



# SGM8295-1/SGM8295-2/SGM8295-4 9MHz, Low Noise, High Voltage, Precision Operational Amplifiers

## GENERAL DESCRIPTION

The SGM8295-1/2/4 are a family of single, dual and quad operational amplifiers, which are optimized for high voltage, low noise and low offset voltage operation. These devices can operate from 3.6V to 36V single supply or from  $\pm 1.8V$  to  $\pm 18V$  dual supplies, while consuming only 1.5mA quiescent current per amplifier.

They exhibit a high gain-bandwidth product of 9MHz and a slew rate of 8V/ $\mu$ s. The output swing is rail-to-rail with heavy loads. These specifications make the operational amplifiers appropriate for various applications.

The SGM8295-1 is available in Green SOT-23-5 and SOIC-8 packages. The SGM8295-2 is available in Green SOIC-8 and MSOP-8 packages. The SGM8295-4 is available in a Green SOIC-14 package. They are specified over the extended  $-40^{\circ}C$  to  $+125^{\circ}C$  temperature range.

## FEATURES

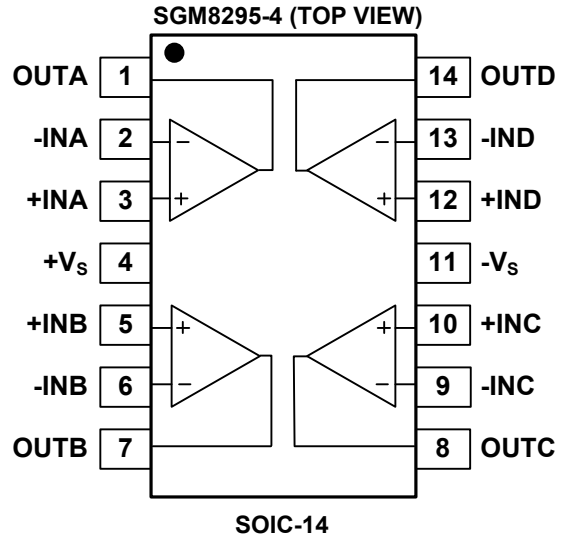
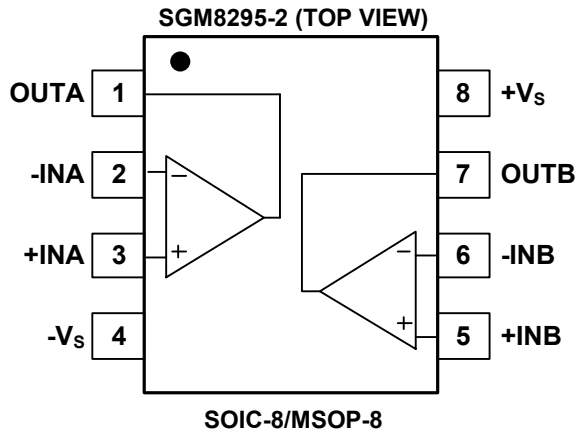
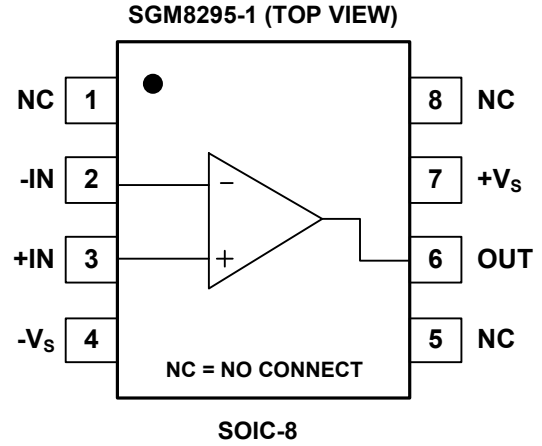
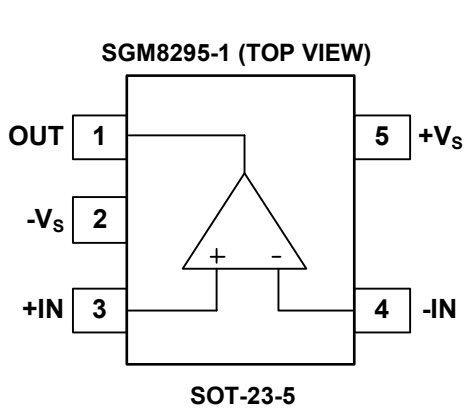
- **Low Noise:**  $4.5nV/\sqrt{Hz}$
- **Input Offset Voltage:** 250 $\mu$ V (MAX)
- **Low Bias Current:**  $\pm 1nA$  (TYP)
- **High Gain-Bandwidth Product:** 9MHz
- **High Slew Rate:** 8V/ $\mu$ s
- **High Open-Loop Gain:** 130dB at  $V_S = \pm 15V$
- **High PSRR:** 145dB
- **Settling Time to 0.1% with 1V Step:** 1 $\mu$ s
- **Overload Recovery Time:** 10 $\mu$ s
- **Rail-to-Rail Output**
- **Supply Voltage Range:**  
3.6V to 36V or  $\pm 1.8V$  to  $\pm 18V$
- **Input Common Mode Voltage Range:**  
 $(-V_S) + 1.5V$  to  $(+V_S) - 2V$
- **Low Supply Current:** 1.5mA/Amplifier (TYP)
- **$-40^{\circ}C$  to  $+125^{\circ}C$  Operating Temperature Range**
- **Small Packaging:**
  - SGM8295-1 Available in Green SOT-23-5 and SOIC-8 Packages
  - SGM8295-2 Available in Green SOIC-8 and MSOP-8 Packages
  - SGM8295-4 Available in a Green SOIC-14 Package

## APPLICATIONS

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



**PIN CONFIGURATIONS**



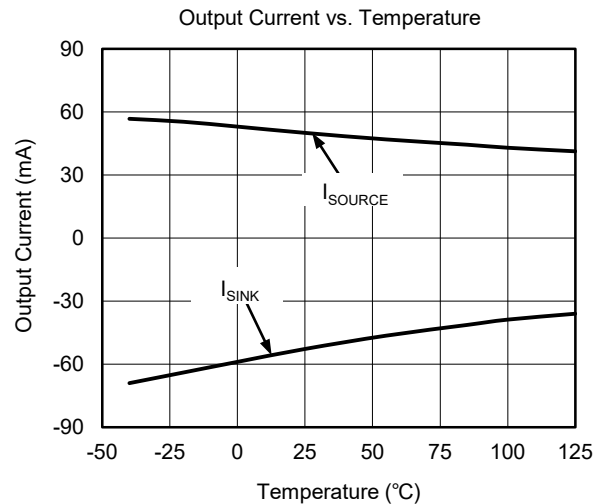
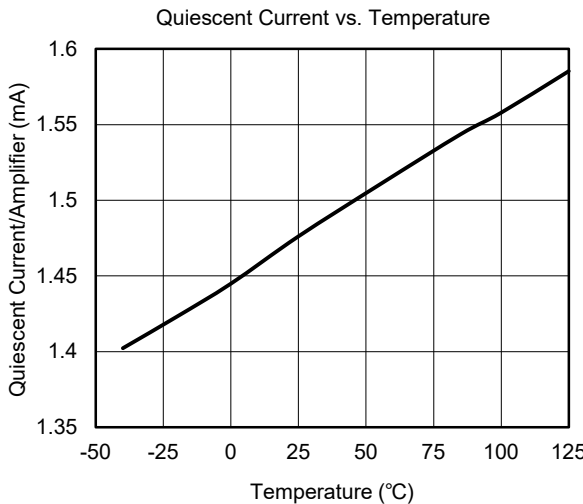
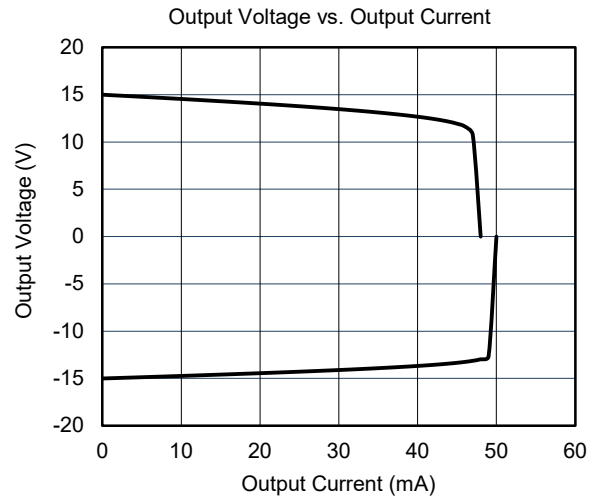
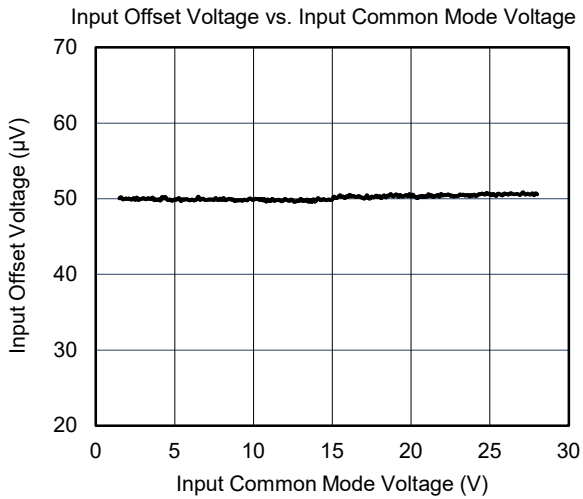
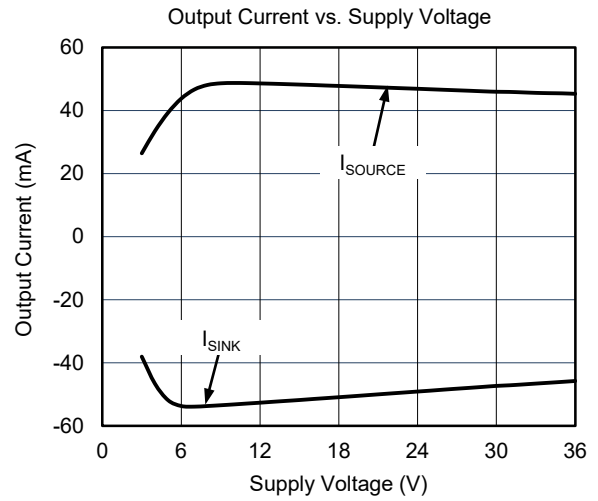
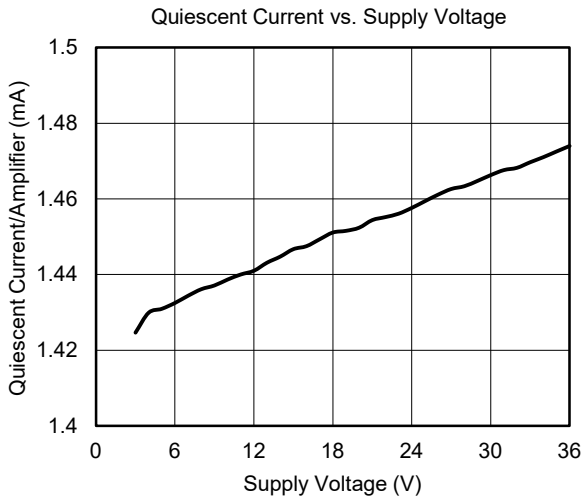
**ELECTRICAL CHARACTERISTICS**

(At  $T_A = +25^\circ\text{C}$ ,  $V_S = \pm 5\text{V}$  to  $V_S = \pm 15\text{V}$ ,  $V_{CM} = 0\text{V}$ ,  $V_{OUT} = 0\text{V}$  and  $R_L$  connected to  $0\text{V}$ , Full =  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ , unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
<b>Input Characteristics</b>							
Input Offset Voltage	$V_{OS}$		+25°C		50	250	$\mu\text{V}$
			Full			360	
Input Bias Current	$I_B$	$V_{CM} = V_S/2$	+25°C		$\pm 1$	$\pm 17$	nA
			Full			$\pm 52$	
Input Offset Current	$I_{OS}$	$V_{CM} = V_S/2$	+25°C		$\pm 1$	$\pm 21$	nA
			Full			$\pm 45$	
Input Common Mode Voltage Range	$V_{CM}$		Full	$(-V_S) + 1.5$		$(+V_S) - 2$	V
Common Mode Rejection Ratio	CMRR	$(-V_S) + 1.5\text{V} \leq V_{CM} \leq (+V_S) - 2\text{V}$	+25°C	112	140		dB
			Full	110			
Open-Loop Voltage Gain	$A_{OL}$	$V_S = \pm 5\text{V}, V_{OUT} = \pm 2.5\text{V}, R_L = 10\text{k}\Omega$	+25°C	118	135		dB
			Full	116			
		$V_S = \pm 15\text{V}, V_{OUT} = \pm 10\text{V}, R_L = 10\text{k}\Omega$	+25°C	124	140		
			Full	122			
		$V_S = \pm 5\text{V}, V_{OUT} = \pm 2.5\text{V}, R_L = 2\text{k}\Omega$	+25°C	108	130		
			Full	106			
		$V_S = \pm 15\text{V}, V_{OUT} = \pm 10\text{V}, R_L = 2\text{k}\Omega$	+25°C	118	130		
			Full	110			
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$		Full		0.4		$\mu\text{V}/^\circ\text{C}$
<b>Output Characteristics</b>							
Output Voltage Swing from Rail	$V_{OUT}$	$V_S = \pm 15\text{V}, R_L = 10\text{k}\Omega$	+25°C		65	95	mV
			Full			125	
		$V_S = \pm 15\text{V}, R_L = 2\text{k}\Omega$	+25°C		310	450	
			Full			600	
Output Short-Circuit Current	$I_{SC}$		+25°C	$\pm 28$	$\pm 50$		mA
<b>Power Supply</b>							
Operating Voltage Range	$V_S$		Full	3.6		36	V
Quiescent Current/Amplifier	$I_Q$	$I_{OUT} = 0\text{mA}$	+25°C		1.5	2	mA
			Full			2.2	
Power Supply Rejection Ratio	PSRR	$V_S = 3\text{V to } 38\text{V}$	+25°C	121	145		dB
			Full	119			
<b>Dynamic Performance</b>							
Gain-Bandwidth Product	GBP	$V_{OUT} = 100\text{mV}_{P-P}, R_L = 2\text{k}\Omega$	+25°C		9		MHz
Slew Rate	SR	$R_L = 2\text{k}\Omega$	+25°C		8		V/ $\mu\text{s}$
Settling Time to 0.1%	$t_s$	$V_{IN} = 1\text{V Step}, R_L = 2\text{k}\Omega, G = +1$	+25°C		1		$\mu\text{s}$
Overload Recovery Time		$R_L = 2\text{k}\Omega, V_{IN} \times G = V_S$	+25°C		10		$\mu\text{s}$
Phase Margin	$\phi_O$	$V_{OUT} = 100\text{mV}_{P-P}, R_L = 2\text{k}\Omega, C_L = 10\text{pF}$	+25°C		45		°
Total Harmonic Distortion + Noise	THD+N	$V_{IN} = 1\text{V}_{RMS}, G = +1, R_L = 2\text{k}\Omega, f = 1\text{kHz}$	+25°C		0.0001		%
<b>Noise</b>							
Input Voltage Noise		$f = 0.1\text{Hz to } 10\text{Hz}$	+25°C		280		$\text{nV}_{P-P}$
Input Voltage Noise Density	$e_n$	$f = 1\text{kHz}$	+25°C		4.5		$\text{nV}/\sqrt{\text{Hz}}$
Input Current Noise Density	$i_n$	$f = 1\text{kHz}$	+25°C		2		$\text{pA}/\sqrt{\text{Hz}}$

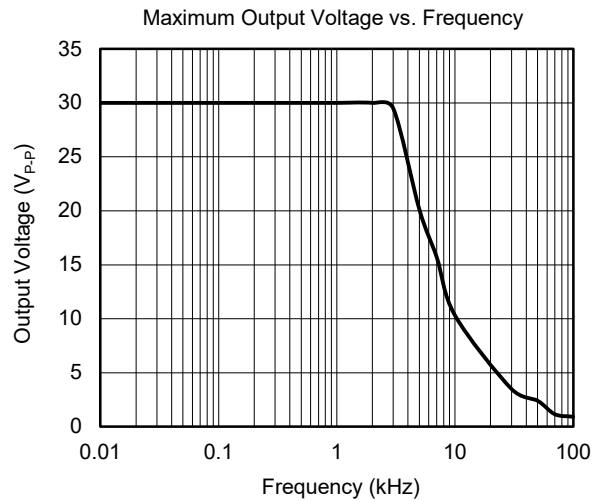
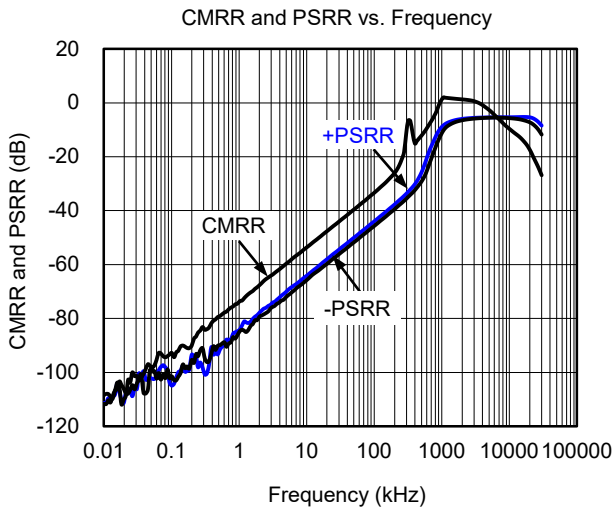
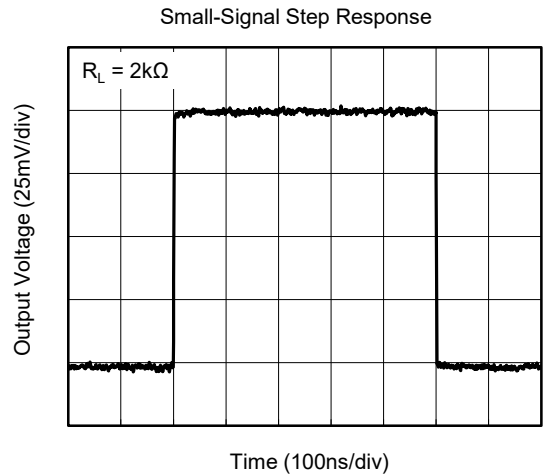
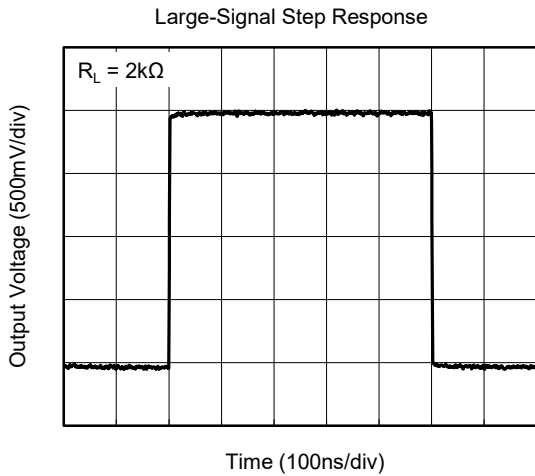
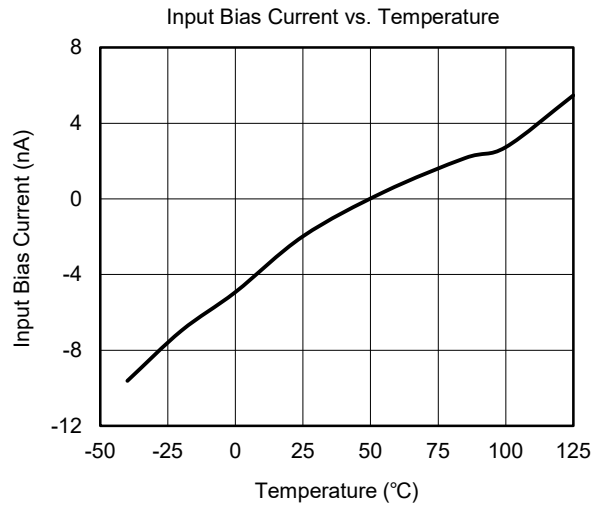
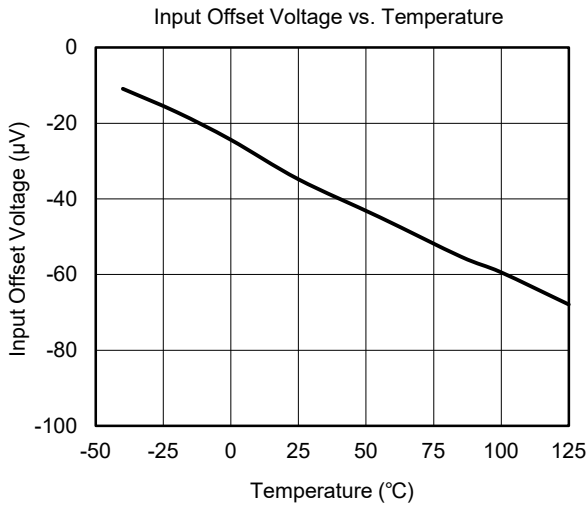
**TYPICAL PERFORMANCE CHARACTERISTICS**

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



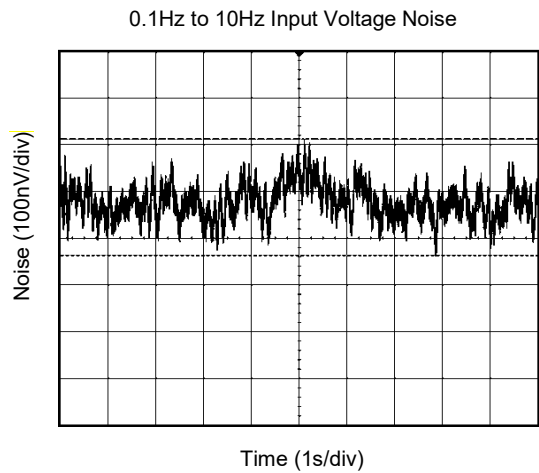
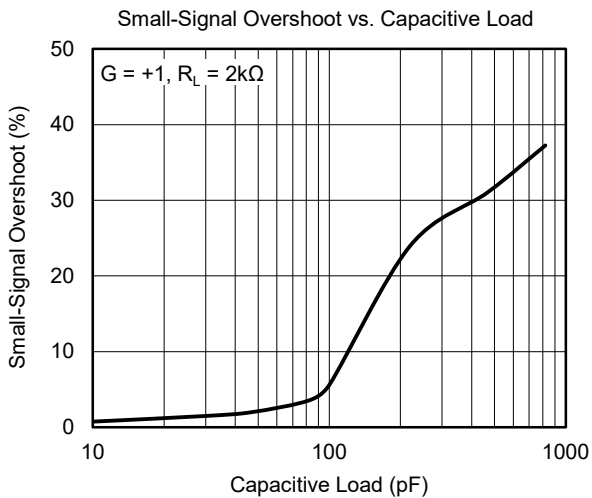
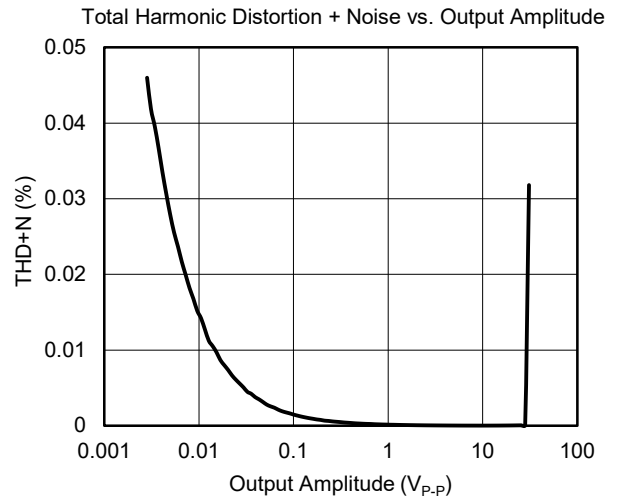
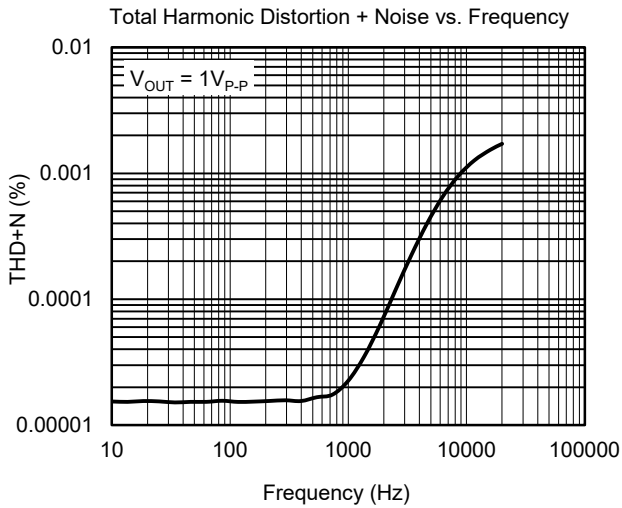
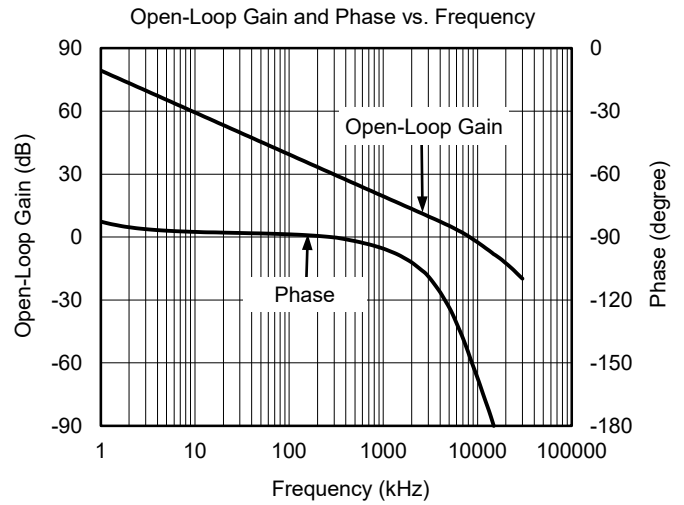
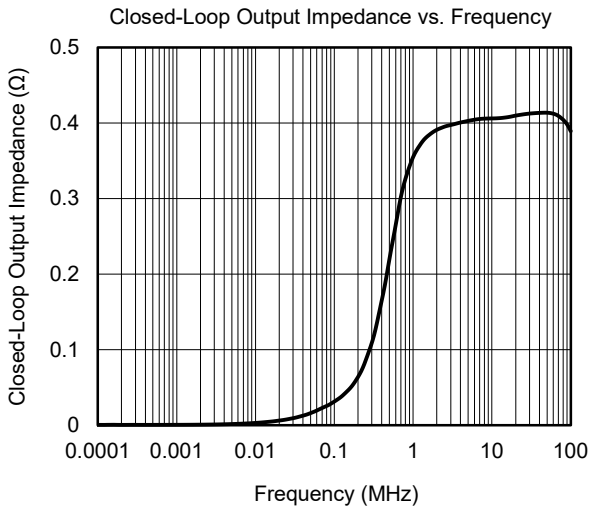
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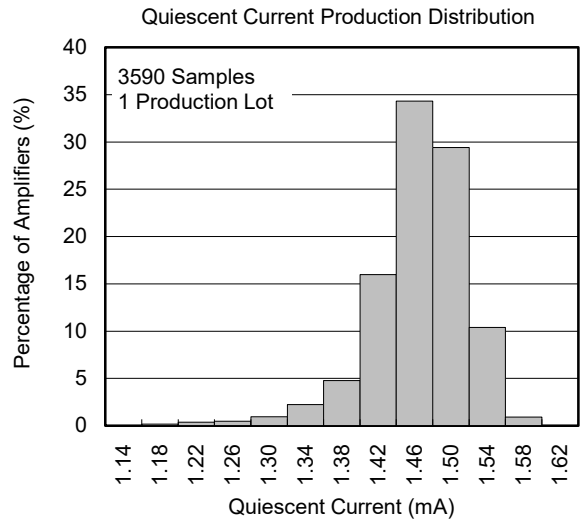
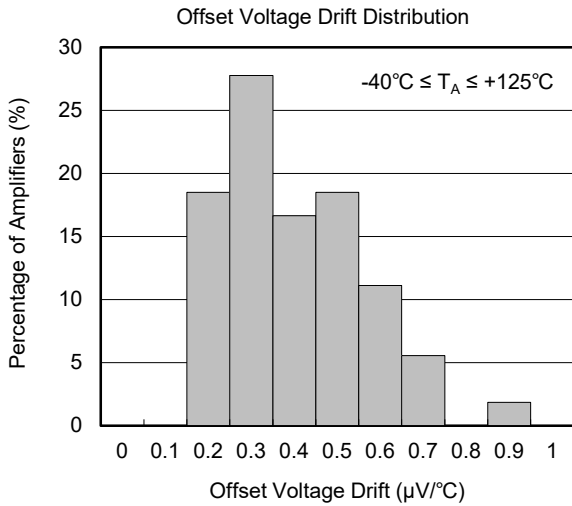
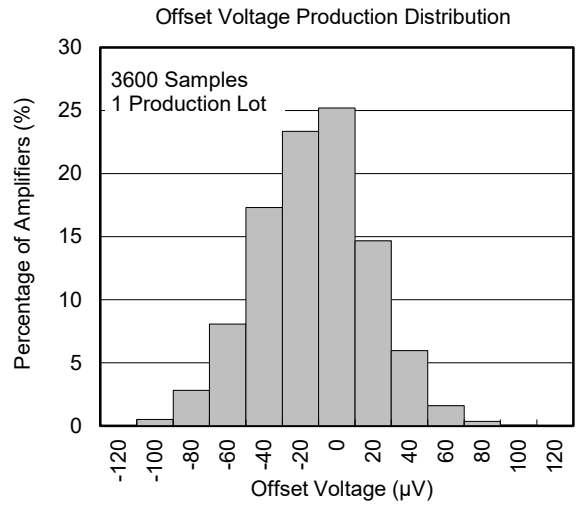
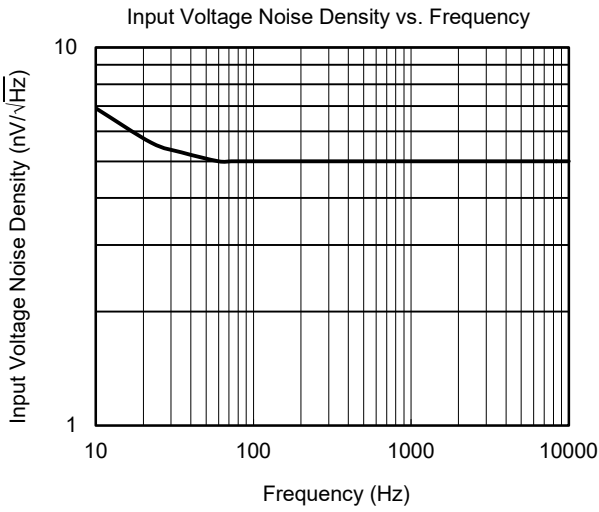
**TYPICAL PERFORMANCE CHARACTERISTICS (continued)**

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.





## **REVISION HISTORY**

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

<b>AUGUST 2017 – REV.A to REV.A.1</b>	<b>Page</b>
Updated open-loop gain and phase vs. frequency .....	7

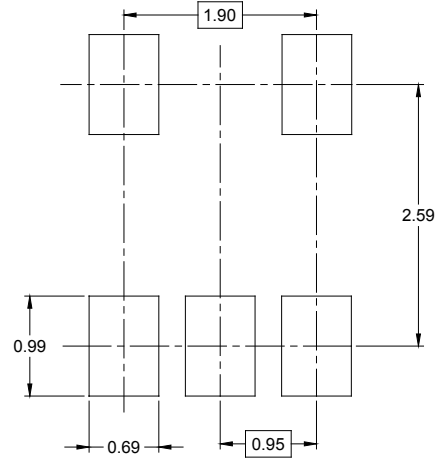
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<b>Changes from Original (AUGUST 2017) to REV.A</b>	<b>Page</b>
Changed from product preview to production data .....	All

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PACKAGE OUTLINE DIMENSIONS

SOT-23-5



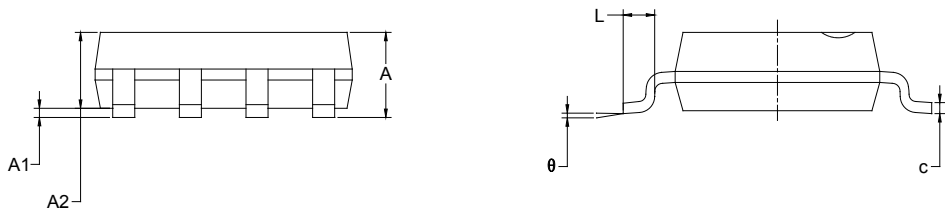
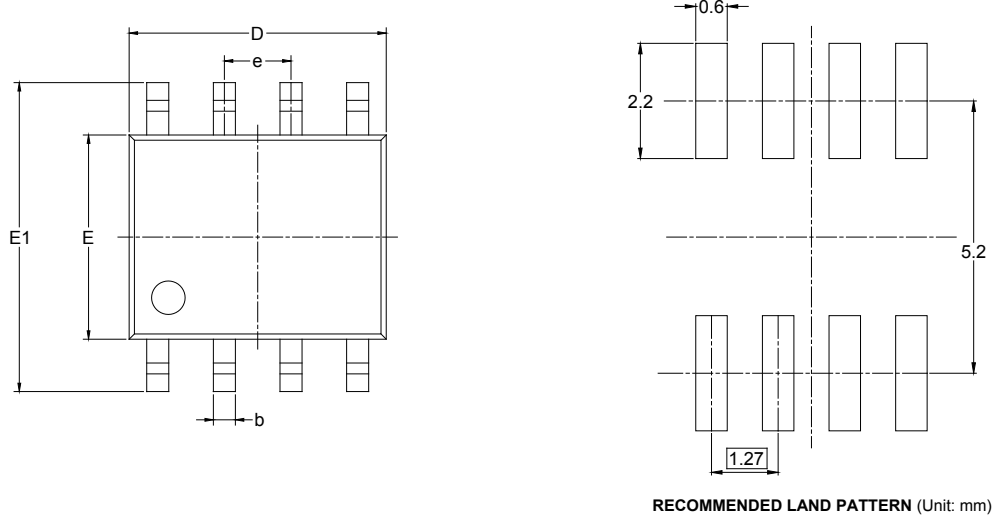
RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.900 BSC		0.075 BSC	
L	0.300	0.600	0.012	0.024
$\theta$	0°	8°	0°	8°

PACKAGE OUTLINE DIMENSIONS

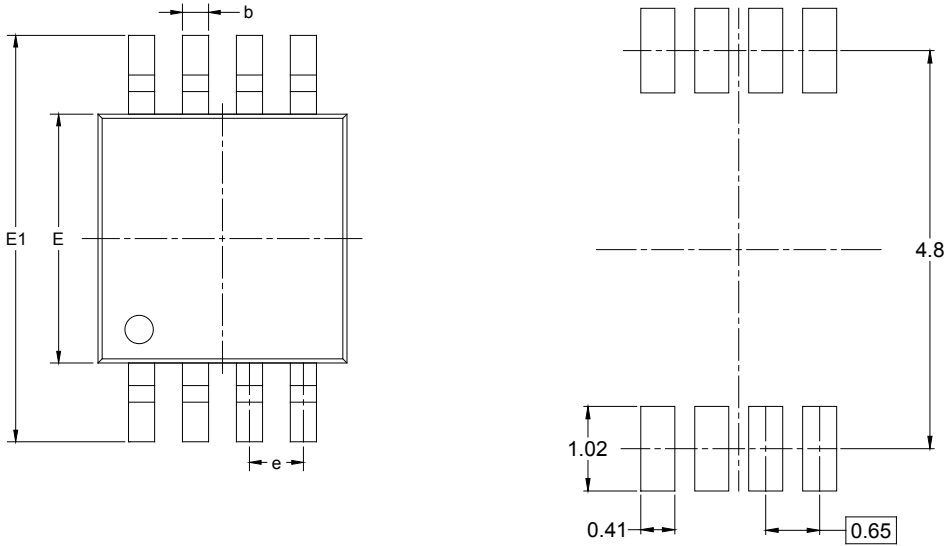
SOIC-8



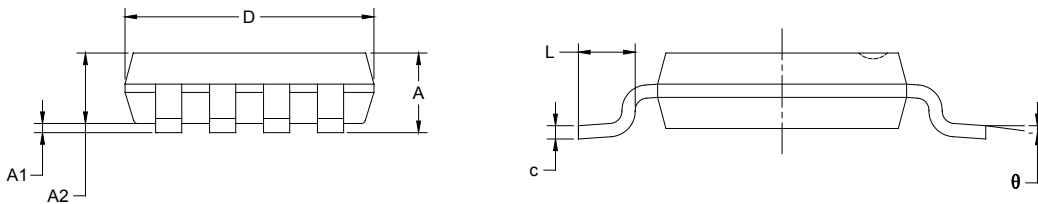
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

PACKAGE OUTLINE DIMENSIONS

MSOP-8



RECOMMENDED LAND PATTERN (Unit: mm)

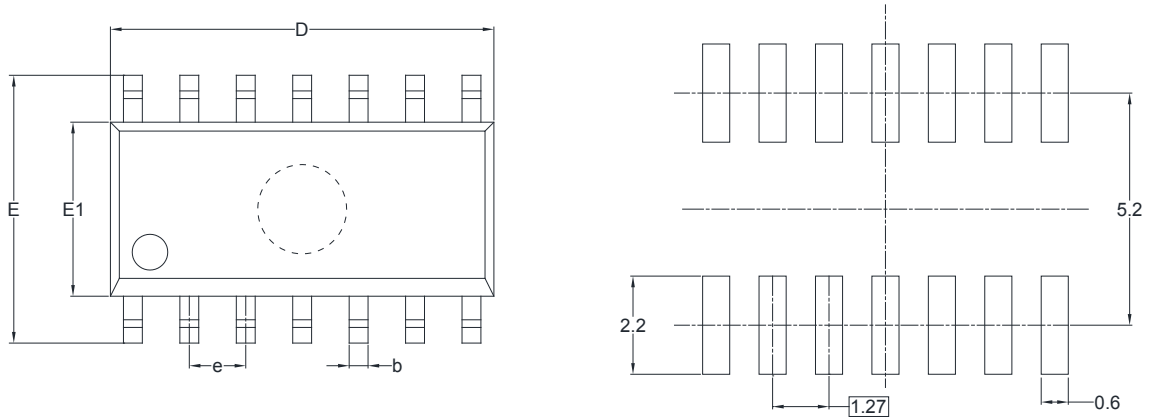


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026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

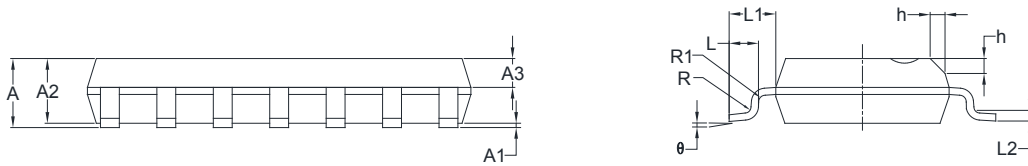
# PACKAGE INFORMATION

## PACKAGE OUTLINE DIMENSIONS

### SOIC-14



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
A2	1.25	1.65	0.049	0.065
A3	0.55	0.75	0.022	0.030
b	0.36	0.49	0.014	0.019
D	8.53	8.73	0.336	0.344
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
L	0.45	0.80	0.018	0.032
L1	1.04 REF		0.040 REF	
L2	0.25 BSC		0.01 BSC	
R	0.07		0.003	
R1	0.07		0.003	
h	0.30	0.50	0.012	0.020
θ	0°	8°	0°	8°

# PACKAGE INFORMATION

## 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
SOT-23-5	7"	9.5	3.20	3.20	1.40	4.0	4.0	2.0	8.0	Q3
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
SOIC-14	13"	16.4	6.60	9.30	2.10	4.0	8.0	2.0	16.0	Q1

D00001

# 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
7" (Option)	368	227	224	8
7"	442	410	224	18
13"	386	280	370	5

DD0002