



# SGMOP07C

## 3MHz, Low Noise, High Voltage, Precision Operational Amplifier

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### GENERAL DESCRIPTION

The SGMOP07C is a low noise, low offset voltage and high voltage operational amplifier, which can be designed into a wide range of applications. The SGMOP07C has a high gain-bandwidth product of 3MHz, a slew rate of 4V/ $\mu$ s, and a quiescent current of 0.9mA at wide power supply range.

The SGMOP07C is designed to provide optimal performance in low noise systems. It provides rail-to-rail output swing into heavy loads.

The single SGMOP07C is available in Green SOIC-8 package. It is specified over the extended -40°C to +125°C temperature range.

### FEATURES

- Rail-to-Rail Output
- Low Bias Current:  $\pm 1\text{nA}$  (TYP)
- High Open-Loop Gain: 120dB at  $V_s = \pm 15\text{V}$
- High PSRR: 146dB
- High Gain-Bandwidth Product: 3MHz
- Settling Time to 0.1% with 1V Step: 0.5 $\mu$ s
- Overload Recovery Time: 10 $\mu$ s
- Low Noise: 8.5nV/ $\sqrt{\text{Hz}}$  at 1kHz
- Supply Voltage Range:  
3.6V to 36V or  $\pm 1.8\text{V}$  to  $\pm 18\text{V}$
- Input Common Mode Voltage Range:  
 $(-V_s) + 1.5\text{V}$  to  $(+V_s) - 2\text{V}$
- Low Quiescent Current: 0.9mA (TYP)
- -40°C to +125°C Operating Temperature Range
- Available in Green SOIC-8 Package

### APPLICATIONS

Sensors  
Audio  
Active Filters  
A/D Converters  
Communications  
Test Equipment  
Cellular and Cordless Phones  
Laptops and PDAs  
Photodiode Amplification

**PACKAGE/ORDERING INFORMATION**

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGMOP07C	SOIC-8	-40°C to +125°C	SGMOP07CXS8G/TR	SGM OP07CXS8 XXXXX	Tape and Reel, 2500

NOTE: XXXXX = Date Code and Vendor Code.

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**

Supply Voltage, +V<sub>S</sub> to -V<sub>S</sub> ..... 40V  
 Input Common Mode Voltage Range  
 ..... (-V<sub>S</sub>) - 0.3V to (+V<sub>S</sub>) + 0.3V  
 Storage Temperature Range ..... -65°C to +150°C  
 Junction Temperature ..... +150°C  
 Lead Temperature (Soldering 10sec) ..... +260°C  
 ESD Susceptibility  
 HBM ..... 2000V  
 MM ..... 200V  
 CDM ..... 1000V

**RECOMMENDED OPERATING CONDITIONS**

Supply Voltage Range ..... 3.6V to 36V  
 Operating Temperature Range ..... -40°C to +125°C

**OVERSTRESS CAUTION**

Stresses beyond those listed may cause permanent damage to the device. Functional operation of the device at these or any other conditions beyond those indicated in the operational section of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

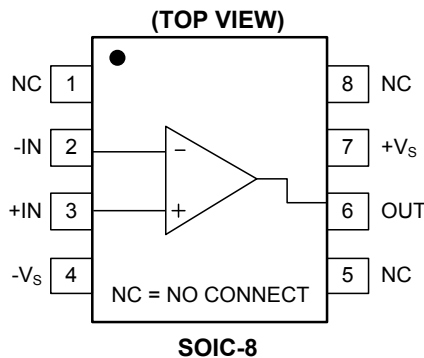
**ESD SENSITIVITY CAUTION**

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.

**DISCLAIMER**

SG Micro Corp reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time.

**PIN CONFIGURATION**



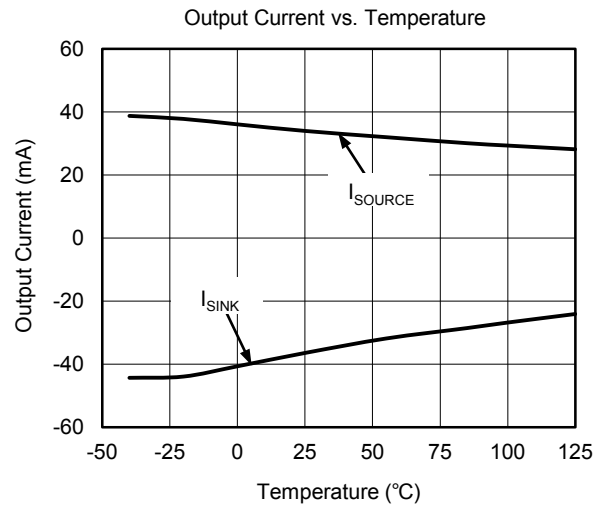
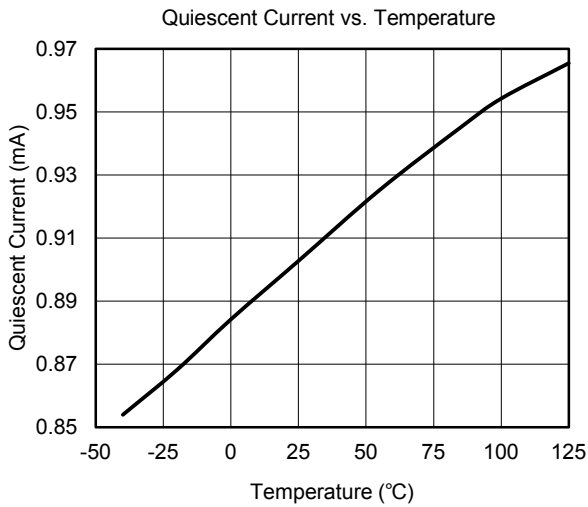
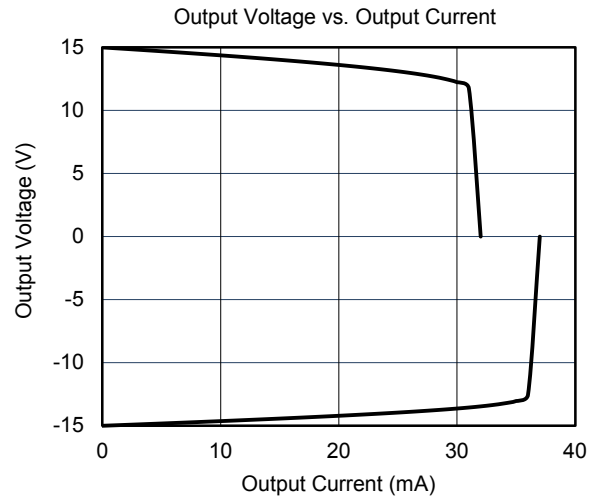
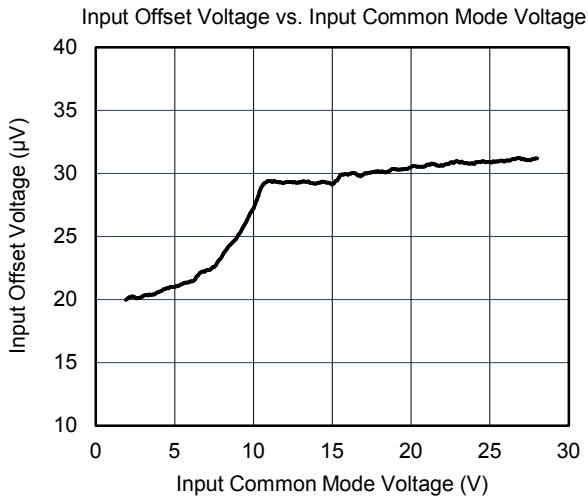
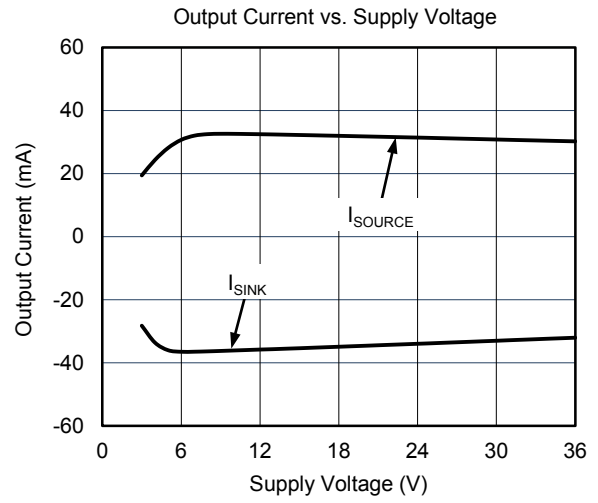
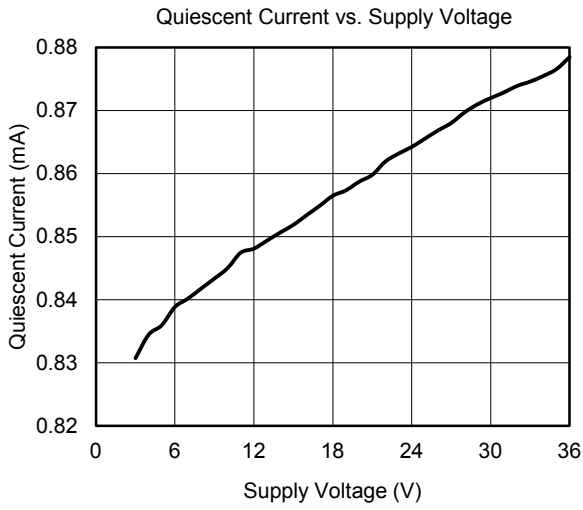
**ELECTRICAL CHARACTERISTICS**

(At T<sub>A</sub> = +25°C, V<sub>S</sub> = ±5V to V<sub>S</sub> = ±15V, V<sub>CM</sub> = 0V, V<sub>OUT</sub> = 0V and R<sub>L</sub> connected to 0V, Full = -40°C to +125°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
<b>INPUT CHARACTERISTICS</b>							
Input Offset Voltage	V <sub>OS</sub>		+25°C		50	150	μV
			Full			280	
Input Bias Current	I <sub>B</sub>	V <sub>CM</sub> = V <sub>S</sub> /2	+25°C		±1	±14	nA
			Full			±52	
Input Offset Current	I <sub>OS</sub>	V <sub>CM</sub> = V <sub>S</sub> /2	+25°C		±1	±15	nA
			Full			±28	
Input Common Mode Voltage Range	V <sub>CM</sub>		Full	(-V <sub>S</sub> ) + 1.5		(+V <sub>S</sub> ) - 2	V
Common Mode Rejection Ratio	CMRR	(-V <sub>S</sub> ) + 1.5V ≤ V <sub>CM</sub> ≤ (+V <sub>S</sub> ) - 2V	+25°C	120	140		dB
			Full	118			
Open-Loop Voltage Gain	A <sub>OL</sub>	V <sub>S</sub> = ±5V, V <sub>OUT</sub> = ±2.5V, R <sub>L</sub> = 10kΩ	+25°C	115	135		dB
			Full	113			
		V <sub>S</sub> = ±15V, V <sub>OUT</sub> = ±10V, R <sub>L</sub> = 10kΩ	+25°C	117	126		
			Full	109			
		V <sub>S</sub> = ±5V, V <sub>OUT</sub> = ±2.5V, R <sub>L</sub> = 2kΩ	+25°C	105	112		
			Full	94			
		V <sub>S</sub> = ±15V, V <sub>OUT</sub> = ±10V, R <sub>L</sub> = 2kΩ	+25°C	112	120		
			Full	102			
Input Offset Voltage Drift	ΔV <sub>OS</sub> /ΔT		Full		0.5		μV/°C
<b>OUTPUT CHARACTERISTICS</b>							
Output Voltage Swing from Rail	V <sub>OUT</sub>	V <sub>S</sub> = ±15V, R <sub>L</sub> = 10kΩ	+25°C		90	130	mV
			Full			168	
		V <sub>S</sub> = ±15V, R <sub>L</sub> = 2kΩ	+25°C		450	650	
			Full			850	
Output Short-Circuit Current	I <sub>SC</sub>		+25°C	±21	±32		mA
<b>POWER SUPPLY</b>							
Operating Voltage Range	V <sub>S</sub>		Full	3.6		36	V
Quiescent Current/Amplifier	I <sub>Q</sub>	I <sub>OUT</sub> = 0mA	+25°C		0.9	1.2	mA
			Full			1.3	
Power Supply Rejection Ratio	PSRR	V <sub>S</sub> = 3V to 38V	+25°C	125	146		dB
			Full	121			
<b>DYNAMIC PERFORMANCE</b>							
Gain-Bandwidth Product	GBP	V <sub>OUT</sub> = 100mV <sub>P-P</sub> , R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 10pF	+25°C		3		MHz
Slew Rate	SR	R <sub>L</sub> = 2kΩ	+25°C		4		V/μs
Settling Time to 0.1%	t <sub>S</sub>	V <sub>IN</sub> = 1V Step, R <sub>L</sub> = 2kΩ, G = +1	+25°C		0.5		μs
Overload Recovery Time		R <sub>L</sub> = 2kΩ, V <sub>IN</sub> × G = V <sub>S</sub>	+25°C		10		μs
Phase Margin	φ <sub>O</sub>	V <sub>OUT</sub> = 100mV <sub>P-P</sub> , R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 10pF	+25°C		55		°
Total Harmonic Distortion + Noise	THD+N	V <sub>IN</sub> = 1V <sub>RMS</sub> , G = +1, R <sub>L</sub> = 2kΩ, f = 1kHz	+25°C		0.0008		%
<b>NOISE</b>							
Input Voltage Noise		f = 0.1Hz to 10Hz	+25°C		300		nV <sub>P-P</sub>
Input Voltage Noise Density	e <sub>n</sub>	f = 1kHz	+25°C		8.5		nV/√Hz
Input Current Noise Density	i <sub>n</sub>	f = 1kHz	+25°C		1.5		pA/√Hz

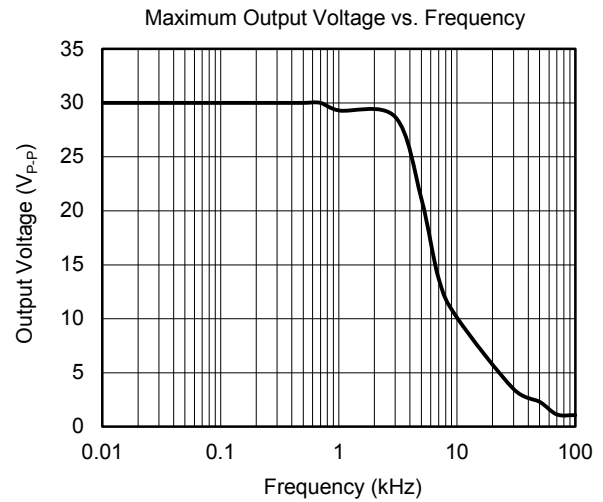
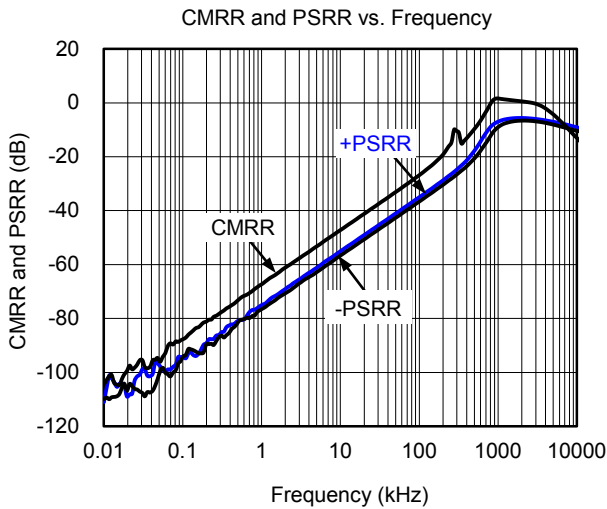
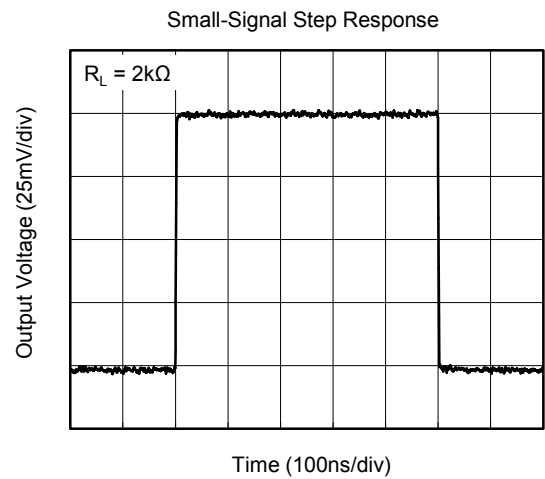
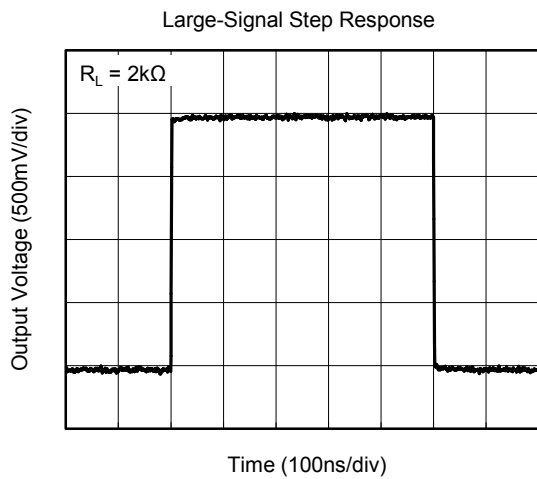
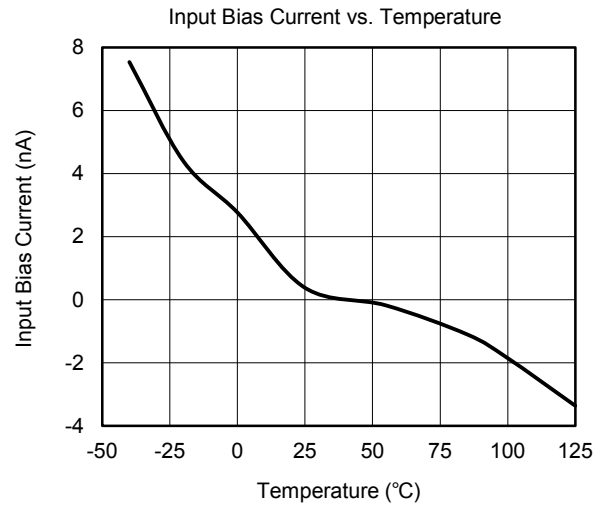
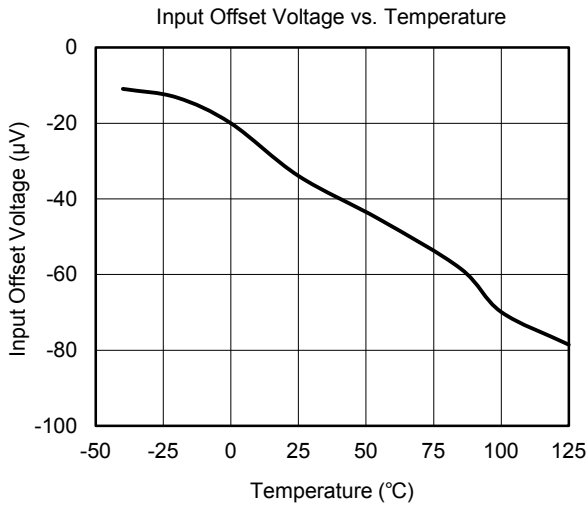
TYPICAL PERFORMANCE CHARACTERISTICS

At  $T_A = +25^\circ\text{C}$  and  $V_S = \pm 15\text{V}$ , unless otherwise noted.



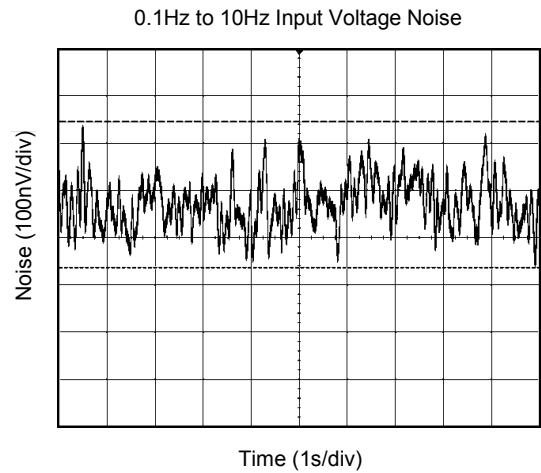
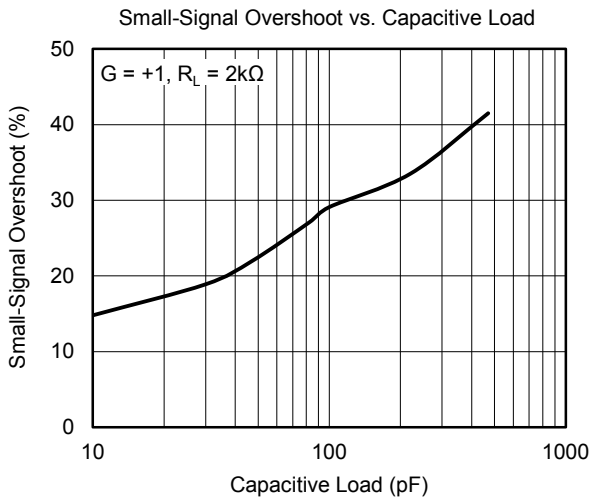
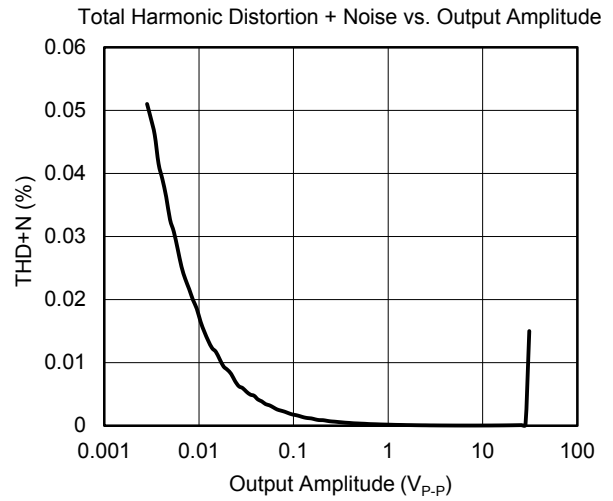
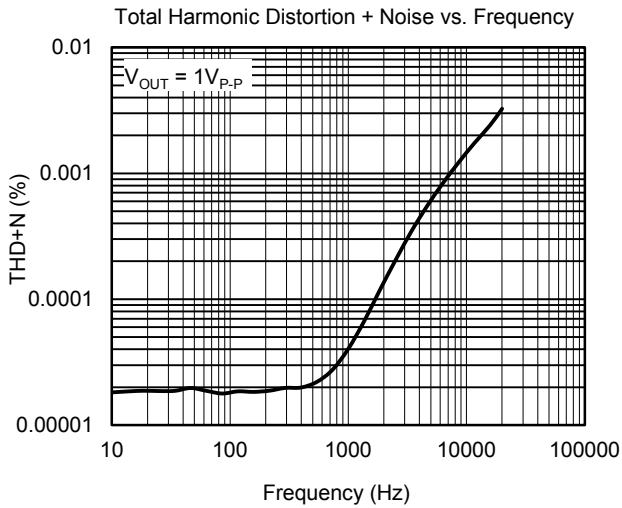
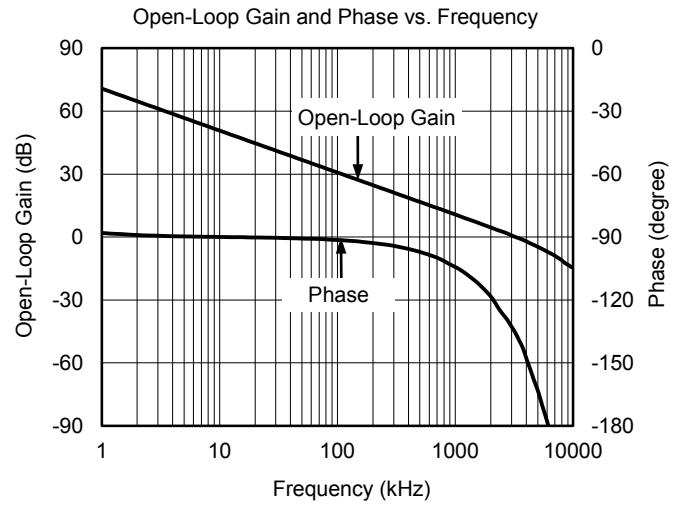
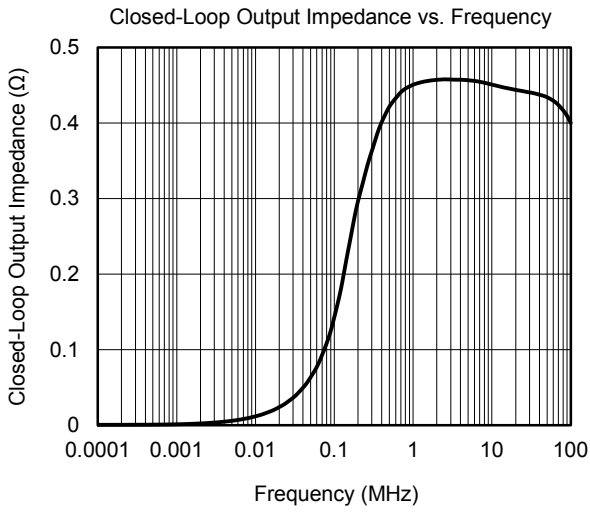
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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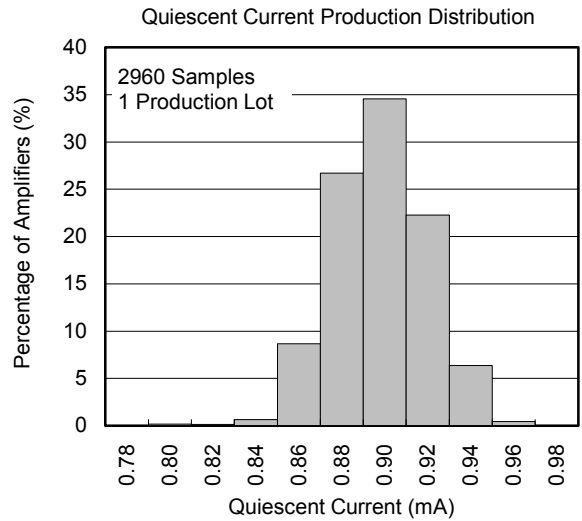
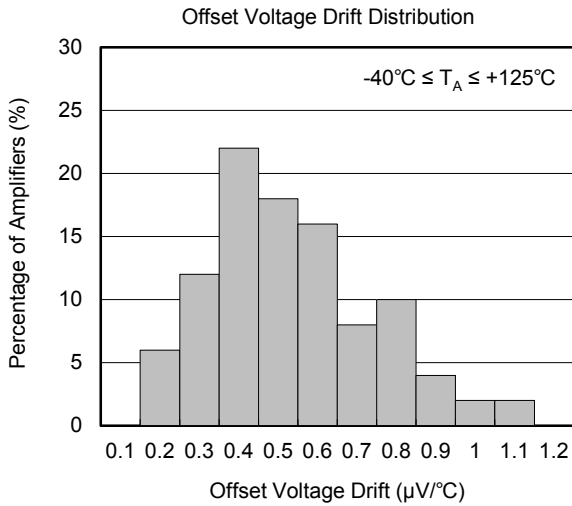
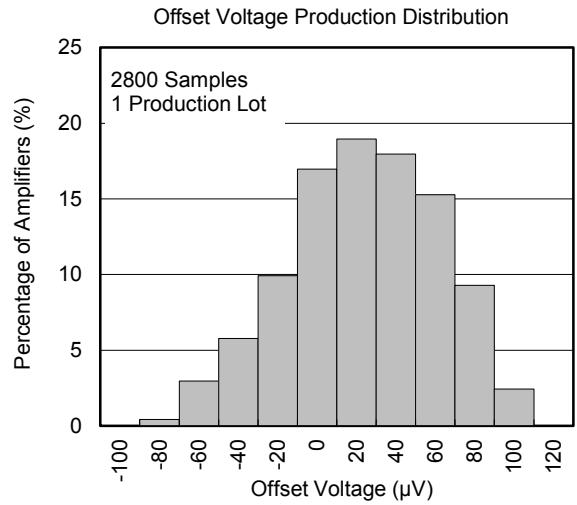
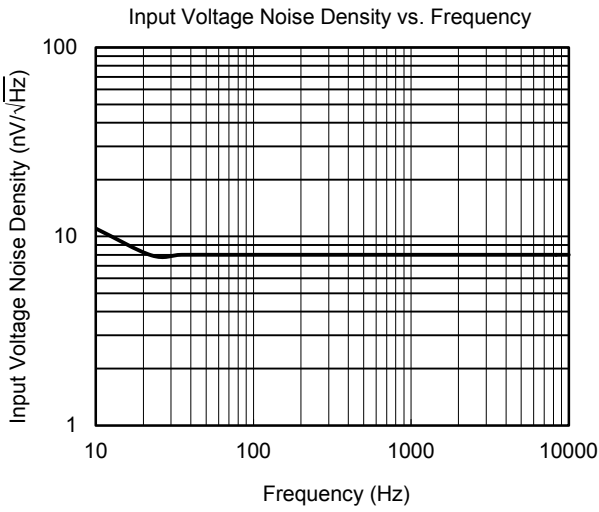
**TYPICAL PERFORMANCE CHARACTERISTICS (continued)**

At  $T_A = +25^\circ\text{C}$  and  $V_S = \pm 15\text{V}$ , unless otherwise noted.



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At  $T_A = +25^\circ\text{C}$  and  $V_S = \pm 15\text{V}$ , unless otherwise noted.



**APPLICATION NOTES**

**Power-Supply Bypassing and Layout**

The SGMOP07C operates from either a single 3.6V to 36V supply or dual ±1.8V to ±18V supplies. For single-supply operation, bypass the power supply +V<sub>S</sub> with a 0.1µF ceramic capacitor which should be placed close to the +V<sub>S</sub> pin. For dual-supply operation, both the +V<sub>S</sub> and the -V<sub>S</sub> supplies should be bypassed to ground with separate 0.1µF ceramic capacitors. A 10µF tantalum capacitor can be added for better performance.

Good PCB 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 operational amplifier, soldering the part to the board directly is strongly recommended. Try to keep the high frequency current loop area small to minimize the EMI (electromagnetic interference).

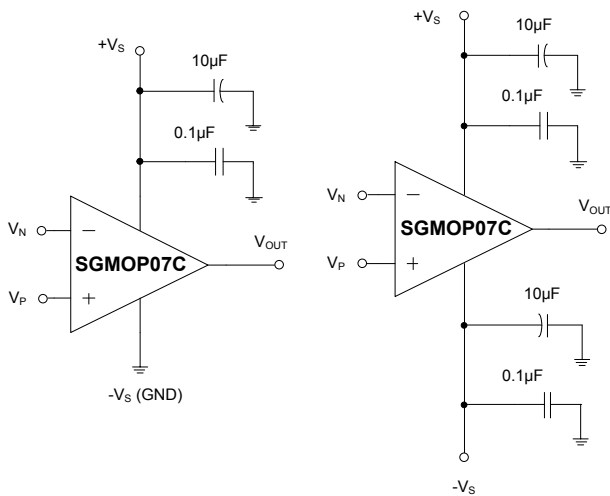


Figure 1. Amplifier with Bypass Capacitors

**Grounding**

A ground plane layer is important for SGMOP07C circuit design. The length of the current path 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 in parallel. This helps reduce unwanted positive feedback.

**Differential Amplifier**

The circuit shown in Figure 2 performs the difference function. If the resistor ratios are equal ( $R_4/R_3 = R_2/R_1$ ),

then  $V_{OUT} = (V_P - V_N) \times R_2/R_1 + V_{REF}$ .

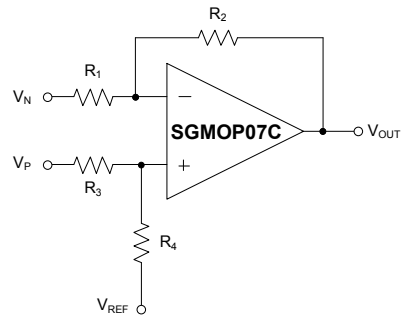


Figure 2. Differential Amplifier

**Instrumentation Amplifier**

The circuit in Figure 3 performs the same function as that in Figure 2 but with a high input impedance.

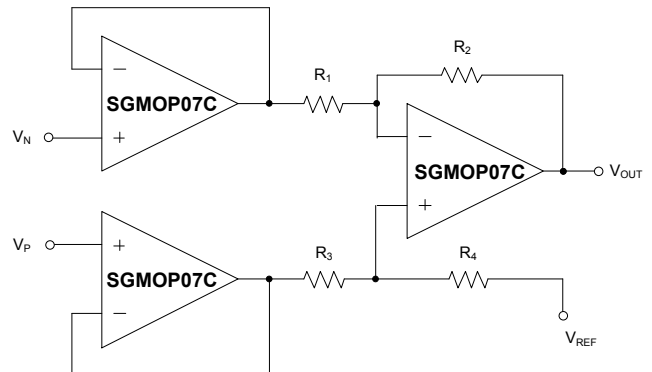


Figure 3. Instrumentation Amplifier

**Active Low-Pass 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. Feedback resistors with large values 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.

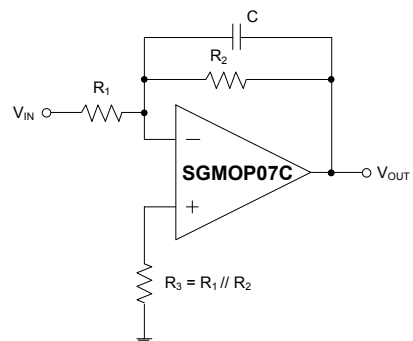


Figure 4. Active Low-Pass Filter



**REVISION HISTORY**

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

**AUGUST 2017 – REV.A to REV.A.1**

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Updated open-loop gain and phase vs. frequency ..... 6

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**Changes from Original (AUGUST 2017) to REV.A**

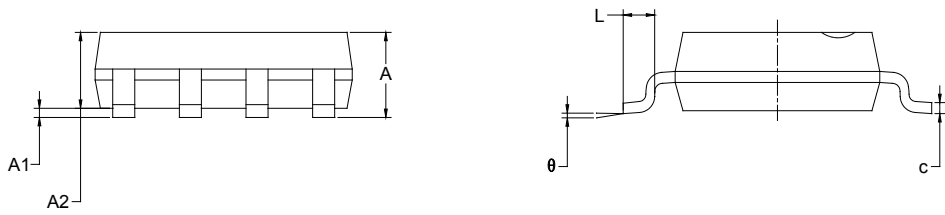
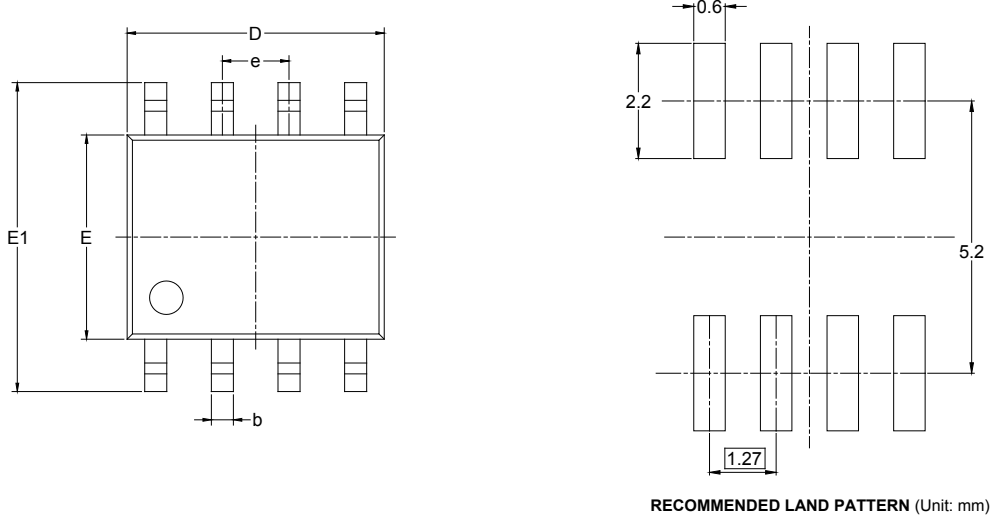
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Changed from product preview to production data ..... All

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PACKAGE OUTLINE DIMENSIONS

SOIC-8



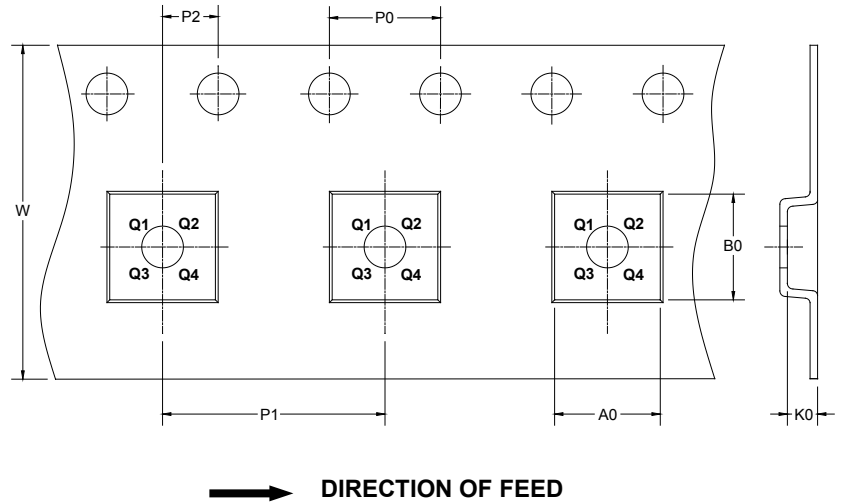
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

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
SOIC-8	13"	12.4	6.40	5.40	2.10	4.0	8.0	2.0	12.0	Q1

DD0001

# 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
13"	386	280	370	5

DD0002