SGM8252
3MHz, High Voltage, High Precision, Low Noise Rail-to-Rail Output Operational Amplifier

GENERAL DESCRIPTION

The dual SGM8252 is a rail-to-rail output, low noise and high precision operational amplifier which has low input offset voltage and bias current. It is guaranteed to operate from 4.5V to 36V single supply.

The rail-to-rail output swing provided by the SGM8252 makes both high-side and low-side sensing easy. The combination of characteristics makes the SGM8252 good choice for temperature, position and pressure sensors, medical equipment and strain gauge amplifiers, or any other 4.5V to 36V application requiring precision and long term stability.

The dual SGM8252 is available in Green SOIC-8 and MSOP-8 packages. It is specified over the extended -40℃ to +125℃ temperature range.

FEATURES

- **Low Offset Voltage: 24μV (MAX)**
- **Rail-to-Rail Output Swing**
- **4.5V to 36V Single Supply Operation**
- **Voltage Gain: 135dB (TYP)**
- **PSRR: 145dB (TYP)**
- **CMRR: 125dB (TYP)**
- **0.1Hz to 10Hz Noise: 1μV_{P-P}**
- **56nV/$\sqrt{Hz}$ Voltage Noise Density at 1kHz**
- **Gain-Bandwidth Product: 3MHz**
- **Low Supply Current: 480μA/Amplifier (TYP)**
- **Overload Recovery Time: 3μs (TYP)**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in Green SOIC-8 and MSOP-8 Packages**

APPLICATIONS

Temperature Measurements
Pressure Sensors
Precision Current Sensing
Electronic Scales
Strain Gauge Amplifiers
Medical Instrumentation
Thermocouple Amplifiers
Handheld Test Equipment

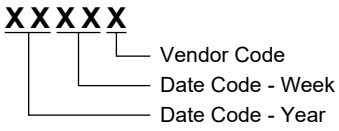
PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8252	SOIC-8	-40℃ to +125℃	SGM8252XS8G/TR	SGM 8252XS8 XXXXX	Tape and Reel, 2500
	MSOP-8	-40℃ to +125℃	SGM8252XMS8G/TR	SGM8252 XMS8 XXXXX	Tape and Reel, 4000

MARKING INFORMATION

NOTE: XXXXX = Date Code and Vendor Code.

SOIC-8/MSOP-8



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 40V
Input Voltage ..... ($-V_S$) - 0.3V to ($+V_S$) + 0.3V
Differential Input Voltage Range ..... -5V to 5V
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 3000V
MM 300V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range ..... 4.5V to 36V
Operating Temperature Range ..... -40℃ to +125℃
Differential Input Voltage Range ..... -0.7V to 0.7V

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

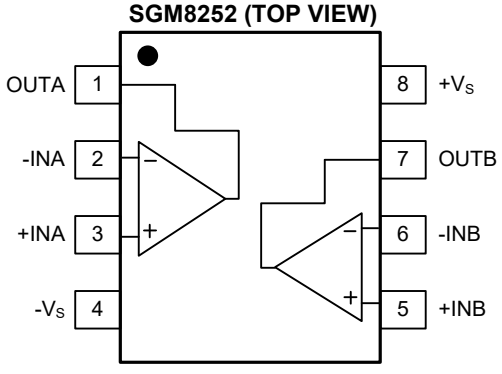
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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, or specifications without prior notice.

PIN CONFIGURATIONS

SGM8252 (TOP VIEW)



SOIC-8/MSOP-8

ELECTRICAL CHARACTERISTICS

(At T_A = +25℃, V_S = 5V, V_{CM} = 2.5V, V_{OUT} = 2.5V, unless otherwise noted.)

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS						
Input Offset Voltage (V_{OS})				5	24	μV
Input Bias Current (I_B)				100		pA
Input Offset Current (I_{OS})				100		pA
Input Voltage Range			0		3.5	V
Common Mode Rejection Ratio (1) (CMRR)		V_{CM} = 0.1V to 3.5V	99	125		dB
		-40℃ ≤ T_A ≤ +125℃	97			
Large Signal Voltage Gain (A_{VO})		R_L = 10kΩ, V_{OUT} = 0.3V to 4.7V	110	135		dB
		-40℃ ≤ T_A ≤ +125℃	108			
Input Offset Voltage Drift ($\Delta V_{OS}/\Delta T$)				75		nV/℃
OUTPUT CHARACTERISTICS						
Output Voltage High (V_{OH})		R_L = 10kΩ to 0V		75	95	mV
		-40℃ ≤ T_A ≤ +125℃			100	
Output Voltage Low (V_{OL})		R_L = 10kΩ to 5V		60	75	mV
		-40℃ ≤ T_A ≤ +125℃			80	
Short Circuit Limit	I_{SOURCE}	V_{OUT} = 2.5V, R_L =10Ω to 0V	4.6	8.5		mA
		-40℃ ≤ T_A ≤ +125℃	3.5			
	I_{SINK}	V_{OUT} = 2.5V, R_L =10Ω to 5V	3.9	10		mA
		-40℃ ≤ T_A ≤ +125℃	2.9			
POWER SUPPLY						
Power Supply Rejection Ratio (1) (PSRR)		V_S = 4.5V to 36V	117	145		dB
		-40℃ ≤ T_A ≤ +125℃	115			
Quiescent Current/Amplifier (I_Q)		V_{OUT} = 2.5V		450	600	μA
		-40℃ ≤ T_A ≤ +125℃			790	
DYNAMIC PERFORMANCE						
Gain-Bandwidth Product (GBP)		A_V = +100		3.1		MHz
Slew Rate (SR)		A_V = +1, R_L = 10kΩ, 2V Output Step		1.7		V/μs
Overload Recovery Time		A_V = -100, R_L = 10kΩ, V_{IN} = 200mV (RET to 0V)		3		μs
Total Harmonic Distortion + Noise (THD+N)		f = 1kHz, A_V = +1, V_{OUT} = $2V_{p-p}$		0.0006		%
NOISE PERFORMANCE						
Input Voltage Noise		f = 0.1Hz to 10Hz		1		μV_{P-P}
Input Voltage Noise Density (e_n)		f = 0.1kHz		56		$nV/\sqrt{Hz}$
		f = 1kHz		56		
		f = 12kHz		22		

NOTE: 1. PSRR and CMRR are affected by the matching between external gain-setting resistor ratios.

ELECTRICAL CHARACTERISTICS (continued)

(At T_A = +25℃, V_S = 30V, V_{CM} = 15V, V_{OUT} = 15V, unless otherwise noted.)

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS						
Input Offset Voltage (V_{OS})				4	20	μV
Input Bias Current (I_B)				100		pA
Input Offset Current (I_{OS})				100		pA
Input Voltage Range			0		28.5	V
Common Mode Rejection Ratio (1) (CMRR)		V_{CM} = 0.1V to 28.5V	112	140		dB
		-40℃ ≤ T_A ≤ +125℃	106			
Large Signal Voltage Gain (A_{VO})		R_L = 10kΩ, V_{OUT} = 0.3V to 29.7V	119	145		dB
		-40℃ ≤ T_A ≤ +125℃	117			
Input Offset Voltage Drift ($\Delta V_{OS}/\Delta T$)				55		nV/℃
OUTPUT CHARACTERISTICS						
Output Voltage High (V_{OH})		R_L = 10kΩ to 0V		425	505	mV
		-40℃ ≤ T_A ≤ +125℃			555	
Output Voltage Low (V_{OL})		R_L = 10kΩ to 30V		360	430	mV
		-40℃ ≤ T_A ≤ +125℃			455	
Short Circuit Limit	I_{SOURCE}	V_{OUT} = 15V, R_L =10Ω to 0V	23	43		mA
	I_{SINK}	V_{OUT} = 15V, R_L =10Ω to 30V	25	48		mA
POWER SUPPLY						
Power Supply Rejection Ratio (1) (PSRR)		V_S = 4.5V to 36V	117	145		dB
		-40℃ ≤ T_A ≤ +125℃	115			
Quiescent Current/Amplifier (I_Q)		V_{OUT} = 15V		465	620	μA
		-40℃ ≤ T_A ≤ +125℃			800	
DYNAMIC PERFORMANCE						
Gain-Bandwidth Product (GBP)		A_V = +100		3.1		MHz
Slew Rate (SR)		A_V = +1, R_L = 10kΩ, 2V Output Step		1.8		V/μs
Overload Recovery Time		A_V = -100, R_L = 10kΩ, V_{IN} = 200mV (RET to 0V)		2		μs
Total Harmonic Distortion + Noise (THD+N)		f = 1kHz, A_V = +1, V_{OUT} = $2V_{p-p}$		0.0006		%
NOISE PERFORMANCE						
Input Voltage Noise		f = 0.1Hz to 10Hz		1		μV_{P-P}
Input Voltage Noise Density (e_n)		f = 0.1kHz		60		$nV/\sqrt{Hz}$
		f = 1kHz		60		
		f = 12kHz		22		

NOTE: 1. PSRR and CMRR are affected by the matching between external gain-setting resistor ratios.

ELECTRICAL CHARACTERISTICS (continued)

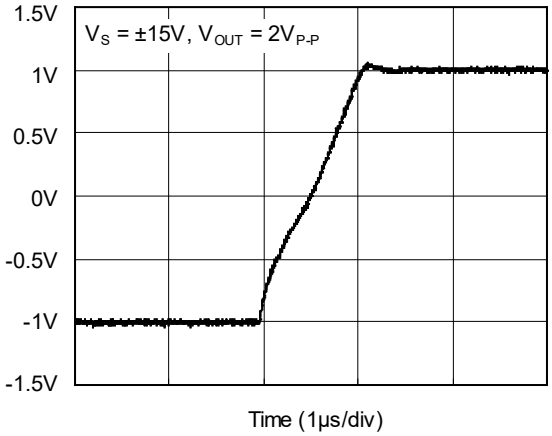
(At T_A = +25℃, V_S = 36V, V_{CM} = 18V, V_{OUT} = 18V, unless otherwise noted.)

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS						
Input Offset Voltage (V_{OS})				4	20	μV
Input Bias Current (I_B)				100		pA
Input Offset Current (I_{OS})				100		pA
Input Voltage Range			0		28.5	V
Common Mode Rejection Ratio (1) (CMRR)		V_{CM} = 0.1V to 34.5V	105	130		dB
		-40℃ ≤ T_A ≤ +125℃	96			
Large Signal Voltage Gain (A_{VO})		R_L = 10kΩ, V_{OUT} = 0.3V to 35.7V	116	150		dB
		-40℃ ≤ T_A ≤ +125℃	114			
Input Offset Voltage Drift ($\Delta V_{OS}/\Delta T$)				70		nV/℃
OUTPUT CHARACTERISTICS						
Output Voltage High (V_{OH})		R_L = 10kΩ to 0V		515	610	mV
		-40℃ ≤ T_A ≤ +125℃			675	
Output Voltage Low (V_{OL})		R_L = 10kΩ to 36V		435	515	mV
		-40℃ ≤ T_A ≤ +125℃			545	
Short Circuit Limit	I_{SOURCE}	V_{OUT} = 15V, R_L =10Ω to 0V	25	47		mA
	I_{SINK}	V_{OUT} = 15V, R_L =10Ω to 36V	26	51		mA
POWER SUPPLY						
Power Supply Rejection Ratio (1) (PSRR)		V_S = 4.5V to 36V	117	145		dB
		-40℃ ≤ T_A ≤ +125℃	115			
Quiescent Current/Amplifier (I_Q)		V_{OUT} = 18V		480	640	μA
		-40℃ ≤ T_A ≤ +125℃			820	
DYNAMIC PERFORMANCE						
Gain-Bandwidth Product (GBP)		A_V = +100		3.2		MHz
Slew Rate (SR)		A_V = +1, R_L = 10kΩ, 2V Output Step		1.7		V/μs
Overload Recovery Time		A_V = -100, R_L = 10kΩ, V_{IN} = 200mV (RET to 0V)		2		μs
Total Harmonic Distortion + Noise (THD+N)		f = 1kHz, A_V = +1, V_{OUT} = $2V_{p-p}$		0.0006		%
NOISE PERFORMANCE						
Input Voltage Noise		f = 0.1Hz to 10Hz		1		μV_{P-P}
Input Voltage Noise Density (e_n)		f = 0.1kHz		60		$nV/\sqrt{Hz}$
		f = 1kHz		60		
		f = 12kHz		22		

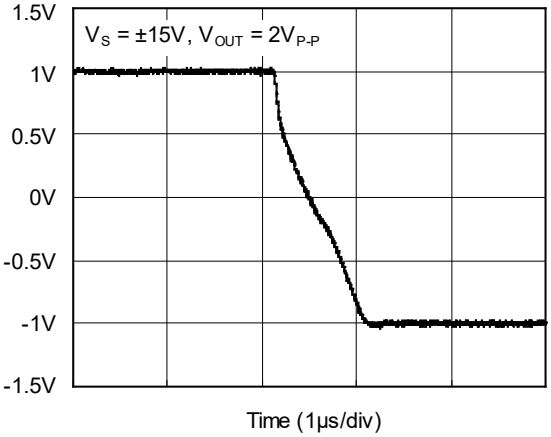
NOTE: 1. PSRR and CMRR are affected by the matching between external gain-setting resistor ratios.

TYPICAL PERFORMANCE CHARACTERISTICS

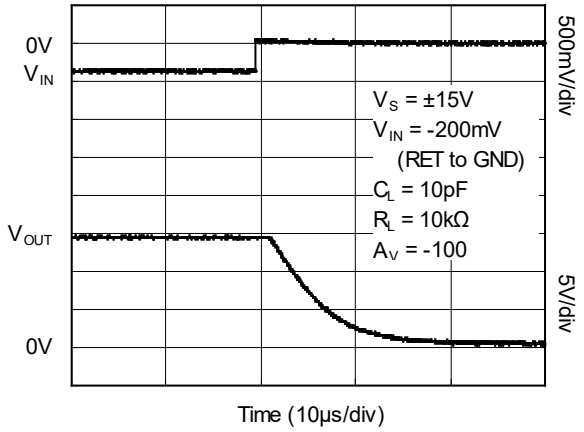
Slew Rate (UP)



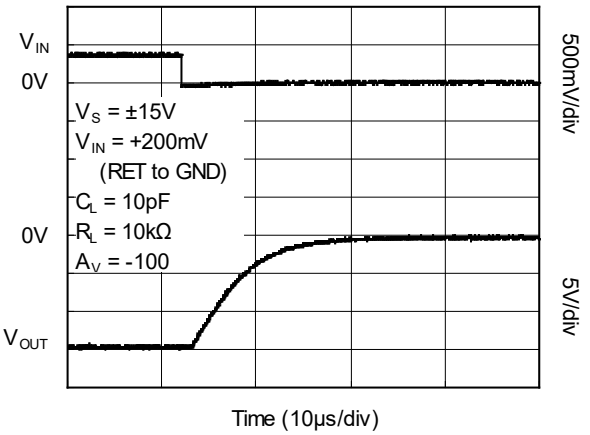
Slew Rate (DOWN)



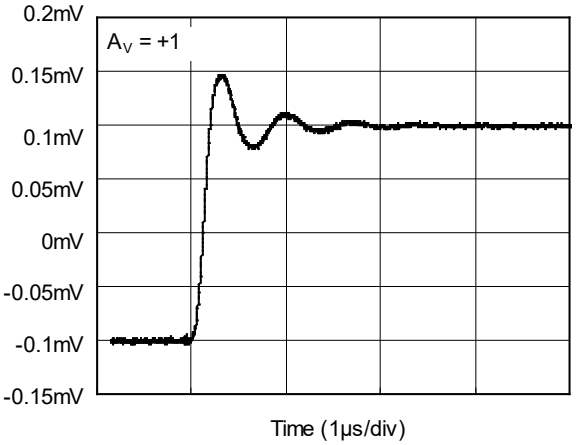
Positive Overload Recovery Time



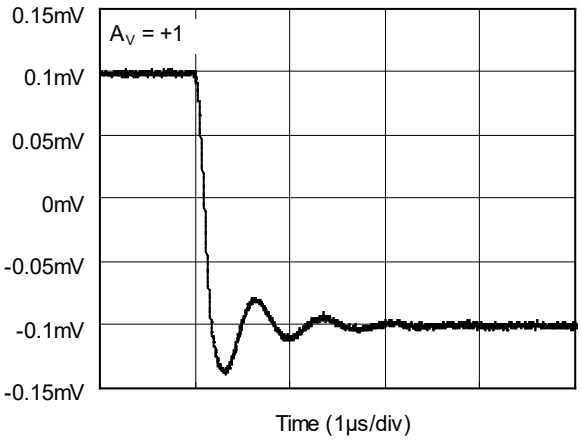
Negative Overload Recovery Time



Positive Settling Time

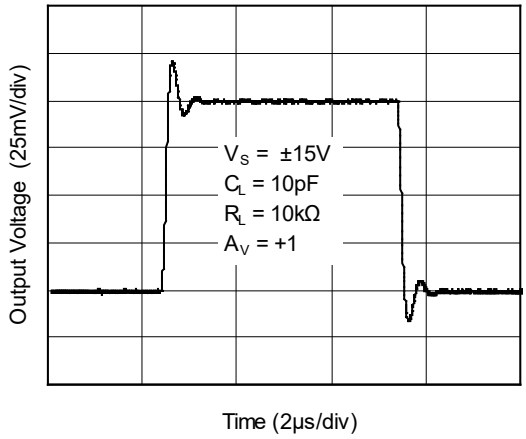


Negative Settling Time

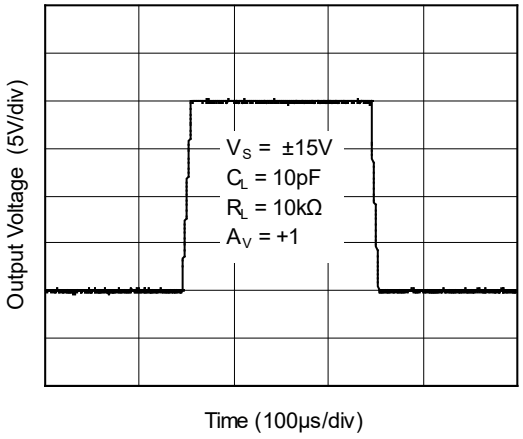


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

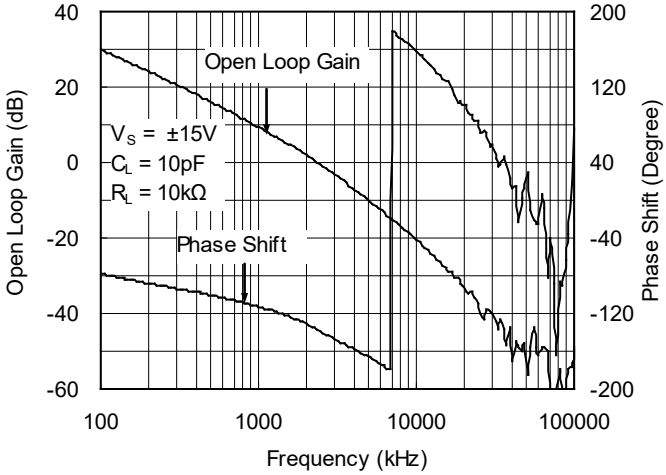
Small Signal Step Response



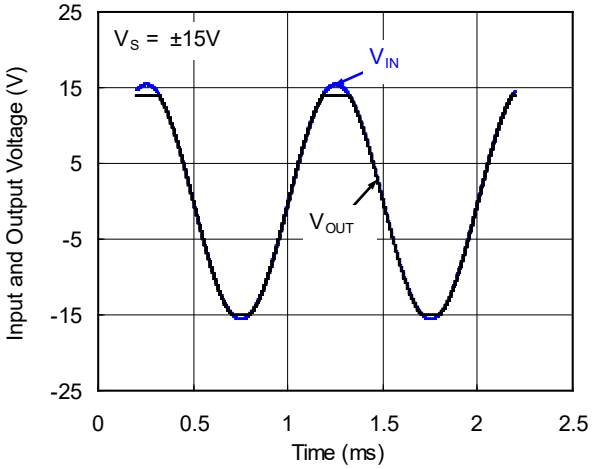
Large Signal Step Response



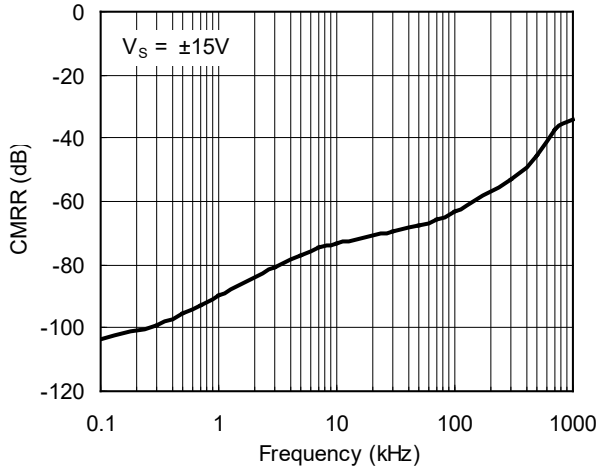
Open Loop Gain and Phase Shift vs. Frequency



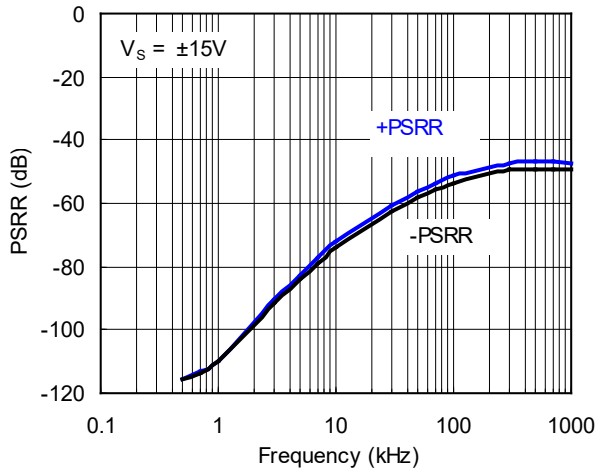
No Phase Reversal



Common Mode Rejection Ratio vs. Frequency

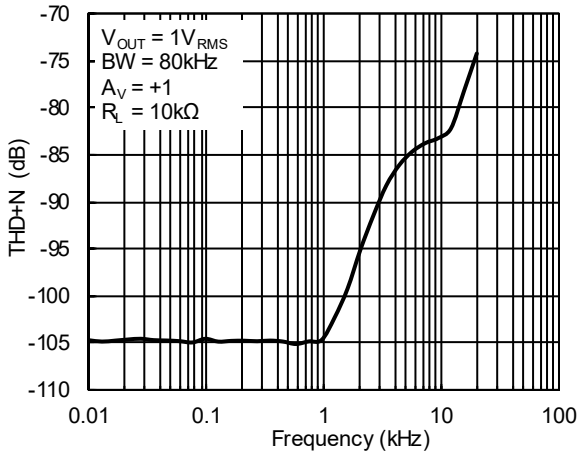


Power Supply Rejection Ratio vs. Frequency

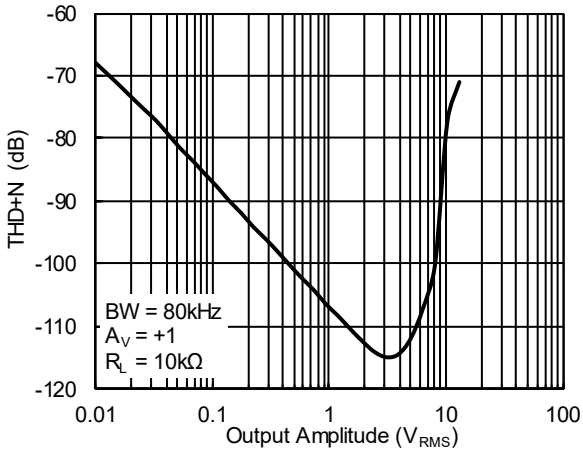


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

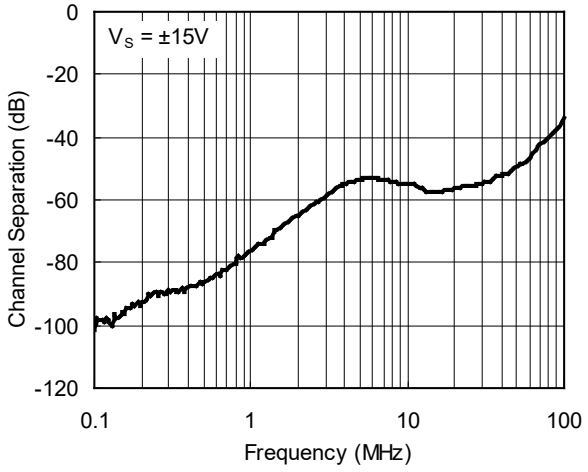
THD+N vs. Frequency



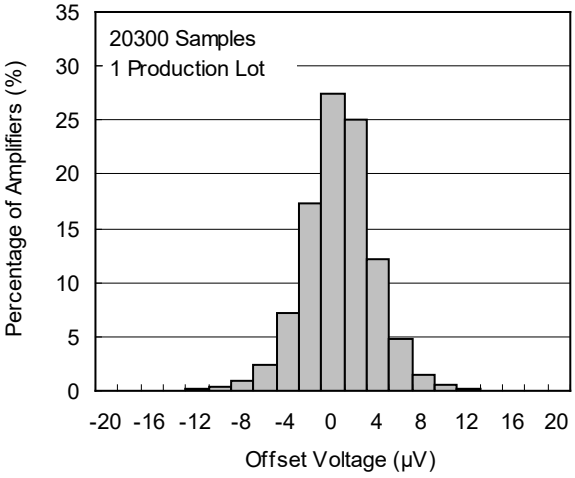
THD+N vs. Output Amplitude



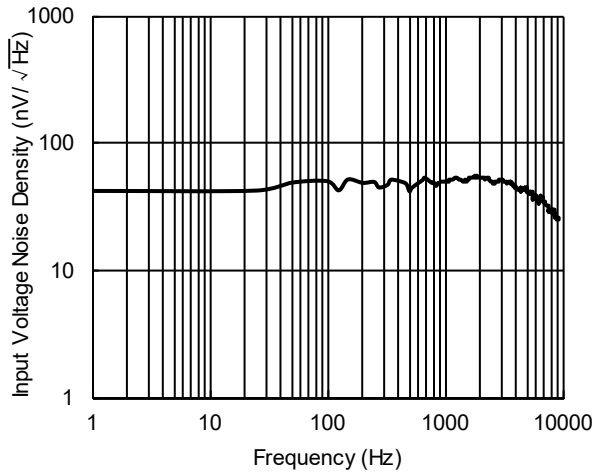
Channel Separation vs. Frequency



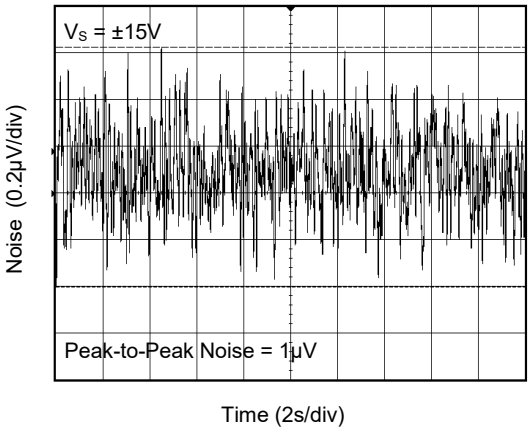
Offset Voltage Production Distribution



Input Voltage Noise Density vs. Frequency



0.1Hz to 10Hz Noise



REVISION HISTORY

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

JANUARY 2019 – REV.A to REV.A.1

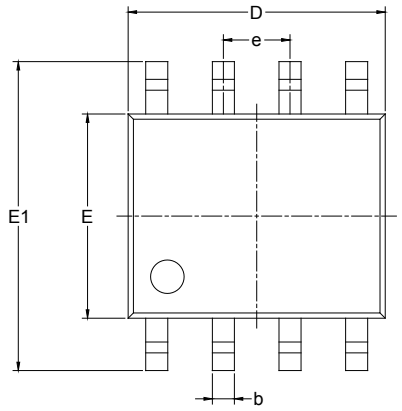
Deleted SGM8251	All
Changed differential input voltage	2

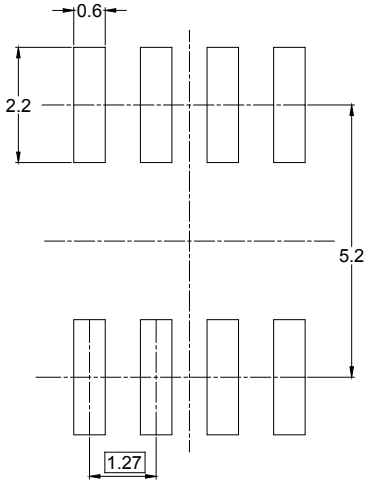
Changes from Original (SEPTEMBER 2015) to REV.A

Changed from product preview to production data	All

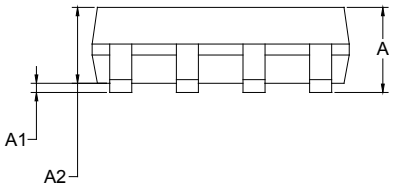
PACKAGE OUTLINE DIMENSIONS

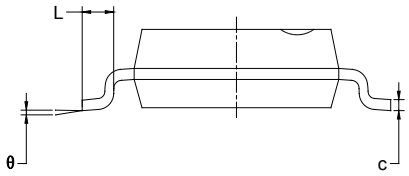
SOIC-8





RECOMMENDED LAND PATTERN (Unit: mm)

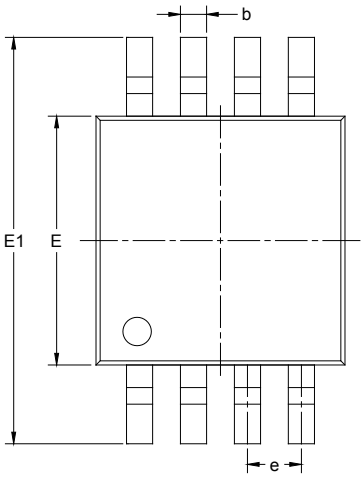


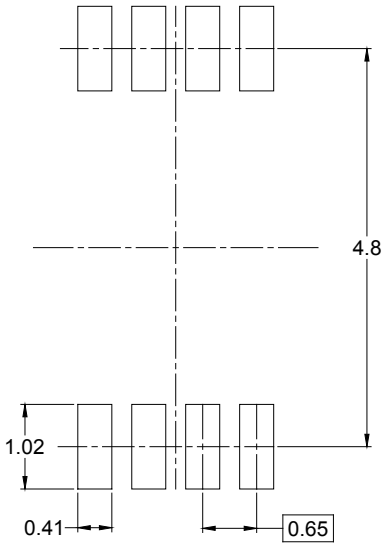


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

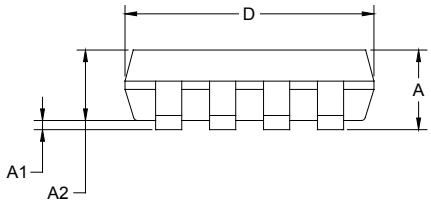
PACKAGE OUTLINE DIMENSIONS

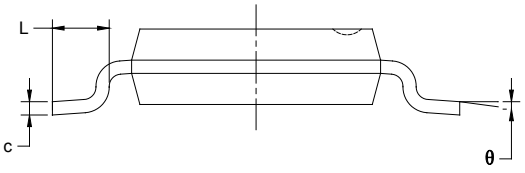
MSOP-8





RECOMMENDED LAND PATTERN (Unit: mm)

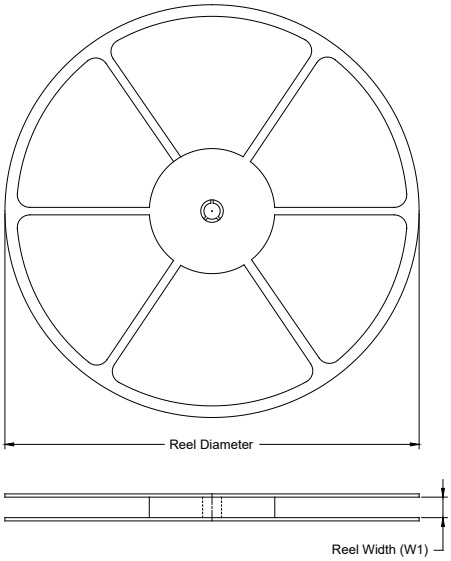




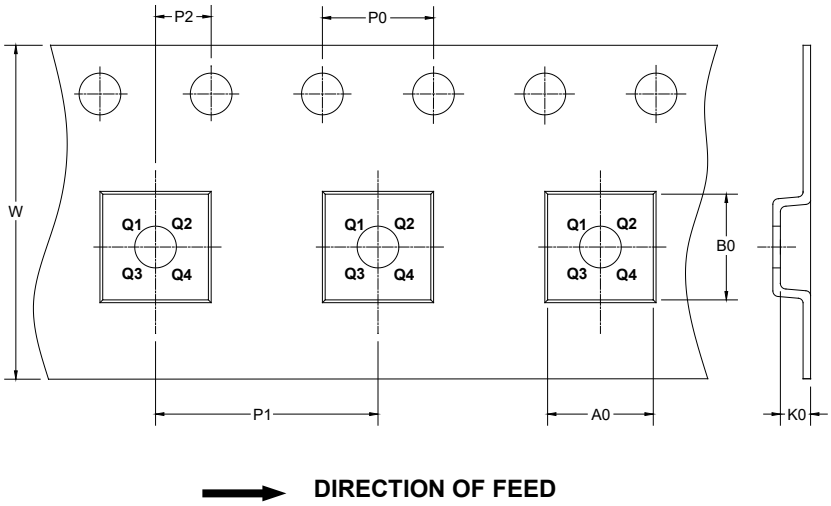
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026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

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



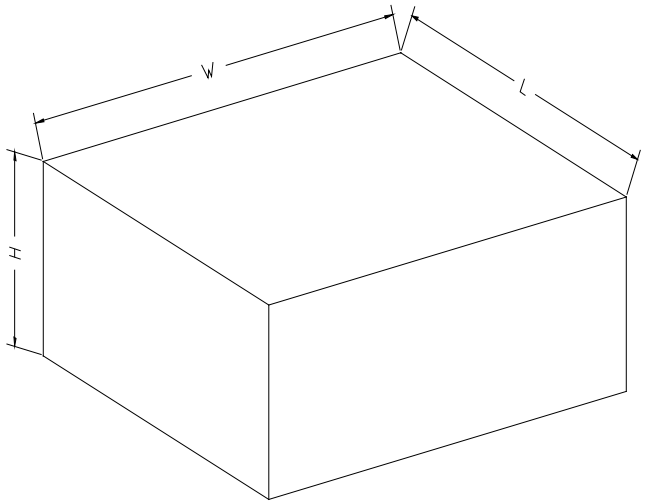
NOTE: The picture is only for reference. Please make the object as the standard.

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
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