SGMOP07E
600kHz, Low Noise, High Voltage, Precision Operational Amplifier

GENERAL DESCRIPTION

The SGMOP07E is a low noise, low offset voltage and high voltage operational amplifier, which can be designed into a wide range of applications. The SGMOP07E has a high gain-bandwidth product of 600kHz, a slew rate of 3V/μs and a quiescent current of 0.75mA at wide power supply range.

The SGMOP07E is designed to provide optimal performance in low noise systems. It provides rail-to-rail output swing into heavy loads.

The single SGMOP07E is available in a Green SOIC-8 package. It is specified over the extended -40℃ to +125℃ temperature range.

FEATURES

- **Rail-to-Rail Output**
- **Low Bias Current: ±1nA (TYP)**
- **High Open-Loop Gain: 130dB at V_S = ±15V**
- **High PSRR: 135dB**
- **Gain-Bandwidth Product: 600kHz**
- **Low Noise: 8.5nV/$\sqrt{Hz}$ at 1kHz**
- **Supply Voltage Range:**
  3.6V to 36V or ±1.8V to ±18V
- **Input Common Mode Voltage Range:**
  ($-V_S$) + 1.5V to ($+V_S$) - 2V
- **Low Quiescent Current: 0.75mA (TYP)**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in a Green SOIC-8 Package**

APPLICATIONS

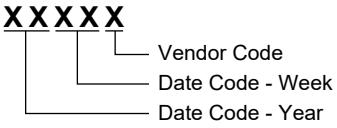
Sensors
Audio
Active Filters
A/D Converters
Communications
Test Equipment
Cellular and Cordless Phones
Laptops and PDAs
Photodiode Amplification

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGMOP07E	SOIC-8	-40℃ to +125℃	SGMOP07EXS8G/TR	SGM OP07EXS8 XXXXX	Tape and Reel, 4000

MARKING INFORMATION

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, $+V_S$ to $-V_S$ 40V
Input Common Mode Voltage Range
..... ($-V_S$) - 0.3V to ($+V_S$) + 0.3V
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 2000V
MM 250V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

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

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.

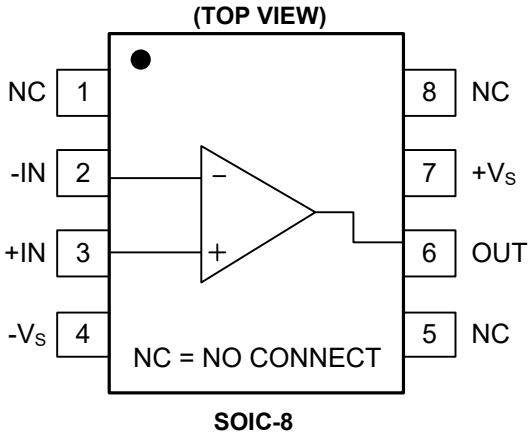
ESD SENSITIVITY CAUTION

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 CONFIGURATION



SOIC-8

ELECTRICAL CHARACTERISTICS

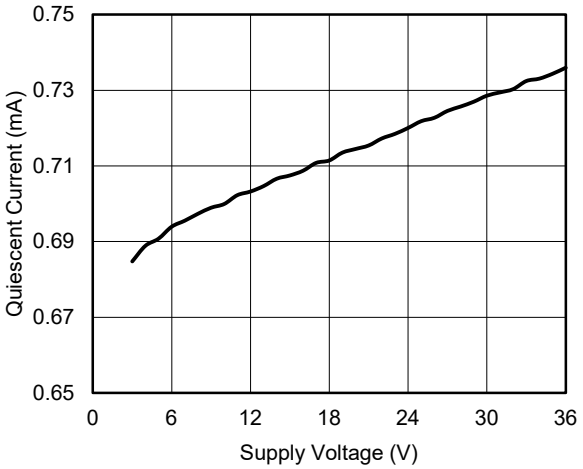
(At T_A = +25℃, V_S = ±5V to ±15V, V_{CM} = 0V, V_{OUT} = 0V and R_L = 2kΩ connected to 0V, Full = -40℃ to +125℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Input Characteristics							
Input Offset Voltage	V_{OS}		+25℃		35	150	μV
			Full			220	
Input Bias Current	I_B		+25℃		±1	±12	nA
			Full			±45	
Input Offset Current	I_{OS}		+25℃		±1	±12	nA
			Full			±35	
Input Common Mode Voltage Range	V_{CM}		Full	$(-V_S)$ + 1.5		$(+V_S)$ - 2	V
Common Mode Rejection Ratio	CMRR	$(-V_S)$ + 1.5V ≤ V_{CM} ≤ $(+V_S)$ - 2V	+25℃	120	140		dB
			Full	115			
Open-Loop Voltage Gain	A_{OL}	V_S = ±5V, V_{OUT} = ±2.5V, R_L = 10kΩ	+25℃	115	135		dB
			Full	112			
		V_S = ±15V, V_{OUT} = ±10V, R_L = 10kΩ	+25℃	120	135		
			Full	117			
		V_S = ±5V, V_{OUT} = ±2.5V, R_L = 2kΩ	+25℃	110	124		
			Full	106			
		V_S = ±15V, V_{OUT} = ±10V, R_L = 2kΩ	+25℃	120	130		
			Full	112			
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$		Full		0.3		μV/℃
Output Characteristics							
Output Voltage Swing from Rail	V_{OUT}	V_S = ±15V, R_L = 10kΩ	+25℃		90	120	mV
			Full			165	
		V_S = ±15V, R_L = 2kΩ	+25℃		450	600	
			Full			820	
Output Short-Circuit Current	I_{SC}	V_S = ±15V	+25℃	±21	±34		mA
Power Supply							
Operating Voltage Range	V_S		Full	3.6		36	V
Quiescent Current	I_Q	I_{OUT} = 0mA	+25℃		0.75	0.9	mA
			Full			1	
Power Supply Rejection Ratio	PSRR	V_S = 3V to 38V	+25℃	123	135		dB
			Full	120			
Dynamic Performance							
Gain-Bandwidth Product	GBP	V_{OUT} = 100mV_{P-P}, C_L = 10pF	+25℃		600		kHz
Slew Rate	SR		+25℃		3		V/μs
Settling Time to 0.1%	t_S	V_{IN} = 1V Step, G = +1	+25℃		3.5		μs
Overload Recovery Time		V_{IN} × G = V_S	+25℃		1.5		μs
Phase Margin	φ_O	V_{OUT} = 100mV_{P-P}, C_L = 10pF	+25℃		60		°
Total Harmonic Distortion + Noise	THD+N	V_{IN} = 1V_{RMS}, G = +1, f = 1kHz	+25℃		0.0008		%
Noise							
Input Voltage Noise		f = 0.1Hz to 10Hz	+25℃		300		nV_{P-P}
Input Voltage Noise Density	e_n	f = 1kHz	+25℃		8.5		$nV/\sqrt{Hz}$
Input Current Noise Density	i_n	f = 1kHz	+25℃		1.5		$pA/\sqrt{Hz}$

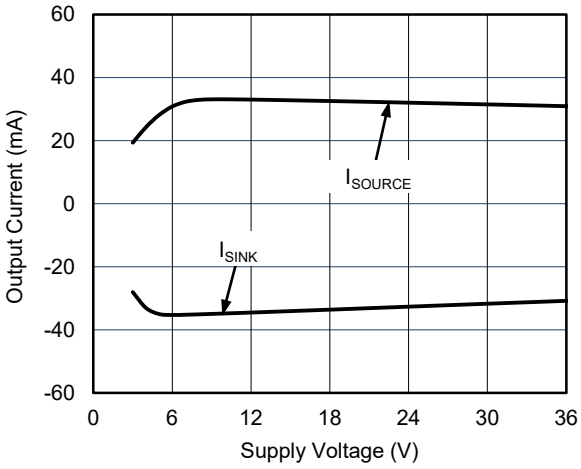
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, V_S = ±15V and R_L = 2kΩ, unless otherwise noted.

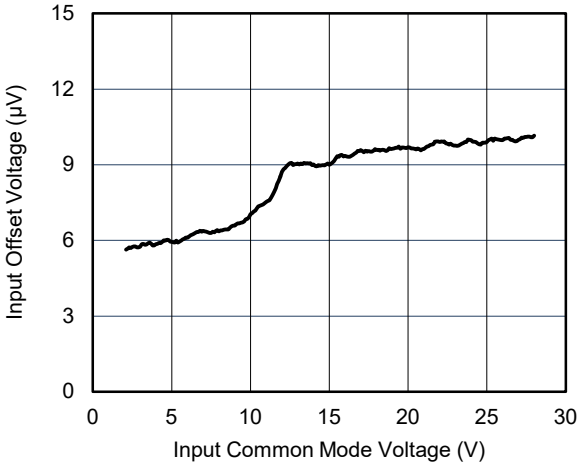
Quiescent Current vs. Supply Voltage



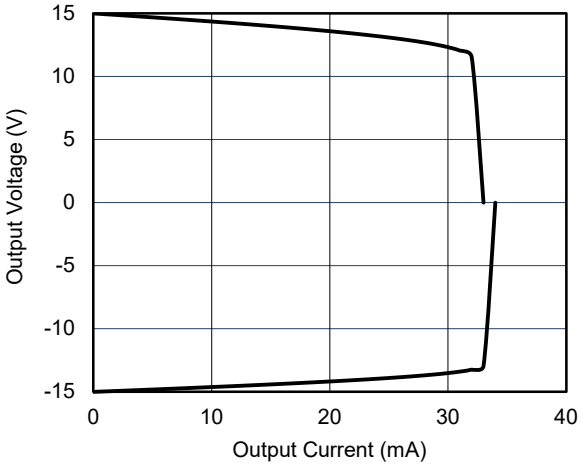
Output Current vs. Supply Voltage



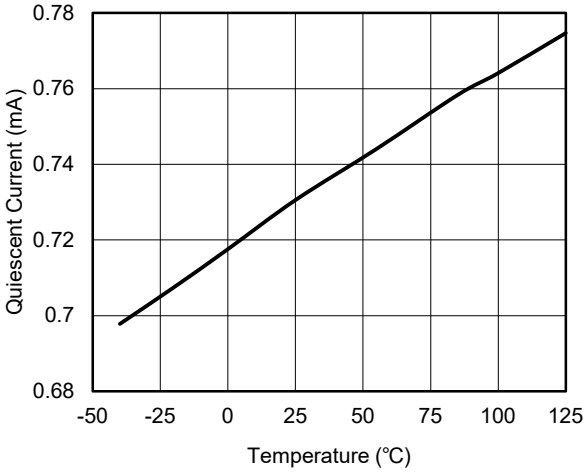
Input Offset Voltage vs. Input Common Mode Voltage



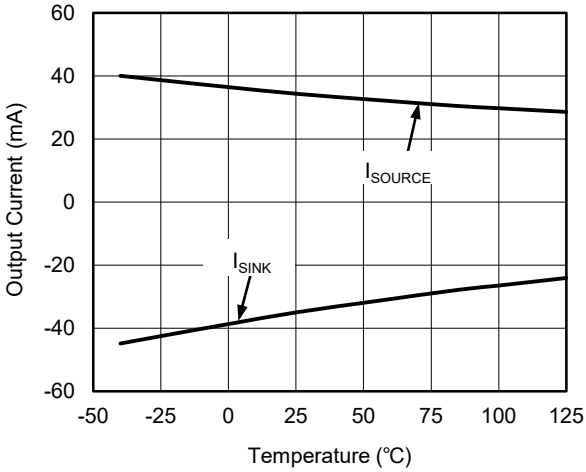
Output Voltage vs. Output Current



Quiescent Current vs. Temperature



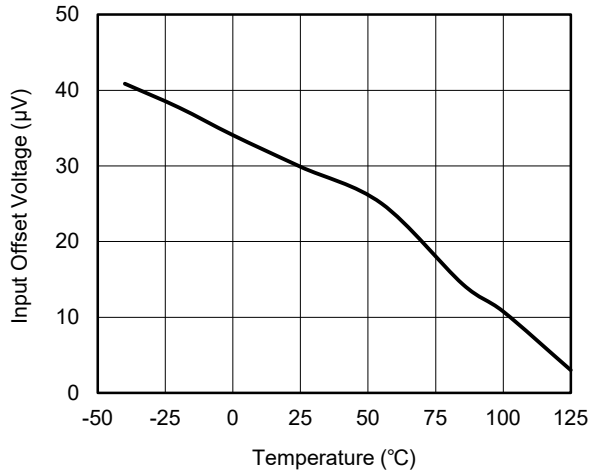
Output Current vs. Temperature



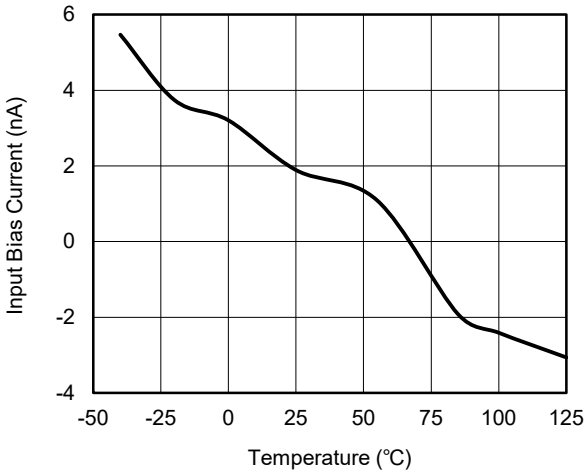
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_S = ±15V and R_L = 2kΩ, unless otherwise noted.

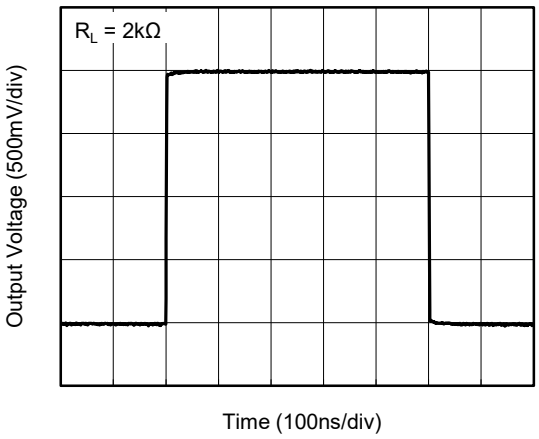
Input Offset Voltage vs. Temperature



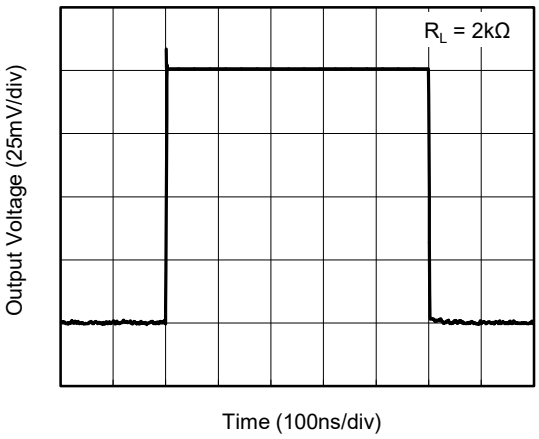
Input Bias Current vs. Temperature



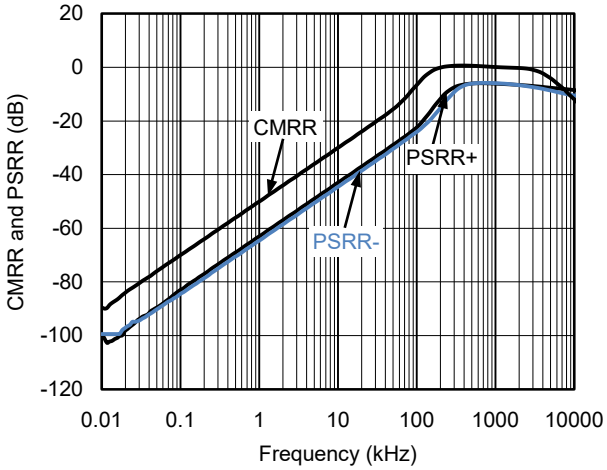
Large-Signal Step Response



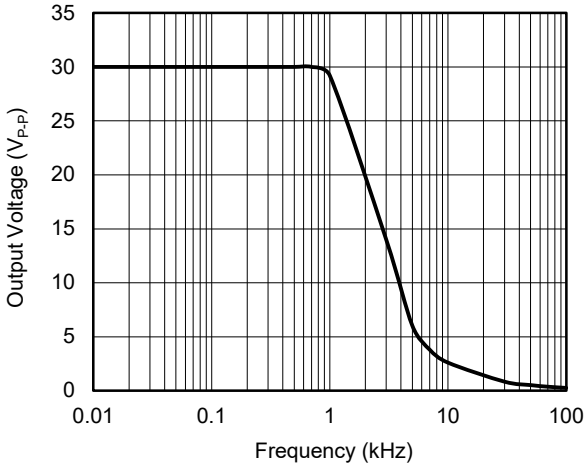
Small-Signal Step Response



CMRR and PSRR vs. Frequency



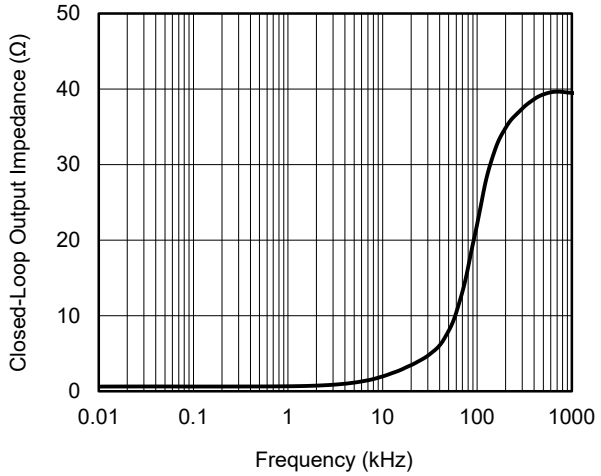
Maximum Output Voltage vs. Frequency



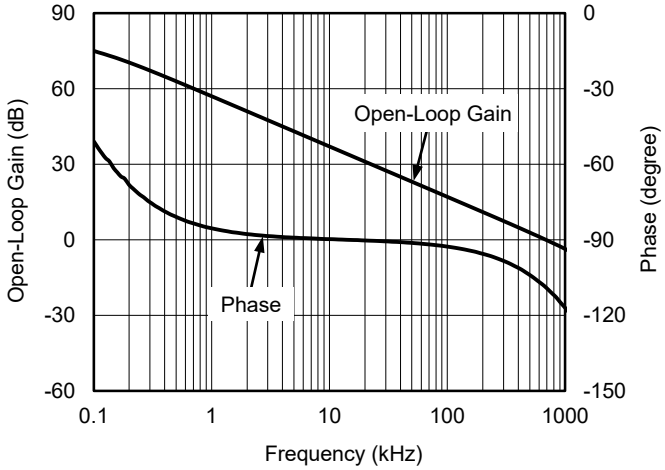
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_S = ±15V and R_L = 2kΩ, unless otherwise noted.

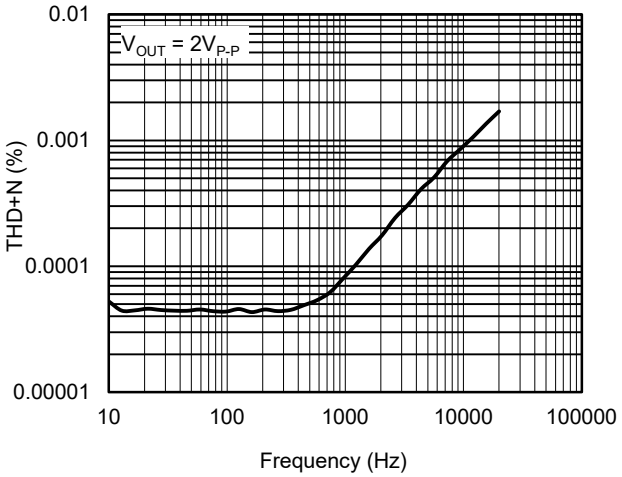
Closed-Loop Output Impedance vs. Frequency



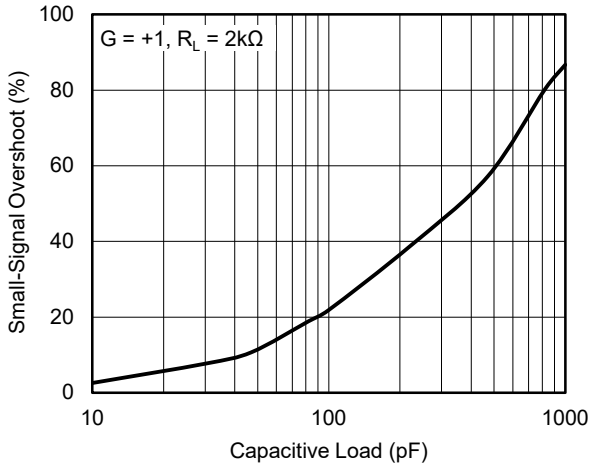
Open-Loop Gain and Phase vs. Frequency



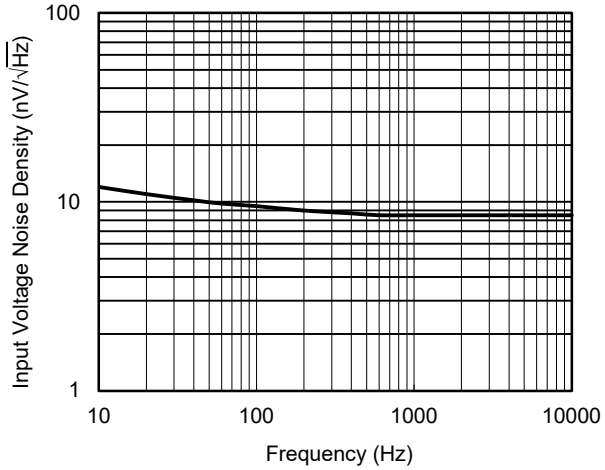
Total Harmonic Distortion + Noise vs. Frequency



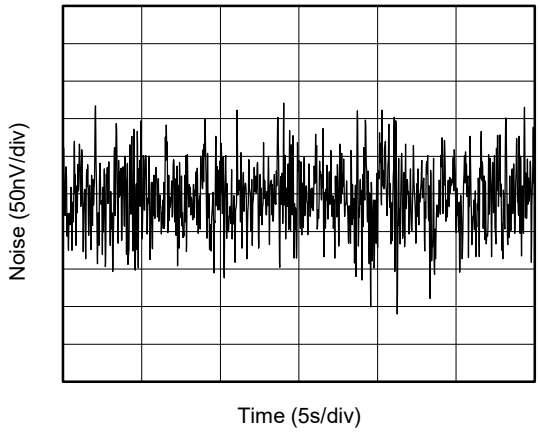
Small-Signal Overshoot vs. Capacitive Load



Input Voltage Noise Density vs. Frequency



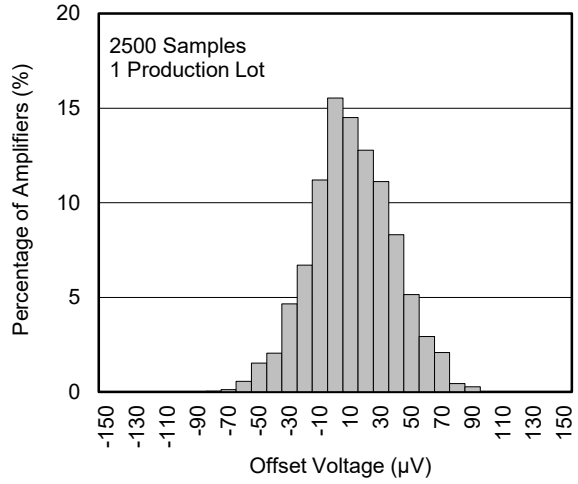
0.1Hz to 10Hz Input Voltage Noise



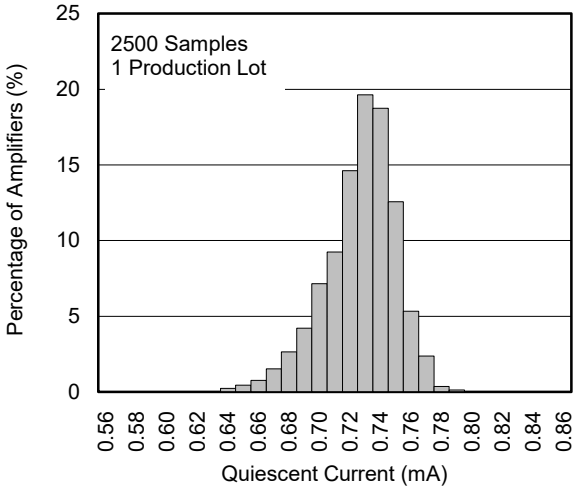
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_S = ±15V and R_L = 2kΩ, unless otherwise noted.

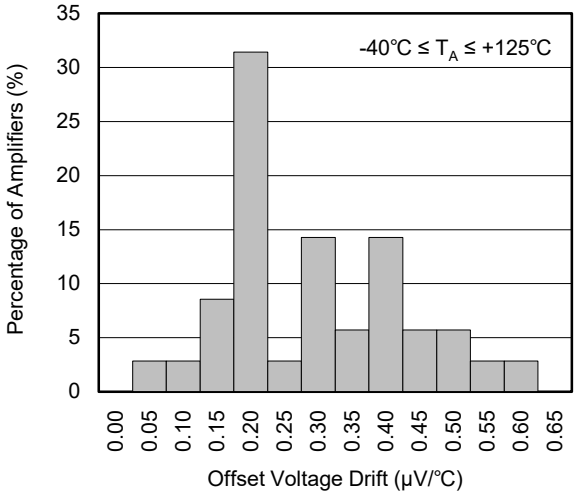
Offset Voltage Production Distribution



Quiescent Current Production Distribution



Offset Voltage Drift Distribution



APPLICATION NOTES

Power Supply Bypassing and Layout

The SGMOP07E 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 $+V_S$ with a 0.1μF ceramic capacitor which should be placed close to the $+V_S$ pin. For dual-supply operation, both the $+V_S$ and the $-V_S$ 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 operational amplifier'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).

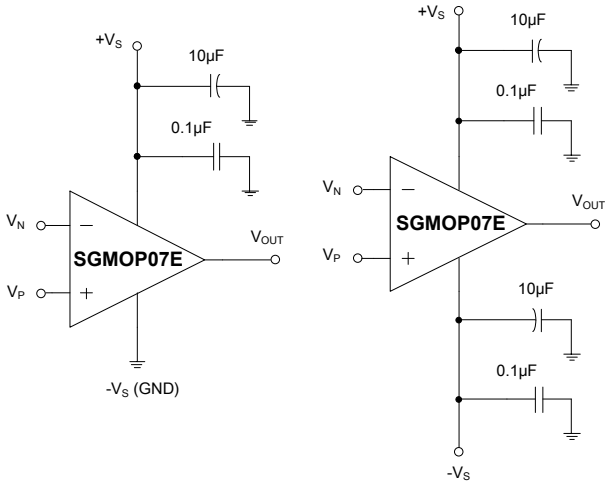


Figure 1. Amplifier with Bypass Capacitors

Grounding

A ground plane layer is important for SGMOP07E 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 $V_{OUT} = (V_P - V_N) \times R_2/R_1 + V_{REF}$.

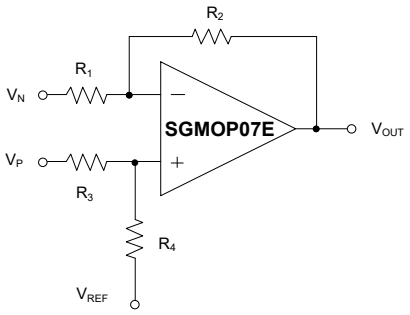


Figure 2. Differential Amplifier

Instrumentation Amplifier

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

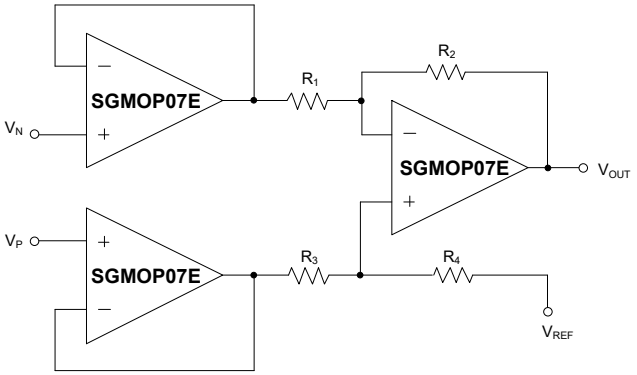


Figure 3. Instrumentation Amplifier

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 $1/2\pi R_2C$. 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.

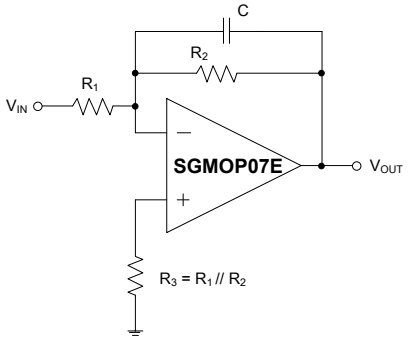


Figure 4. Active Low-Pass Filter

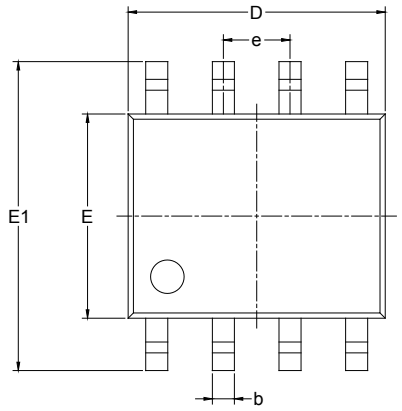
REVISION HISTORY

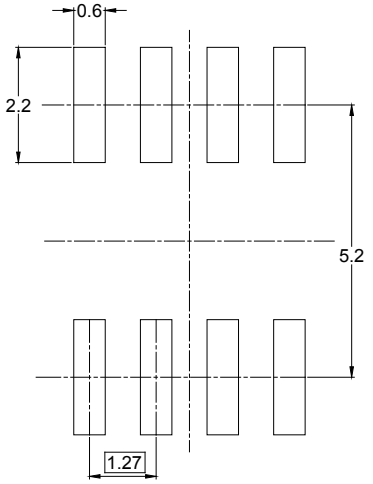
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (DECEMBER 2017) to REV.A	Page
Changed from product preview to production data	All

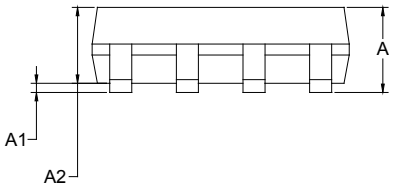
PACKAGE OUTLINE DIMENSIONS

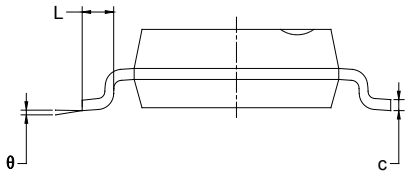
SOIC-8





RECOMMENDED LAND PATTERN (Unit: mm)

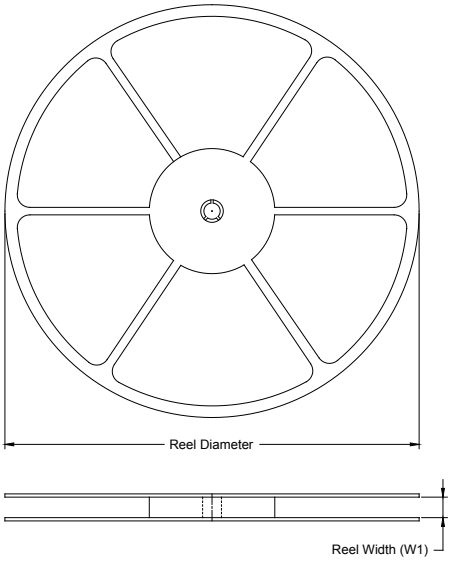




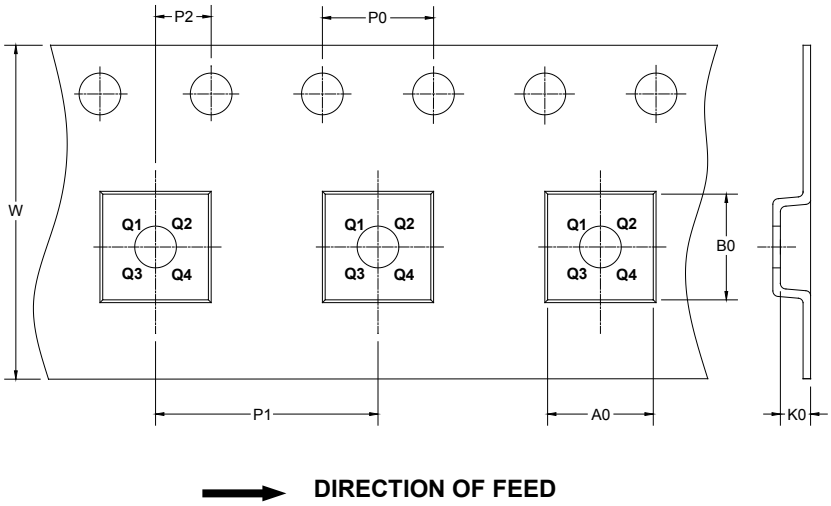
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



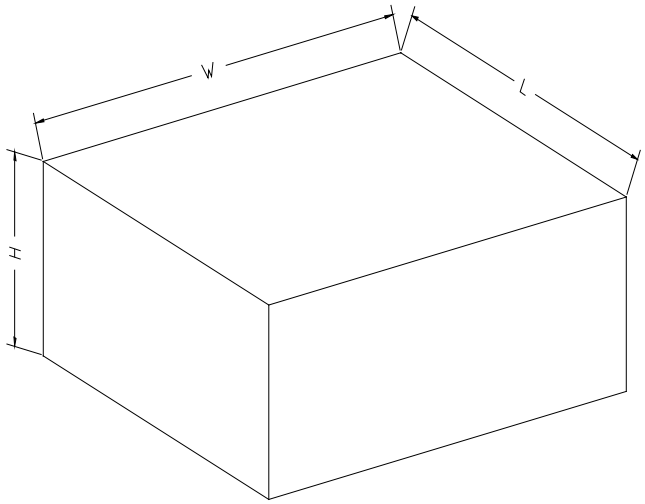
NOTE: The picture is only for reference. Please make the object as the standard.

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

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