SGM8051/2/4
SGM8053/5

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

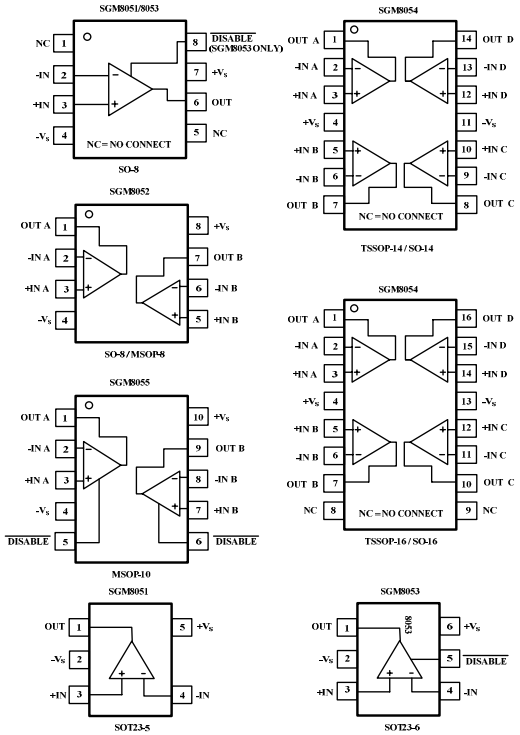
PRODUCT DESCRIPTION

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 2.5 V.

Despite being low cost, the SGM8051 series provide excellent overall performance. They offer wide bandwidth to 250 MHz (G=+1) along with 0.1 dB flatness out to 37 MHz（G = +2）and offer a typical low power of 2.3 mA/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 μA. 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°C temperature range.

PIN CONFIGURATIONS (Top View)

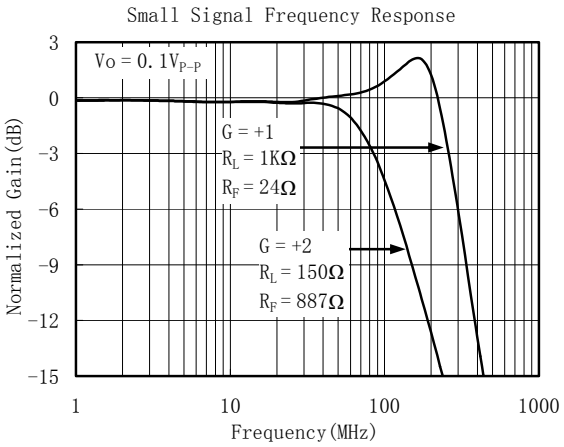


FEATURES

- **Low Cost**
- **Rail-to-Rail Output**
  - **2mV Typical Vos**
- **High Speed**
  - **250 MHz, –3 dB Bandwidth (G = +1)**
  - **130 V/μs, Slew Rate**
  - **58 ns Settling Time to 0.1% with 2V Step**
- **Operates on 2.5 V to 5.5 V Supplies**
- **Input Voltage Range = – 0.2 V to + 3.8 V with V_S = 5 V**
- **Excellent Video Specs (R_L = 150Ω, G = +2)**
  - **Gain Flatness 0.1dB to 37 MHz**
  - **Diff Gain: 0.03 % , Diff Phase: 0.08 degree**
- **Low Power**
  - **2.3 mA/Amplifier Typical Supply Current**
  - **75μA/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-16 and SO-16**
  - **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



ELECTRICAL CHARACTERISTICS : V_S = +5V

(G=+2, R_F=887Ω, R_L = 150Ω, unless otherwise noted)

PARAMETER	CONDITION	SGM8051/2/3/4/5						
		TYP	MIN/MAX OVER TEMPERATURE					
		+25℃	+25℃	0℃ to70℃	-40℃ to 85℃	-40℃to 125℃	UNITS	MIN/ MAX
DYNAMIC PERFORMANCE								
-3dB Small Signal Bandwidth	G = +1, Vo = 0.1 V p-p, R_F = 24Ω, R_L = 150Ω	180					MHz	TYP
	G = +1, Vo = 0.1 V p-p, R_F = 24Ω, R_L = 1KΩ	250					MHz	TYP
	G = +2, Vo = 0.1 V p-p, R_L = 50Ω	40					MHz	TYP
	G = +2, Vo = 0.1 V p-p, R_L = 150Ω	80					MHz	TYP
	G = +2, Vo = 0.1 V p-p, R_L = 1kΩ	130					MHz	TYP
	G = +2, Vo = 0.1 V p-p, R_L = 10kΩ	160					MHz	TYP
Gain-Bandwidth Product	G = +10, R_L =150Ω	90					MHz	TYP
	G = +10, R_L =1KΩ	120					MHz	TYP
Bandwidth for 0.1dB Flatness	G = +2, Vo = 0.1 V p-p, R_L =150Ω, R_F =887Ω	37					MHz	TYP
Slew Rate	G = +1, 2V Output Step	93/-118					V/μs	TYP
	G = +2, 2V Output Step	116/-103					V/μs	TYP
	G = +2, 4V Output Step	130/-130					V/μs	TYP
Rise-and-Fall Time	G = +2, Vo = 0.2 V p-p, 10% to 90%	4					ns	TYP
	G = +2, Vo = 2 V p-p, 10% to 90%	14					ns	TYP
Settling Time to 0.1%	G = +2, 2 V Output Step	58					ns	TYP
Overload Recovery Time	V_{IN} · G = +V_S	18					ns	TYP
NOISE/DISTORTION PERFORMANCE								
Harmonic Distortion								
2nd-Harmonic	G = +2, f = 1MHz, V_O = 2Vp-p, R_L = 150Ω						dBc	TYP
3rd-Harmonic	G = +2, f = 1MHz, V_O = 2Vp-p, R_L = 150Ω						dBc	TYP
Input Voltage Noise	f = 1 MHz	8.1					nV/$\sqrt{Hz}$	TYP
Input Current Noise	f = 1 MHz						f A/$\sqrt{Hz}$	TYP
Differential Gain Error (NTSC)	G = +2, R_L = 150Ω	0.03					%	TYP
Differential Phase Error (NTSC)	G = +2, R_L = 150Ω	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					μV/℃	TYP
Input Bias Current（I_B）		6					PA	TYP
Input offset Current（I_{OS}）		2					PA	TYP
Open-Loop Gain (A_{OL})	V_O = 0.3 V to 4.7 V, R_L = 150Ω	80	75	74	74	73	dB	MIN
	V_O = 0.2 V to 4.8 V, R_L = 1KΩ	104	92	91	91	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} = - 0.1 V to + 3.5 V	80	66	65	65	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		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
$\overline{DISABLE}$ Voltage-Off			0.8				V	MAX
$\overline{DISABLE}$ 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 (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	μA	MAX
Power Supply Rejection Ratio (PSRR)	ΔVs = + 2.7V to + 5.5V, V_{CM} = (-V_S) + 0.5	80	67	67	65	62	dB	MIN

Specifications subject to change without notice.

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	SO-14	Tube, 50	SGM8054XS14
		SGM8054XTS14	TSSOP-14	Tape and Reel, 3000	SGM8054XTS14
		SGM8054XS/TR	SO-16	Tape and Reel, 2500	SGM8054XS
		SGM8054XTS	TSSOP-16	Tape and Reel, 3000	SGM8054XTS
SGM8055	Dual with shutdown	SGM8055XMS/TR	MSOP-10	Tape and Reel, 3000	SGM8055XMS

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V+ to V- ..... 7.5 V
Common-Mode Input Voltage
..... ($-V_S$)– 0.5 V to ($+V_S$) +0.5V
Storage Temperature Range ..... –65℃ to +150℃
Junction
Temperature .....160℃
Operating Temperature Range ..... –55℃ to +150℃
Package Thermal Resistance @ T_A = 25℃
SOT23-5, θ_{JA}..... 190℃/W
SOT23-6, θ_{JA}..... 190℃/W
SO-8, θ_{JA}.....125℃/W
MSOP-8, θ_{JA}..... 216℃/W
MSOP-10, θ_{JA}..... 216℃/W
SO-16, θ_{JA}..... 82℃/W
TSSOP-16, θ_{JA}..... 105℃/W
Lead Temperature Range (Soldering 10 sec)
..... 260℃
ESD Susceptibility
HBM.....1000V
MM.....400V

NOTES

1. 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

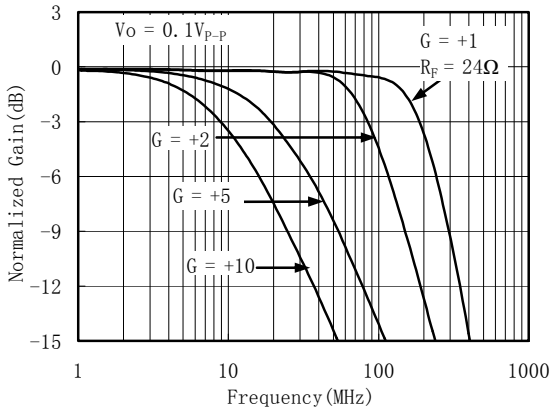
This integrated circuit can be damaged by ESD. Shengbang Micro-electronics recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

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.

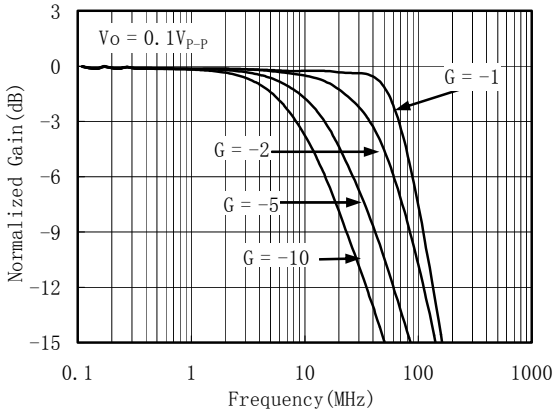
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A= +25℃, V_S = +5V, G = +2, R_F = 887Ω, R_G = 887Ω, and R_L = 150Ω connected to Vs/2,unless otherwise noted.

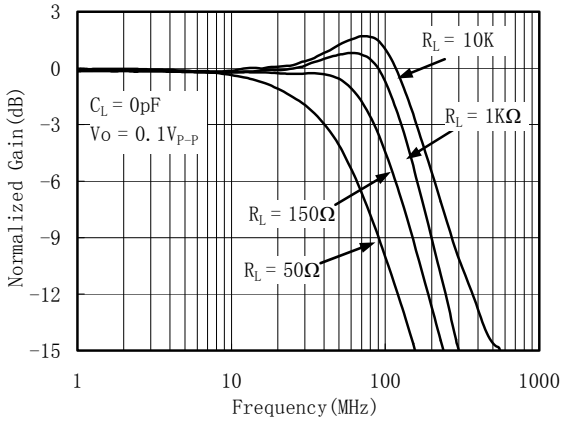
Non-Inverting Small Signal
Frequency Response



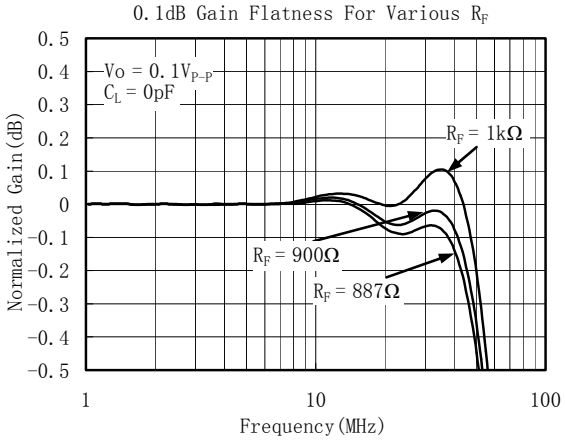
Inverting Small Signal
Frequency Response



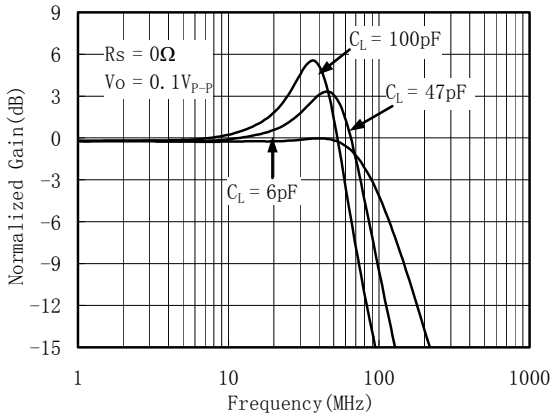
Frequency Response For Various R_L



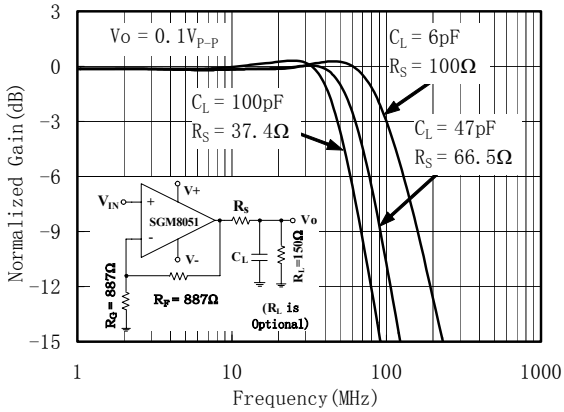
0.1dB Gain Flatness For Various R_F



Frequency Response For Various C_L



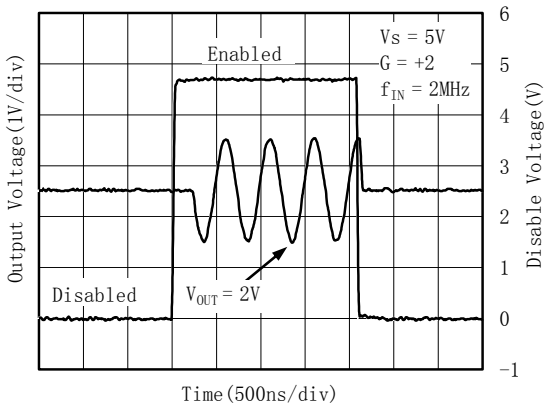
Frequency Response vs.Capacitive Load



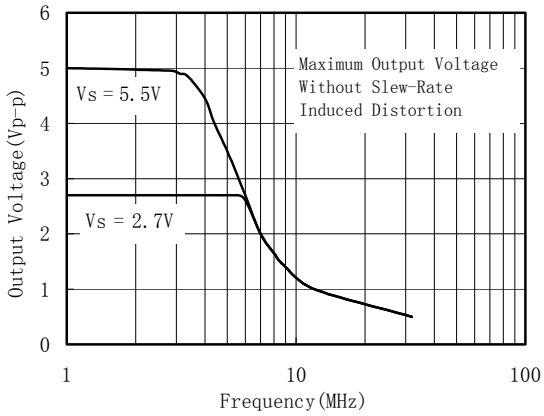
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A= +25℃, V_S = +5V, G = +2, R_F = 887Ω, R_G = 887Ω, and R_L = 150Ω connected to Vs/2,unless otherwise noted.

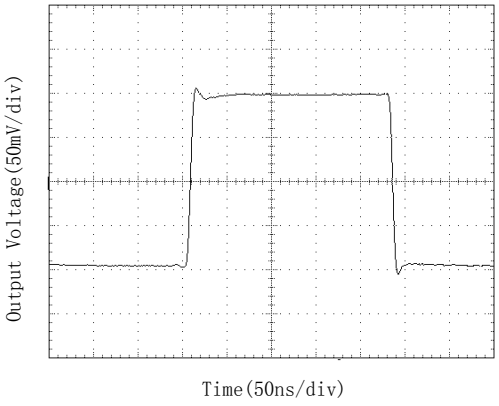
Large-Signal Disable/Enable Response



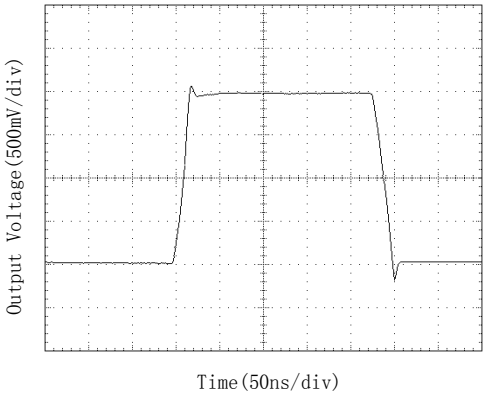
Maximum Output Voltage vs.Frequency



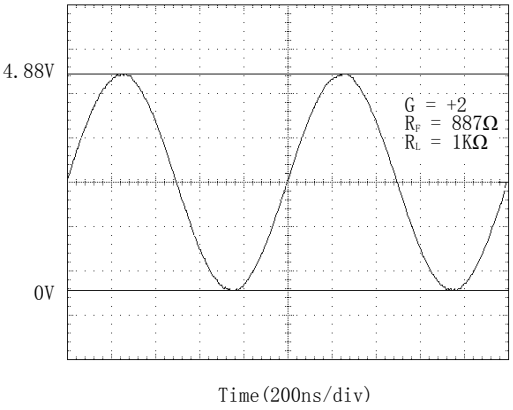
Non-Inverting Small Signal Step Response



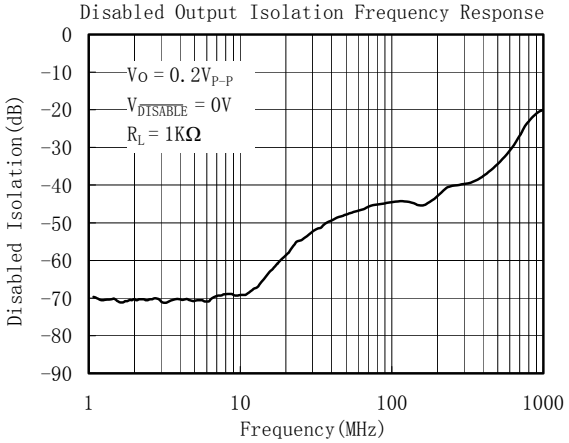
Non-Inverting Large Signal Step Response



Rail-To-Rail



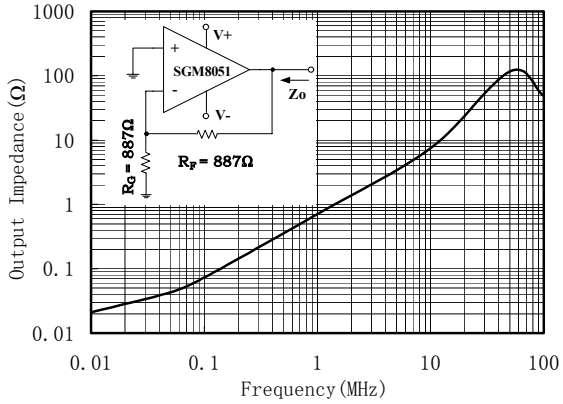
Disabled Output Isolation Frequency Response



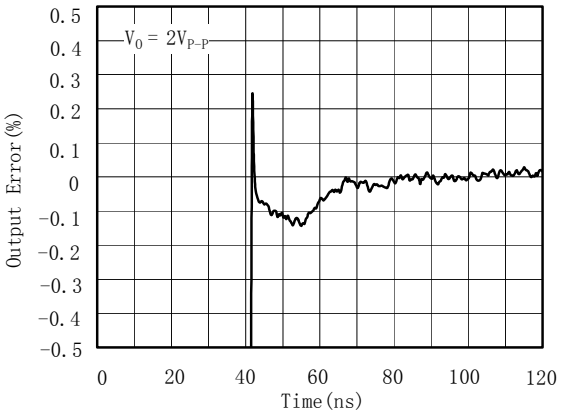
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A= +25℃, V_S = +5V, G = +2, R_F = 887Ω, R_G = 887Ω, and R_L = 150Ω connected to Vs/2,unless otherwise noted.

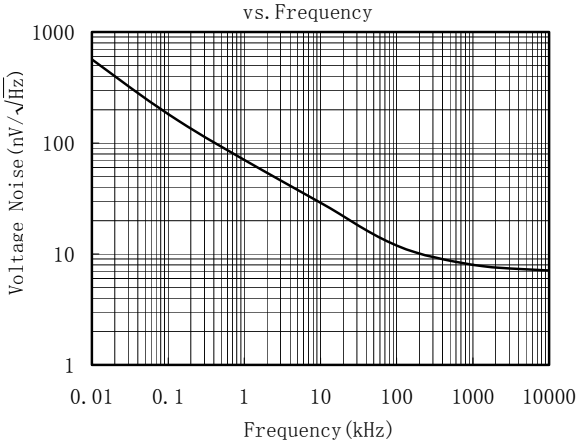
Closed-Loop Output Impedance vs.Frequency



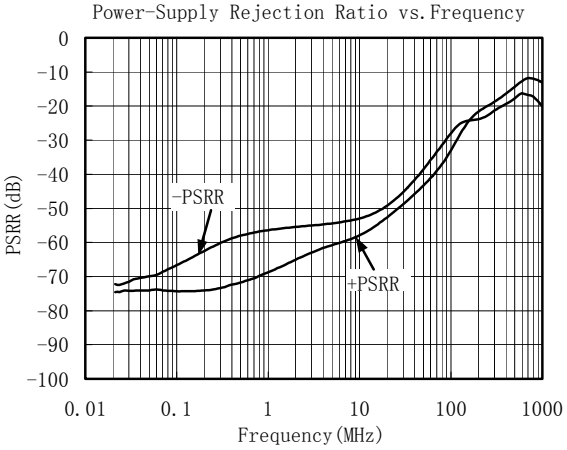
Output Settling Time To 0.1%



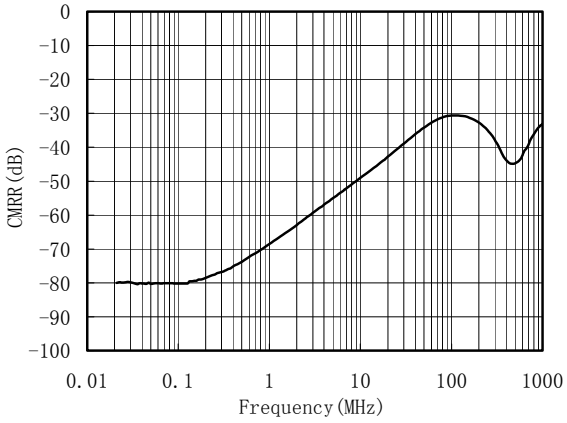
Input Voltage Noise Spectral Density vs.Frequency



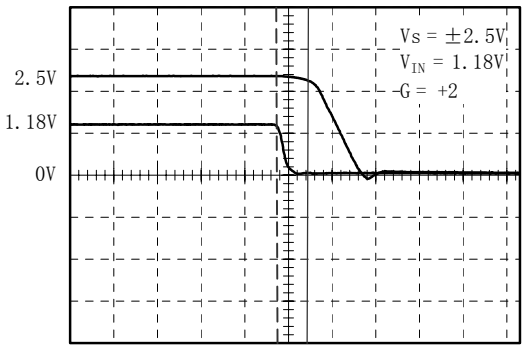
Power-Supply Rejection Ratio vs.Frequency



Common-Mode Rejection Ratio vs.Frequency



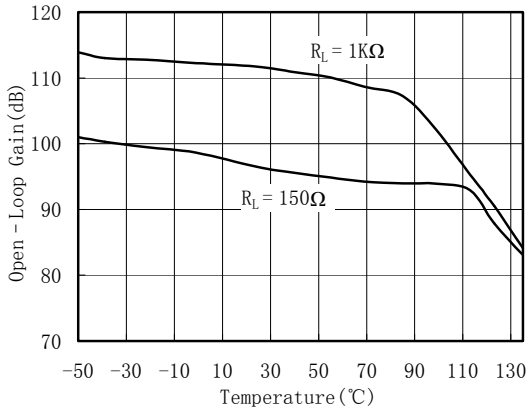
Overload Recovery Time



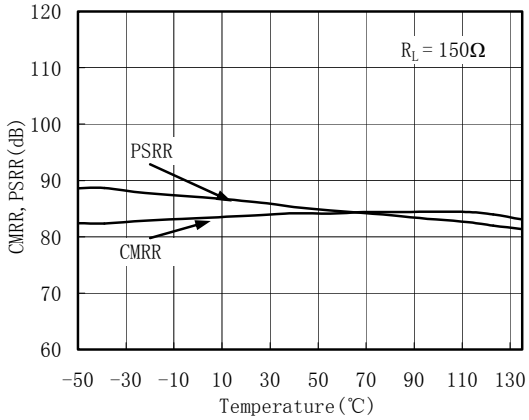
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A= +25℃, V_S = +5V, G = +2, R_F = 887Ω, R_G = 887Ω, and R_L = 150Ω connected to Vs/2,unless otherwise noted.

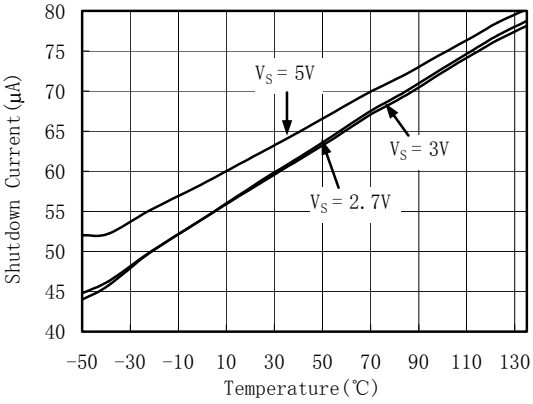
Open-Loop Gain vs. Temperature



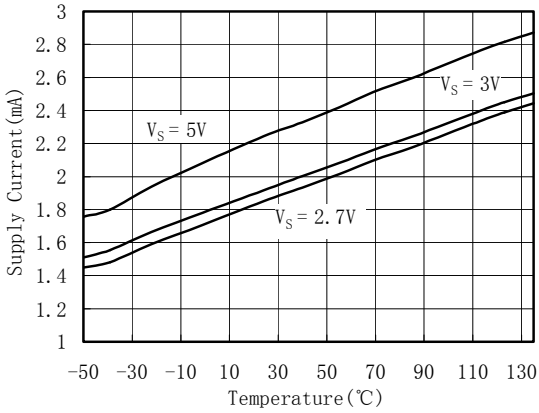
CMRR And PSRR vs. Temperature



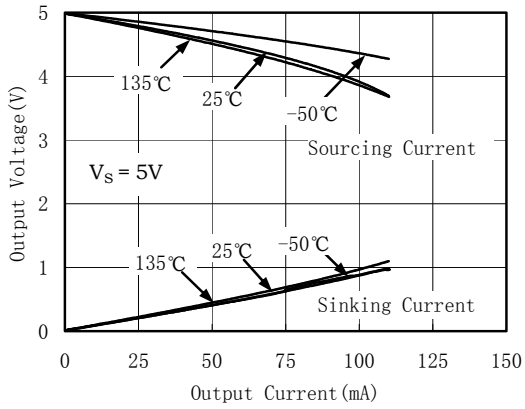
Shutdown Current vs. Temperature



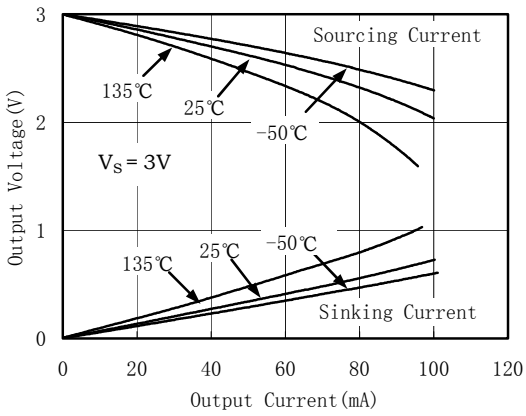
Supply Current vs. Temperature



Output Voltage Swing vs. Output Current

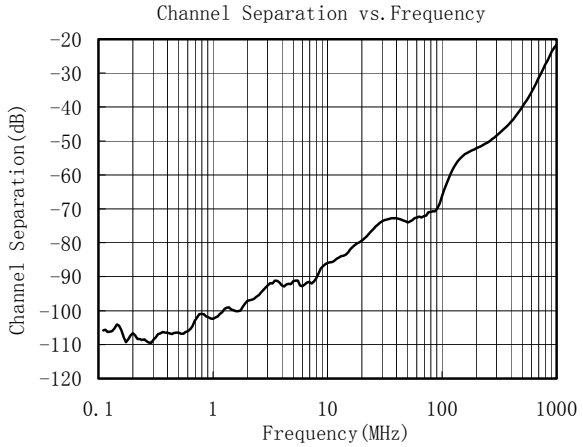


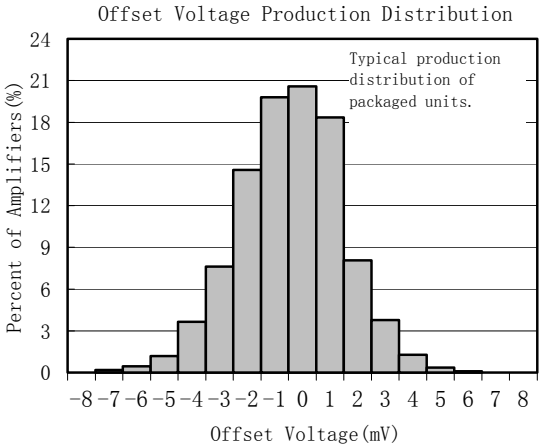
Output Voltage Swing vs. Output Current



TYPICAL PERFORMANCE CHARACTERISTICS

At T_A= +25℃, V_S = +5V, G = +2, R_F = 887Ω, R_G = 887Ω, and R_L = 150Ω connected to Vs/2,unless otherwise noted.





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.

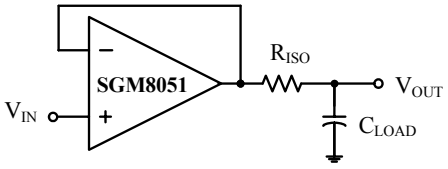


Figure 1. Series Resistor Isolating Capacitive Load

Power-Supply Bypassing and Layout

The SGM805x family operates from either a single +2.7V to +5.5V supply or dual ±1.35V to ±2.75V supplies. For single-supply operation, bypass the power supply V_{DD} with a 0.1μF 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 0.1μF ceramic capacitors. 2.2μF 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).

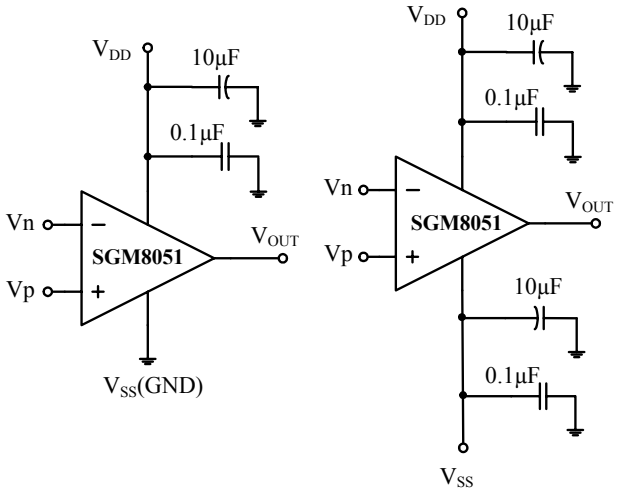


Figure 2. Amplifier with Bypass Capacitors

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 (R4 / R3 = R2 / R1), then V_{OUT} = (Vp – Vn) × R_2 / R_1 + Vref.

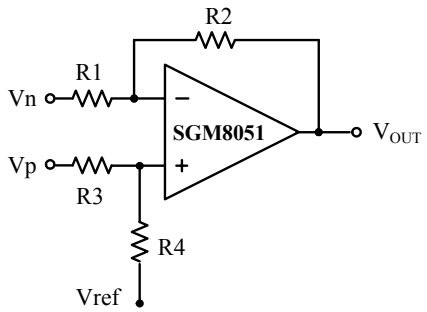


Figure 3. Differential Amplifier

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 1/2πR_2C. 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.

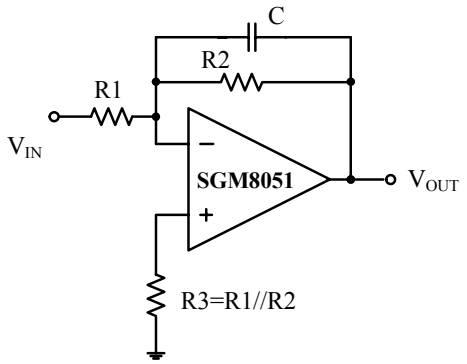
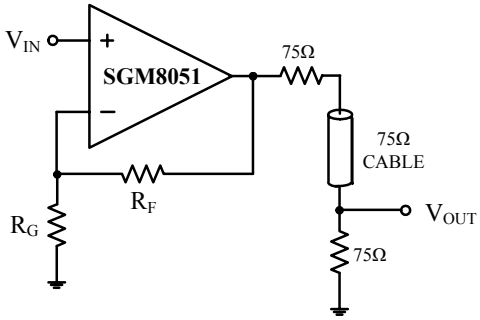


Figure 4. Low Pass Active Filter

Driving Video

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

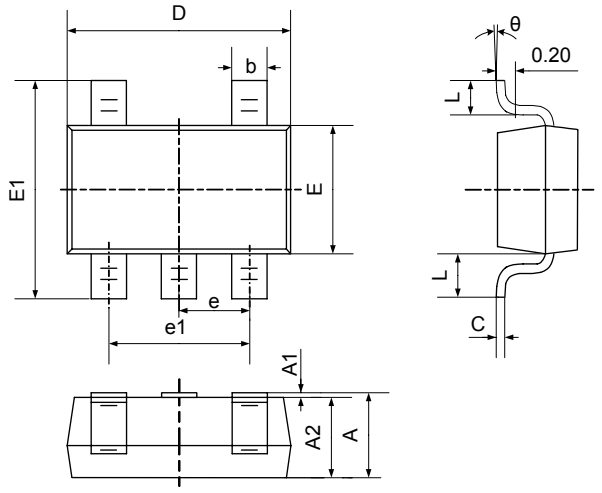


$G = 1 + R_F / R_G$

Figure 5. Typical Video Driving

PACKAGE OUTLINE DIMENSIONS

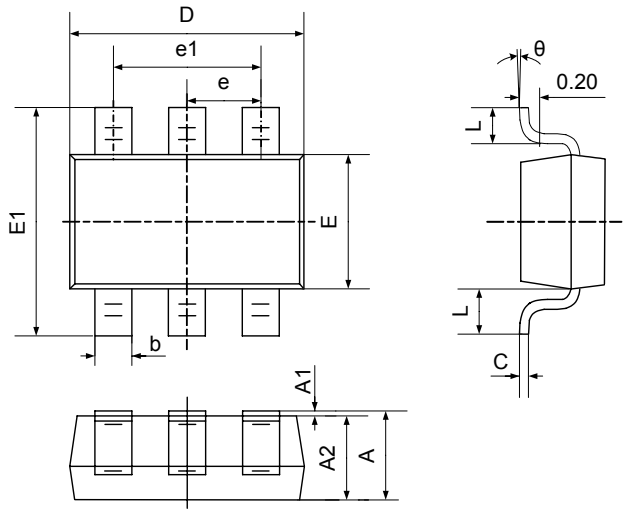
SOT23-5



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

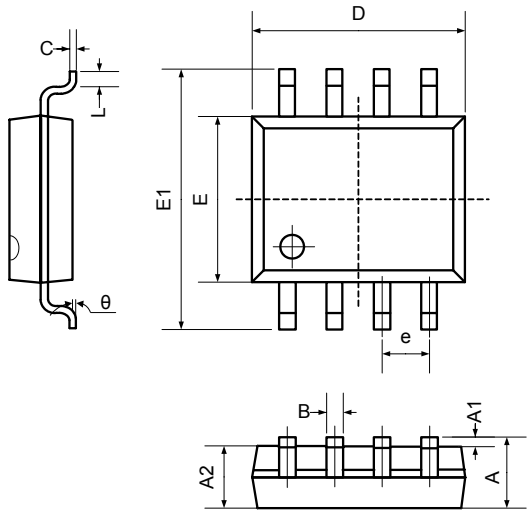
SOT23-6



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

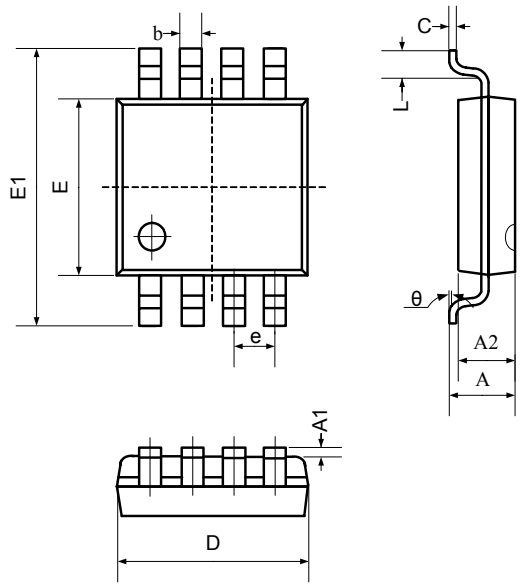
SO-8



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	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

PACKAGE OUTLINE DIMENSIONS

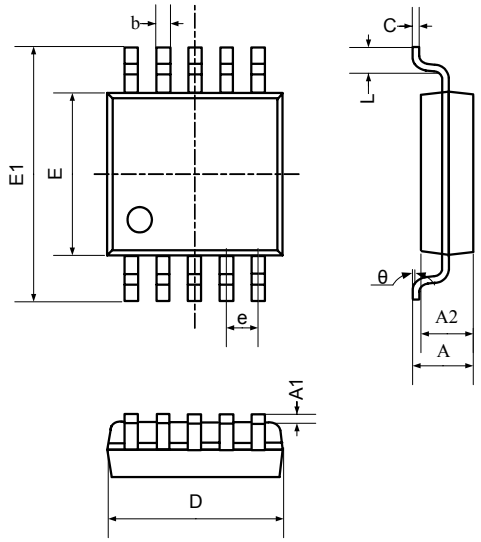
MSOP-8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.800	1.200	0.031	0.047
A1	0.000	0.200	0.000	0.008
A2	0.760	0.970	0.030	0.038
b	0.30 TYP		0.012 TYP	
c	0.15 TYP		0.006 TYP	
D	2.900	3.100	0.114	0.122
e	0.65 TYP		0.026 TYP	
E	2.900	3.100	0.114	0.122
E1	4.700	5.100	0.185	0.201
L	0.410	0.650	0.016	0.026
θ	0°	6°	0°	6°

PACKAGE OUTLINE DIMENSIONS

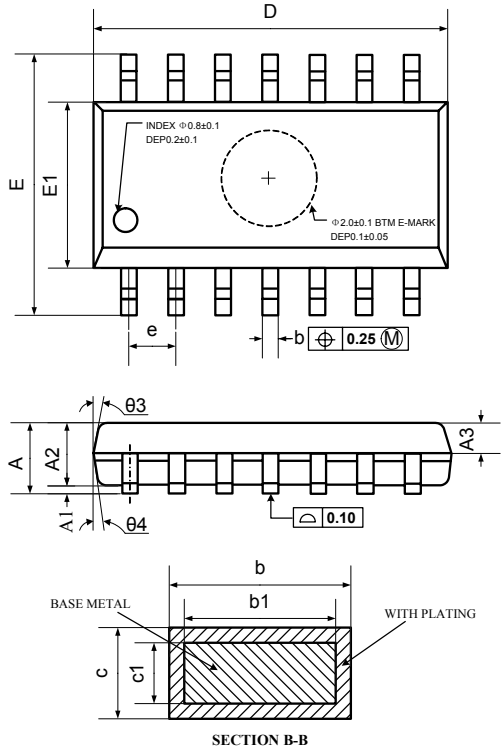
MSOP-10

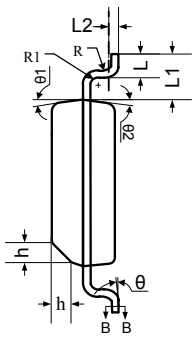


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.800	1.200	0.031	0.047
A1	0.000	0.200	0.000	0.008
A2	0.760	0.970	0.030	0.038
b	0.30 TYP		0.012 TYP	
c	0.152 TYP		0.006 TYP	
D	2.900	3.100	0.114	0.122
e	0.50 TYP		0.020 TYP	
E	2.900	3.100	0.114	0.122
E1	4.700	5.100	0.185	0.201
L	0.410	0.650	0.016	0.026
θ	0°	6°	0°	6°

PACKAGE OUTLINE DIMENSIONS

SO-14

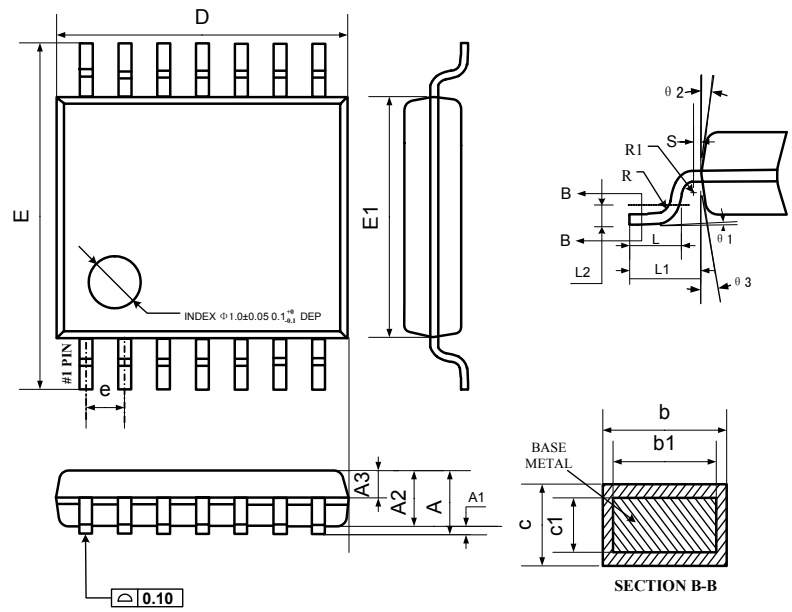




Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	1.35	1.60	1.75
A1	0.10	0.15	0.25
A2	1.25	1.45	1.65
A3	0.55	0.65	0.75
b	0.36		0.49
b1	0.35	0.40	0.45
c	0.16		0.25
c1	0.15	0.20	0.25
D	8.53	8.63	8.73
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
L	0.45	0.60	0.80
L1	1.04 REF		
L2	0.25 BSC		
R	0.07		
R1	0.07		
h	0.30	0.40	0.50
θ	0°		8°
θ1	6°	8°	10°
θ2	6°	8°	10°
θ3	5°	7°	9°
θ4	5°	7°	9°

PACKAGE OUTLINE DIMENSIONS

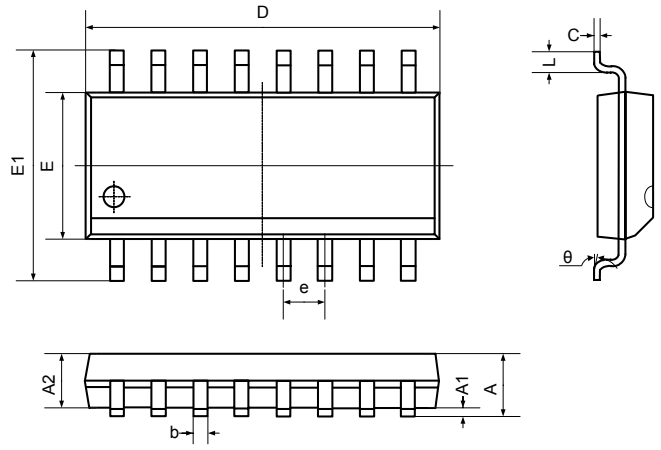
TSSOP-14



Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	—	—	1.20
A1	0.05	—	0.15
A2	0.90	1.00	1.05
A3	0.34	0.44	0.54
b	0.20	—	0.28
b1	0.20	0.22	0.24
c	0.10	—	0.19
c1	0.10	0.13	0.15
D	4.86	4.96	5.06
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65 BSC		
L	0.45	0.60	0.75
L1	1.00 REF		
L2	0.25 BSC		
R	0.09	—	—
R1	0.09	—	—
S	0.20	—	—
θ1	0°	—	8°
θ2	10°	12°	14°
θ3	10°	12°	14°

PACKAGE OUTLINE DIMENSIONS

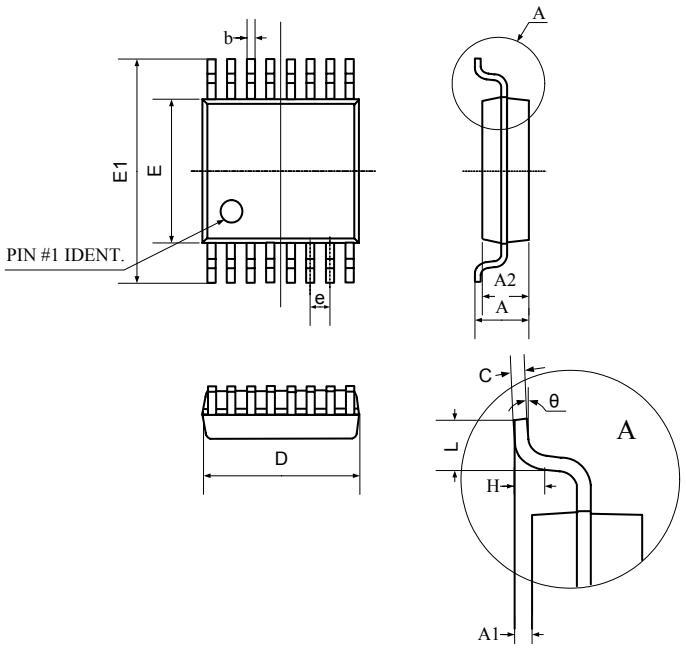
SO-16



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	0.007	0.010
D	9.800	10.20	0.386	0.402
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

PACKAGE OUTLINE DIMENSIONS

TSSOP-16



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
D	4.900	5.100	0.193	0.201
E	4.300	4.500	0.169	0.177
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
E1	6.250	6.550	0.246	0.258
A		1.100		0.043
A2	0.800	1.000	0.031	0.039
A1	0.020	0.150	0.001	0.006
e	0.65 (BSC)		0.026 (BSC)	
L	0.500	0.700	0.020	0.028
H	0.25(TYP)		0.01(TYP)	
θ	1°	7°	1°	7°

REVISION HISTORY

Location **Page**

9/05— Data Sheet changed from REV.A to REV.B

Added SGM8055 . . . . . Universal
Changes to PRODUCT DESCRIPTION, FEATURES, and PIN CONFIGURATIONS 1
Changes to ELECTRICAL CHARACTERISTICS. 2
Updated PACKAGE/ORDERING INFORMATION. 3

11/06— Data Sheet changed from REV. B to REV. C

Changes to ABSOLUTE MAXIMUM ATINGS 3

01/08— Data Sheet changed from REV. C to REV. D

Added SGM8054's SO-14 and TSSOP-14 Packages. 1, 3, 16, 17

SG Microelectronics Co., Ltd

A2608, NO.72 North Road
Xisanhuan, Haidian District,
Beijing, China 100037
Tel: 86-10-51798160/80
Fax: 86-10-51798180-803
www.sg-micro.com