SGM8632C
480µA, 6MHz, Rail-to-Rail I/O CMOS Operational Amplifier

GENERAL DESCRIPTION

The SGM8632C is a dual, low voltage, low noise and low power operational amplifier, which can operate from 2V to 5.5V single supply, while consuming only 480µA quiescent current per amplifier at 5V.

The SGM8632C features a 3.5mV maximum input offset voltage. The minimum input common mode voltage is within 0.1V below the negative rail, and the output swing is rail-to-rail with heavy loads. It exhibits a high gain-bandwidth product of 6MHz and a slew rate of 3.7V/µs. These specifications make the operational amplifier appropriate for various applications.

The SGM8632C is available in a Green MSOP-8 package. It is specified over the extended industrial temperature range (-40℃ to +125℃).

FEATURES

- **Input Offset Voltage: 3.5mV (MAX)**
- **High Gain-Bandwidth Product: 6MHz**
- **High Slew Rate: 3.7V/µs**
- **Settling Time to 0.1% with 2V Step: 0.5µs**
- **Overload Recovery Time: 0.9µs**
- **Low Noise: 13nV/$\sqrt{Hz}$ at 1kHz**
- **Rail-to-Rail Input and Output**
- **Supply Voltage Range: 2V to 5.5V**
- **Input Voltage Range: -0.1V to +5.6V with V_S = 5.5V**
- **Low Supply Current: 480µA/Amplifier (TYP)**
- **Available in a Green MSOP-8 Package**

APPLICATIONS

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

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8632C	MSOP-8	-40℃ to +125℃	SGM8632CXMS8G/TR	SGM8632 XMS XXXXX	Tape and Reel, 4000

MARKING INFORMATION

NOTE: XXXXX = Date Code and Vendor Code.

XXXXX
- Vendor Code
- Date Code - Week
- Date Code - Year

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 $-V_S$ 6V
Input Common Mode Voltage Range
.... $(-V_S) - 0.3V$ to $(+V_S) + 0.3V$
Package Thermal Resistance @ T_A = +25℃
MSOP-8, θ_{JA} .... 182℃/W
Junction Temperature .... +150℃
Storage Temperature Range .... -65℃ to +150℃
Lead Temperature (Soldering, 10s) .... +260℃
ESD Susceptibility
HBM 8000V
MM 400V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

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

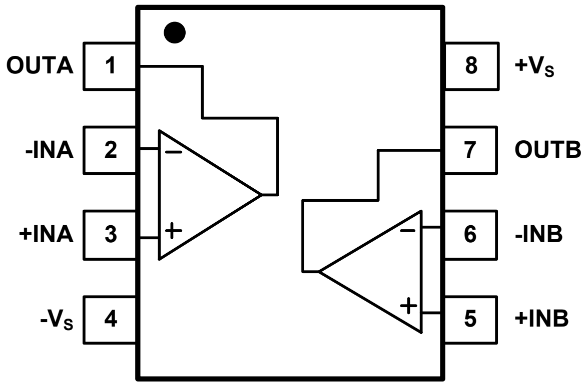
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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

(TOP VIEW)



MSOP-8

ELECTRICAL CHARACTERISTICS

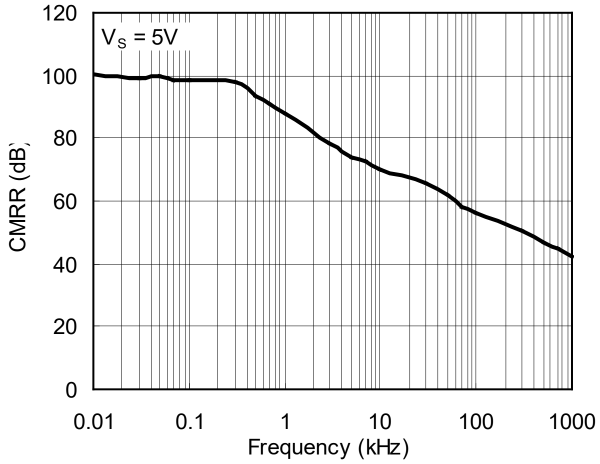
(At T_A = +25℃, V_S = 5V, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.)

PARAMETER	CONDITIONS	TYP	MIN/MAX OVER TEMPERATURE				
		+25℃	+25℃	-40℃ to +85℃	-40℃ to +125℃	UNITS	MIN/ MAX
Input Characteristics							
Input Offset Voltage (V_{OS})		0.9	3.5	3.7	3.8	mV	MAX
Input Bias Current (I_B)		1				pA	TYP
Input Offset Current (I_{OS})		1				pA	TYP
Input Common Mode Voltage Range (V_{CM})	V_S = 5.5V	-0.1 to 5.6				V	TYP
Common Mode Rejection Ratio (CMRR)	V_S = 5.5V, V_{CM} = -0.1V to 4V	84	68	67	66	dB	MIN
	V_S = 5.5V, V_{CM} = -0.1V to 5.6V	76				dB	MIN
Open-Loop Voltage Gain (A_{OL})	R_L = 600Ω ,V_{OUT} = 0.15V to 4.85V	86	79	73	69	dB	MIN
	R_L = 10kΩ ,V_{OUT} = 0.05V to 4.95V	103				dB	MIN
Input Offset Voltage Drift ($\Delta V_{OS}/\Delta T$)		2.4				μV/℃	TYP
Output Characteristics							
Output Voltage Swing from Rail	R_L = 600Ω	0.079				V	TYP
	R_L = 10kΩ	0.007				V	TYP
Output Current (I_{OUT})		58	40	30	26	mA	MIN
Closed-Loop Output Impedance	f = 200kHz, G = 1	5.4				Ω	TYP
Power Supply							
Operating Voltage Range		2	2	2	2	V	MIN
		5.5	5.5	5.5	5.5	V	MAX
Power Supply Rejection Ratio (PSRR)	V_S = 2V to 5.5V, V_{CM} = (-V_S) + 0.5V	84	69	68	67	dB	MIN
Quiescent Current/Amplifier (I_Q)	I_{OUT} = 0	480	620	720	790	μA	MAX
Dynamic Performance							
Gain-Bandwidth Product (GBP)		6				MHz	TYP
Phase Margin (φ_O)		63				°	TYP
Full Power Bandwidth (BW_P)	<1% distortion	250				kHz	TYP
Slew Rate (SR)	G = 1, 2V output step	3.7				V/μs	TYP
Settling Time to 0.1% (t_S)	G = 1, 2V output step	0.5				μs	TYP
Overload Recovery Time	V_{IN} × Gain = V_S	0.9				μs	TYP
Noise Performance							
Voltage Noise Density (e_n)	f = 1kHz	13				nV/$\sqrt{Hz}$	TYP

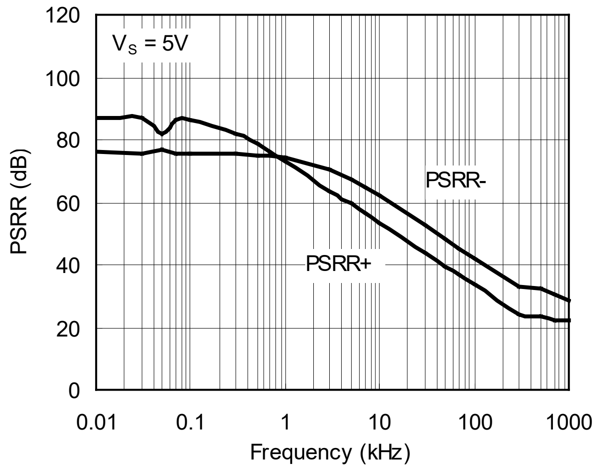
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.

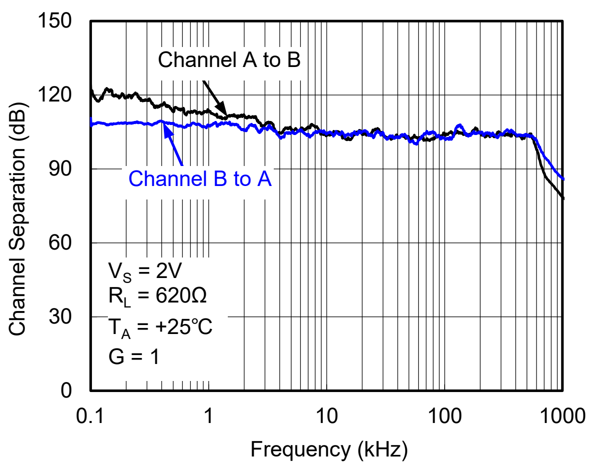
CMRR vs. Frequency



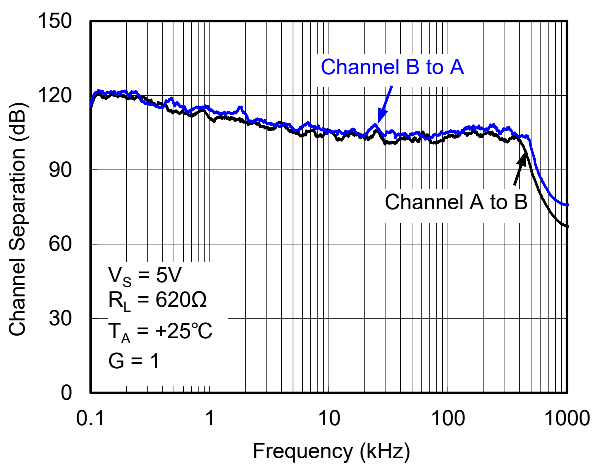
PSRR vs. Frequency



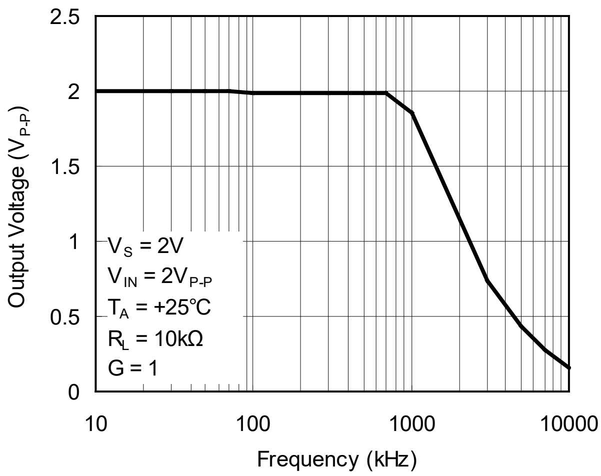
Channel Separation vs. Frequency



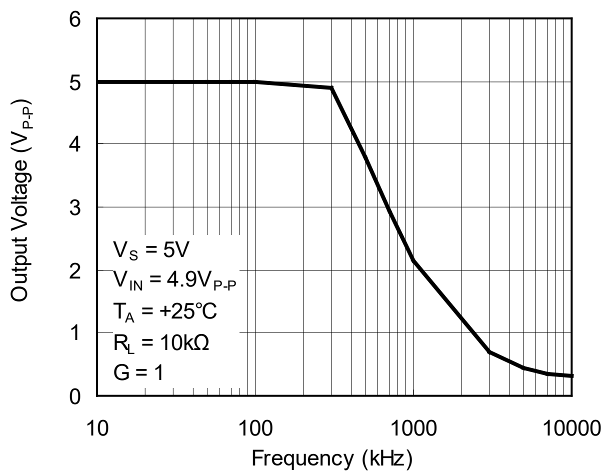
Channel Separation vs. Frequency



Closed-Loop Output Voltage Swing



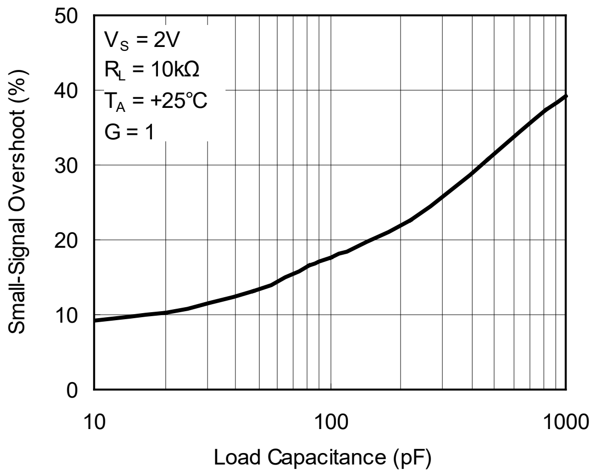
Closed-Loop Output Voltage Swing



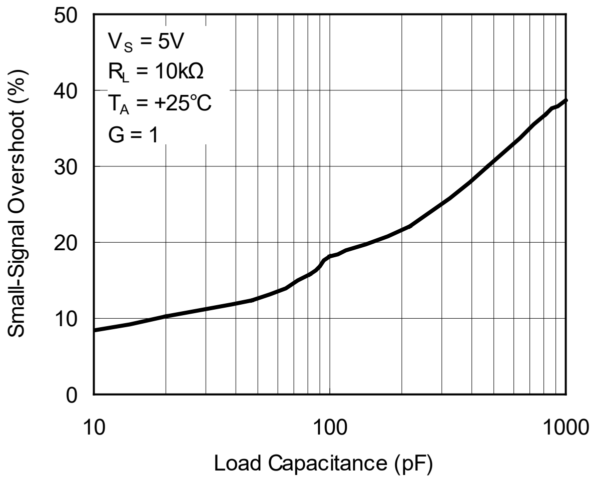
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.

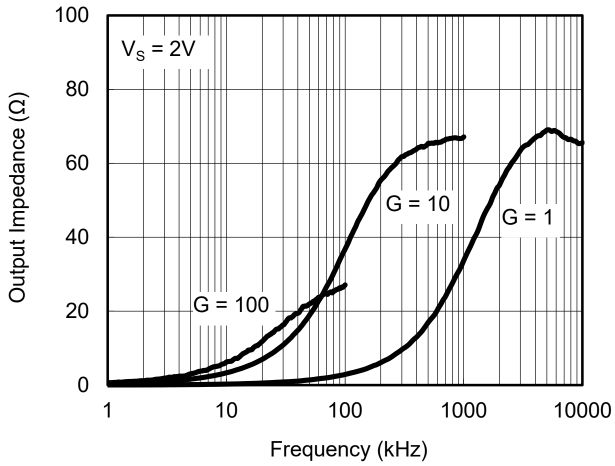
Small-Signal Overshoot vs. Load Capacitance



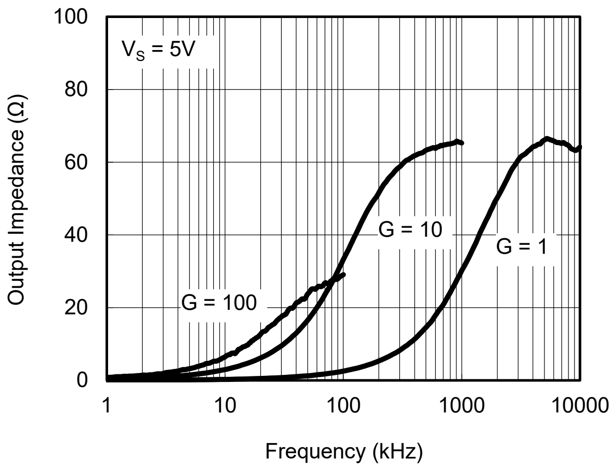
Small-Signal Overshoot vs. Load Capacitance



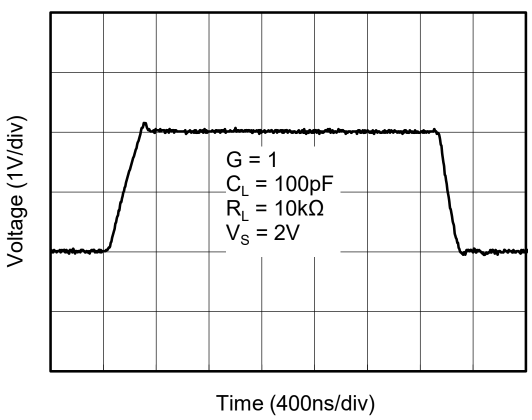
Output Impedance vs. Frequency



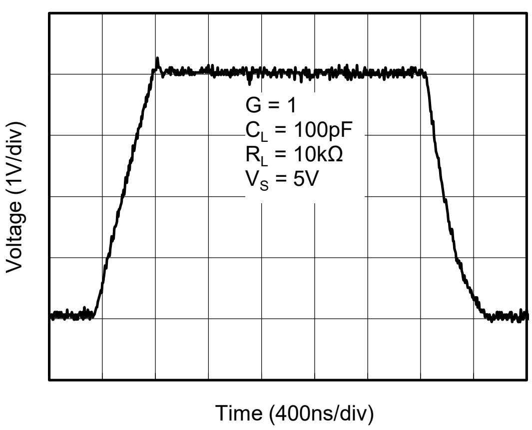
Output Impedance vs. Frequency



Large-Signal Step Response



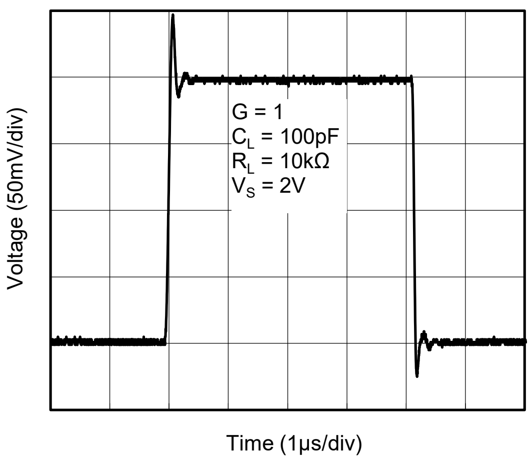
Large-Signal Step Response



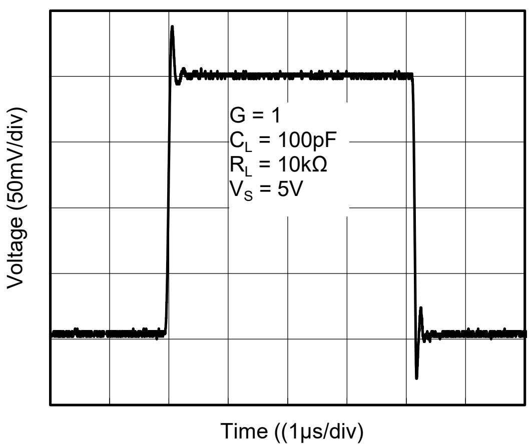
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.

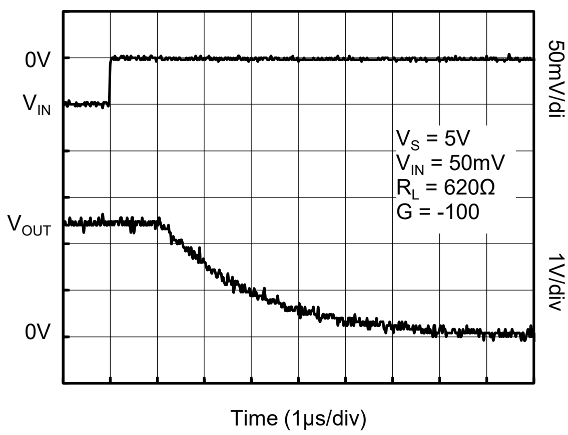
Small-Signal Step Response



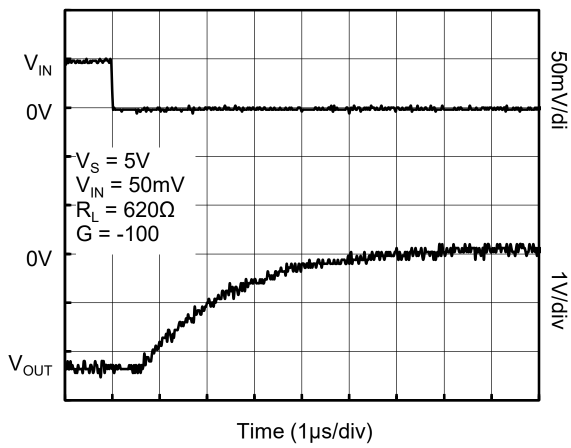
Small-Signal Step Response



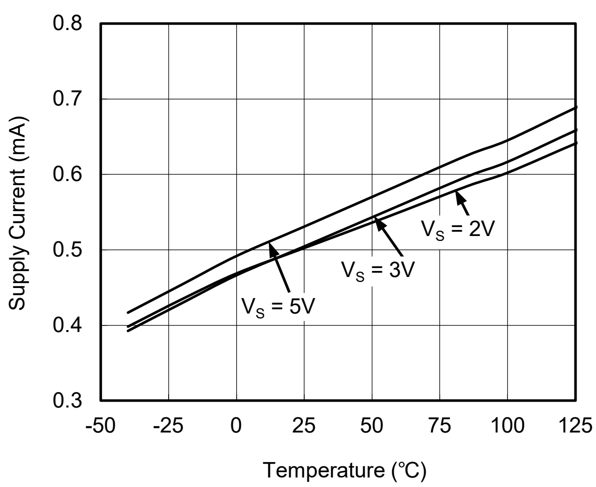
Positive overload Recovery



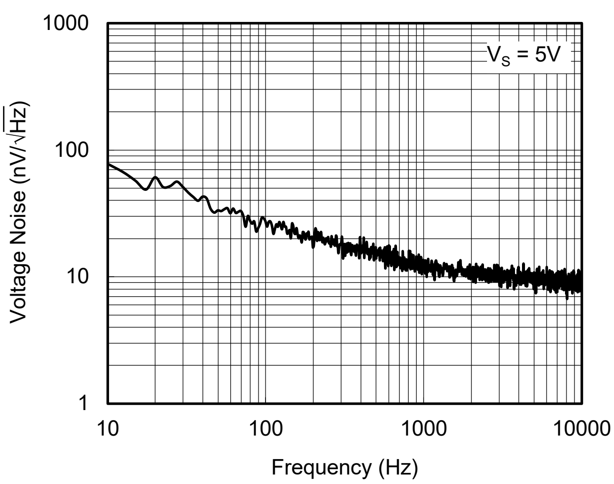
Negative Overload Recovery



Supply Current vs. Temperature



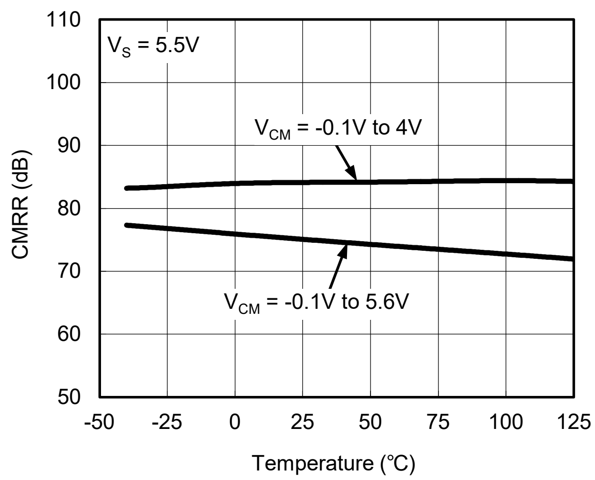
Input Voltage Noise Spectral Density vs. Frequency



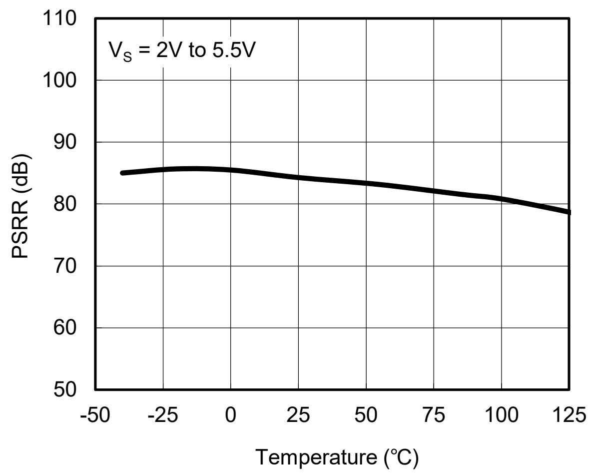
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.

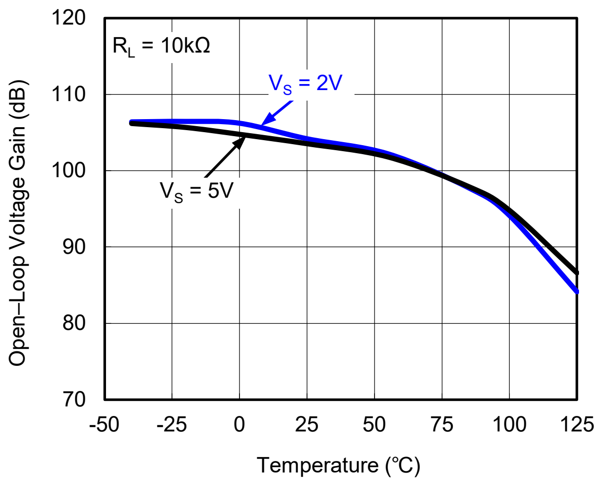
CMRR vs. Temperature



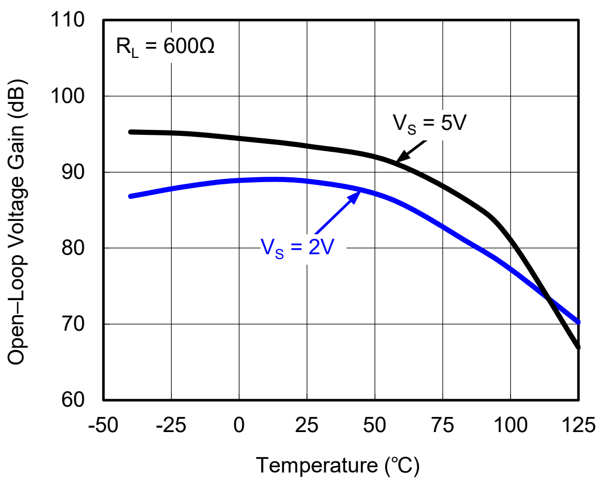
PSRR vs. Temperature



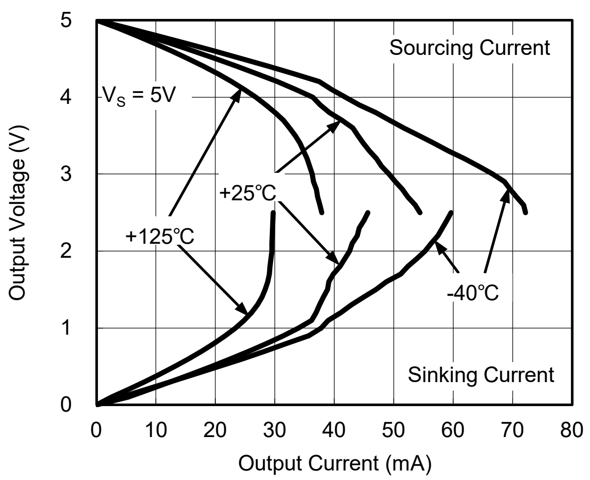
Open-Loop Voltage Gain vs. Temperature



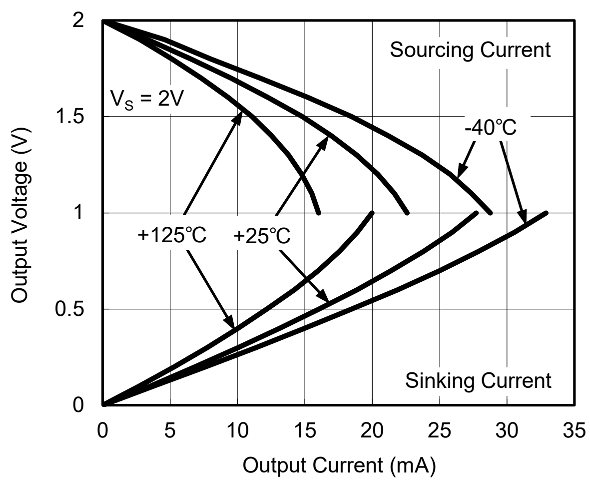
Open-Loop Voltage Gain vs. Temperature



Output Voltage Swing vs. Output Current

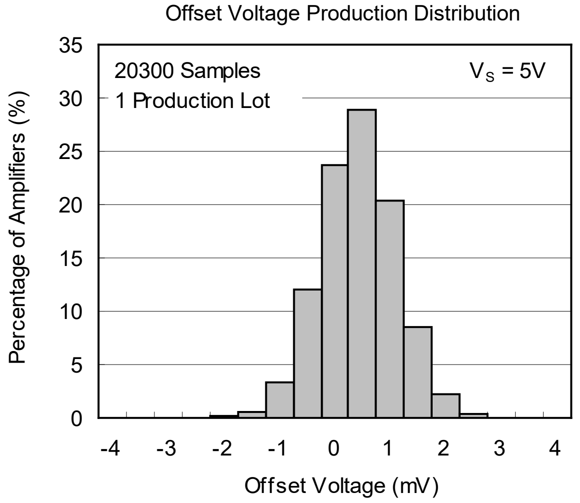


Output Voltage Swing vs. Output Current



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.



APPLICATION INFORMATION

Rail-to-Rail Input

When SGM8632C works at the power supply between 2V and 5.5V, the input common mode voltage range is from (-V_S) - 0.1V to (+V_S) + 0.1V. In Figure 1, the ESD diodes between the inputs and the power supply rails will clamp the input voltage not to exceed the rails.

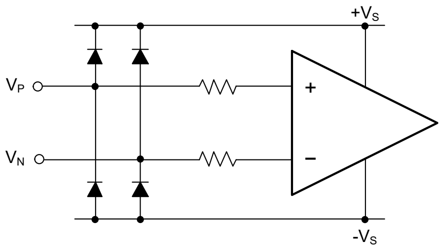


Figure 1. Input Equivalent Circuit

Rail-to-Rail Output

The SGM8632C supports rail-to-rail output operation. In single power supply application, for example, when +V_S = 5V, -V_S = GND, 10kΩ load resistor is tied from OUT pin to ground, the typical output swing range is from 0.007V to 4.993V.

Driving Capacitive Loads

The SGM8632C is designed for unity-gain stable for capacitive load up to 1000pF. If greater capacitive load must be driven in application, the circuit in Figure 2 can be used. In this circuit, the IR drop voltage generated by R_{ISO} is compensated by feedback loop.

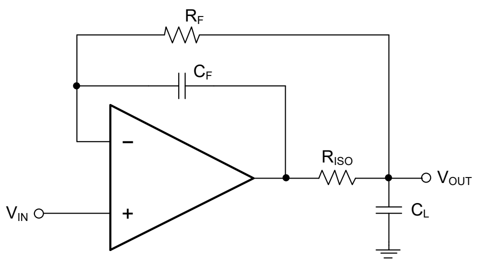


Figure 2. Circuit to Drive Heavy Capacitive Load

Power Supply Decoupling and Layout

A clean and low noise power supply is very important in amplifier circuit design, besides of input signal noise, the power supply is one of important source of noise to the amplifier through +V_S and -V_S pins. Power supply bypassing is an effective method to clear up the noise at power supply, and the low impedance path to ground of decoupling capacitor will bypass the noise to GND. In application, 10μF ceramic capacitor paralleled with 0.1μF or 0.01μF ceramic capacitor is used in Figure 3. The ceramic capacitors should be placed as close as possible to +V_S and -V_S power supply pins.

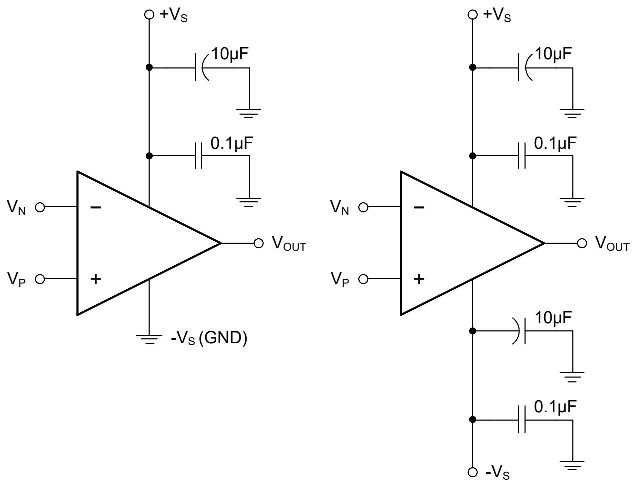


Figure 3. Amplifier Power Supply Bypassing

Grounding

In low speed application, one node grounding technique is the simplest and most effective method to eliminate the noise generated by grounding. In high speed application, the general method to eliminate noise is to use a complete ground plane technique, and the whole ground plane will help distribute heat and reduce EMI noise pickup.

Reduce Input-to-Output Coupling

To reduce the input-to-output coupling, the input traces must be placed as far away from the power supply or output traces as possible. The sensitive trace must not be placed in parallel with the noisy trace in same layer. They must be placed perpendicularly in different layers to reduce the crosstalk. These PCB layout techniques will help to reduce unwanted positive feedback and noise.

APPLICATION INFORMATION (continued)

Typical Application Circuits

Difference Amplifier

The circuit in Figure 4 is a design example of classical difference amplifier. If $R_4/R_3 = R_2/R_1$, then $V_{OUT} = (V_P - V_N) \times R_2/R_1 + V_{REF}$.

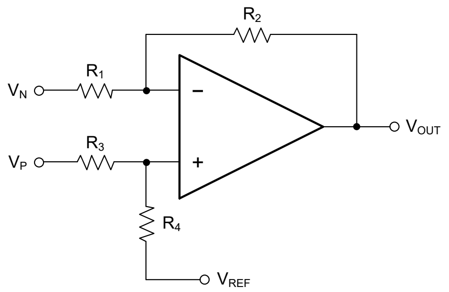


Figure 4. Difference Amplifier

High Input Impedance Difference Amplifier

The circuit in Figure 5 is a design example of high input impedance difference amplifier, the added amplifiers at the input are used to increase the input impedance and eliminate drawback of low input impedance in Figure 4.

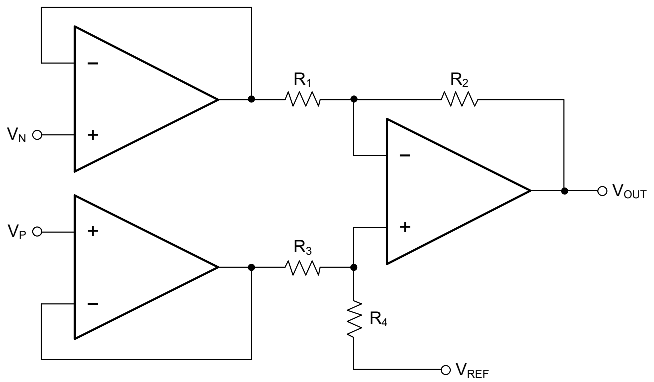


Figure 5. High Input Impedance Difference Amplifier

Active Low-Pass Filter

The circuit in Figure 6 is a design example of active low-pass filter, the DC gain is equal to $-R_2/R_1$ and the -3dB corner frequency is equal to $1/2\pi R_2C$. In this design, the filter bandwidth must be less than the bandwidth of the amplifier, the resistor values must be selected as low as possible to reduce ringing or oscillation generated by the parasitic parameters in PCB layout.

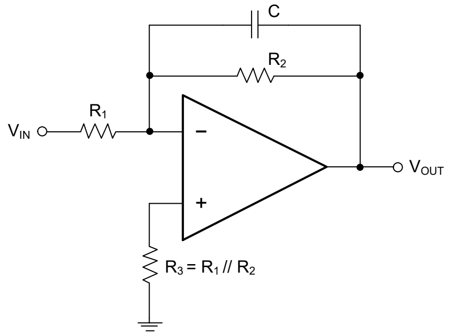


Figure 6. Active Low-Pass Filter

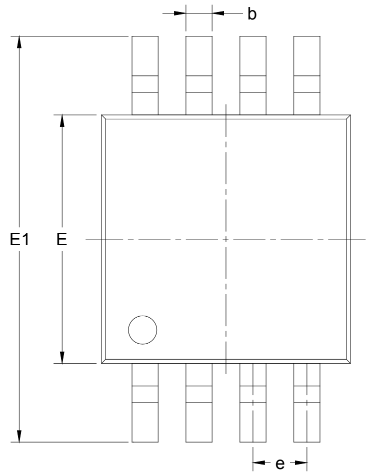
REVISION HISTORY

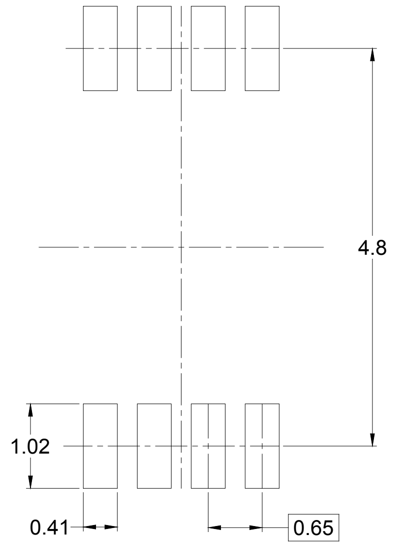
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

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

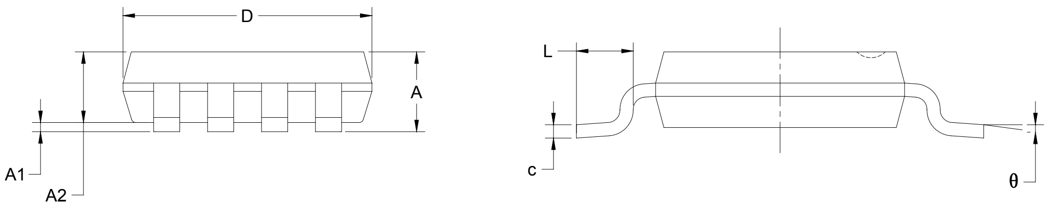
PACKAGE OUTLINE DIMENSIONS

MSOP-8





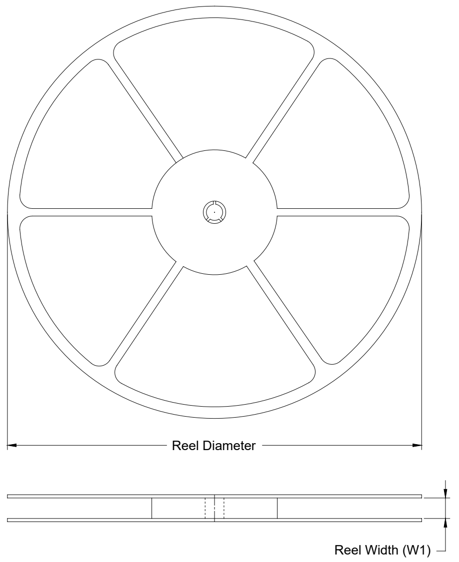
RECOMMENDED LAND PATTERN (Unit: mm)



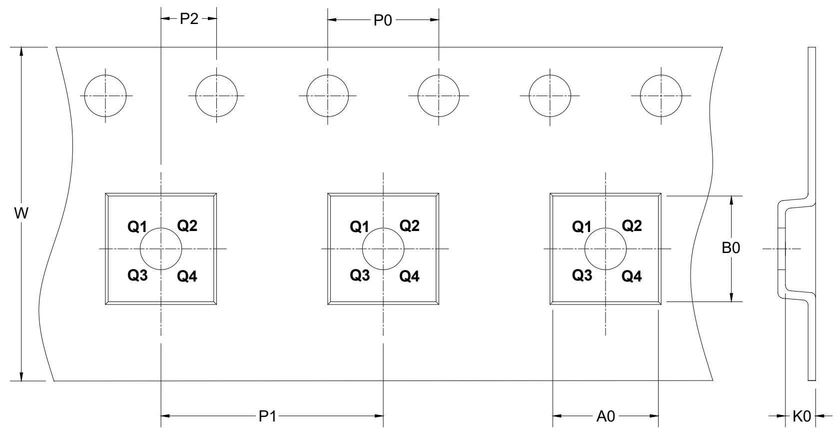
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026 BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



DIRECTION OF FEED

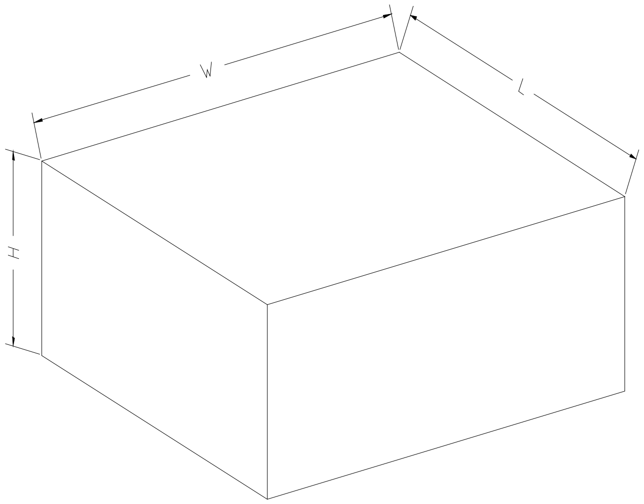
NOTE: The picture is only for reference. Please make the object as the standard.

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
MSOP-8	13″	12.4	5.20	3.30	1.50	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