



# SGM8535/SGM8536/SGM8537/SGM8538 1.5MHz, Rail-to-Rail Output Operational Amplifiers

## GENERAL DESCRIPTION

The SGM8535 (single), SGM8536 (dual), SGM8537 (single with shutdown) and SGM8538 (quad) are voltage feedback amplifiers. These devices can operate from 1.8V to 5.5V single supply, while consuming only 80 $\mu$ A quiescent current per amplifier. They provide a wide input common mode voltage range and rail-to-rail output voltage swing. This feature makes SGM8535/6/7/8 appropriate for buffering ASIC.

The SGM8535/6/7/8 offer a gain-bandwidth product of 1.5MHz and an ultra-low input bias current of 3pA. They are well suited for piezoelectric sensors, integrators and photodiode amplifiers.

The SGM8535/6/7/8 are designed into a wide range of applications, such as battery-powered instrumentation, safety monitoring, portable systems, and transducer interface circuits in low power systems.

The SGM8535 is available in Green SOT-23-5, SC70-5, MSOP-8 and SOIC-8 packages. The SGM8536 is available in Green MSOP-8 and SOIC-8 packages. The SGM8537 is available in Green SOT-23-6, MSOP-8 and SOIC-8 packages. The SGM8538 is available in Green SOIC-14 and TSSOP-14 packages. They are specified over the -40°C to +85°C temperature range.

## FEATURES

- **Low Input Offset Voltage: 3.4mV (MAX)**
- **Unity-Gain Stable**
- **Gain-Bandwidth Product: 1.5MHz**
- **Rail-to-Rail Output**
- **Supply Voltage Range: 1.8V to 5.5V**
- **Low Supply Current**
  - 80 $\mu$ A/Amplifier (TYP)**
  - 0.1 $\mu$ A Shutdown Current for SGM8537**
- **-40°C to +85°C Operating Temperature Range**
- **Small Packaging:**
  - SGM8535 Available in SOT-23-5, SC70-5, MSOP-8 and SOIC-8 Packages**
  - SGM8536 Available in MSOP-8 and SOIC-8 Packages**
  - SGM8537 Available in SOT-23-6, MSOP-8 and SOIC-8 Packages**
  - SGM8538 Available in SOIC-14 and TSSOP-14 Packages**

## APPLICATIONS

ASIC Input or Output Amplifiers  
Piezoelectric Transducer Amplifiers  
Battery-Powered Equipment  
Portable Systems  
Sensor Interfaces  
Medical Instrumentation  
Mobile Communications  
Audio Outputs  
Smoke Detectors  
Mobile Telephones  
Notebook PCs  
PCMCIA Cards



**ABSOLUTE MAXIMUM RATINGS**

Supply Voltage, +Vs to -Vs.....	6V
Input Common Mode Voltage Range.....	-0.1V to (+Vs) - 1.3V
Junction Temperature .....	+150°C
Storage Temperature Range.....	-65°C to +150°C
Lead Temperature (Soldering, 10s) .....	+260°C
ESD Susceptibility	
HBM (SGM8535/6/8) .....	8000V
HBM (SGM8537) .....	3000V
MM.....	400V

**RECOMMENDED OPERATING CONDITIONS**

Operating Temperature Range .....	-40°C to +85°C
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**OVERSTRESS CAUTION**

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods

may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

**ESD SENSITIVITY CAUTION**

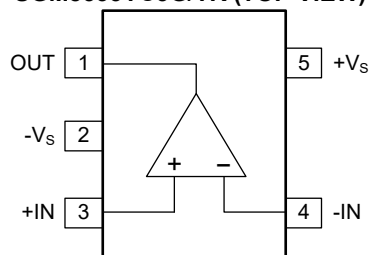
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

**DISCLAIMER**

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

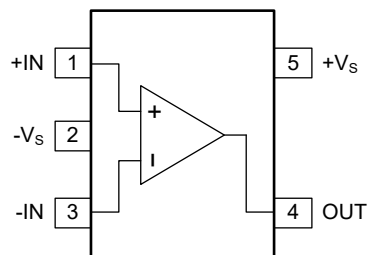
**PIN CONFIGURATIONS**

**SGM8535AYN5G/TR (TOP VIEW)  
SGM8535YC5G/TR (TOP VIEW)**



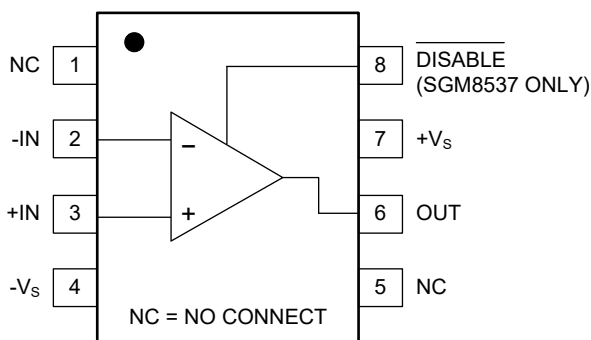
**SOT-23-5/SC70-5**

**SGM8535BYN5G/TR (TOP VIEW)**



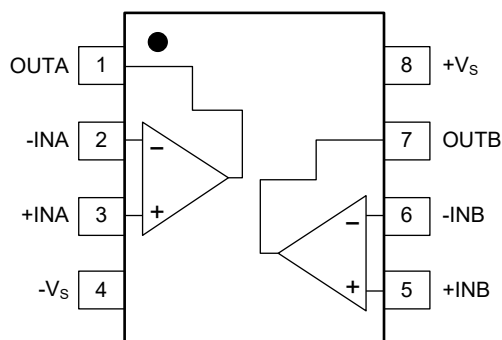
**SOT-23-5**

**SGM8535/7 (TOP VIEW)**



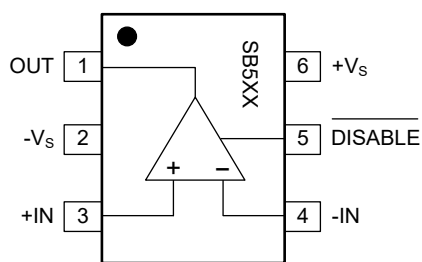
**MSOP-8/SOIC-8**

**SGM8536 (TOP VIEW)**



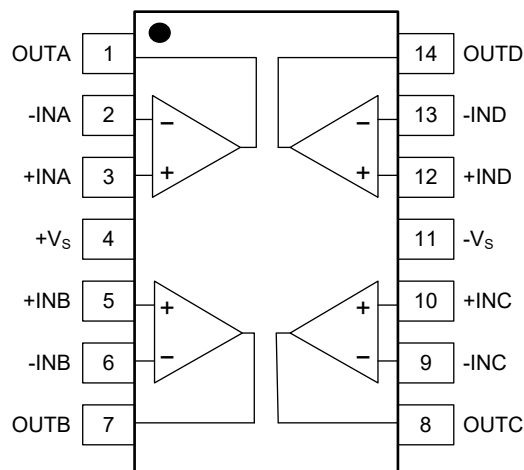
**MSOP-8/SPIC-8**

**SGM8537 (TOP VIEW)**



**SOT-23-6**

**SGM8538 (TOP VIEW)**



**SOIC-14/TSSOP-14**

NOTE: The location of pin 1 on the SOT-23-6 is determined by orienting the package marking as shown.

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

( $V_{OUT} = V_S/2$ , Full =  $-40^{\circ}C$  to  $+85^{\circ}C$ , typical values are at  $T_A = +25^{\circ}C$ , unless otherwise noted.)

PARAMETER	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
<b>Input Characteristics</b>						
Input Offset Voltage ( $V_{OS}$ )	$V_{CM} = V_S/2$	+25°C		0.6	3.4	mV
		Full			3.8	
Input Offset Voltage Drift ( $\Delta V_{OS}/\Delta T$ )	$V_{CM} = V_S/2$	Full		1.5		$\mu V/^{\circ}C$
Input Bias Current ( $I_B$ )		+25°C		3		pA
Input Offset Current ( $I_{OS}$ )		+25°C		3		pA
Input Common Mode Voltage Range ( $V_{CM}$ )		Full	-0.1		3.7	V
Common Mode Rejection Ratio (CMRR)	$V_{CM} = -0.1V$ to $3.7V$	+25°C	70	85		dB
		Full	65			
Open-Loop Voltage Gain ( $A_{OL}$ )	$R_L = 2k\Omega$ , $V_{OUT} = 0.2V$ to $4.8V$	+25°C	80	90		dB
		Full	75			
	$R_L = 100k\Omega$ , $V_{OUT} = 0.035V$ to $4.965V$	+25°C		103		
<b>Output Characteristics</b>						
Output Voltage Swing from Rail	$R_L = 2k\Omega$	+25°C		80	100	mV
		Full			110	
Output Short-Circuit Current ( $I_{SC}$ )		+25°C	22	35		mA
		Full	18			
<b>Power-Down (SGM8537 only)</b>						
Logic Low Voltage ( $V_{IL}$ )		+25°C			0.8	V
Logic High Voltage ( $V_{IH}$ )		+25°C	2			V
<b>Power Supply</b>						
Quiescent Current/Amplifier ( $I_Q$ )	$I_{OUT} = 0mA$	+25°C		80	130	$\mu A$
		Full			165	
Supply Current when Disabled (SGM8537 only)		+25°C		100	1500	nA
Power Supply Rejection Ratio (PSRR)	$V_S = 1.8V$ to $5.5V$ , $V_{CM} = 0.5V$	+25°C	65	80		dB
		Full	60			
<b>Dynamic Performance</b>						
Gain-Bandwidth Product (GBP)	$R_L = 2k\Omega$ , $C_L = 100pF$	+25°C		1.5		MHz
Slew Rate (SR)	$V_{OUT} = 2V_{P-P}$ , $A_V = 1$	+25°C		0.8		$V/\mu s$
Crosstalk	$f = 1kHz$	+25°C		110		dB
Settling Time to 0.1% ( $t_s$ )	$V_{OUT} = 2V_{P-P}$ , $f = 1kHz$ , $A_V = 1$ , $R_L = 2k\Omega$ , $C_L = 100pF$	+25°C		3.5		$\mu s$
Overload Recovery Time	$R_L = 2k\Omega$ , $A_V = -50$	+25°C		7		$\mu s$
<b>Noise Performance</b>						
Input Voltage Noise Density ( $e_n$ )	$f = 1kHz$	+25°C		30		$nV/\sqrt{Hz}$

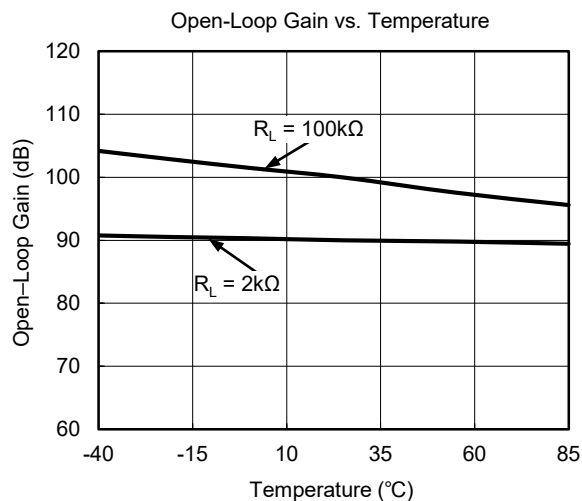
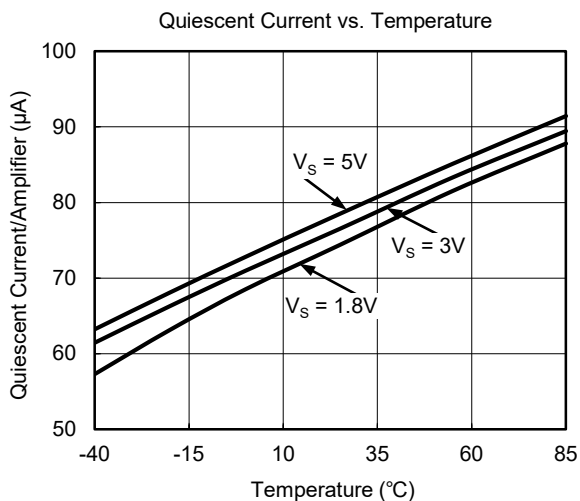
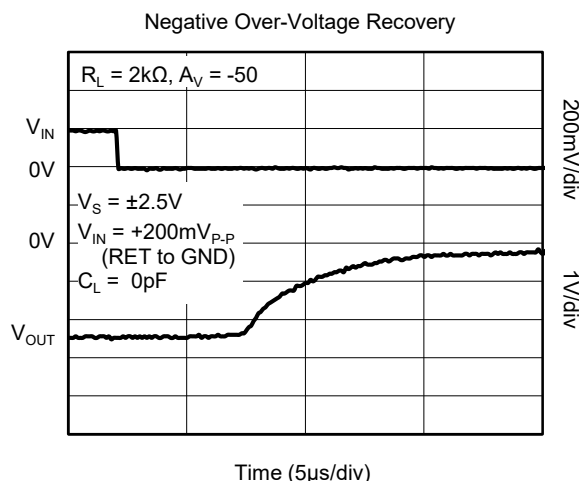
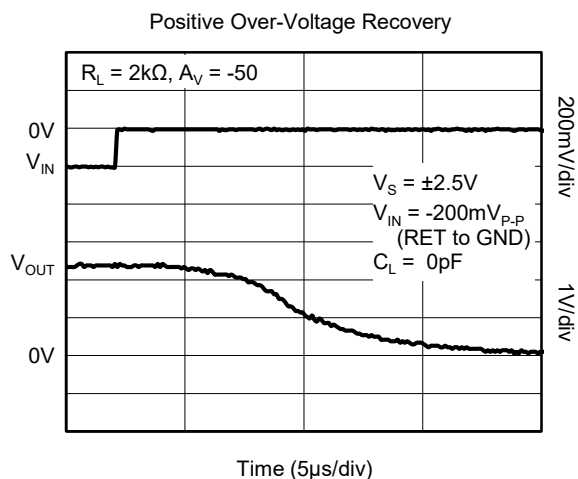
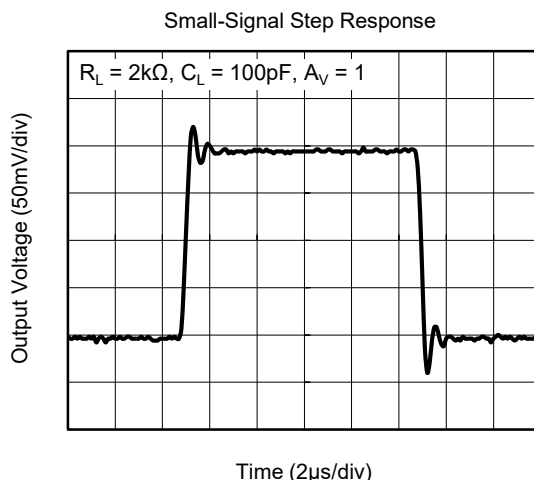
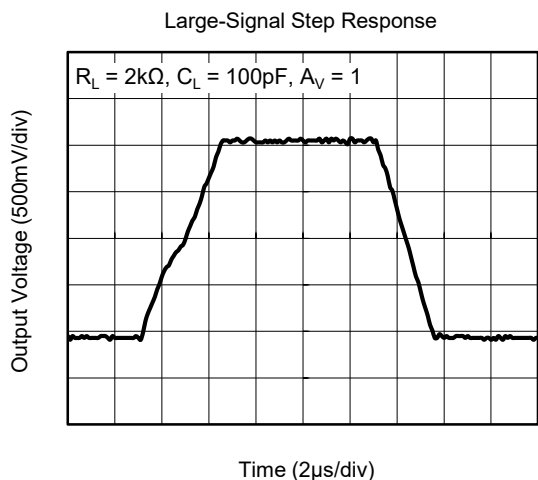
**ELECTRICAL CHARACTERISTICS:  $V_S = 1.8V$**

( $V_{OUT} = V_S/2$ , Full =  $-40^{\circ}C$  to  $+85^{\circ}C$ , typical values are at  $T_A = +25^{\circ}C$ , unless otherwise noted.)

PARAMETER	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
<b>Input Characteristics</b>						
Input Offset Voltage ( $V_{OS}$ )	$V_{CM} = 0.5V$	+25°C		0.6	3.5	mV
		Full			4	
Input Offset Voltage Drift ( $\Delta V_{OS}/\Delta T$ )	$V_{CM} = 0.5V$	Full		1.5		$\mu V/^{\circ}C$
Input Bias Current ( $I_B$ )		+25°C		3		pA
Input Offset Current ( $I_{OS}$ )		+25°C		3		pA
Input Common Mode Voltage Range ( $V_{CM}$ )		Full	-0.1		0.5	V
Common Mode Rejection Ratio (CMRR)	$V_{CM} = -0.1V$ to $0.5V$	+25°C	64	78		dB
		Full	60			
Open-Loop Voltage Gain ( $A_{OL}$ )	$R_L = 2k\Omega$ , $V_{OUT} = 0.2V$ to $1.6V$	+25°C	72	82		dB
		Full	65			
	$R_L = 100k\Omega$ , $V_{OUT} = 0.035V$ to $1.765V$	+25°C		100		
<b>Output Characteristics</b>						
Output Voltage Swing from Rail	$R_L = 2k\Omega$	+25°C		55	70	mV
		Full			100	
Output Short-Circuit Current ( $I_{SC}$ )		+25°C	2.5	5		mA
		Full	2			
<b>Power-Down (SGM8537 only)</b>						
Logic Low Voltage ( $V_{IL}$ )		+25°C			0.4	V
Logic High Voltage ( $V_{IH}$ )		+25°C	1.3			V
<b>Power Supply</b>						
Quiescent Current/Amplifier	$I_{OUT} = 0mA$	+25°C		75	125	$\mu A$
		Full			160	
Supply Current when Disabled (SGM8537 only)		+25°C		10	1200	nA
<b>Dynamic Performance</b>						
Gain-Bandwidth Product (GBP)	$R_L = 2k\Omega$ , $C_L = 100pF$	+25°C		1.3		MHz
Slew Rate (SR)	$V_{OUT} = 0.5V_{P-P}$ , $A_V = 1$	+25°C		0.7		$V/\mu s$
Crosstalk	$f = 1kHz$	+25°C		110		dB
Settling Time to 0.1% ( $t_S$ )	$V_{OUT} = 0.5V_{P-P}$ , $f = 1kHz$ , $A_V = 1$ , $R_L = 2k\Omega$ , $C_L = 100pF$	+25°C		2.5		$\mu s$
Overload Recovery Time	$R_L = 2k\Omega$ , $A_V = -50$	+25°C		6		$\mu s$
<b>Noise Performance</b>						
Input Voltage Noise Density ( $e_n$ )	$f = 1kHz$	+25°C		35		$nV/\sqrt{Hz}$

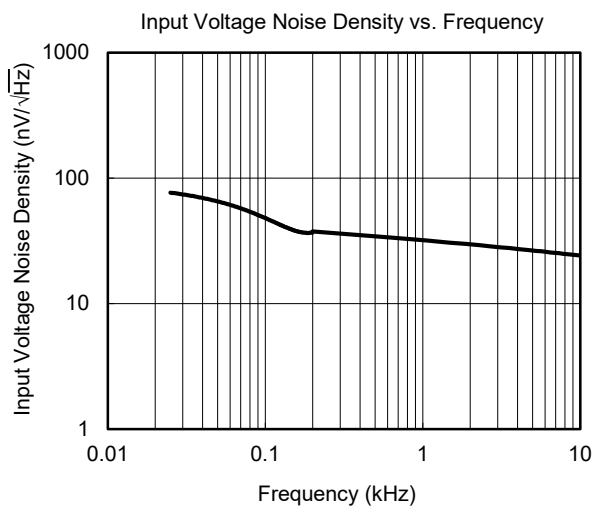
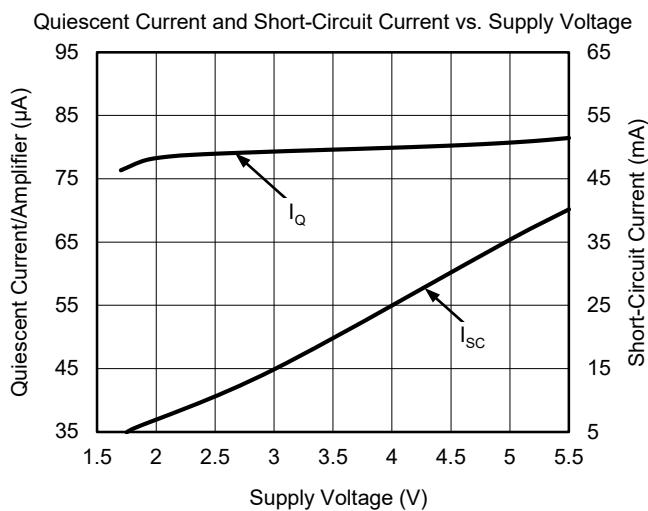
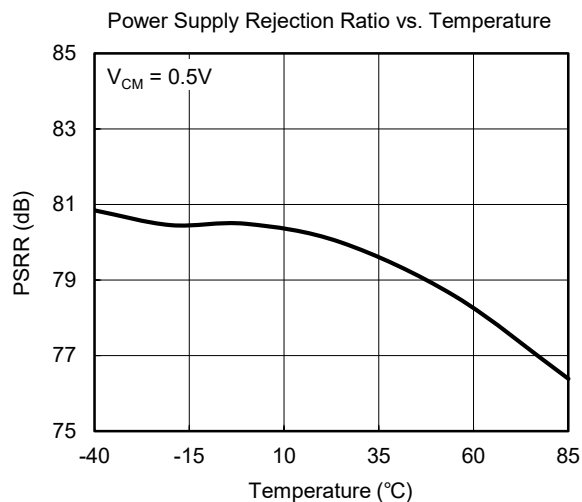
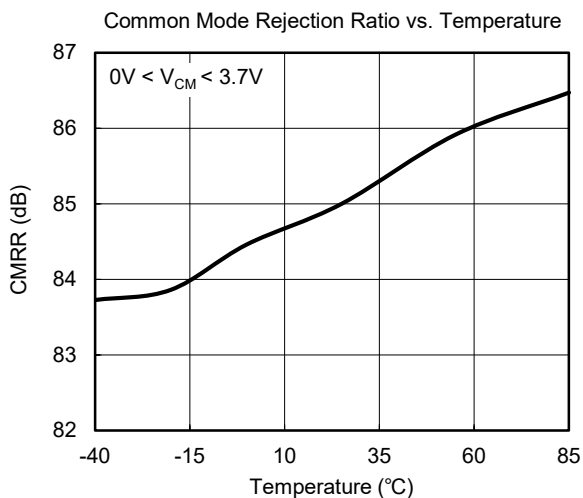
**TYPICAL PERFORMANCE CHARACTERISTICS**

At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ , unless otherwise noted.



**TYPICAL PERFORMANCE CHARACTERISTICS (continued)**

At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ , unless otherwise noted.





## REVISION HISTORY

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

<b>JANUARY 2013 – REV.A.1 to REV.A.2</b>	<b>Page</b>
Updated Electrical Characteristics section .....	4, 5

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<b>JANUARY 2013 – REV.A to REV.A.1</b>	<b>Page</b>
Added Tape and Reel Information section .....	15, 16

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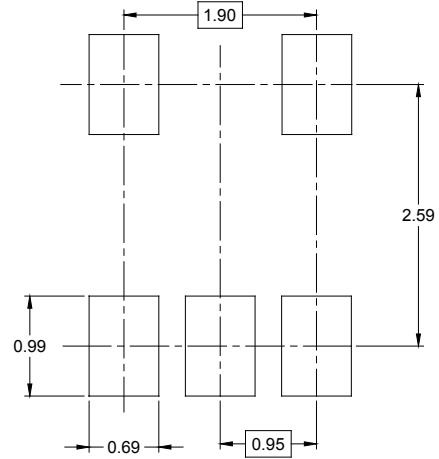
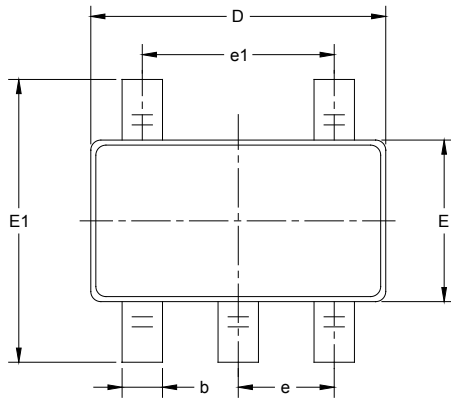
<b>Changes from Original (FEBRUARY 2012) to REV.A</b>	<b>Page</b>
Changed from product preview to production data .....	All

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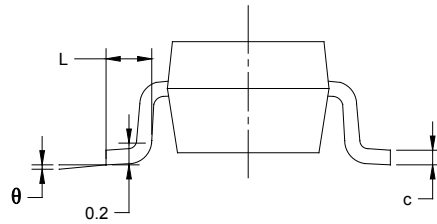
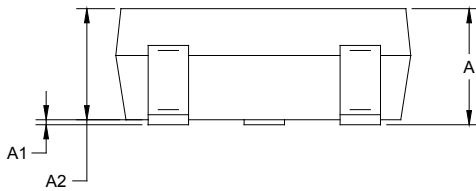
# PACKAGE INFORMATION

## PACKAGE OUTLINE DIMENSIONS

### SOT-23-5



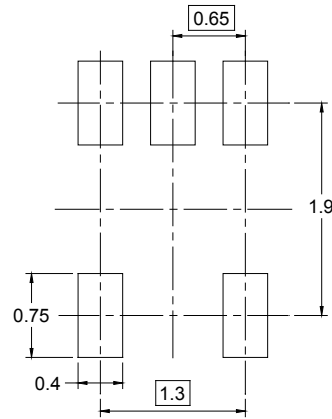
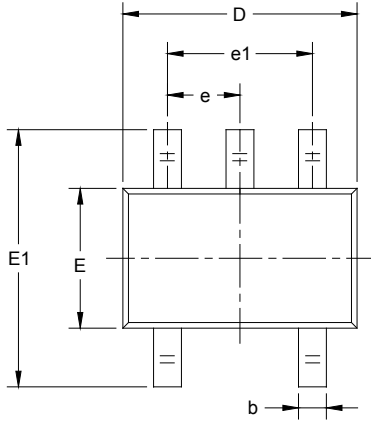
RECOMMENDED LAND PATTERN (Unit: mm)



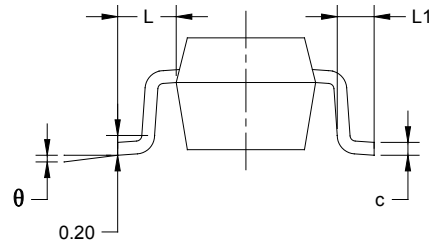
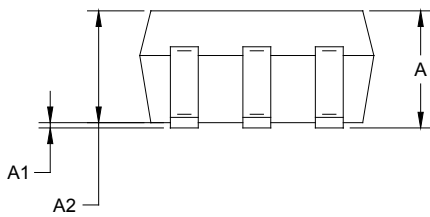
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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

PACKAGE OUTLINE DIMENSIONS

SC70-5



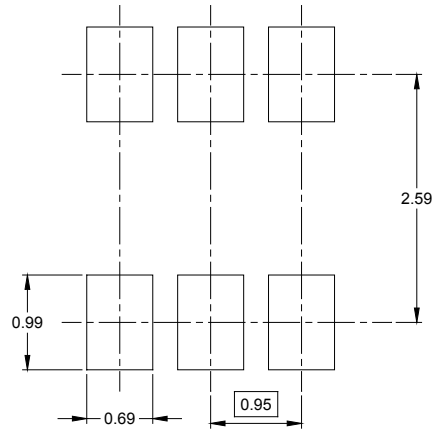
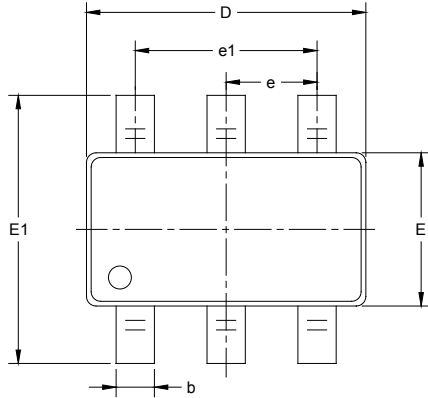
RECOMMENDED LAND PATTERN (Unit: mm)



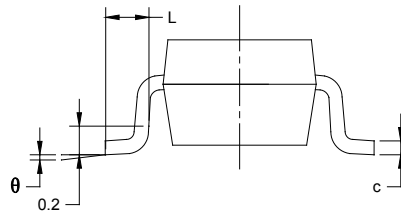
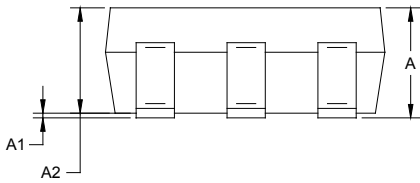
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
c	0.080	0.150	0.003	0.006
D	2.000	2.200	0.079	0.087
E	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.65 TYP		0.026 TYP	
e1	1.300 BSC		0.051 BSC	
L	0.525 REF		0.021 REF	
L1	0.260	0.460	0.010	0.018
$\theta$	0°	8°	0°	8°

PACKAGE OUTLINE DIMENSIONS

SOT-23-6



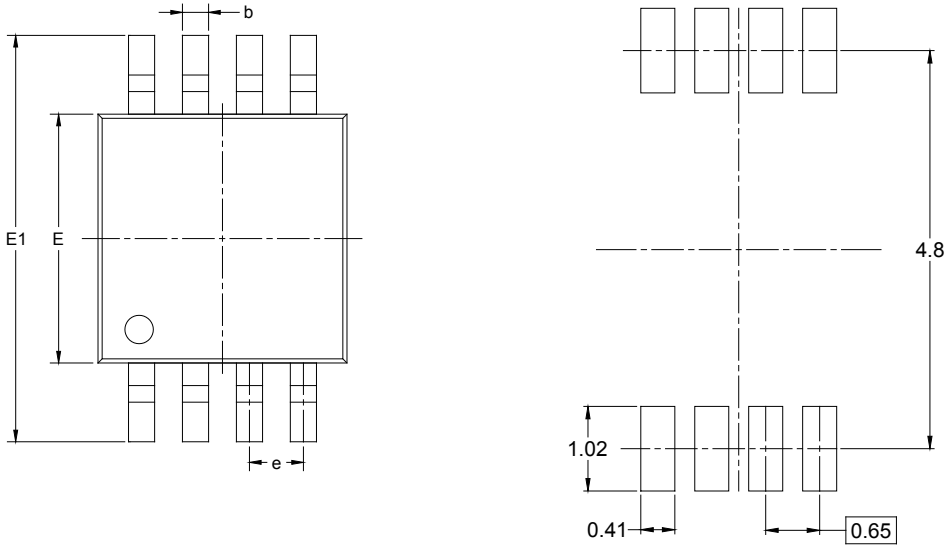
RECOMMENDED LAND PATTERN (Unit: mm)



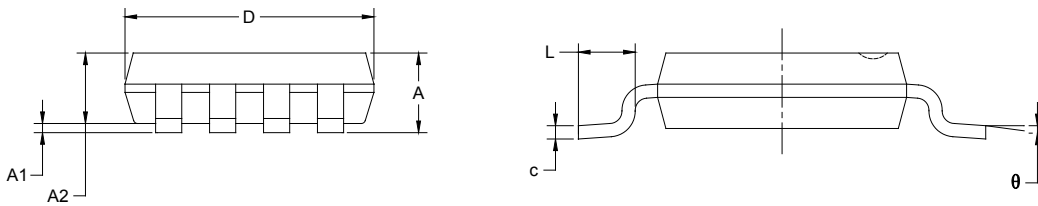
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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

PACKAGE OUTLINE DIMENSIONS

MSOP-8



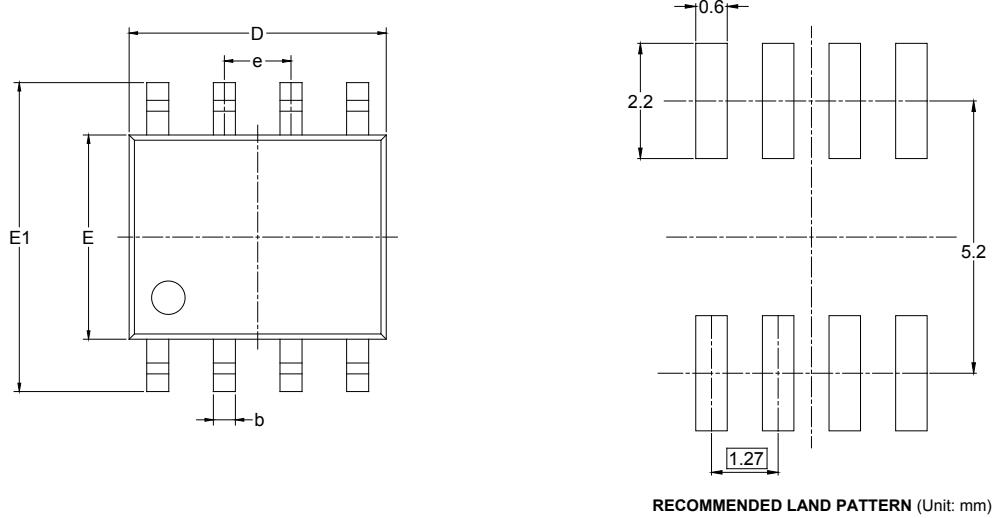
RECOMMENDED LAND PATTERN (Unit: mm)



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

SOIC-8

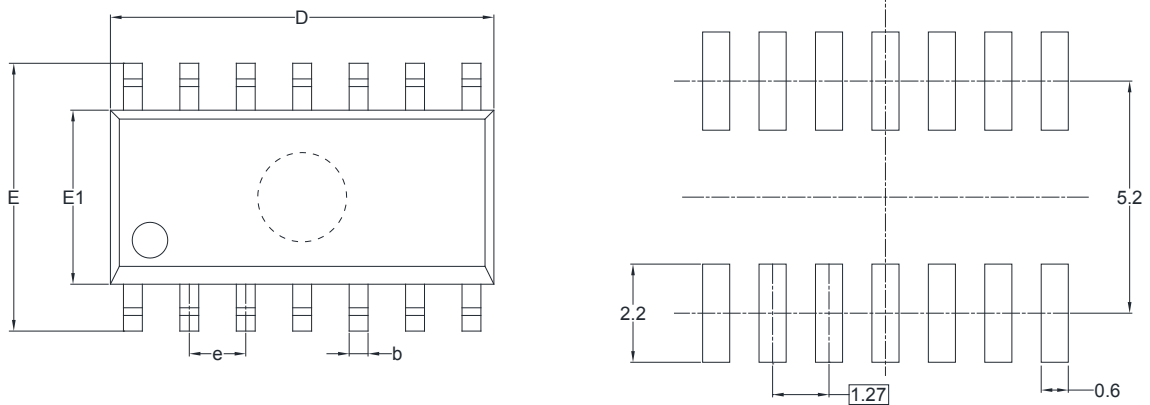


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

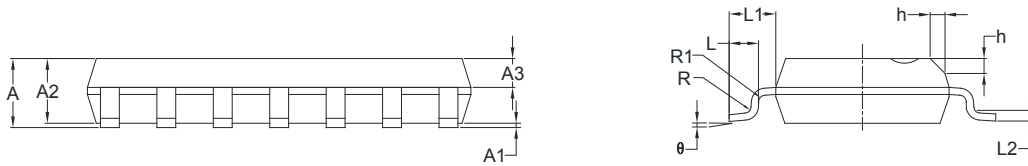
# PACKAGE INFORMATION

## PACKAGE OUTLINE DIMENSIONS

### SOIC-14



RECOMMENDED LAND PATTERN (Unit: mm)

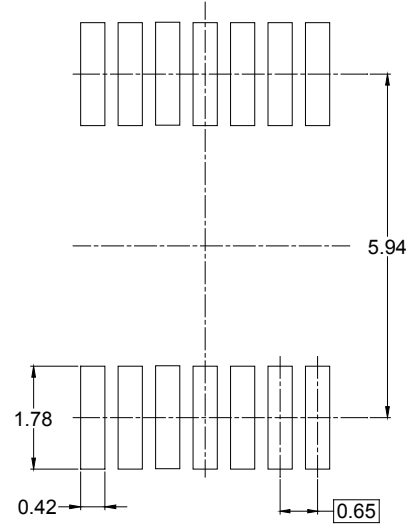
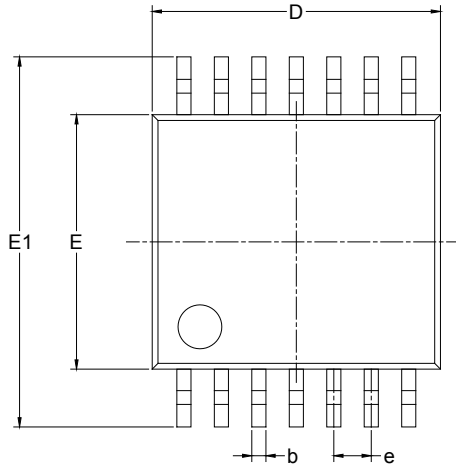


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
A2	1.25	1.65	0.049	0.065
A3	0.55	0.75	0.022	0.030
b	0.36	0.49	0.014	0.019
D	8.53	8.73	0.336	0.344
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
L	0.45	0.80	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°

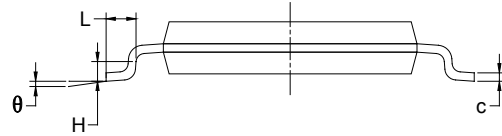
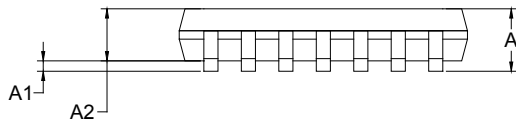
# PACKAGE INFORMATION

## PACKAGE OUTLINE DIMENSIONS

### TSSOP-14



RECOMMENDED LAND PATTERN (Unit: mm)



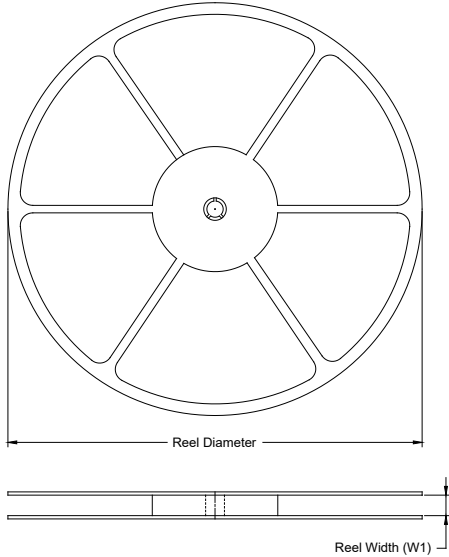
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650 BSC		0.026 BSC	
L	0.500	0.700	0.02	0.028
H	0.25 TYP		0.01 TYP	
θ	1°	7°	1°	7°



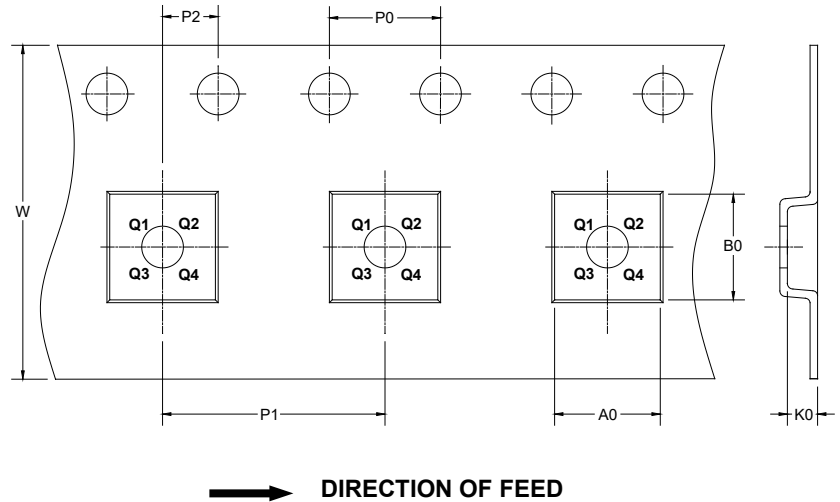
# PACKAGE INFORMATION

## TAPE AND REEL INFORMATION

### REEL DIMENSIONS



### TAPE DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

### KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOT-23-5	7"	9.5	3.20	3.20	1.40	4.0	4.0	2.0	8.0	Q3
SC70-5	7"	9.5	2.25	2.55	1.20	4.0	4.0	2.0	8.0	Q3
SOT-23-6	7"	9.5	3.17	3.23	1.37	4.0	4.0	2.0	8.0	Q3
MSOP-8	13"	12.4	5.20	3.30	1.50	4.0	8.0	2.0	12.0	Q1
SOIC-8	13"	12.4	6.40	5.40	2.10	4.0	8.0	2.0	12.0	Q1
SOIC-14	13"	16.4	6.60	9.30	2.10	4.0	8.0	2.0	16.0	Q1
TSSOP-14	13"	12.4	6.95	5.60	1.20	4.0	8.0	2.0	12.0	Q1

D00001

# PACKAGE INFORMATION

## CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

## KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
7" (Option)	368	227	224	8
7"	442	410	224	18
13"	386	280	370	5

DD0002

单击下面可查看定价，库存，交付和生命周期等信息

[>>SGMICRO\(圣邦微电子\)](#)