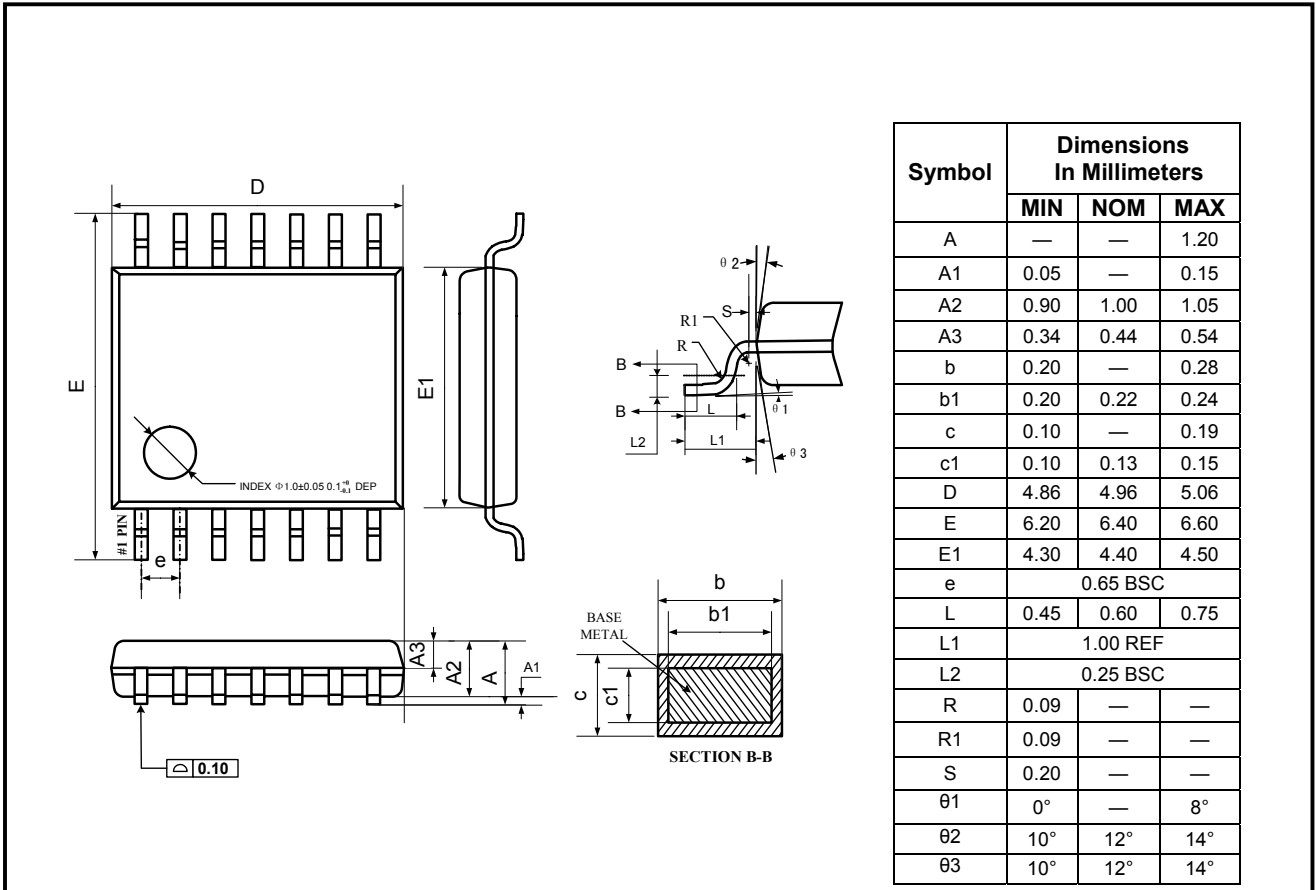
SO-14





PACKAGE OUTLINE DIMENSIONS

TSSOP-14



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