SGM8557-2XMS8G
15MHz, High Output Drive, High Precision, Low Noise Operational Amplifier

GENERAL DESCRIPTION

The dual SGM8557-2XMS8G high output drive CMOS operational amplifier features a peak output current of 235mA, rail-to-rail output capability from a single 2.7V to 5.5V supply. This amplifier exhibits a high slew rate of 7V/μs and a gain-bandwidth product (GBP) of 15MHz.

The SGM8557-2XMS8G offers low input offset voltage, low input offset voltage drift, wide bandwidth and high output drive.

The SGM8557-2XMS8G is available in a Green MSOP-8 package. It operates over an ambient temperature range of -40℃ to +125℃.

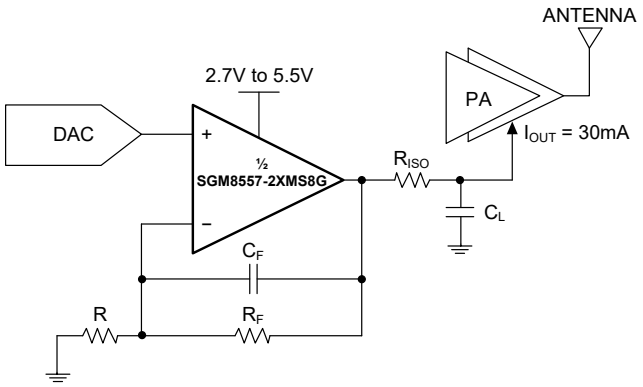
FEATURES

- **235mA Output Drive Capability**
- **Rail-to-Rail Output**
- **Low Input Offset Voltage: 5μV (MAX)**
- **Low Input Offset Voltage Drift: 20nV/℃ (TYP)**
- **Low Noise: 30nV/$\sqrt{Hz}$ at 1kHz**
- **Over-Temperature Protection**
- **Supply Voltage Range: 2.7V to 5.5V**
- **Quiescent Supply Current: 2.4mA (TYP)**
- **Gain-Bandwidth Product: 15MHz**
- **High Slew Rate: 7V/μs**
- **High Open-Loop Gain (R_L = 2kΩ): 135dB**
- **Power Supply Rejection Ratio: 121dB**
- **No Phase Reversal for Overdriven Inputs**
- **Available in a Green MSOP-8 Package**

APPLICATIONS

Portable/Battery-Powered Audio Applications
Audio Hands-Free Car Phones (Kits)
Laptop/Notebook Computers/TFT Panels
Sound Ports/Cards
Set-Top Boxes
Digital-to-Analog Converter Buffers
Transformer/Line Drivers
Motor Drivers

TYPICAL OPERATING CIRCUIT

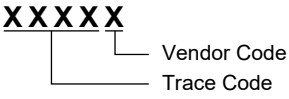


PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8557-2XMS8G	MSOP-8	-40℃ to +125℃	SGM8557-2XMS8G/TR	SGM85572 XMS8 XXXXX	Tape and Reel, 4000

MARKING INFORMATION

NOTE: XXXXX = Trace 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 $-V_S$ 6V
All Other Pins ..... ($-V_S$) - 0.3V to ($+V_S$) + 0.3V
Package Thermal Resistance
MSOP-8, θ_{JA} ..... 162℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 7000V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Operating Temperature Range ..... -40℃ to +125℃
Operating Supply Voltage Range ..... 2.7V to 5.5V

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

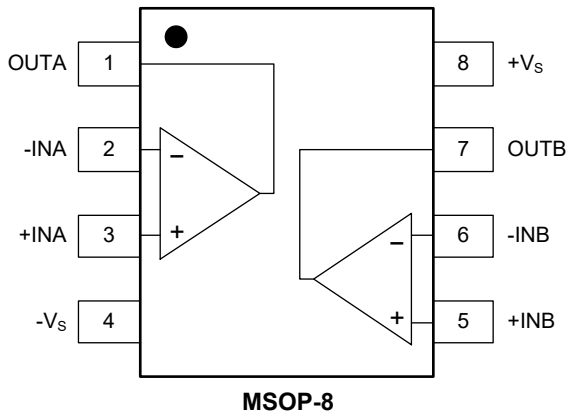
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance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

(V_S = 2.7V to 5V, $-V_S$ = 0V, V_{CM} = V_S/2, V_{OUT} = V_S/2, R_L connected to V_S/2, Full = -40℃ to +125℃, typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER	CONDITIONS		TEMP	MIN	TYP	MAX	UNITS
Input Characteristics							
Input Offset Voltage (V_{OS})	V_S = 2.7V		+25℃		2.5	5	μV
	V_S = 5V		+25℃		3	5	
Input Offset Voltage Drift ($\Delta V_{OS}/\Delta T$)	V_S = 2.7V		+25℃		25	126	nV/℃
	V_S = 5V		+25℃		20	130	
Input Bias Current (I_B)	V_S = 5V		+25℃		320	500	pA
Input Offset Current (I_{OS})	V_S = 5V		+25℃		640	1000	pA
Input Common Mode Voltage Range (V_{CM})			Full	($-V_S$) - 0.1		($+V_S$) + 0.1	V
Common Mode Rejection Ratio (CMRR)	($-V_S$) - 0.1V < V_{CM} < ($+V_S$) + 0.1V		+25℃	106	115		dB
			Full	102			
Open-Loop Voltage Gain (A_{OL})	V_S = 2.7V, ($-V_S$) + 0.2V < V_{OUT} < ($+V_S$) - 0.2V	R_L = 2kΩ	+25℃	112	130		dB
			Full	110			
		R_L = 200Ω	+25℃	110	130		
			Full	107			
	V_S = 5V, ($-V_S$) + 0.2V < V_{OUT} < ($+V_S$) - 0.2V	R_L = 2kΩ	+25℃	115	135		
			Full	112			
		R_L = 200Ω	+25℃	110	135		
			Full	108			
Output Characteristics							
Output Voltage Swing from Rail	V_S = 2.7V	R_L = 32Ω	+25℃		220	300	mV
			Full			370	
		R_L = 200Ω	+25℃		40	60	
			Full			72	
		R_L = 2kΩ	+25℃		4	10	
			Full			11	
		I_{OUT} = 10mA	+25℃		65	95	
			Full			115	
	V_S = 5V	R_L = 32Ω	+25℃		360	485	
			Full			580	
		R_L = 200Ω	+25℃		65	95	
			Full			115	
		R_L = 2kΩ	+25℃		7	15	
			Full			18	
		I_{OUT} = 10mA	+25℃		55	82	
			Full			98	
Output Short-Circuit Current (I_{SC})	V_S = 2.7V		+25℃	92	120		mA
			Full	64			
	V_S = 5V		+25℃	182	235		
			Full	148			

ELECTRICAL CHARACTERISTICS (continued)

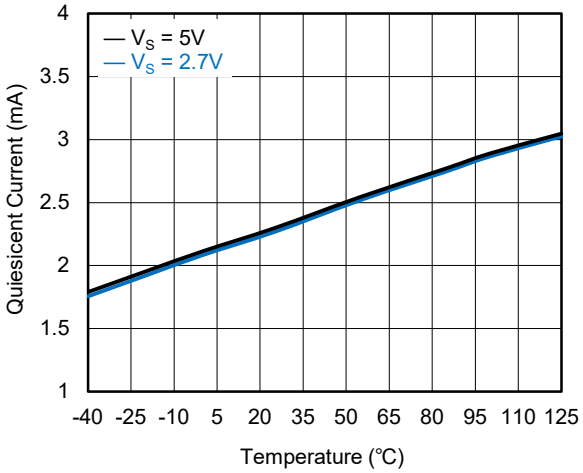
(V_S = 2.7V to 5V, $-V_S$ = 0V, V_{CM} = V_S/2, V_{OUT} = V_S/2, R_L connected to V_S/2, Full = -40℃ to +125℃, typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Power Supply						
Specified Voltage Range (V_S)		Full	2.7		5.5	V
Power Supply Rejection Ratio (PSRR)		+25℃	102	121		dB
		Full	94			
Quiescent Current (I_Q)	I_{OUT} = 0mA	+25℃		2.4	2.9	mA
		Full			3.7	
Frequency Response						
Gain-Bandwidth Product	R_L = 10kΩ, C_L = 100pF	+25℃		15		MHz
Slew Rate	G = +1,V_{OUT} = $2V_{P-P}$	+25℃		7		V/μs
Total Harmonic Distortion + Noise	V_S = 5V, R_L = 32Ω, f = 10kHz, BW = 10Hz to 90kHz, V_{OUT} = $2V_{P-P}$, A_{VCL} = 1V/V	+25℃		0.017		%
Input Capacitance		+25℃		20		pF
Channel-to-Channel Isolation	f = 1kHz, R_L = 100kΩ	+25℃		-125		dB
Capacitive-Load Stability	A_{VCL} = 1V/V, no sustained oscillations	+25℃		780		pF
Noise						
Input Voltage Noise	f = 0.1Hz to 10Hz	+25℃		0.5		μV_{P-P}
Input Voltage Noise Density	f = 1kHz	+25℃		30		$nV/\sqrt{Hz}$
	f = 10kHz	+25℃		28		

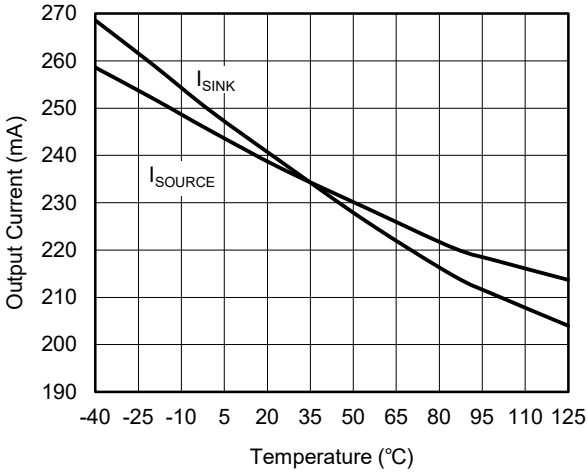
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, V_S = 5V, unless otherwise noted.

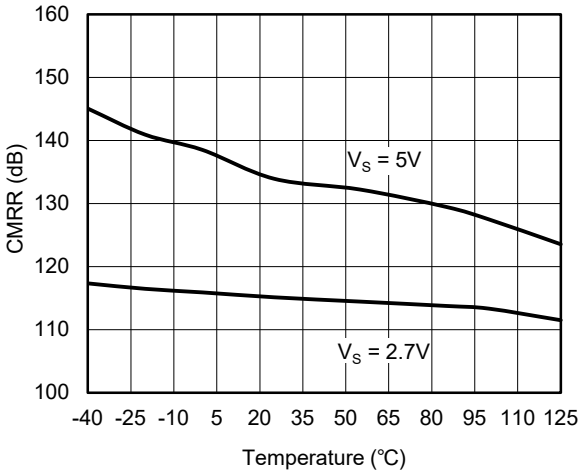
Quiescent Current vs. Temperature



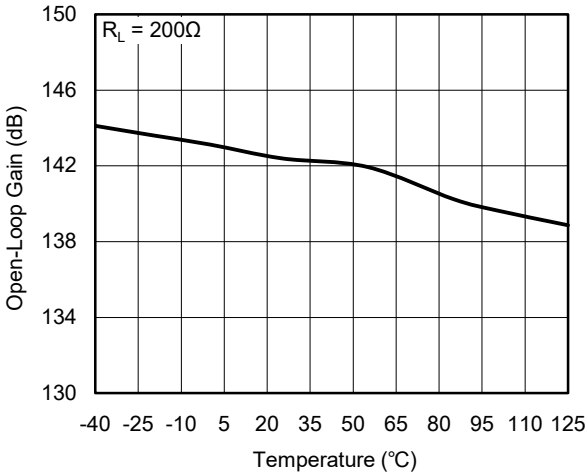
Output Current vs. Temperature



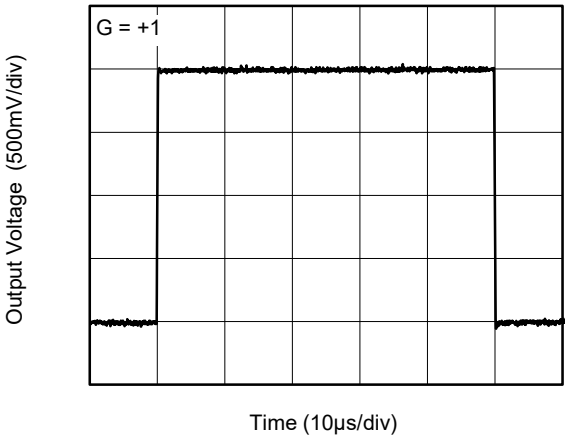
Common Mode Rejection Ratio vs. Temperature



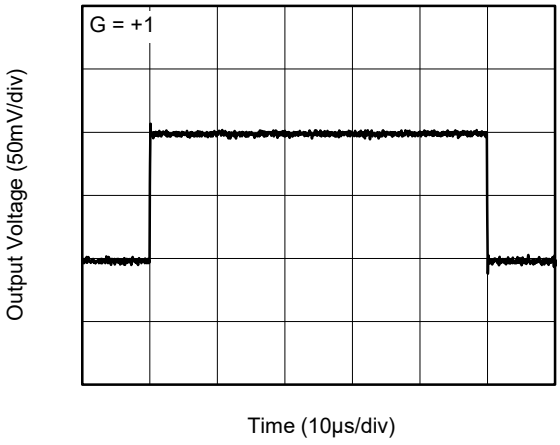
Open-Loop Gain vs. Temperature



Large-Signal Step Response



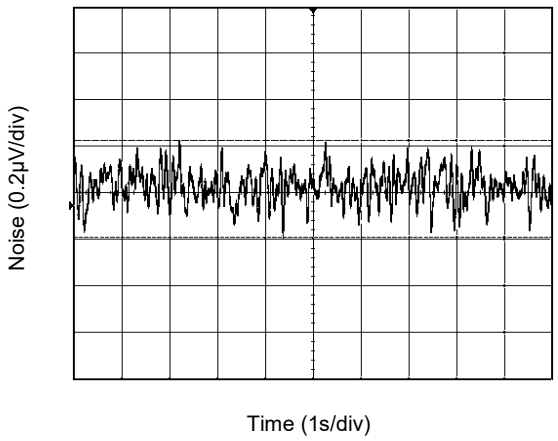
Small-Signal Step Response



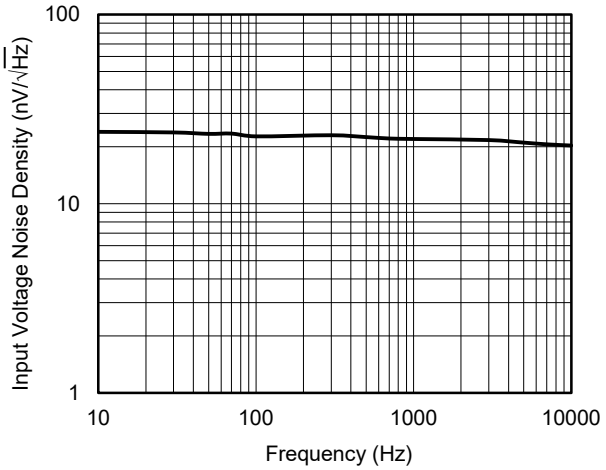
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_S = 5V, unless otherwise noted.

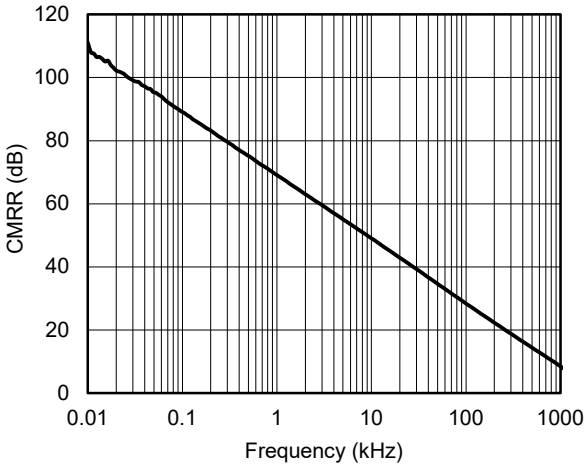
0.1Hz to 10Hz Noise



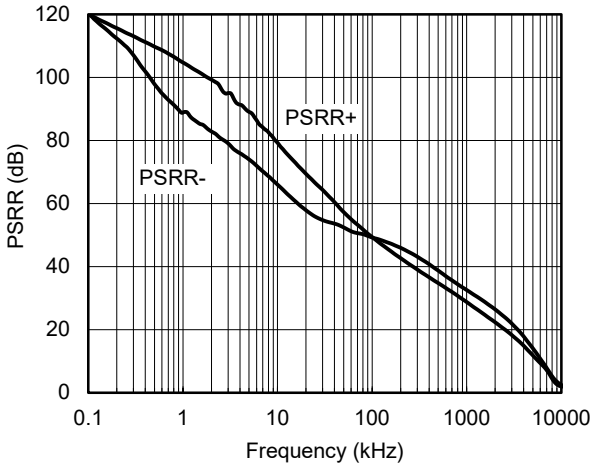
Input Voltage Noise Density vs. Frequency



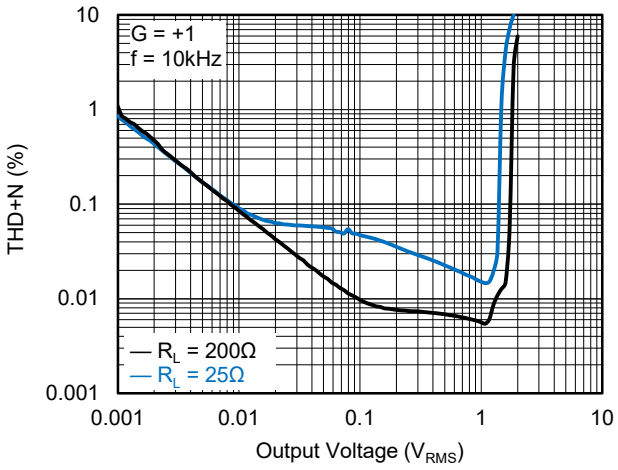
Common Mode Rejection Ratio vs. Frequency



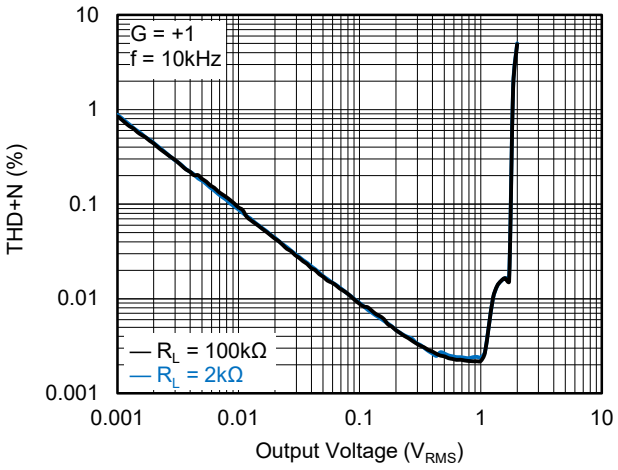
Power Supply Rejection Ratio vs. Frequency



THD+N vs. Output Voltage



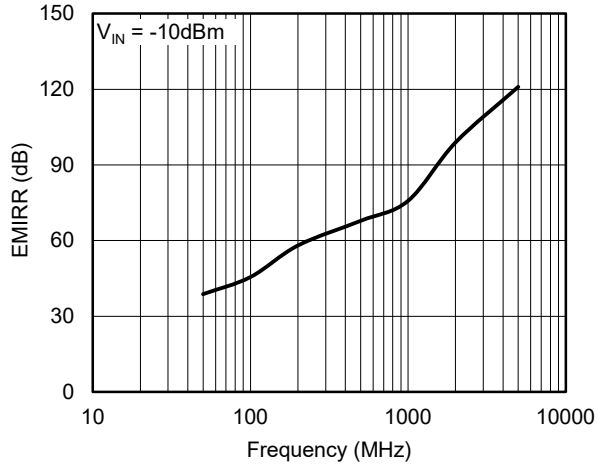
THD+N vs. Output Voltage



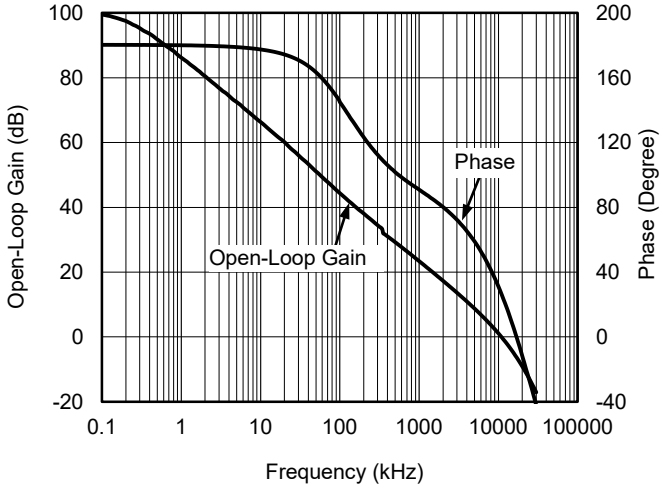
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_S = 5V, unless otherwise noted.

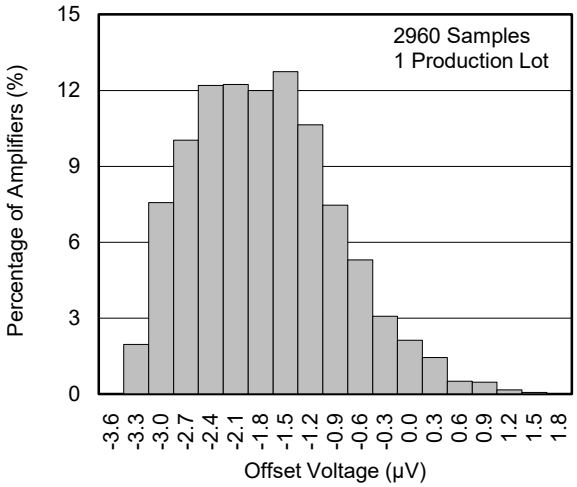
EMIRR vs. Frequency



Open-Loop Gain and Phase vs. Frequency



Offset Voltage Production Distribution



APPLICATION INFORMATION

60mW Single-Supply Stereo Headphone Driver

The SGM8557-2XMS8G can be used as a single-supply, stereo headphone driver. The circuit shown in Figure 1 can deliver 60mW per channel with 1% distortion from a single 5V supply.

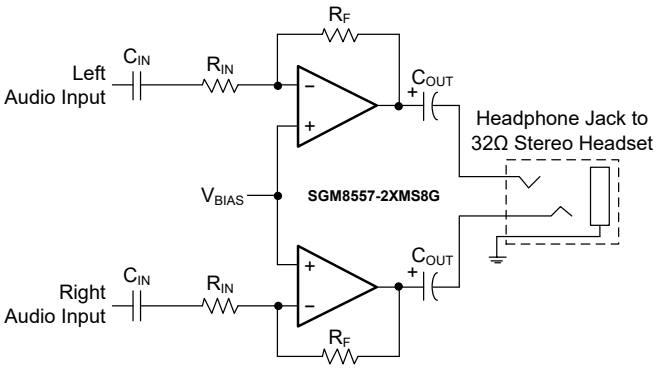


Figure 1. Circuit Example: A Single-Supply, Stereo Headphone Driver

The input capacitor (C_{IN}), in conjunction with R_{IN}, forms a high-pass filter that removes the DC bias from the incoming signal. The -3dB point of the high-pass filter is given by:

$$f_{-3dB} = \frac{1}{2\pi R_{IN} C_{IN}} \quad (1)$$

Choose gain-setting resistors R_{IN} and R_F according to the amount of desired gain, while keeping in mind the maximum output amplitude. The output coupling capacitor (C_{OUT}) blocks the DC component of the amplifier output and prevents DC current flowing to the load. The output capacitor and the load impedance form a high-pass filer with the -3dB point determined by:

$$f_{-3dB} = \frac{1}{2\pi R_L C_{OUT}} \quad (2)$$

For a 32Ω load, a 100μF aluminum electrolytic capacitor gives a low-frequency pole at 50Hz.

Bridge Amplifier

The circuit shown in Figure 2 uses an SGM8557-2XMS8G to implement a 3V, 200mW amplifier suitable for use in size-constrained applications. This configuration eliminates the need for the large coupling capacitor required by the single operational amplifier speaker driver when single-supply operation is necessary. Voltage gain is set to 10V/V; however, it can be changed by adjusting the 82kΩ resistor value.

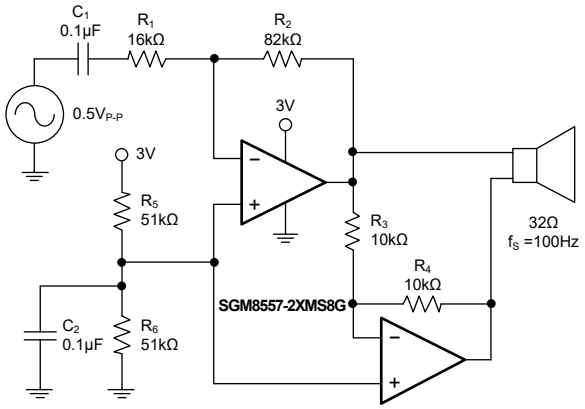


Figure 2. SGM8557-2XMS8G Bridge Amplifier for 200mW at 3V

APPLICATIONS INFORMATION (continued)

Input Capacitance

One consequence of the parallel-connected differential input stages is a relatively large input capacitance C_{IN} (20pF TYP). This introduces a pole at frequency $(2\pi R'C_{IN})^{-1}$, where R′ is the parallel combination of the gain-setting resistors for the inverting or non-inverting amplifier configuration (Figure 3). If the pole frequency is less than or comparable to the unity-gain bandwidth (15MHz), the phase margin is reduced, and the amplifier exhibits degraded AC performance through either ringing in the step response or sustained oscillations. The pole frequency is 10MHz when R′ = 2kΩ. To maximize stability, R′ << 2kΩ is recommended.

To improve step response when R′ > 2kΩ, connect small capacitor C_F between the inverting input and output. Choose C_F as follows:

$$C_F = 8(R/R_F)\ [pF] \quad (3)$$

where R_F is the feedback resistor and R is the gain-setting resistor (Figure 3).

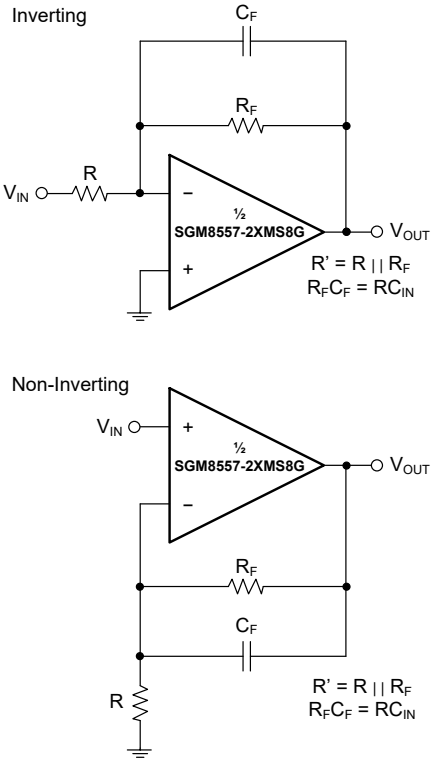


Figure 3. Inverting and Non-Inverting Amplifiers with Feedback Compensation

Driving Capacitive Loads

The SGM8557-2XMS8G has a high tolerance for capacitive loads. It is stable with capacitive loads up to 780pF. Figure 4 shows the transient response with capacitive loads (780pF), with and without the addition of an isolation resistor in series with the output. Figure 5 shows a typical non-inverting capacitive-load-driving circuit in the unity-gain configuration.

The resistor improves the circuit's phase margin by isolating the load capacitor from the operational amplifier's output.

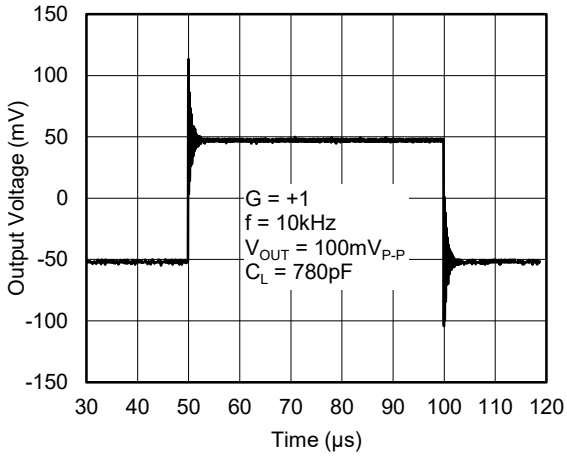


Figure 4. Small-Signal Transient Response with Capacitive Load

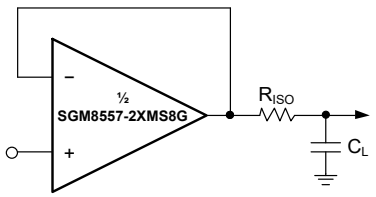


Figure 5. Capacitive-Load-Driving Circuit

Power Supplies and Layout

The SGM8557-2XMS8G can operate from a single 2.7V to 5.5V supply or from dual ±1.35V to ±2.75V supplies. For single-supply operation, bypass the power supply with a 0.1μF ceramic capacitor. For dual-supply operation, bypass each supply to ground. Good layout improves performance by decreasing the amount of stray capacitance at the operational amplifier's inputs and outputs. Decrease stray capacitance by placing external components close to the operational amplifier's pins, minimizing trace and lead lengths.

REVISION HISTORY

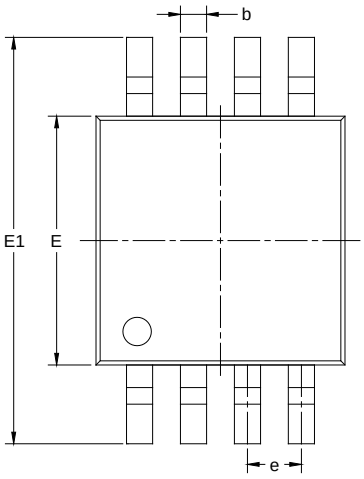
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

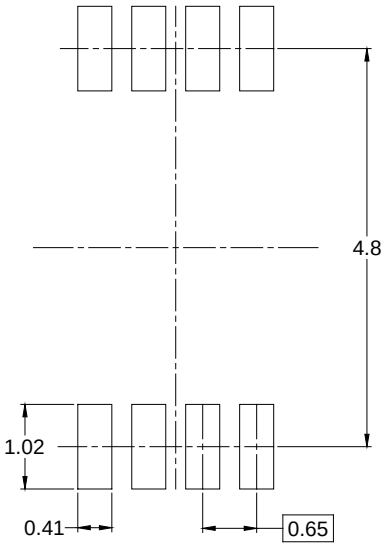
OCTOBER 2021 – REV.A to REV.A.1	Page
Updated Marking Information section	2

Changes from Original (SEPTEMBER 2021) to REV.A	Page
Changed from product preview to production data	All

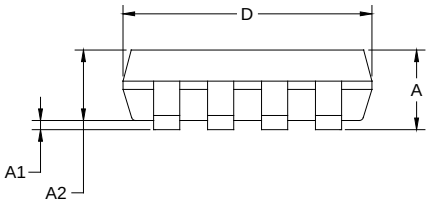
PACKAGE OUTLINE DIMENSIONS

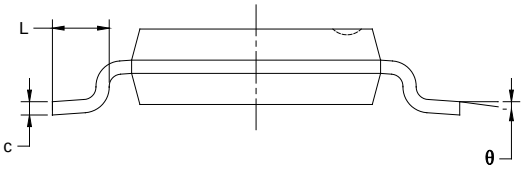
MSOP-8





RECOMMENDED LAND PATTERN (Unit: mm)



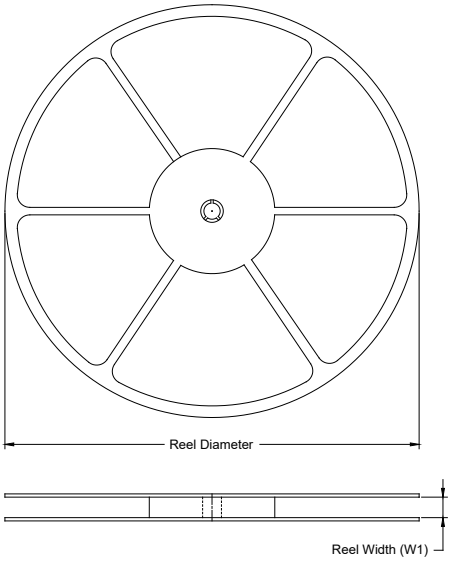


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026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

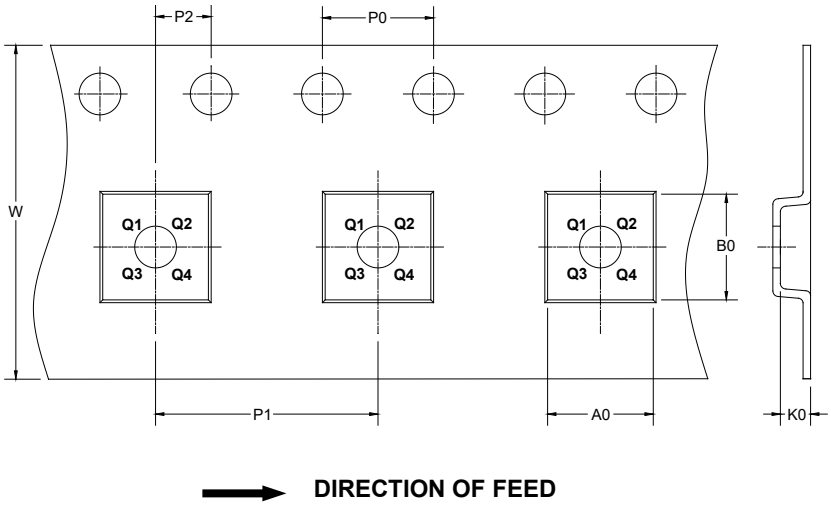
NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



DIRECTION OF FEED

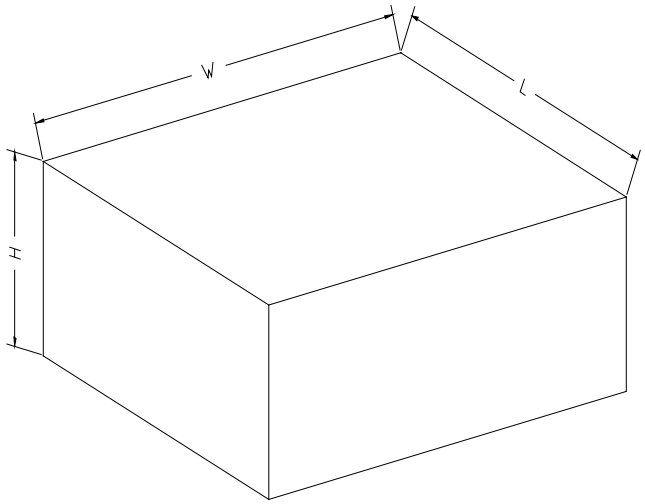
NOTE: The picture is only for reference. Please make the object as the standard.

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