

# SGM8193

## Tiny Packages, Nano-Power, Precision Current-Sense Amplifier

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### GENERAL DESCRIPTION

The SGM8193 series is a nano-power, high precision, high-side current-sense amplifier. The device consumes only 1.1 $\mu$ A (MAX) quiescent current. It features a maximum 100 $\mu$ V low offset voltage, which enables 25mV to 50mV full-scale drops when sensing full current. It has a gain error less than 0.5%. The device can sense the voltage across a current-sense resistor at common mode voltages from 1.6V to 28V. The SGM8193 series provides four fixed gains: 25V/V, 50V/V, 100V/V and 200V/V, which allows flexible selection of the external current-sense resistor.

The SGM8193 is available in Green SOT-23-5 and WLCSP-1 $\times$ 1-4B packages. The tiny packages make the device a good choice for portable and battery-powered applications where limited size of PCB is the limitation. It is rated over the -40 $^{\circ}$ C to +125 $^{\circ}$ C temperature range.

### FEATURES

- **Ultra-Low Quiescent Current at  $T_A = +25^{\circ}\text{C}$ : 0.8 $\mu$ A (TYP), 1.1 $\mu$ A (MAX)**
- **Input Common Mode Range: 1.6V to 28V**
- **Low Input Offset Voltage: 100 $\mu$ V (MAX)**
- **Choice of Gains:**
  - ◆ **SGM8193A0 Gain: 25V/V**
  - ◆ **SGM8193A1 Gain: 50V/V**
  - ◆ **SGM8193A2 Gain: 100V/V**
  - ◆ **SGM8193A3 Gain: 200V/V**
- **Low Gain Error: 0.5% (MAX)**
- **Voltage Output**
- **-40 $^{\circ}$ C to +125 $^{\circ}$ C Operating Temperature Range**
- **Available in Green SOT-23-5 and WLCSP-1 $\times$ 1-4B Packages**

### APPLICATIONS

Portable Equipment  
Battery-Powered Equipment  
Cell Phones  
Notebook PCs  
PDAs  
Power Management

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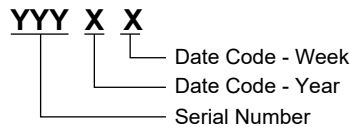
**PACKAGE/ORDERING INFORMATION**

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8193A0 (Gain = 25V/V)	SOT-23-5	-40°C to +125°C			
	WLCSP-1×1-4B	-40°C to +125°C			
SGM8193A1 (Gain = 50V/V)	SOT-23-5	-40°C to +125°C	SGM8193A1XN5G/TR	MF5XX	Tape and Reel, 3000
	WLCSP-1×1-4B	-40°C to +125°C	SGM8193A1XG/TR	5G XX	Tape and Reel, 3000
SGM8193A2 (Gain = 100V/V)	SOT-23-5	-40°C to +125°C			
	WLCSP-1×1-4B	-40°C to +125°C			
SGM8193A3 (Gain = 200V/V)	SOT-23-5	-40°C to +125°C			
	WLCSP-1×1-4B	-40°C to +125°C			

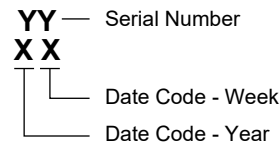
**MARKING INFORMATION**

NOTE: XX = Date Code.

**SOT-23-5**



**WLCSP-1×1-4B**



Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

**ABSOLUTE MAXIMUM RATINGS**

- RS+, RS- to GND..... -0.3V to +30V
- OUT to GND ..... -0.3V to +6V
- RS+ to RS- ..... ±30V
- Short-Circuit Duration, OUT to GND..... Continuous
- Continuous Input Current (any pin)..... ±20mA
- Junction Temperature..... +150°C
- Storage Temperature Range ..... -65°C to +150°C
- Lead Temperature (Soldering, 10s)..... +260°C
- ESD Susceptibility
- HBM..... TBD
- CDM ..... TBD

**RECOMMENDED OPERATING CONDITIONS**

Operating Temperature Range ..... -40°C to +125°C

**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.

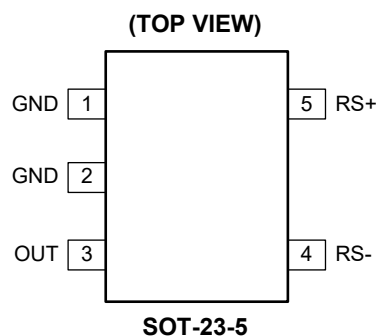
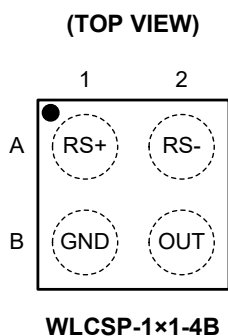
**ESD SENSITIVITY CAUTION**

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**



**PIN DESCRIPTION**

PIN		NAME	FUNCTION
WLCSP-1x1-4B	SOT-23-5		
A1	5	RS+	Connect to the supply-side of the external current-sense resistor.
A2	4	RS-	Connect to the load-side of the external current-sense resistor.
B1	1, 2	GND	Ground.
B2	3	OUT	Output Voltage. $V_{OUT}$ and $V_{SENSE} = V_{RS+} - V_{RS-}$ are in direct proportion.

**ELECTRICAL CHARACTERISTICS**(V<sub>RS+</sub> = V<sub>RS-</sub> = 3.6V, V<sub>SENSE</sub> = (V<sub>RS+</sub> - V<sub>RS-</sub>) = 0V, Full = -40°C to +125°C, typical values are at T<sub>A</sub> = +25°C, unless otherwise noted.)

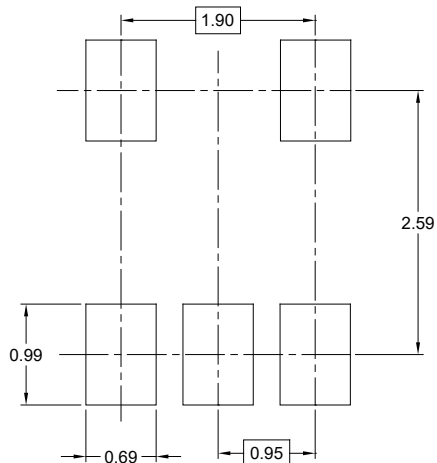
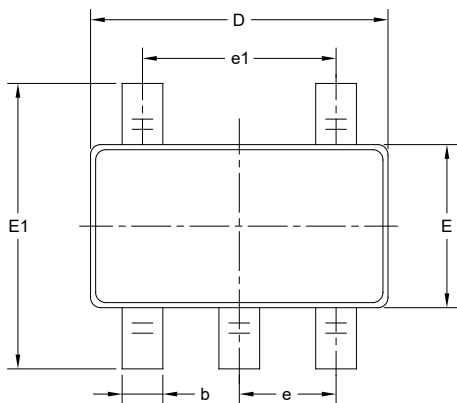
PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN <sup>(1)</sup>	TYP	MAX <sup>(1)</sup>	UNITS
<b>Input Characteristics</b>							
Input Offset Voltage <sup>(2)</sup>	V <sub>OS</sub>		+25°C		3		μV
Input Common Mode Voltage Range	V <sub>CM</sub>	Guaranteed by CMRR	+25°C	1.6		28	V
Common Mode Rejection Ratio	CMRR	1.6V < V <sub>RS+</sub> < 28V	+25°C		130		dB
<b>Output Characteristics</b>							
Gain	G	SGM8193A0	+25°C		25		V/V
		SGM8193A1	+25°C		50		
		SGM8193A2	+25°C		100		
		SGM8193A3	+25°C		200		
Gain Error <sup>(3)</sup>	GE		+25°C		±0.1		%
Output Resistance <sup>(4)</sup>	R <sub>OUT</sub>	SGM8193A0/SGM8193A1/SGM8193A2	Full		10		kΩ
		SGM8193A3	Full		20		
Low Output Voltage	V <sub>OL</sub>	G = 25, SGM8193A0	+25°C		0.05		mV
		G = 50, SGM8193A1	+25°C		0.1		
		G = 100, SGM8193A2	+25°C		0.2		
		G = 200, SGM8193A3	+25°C		0.4		
High Output Voltage <sup>(5)</sup>	V <sub>OH</sub>	V <sub>OH</sub> = V <sub>RS-</sub> - V <sub>OUT</sub>	SGM8193A0/ SGM8193A1/ SGM8193A2	Full		0.1	V
			SGM8193A3	Full		0.06	
<b>Dynamic Performance</b>							
Small-Signal Bandwidth <sup>(4)</sup>	BW	V <sub>SENSE</sub> = 100mV, G = 25	+25°C		TBD		kHz
		V <sub>SENSE</sub> = 50mV, G = 50	+25°C		300		
		V <sub>SENSE</sub> = 25mV, G = 100	+25°C		225		
		V <sub>SENSE</sub> = 12.5mV, G = 200	+25°C		150		
Output Settling Time	t <sub>s</sub>	1% final value, V <sub>SENSE</sub> = 100mV, SGM8193A0	+25°C		TBD		μs
		1% final value, V <sub>SENSE</sub> = 50mV, SGM8193A1	+25°C		10		
		1% final value, V <sub>SENSE</sub> = 25mV, SGM8193A2	+25°C		20		
		1% final value, V <sub>SENSE</sub> = 12.5mV, SGM8193A3	+25°C				
<b>Power Supply</b>							
Supply Current <sup>(6)</sup>	I <sub>CC</sub>	1.6V < V <sub>RS+</sub> < 28V	+25°C		0.8		μA

## NOTES:

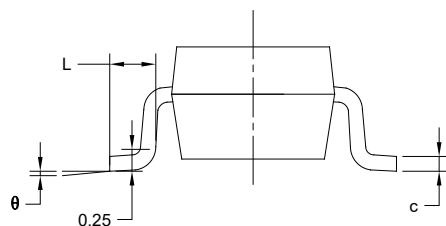
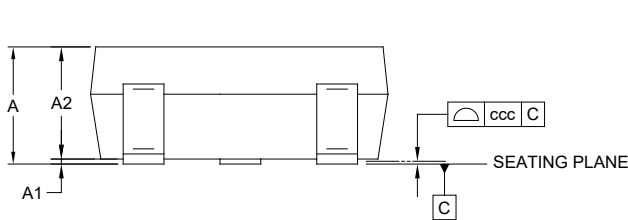
- Specified by design and characterization; not production tested.
- V<sub>OS</sub> is inferred from the measured value of gain error test.
- Gain error is the difference between the ideal gain and the gain obtained by calculating two V<sub>SENSE</sub> measured values.
  - G = 25, V<sub>SENSE</sub> = 20mV and 120mV.
  - G = 50, V<sub>SENSE</sub> = 10mV and 60mV.
  - G = 100, V<sub>SENSE</sub> = 5mV and 30mV.
  - G = 200, V<sub>SENSE</sub> = 2.5mV and 15mV.
- The device can keep stable with all external capacitance values.
- V<sub>OH</sub> is defined as the voltage difference between V<sub>RS-</sub> and V<sub>OUT</sub>, under the corresponding gain when V<sub>SENSE</sub> = V<sub>RS+</sub> - V<sub>RS-</sub> = 3.6V.
- I<sub>CC</sub> is defined as the total current of I<sub>RS+</sub> and I<sub>RS-</sub> when V<sub>OUT</sub> = 0.

PACKAGE OUTLINE DIMENSIONS

SOT-23-5



RECOMMENDED LAND PATTERN (Unit: mm)



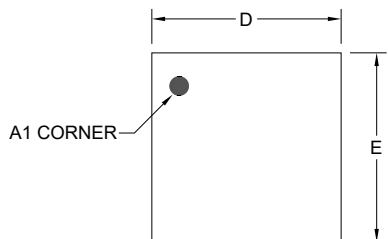
Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	-	-	1.450
A1	0.000	-	0.150
A2	0.900	-	1.300
b	0.300	-	0.500
c	0.080	-	0.220
D	2.750	-	3.050
E	1.450	-	1.750
E1	2.600	-	3.000
e	0.950 BSC		
e1	1.900 BSC		
L	0.300	-	0.600
θ	0°	-	8°
ccc	0.100		

NOTES:

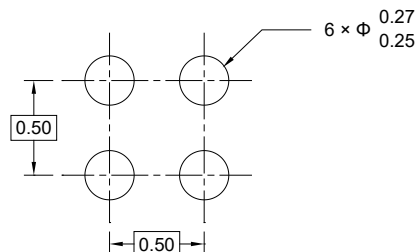
1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MO-178.

PACKAGE OUTLINE DIMENSIONS

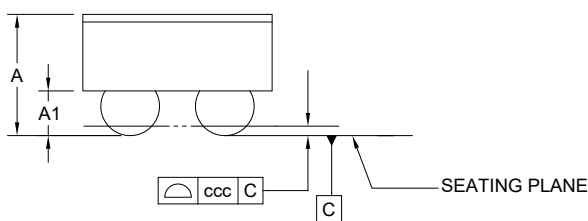
WLCSP-1x1-4B



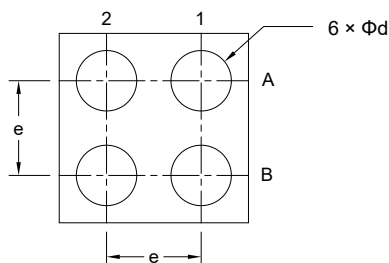
TOP VIEW



RECOMMENDED LAND PATTERN (Unit: mm)



SIDE VIEW



BOTTOM VIEW

Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	0.602	0.640	0.678
A1	0.216	0.236	0.256
D	0.970	1.000	1.030
E	0.970	1.000	1.030
d	0.299	0.319	0.339
e	0.500 BSC		
ccc	0.050		

NOTE: This drawing is subject to change without notice.