

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

GENERAL DESCRIPTION

The SGM8295-1 (single), SGM8295-2 (dual) and SGM8295-4 (quad) are low noise, low offset voltage and high voltage operational amplifiers, which can be designed into a wide range of applications. The SGM8295-1/2/4 have a high gain-bandwidth product of 9MHz, a slew rate of 8V/ μ s, and a quiescent current of 1.5mA/amplifier at wide power supply range.

The SGM8295-1/2/4 are designed to provide optimal performance in low noise systems. They provide rail-to-rail output swing into heavy loads.

The single version SGM8295-1 is available in Green SOT-23-5 and SOIC-8 packages. The dual version SGM8295-2 is available in Green SOIC-8 and MSOP-8 packages. The quad version SGM8295-4 is available in a Green SOIC-14 package. They are specified over the extended -40°C to +125°C temperature range.

FEATURES

- **Low Noise:** 4.5nV/ $\sqrt{\text{Hz}}$
- **Rail-to-Rail Output**
- **Very Low Offset Voltage:** 250 μ V (MAX)
- **Low Bias Current:** \pm 1nA (TYP)
- **High Gain-Bandwidth Product:** 9MHz
- **High Slew Rate:** 8V/ μ s
- **High Open-Loop Gain:** 130dB at $V_S = \pm$ 15V
- **High PSRR:** 145dB
- **Settling Time to 0.1% with 1V Step:** 1 μ s
- **Overload Recovery Time:** 10 μ s
- **Operating 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°C to +125°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

SGM8295-1/SGM8295-2 SGM8295-4

9MHz, Low Noise, High Voltage, Precision Operational Amplifiers

PACKAGE/ORDERING INFORMATION

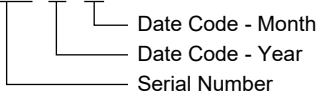
MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8295-1	SOT-23-5	-40°C to +125°C	SGM8295-1XN5G/TR	G62XX	Tape and Reel, 3000
	SOIC-8	-40°C to +125°C	SGM8295-1XS8G/TR	SGM 82951XS8 XXXXX	Tape and Reel, 2500
SGM8295-2	SOIC-8	-40°C to +125°C	SGM8295-2XS8G/TR	SGM 82952XS8 XXXXX	Tape and Reel, 2500
	MSOP-8	-40°C to +125°C	SGM8295-2XMS8G/TR	SGM82952 XMS8 XXXXX	Tape and Reel, 4000
SGM8295-4	SOIC-14	-40°C to +125°C	SGM8295-4XS14G/TR	SGM82954XS14 XXXXX	Tape and Reel, 2500

MARKING INFORMATION

NOTE: XX = Date Code. XXXXX = Date Code and Vendor Code.

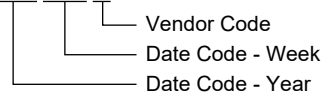
SOT-23-5

YYY X X



SOIC-8/MSOP-8/SOIC-14

XXXXX



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°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10s)	+260°C
ESD Susceptibility	
HBM	4000V
MM	200V
CDM	1000V

RECOMMENDED OPERATING CONDITIONS

Supply Voltage Range	3.6V to 36V
Operating Temperature Range	-40°C to +125°C

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.

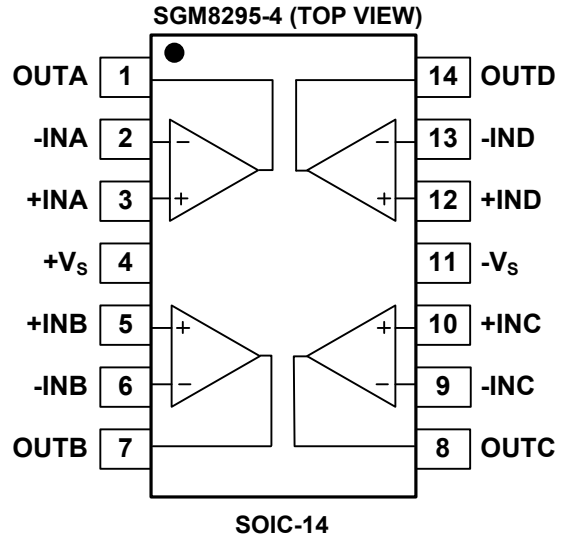
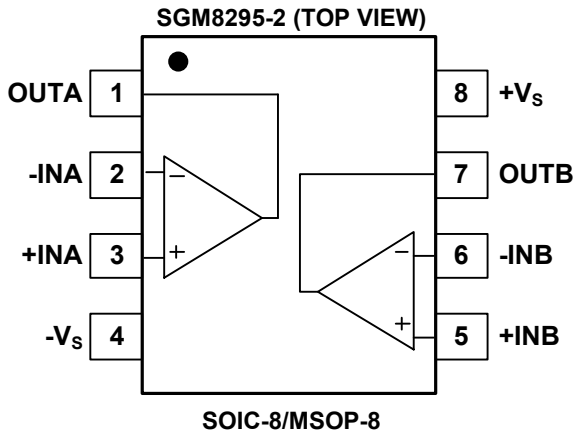
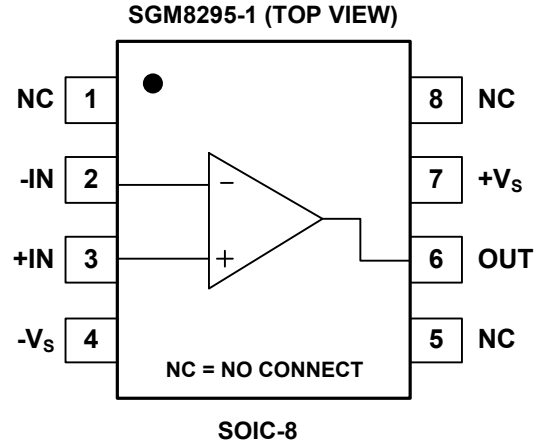
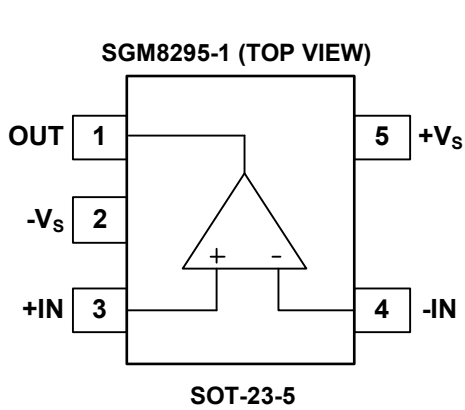
ESD SENSITIVITY CAUTION

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 CONFIGURATIONS



SGM8295-1/SGM8295-2
SGM8295-4

9MHz, Low Noise, High Voltage,
Precision Operational Amplifiers

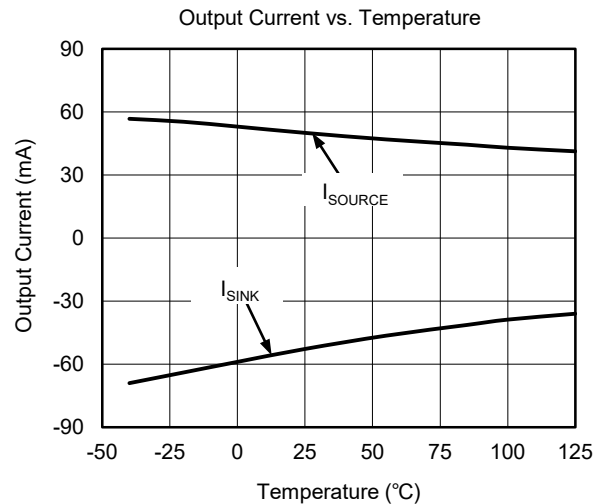
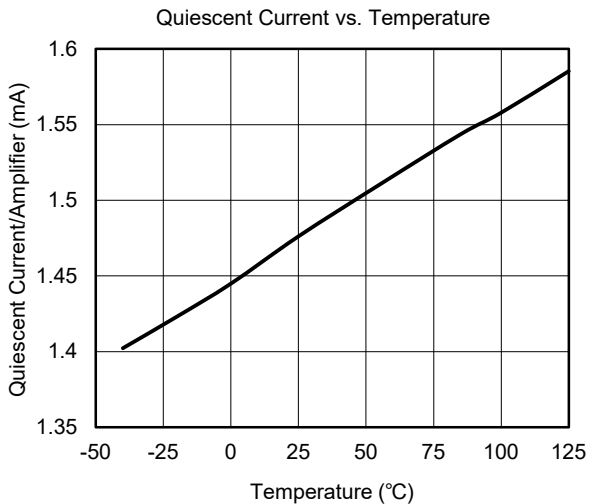
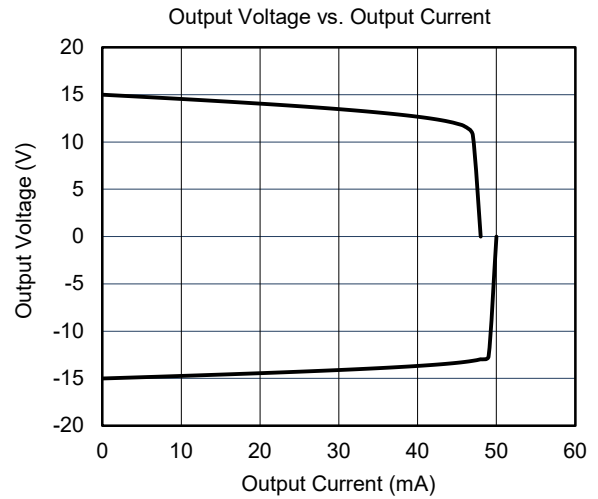
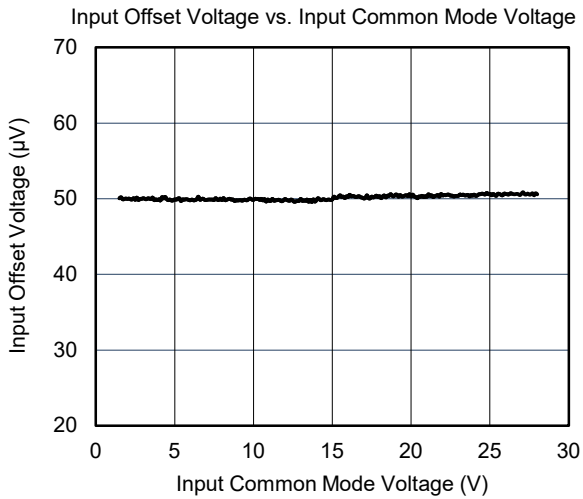
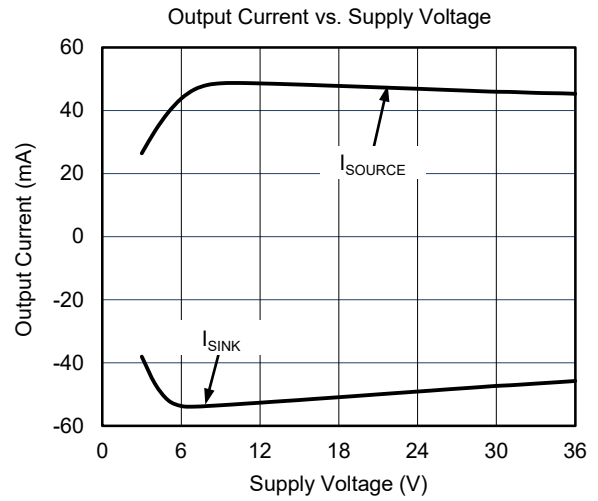
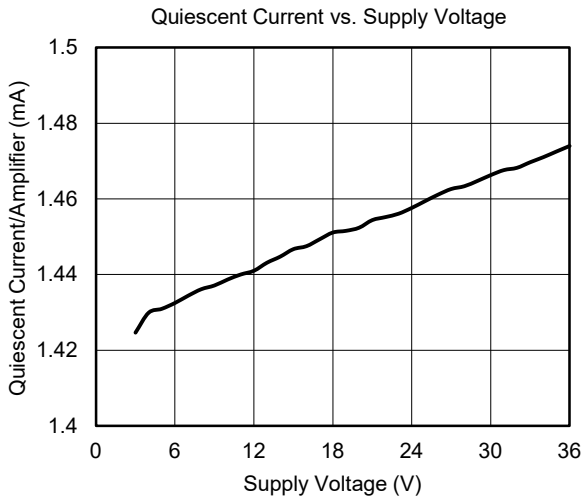
ELECTRICAL CHARACTERISTICS

(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 0V , Full = -40°C to $+125^\circ\text{C}$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Input Characteristics							
Input Offset Voltage	V_{OS}		+25°C		50	250	μV
			Full			360	
Input Bias Current	I_B	$V_{CM} = V_S/2$	+25°C		± 1	± 17	nA
			Full			± 52	
Input Offset Current	I_{OS}	$V_{CM} = V_S/2$	+25°C		± 1	± 21	nA
			Full			± 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		$\mu\text{V}/^\circ\text{C}$
Output Characteristics							
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	± 28	± 50		mA
Power Supply							
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 38V	+25°C	121	145		dB
			Full	119			
Dynamic Performance							
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		$\text{V}/\mu\text{s}$
Settling Time to 0.1%	t_s	$V_{IN} = 1\text{V}$ Step, $R_L = 2\text{k}\Omega$, $G = +1$	+25°C		1		μs
Overload Recovery Time		$R_L = 2\text{k}\Omega$, $V_{IN} \times G = V_S$	+25°C		10		μs
Phase Margin	ϕ_O	$V_{OUT} = 100\text{mV}_{P-P}$, $R_L = 2\text{k}\Omega$, $C_L = 10\text{pF}$	+25°C		45		$^\circ$
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		%
Noise							
Input Voltage Noise		$f = 0.1\text{Hz}$ to 10Hz	+25°C		280		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		$\text{pA}/\sqrt{\text{Hz}}$

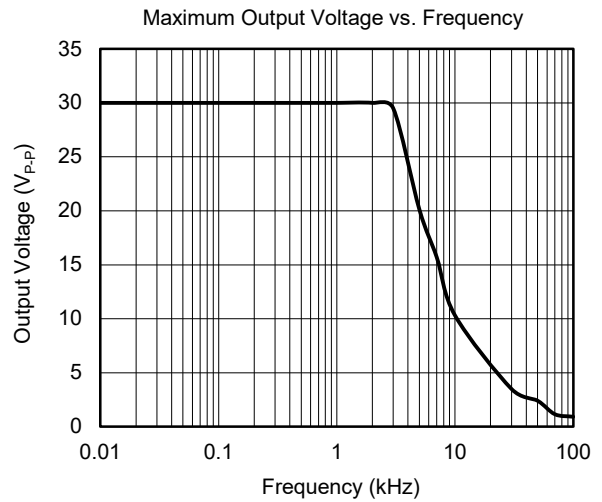
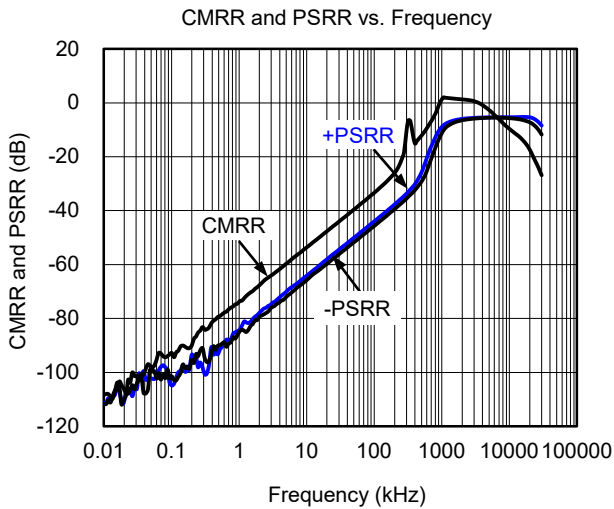
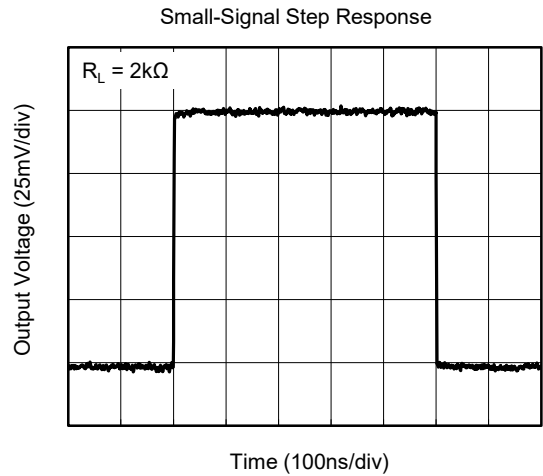
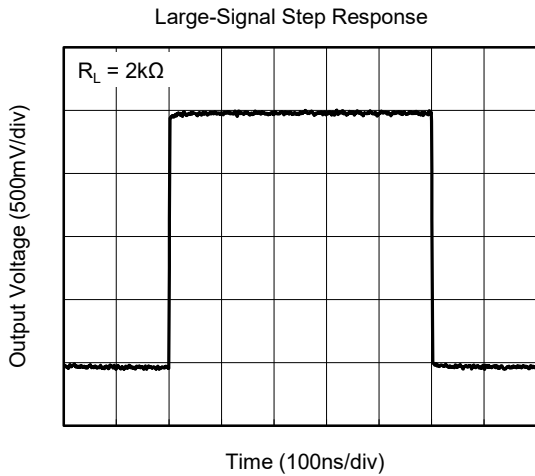
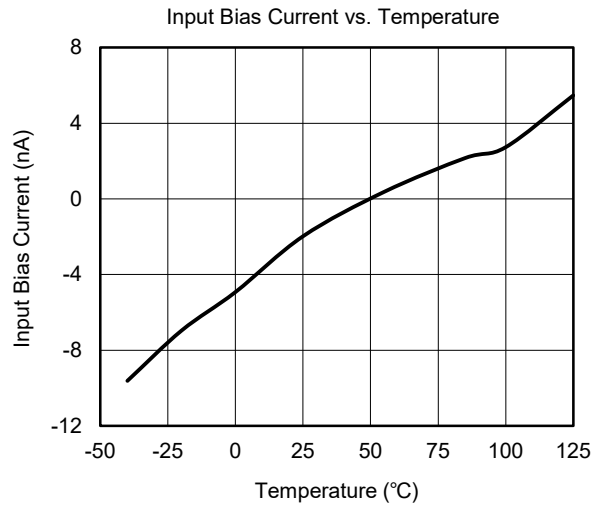
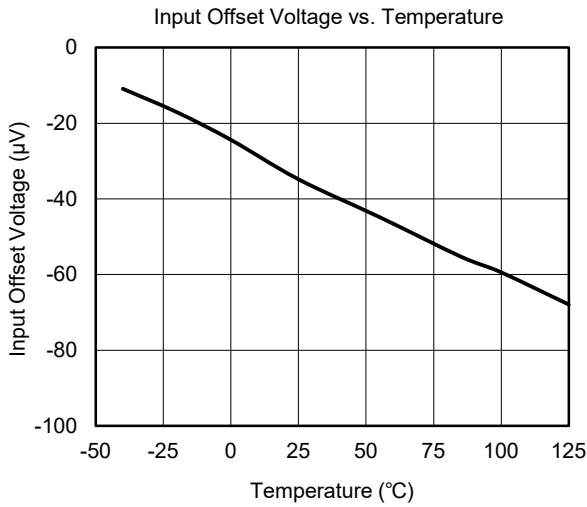
TYPICAL PERFORMANCE CHARACTERISTICS

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



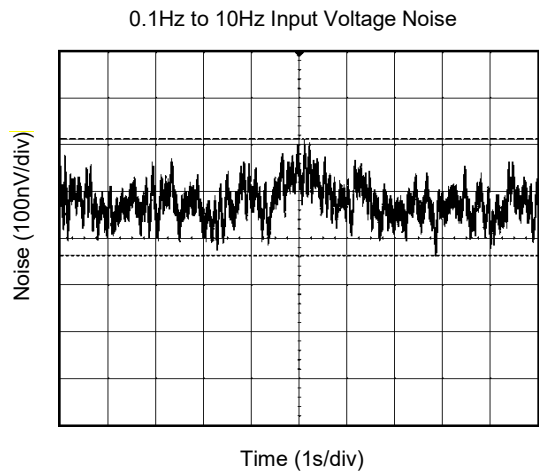
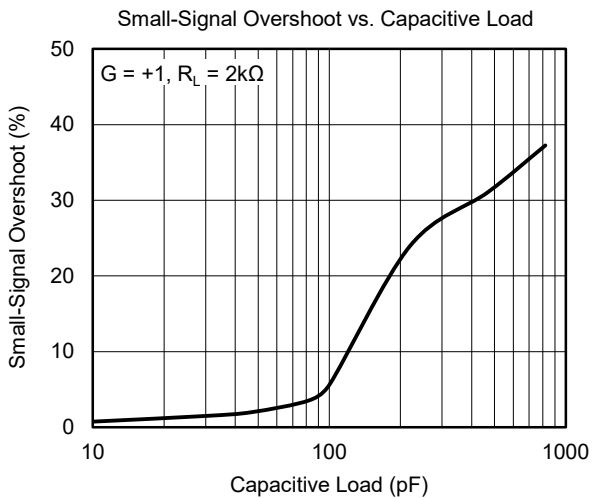
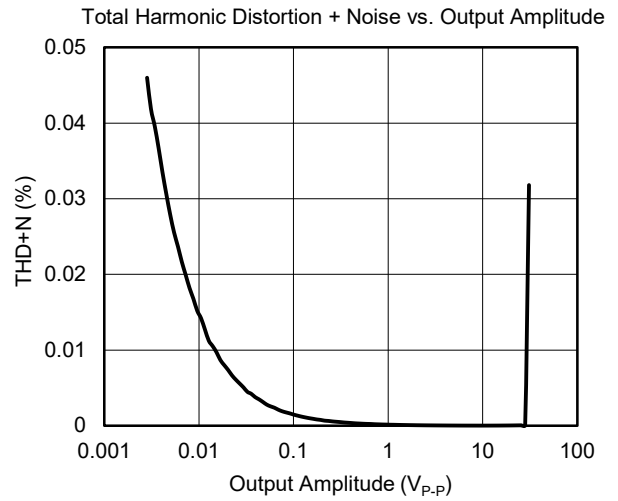
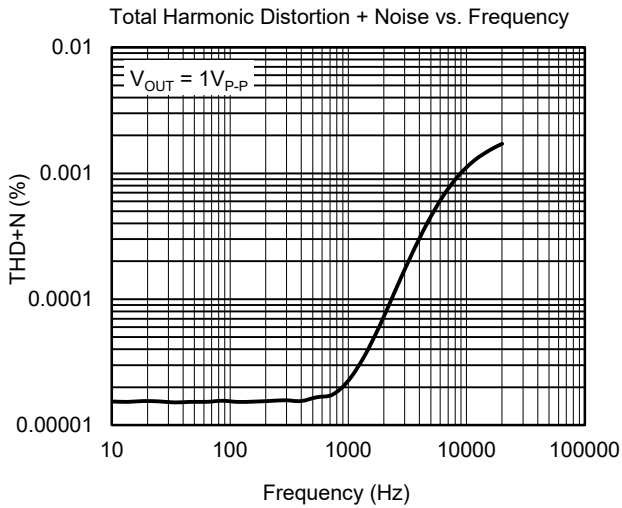
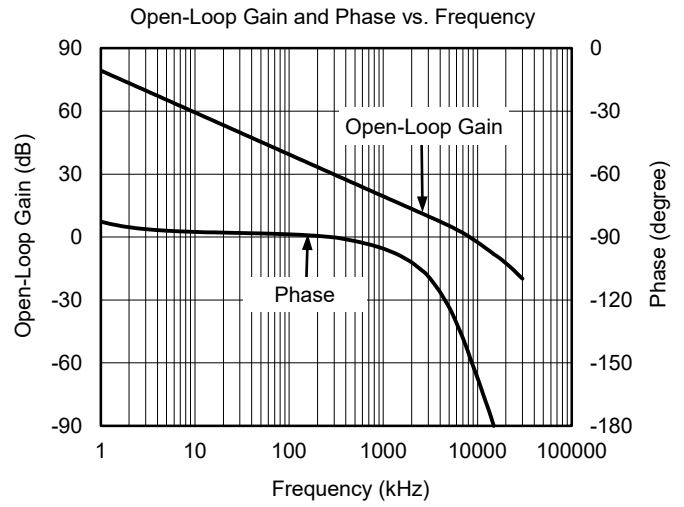
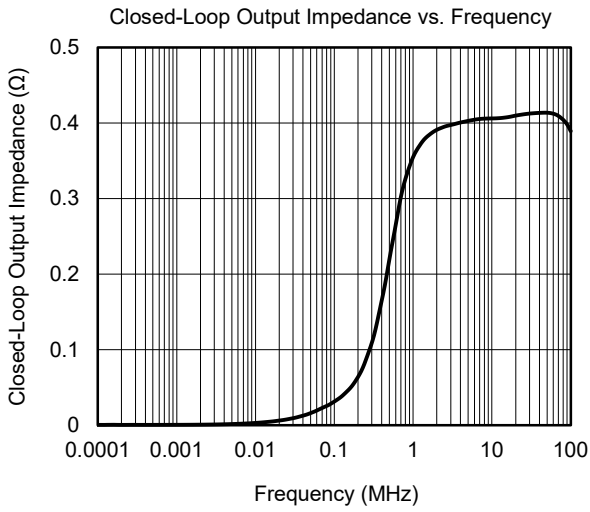
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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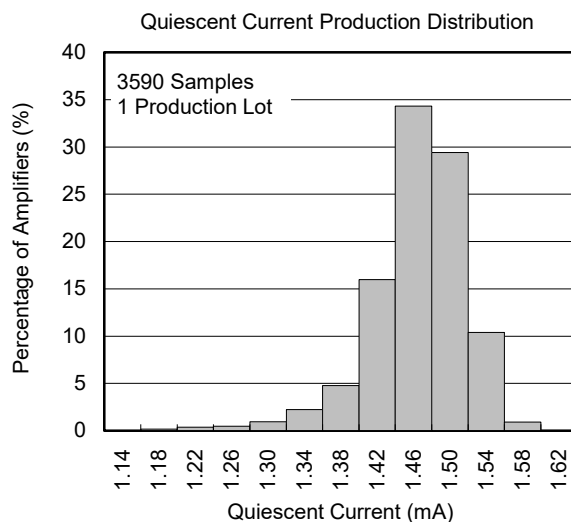
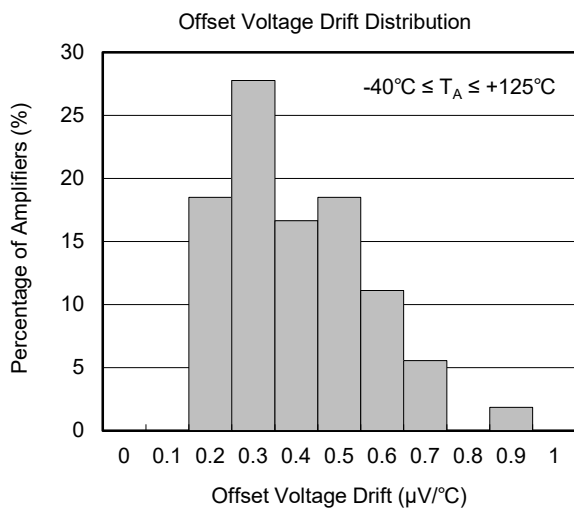
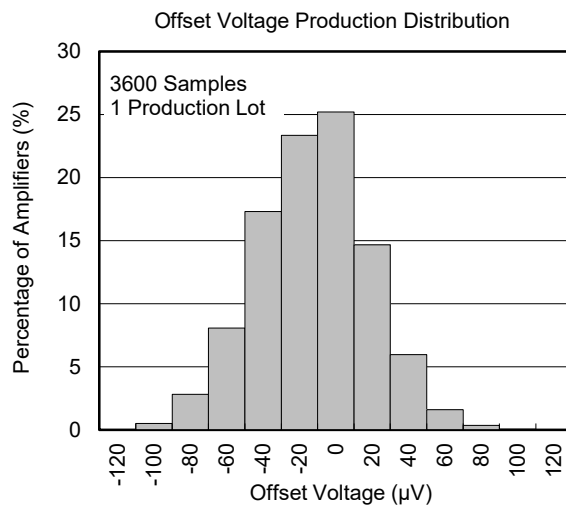
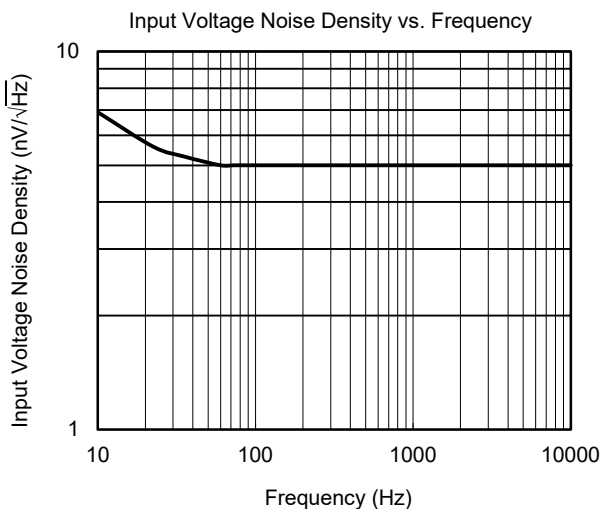
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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.



APPLICATION NOTES

Power Supply Bypassing and Layout

The SGM8295-1/2/4 operate 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).

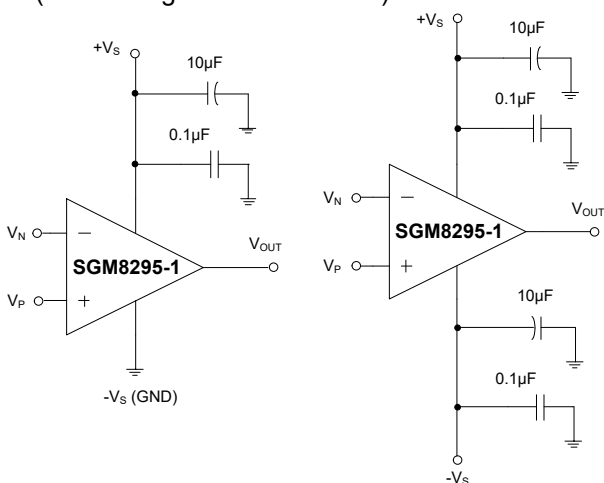


Figure 1. Amplifier with Bypass Capacitors

Grounding

A ground plane layer is important for SGM8295-1/2/4 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 $V_{OUT} = (V_P - V_N) \times R_2/R_1 + V_{REF}$.

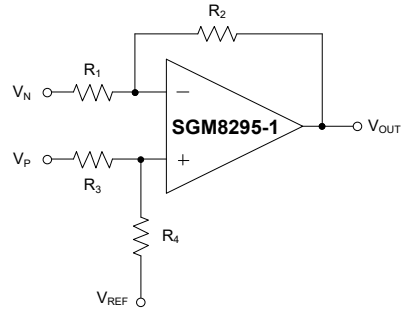


Figure 2. Differential Amplifier

Instrumentation Amplifier

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

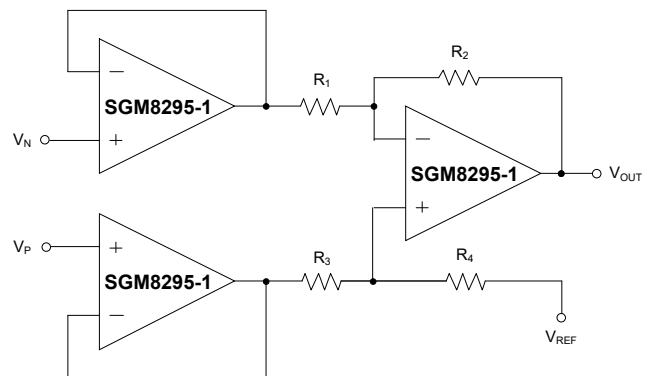


Figure 3. Instrumentation Amplifier

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 $1/2\pi R_2 C$. 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.

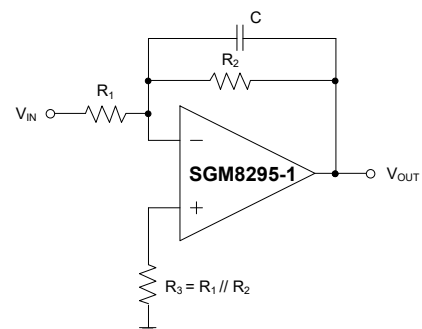


Figure 4. Active Low-Pass Filter

REVISION HISTORY

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

AUGUST 2017 – REV.A to REV.A.1

Page

Updated open-loop gain and phase vs. frequency 7

Changes from Original (AUGUST 2017) to REV.A

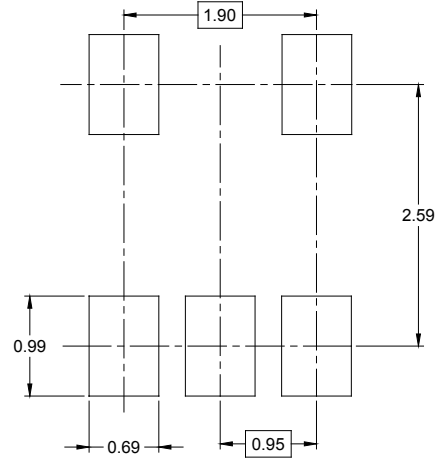
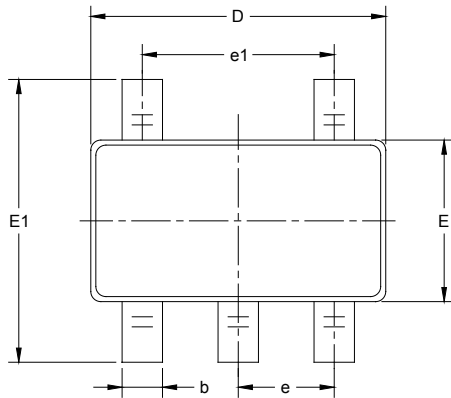
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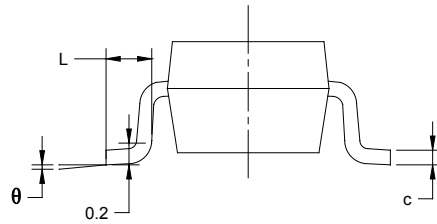
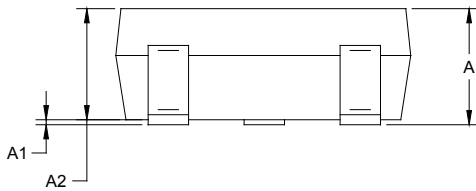
PACKAGE INFORMATION

PACKAGE OUTLINE DIMENSIONS

SOT-23-5



RECOMMENDED LAND PATTERN (Unit: mm)

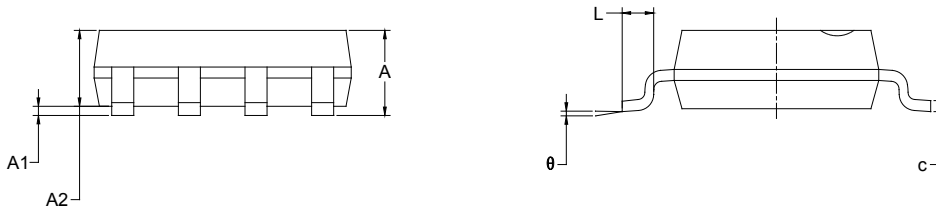
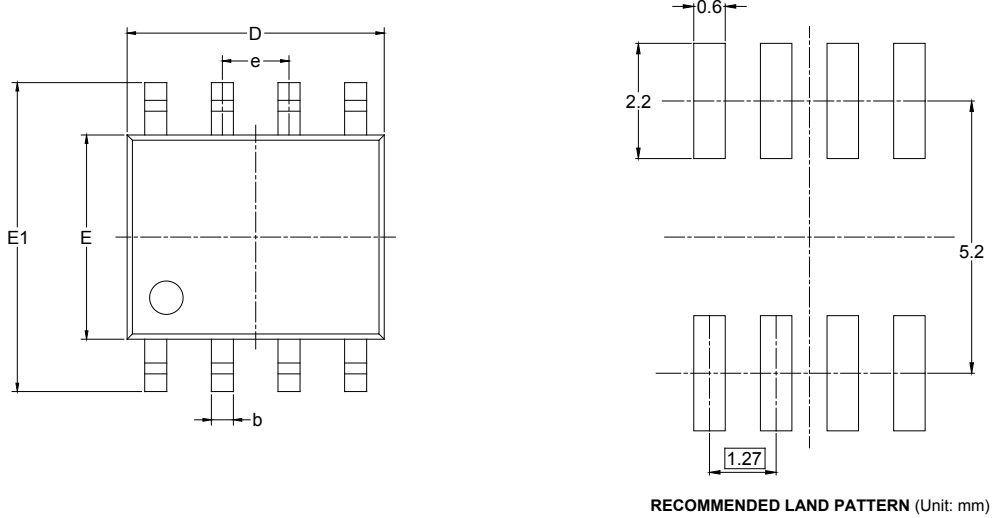


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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

PACKAGE INFORMATION

PACKAGE OUTLINE DIMENSIONS

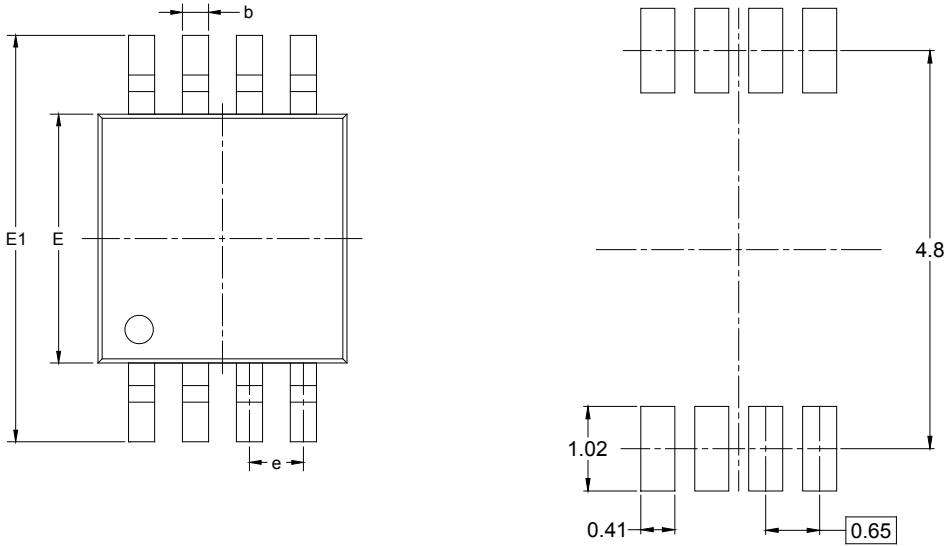
SOIC-8



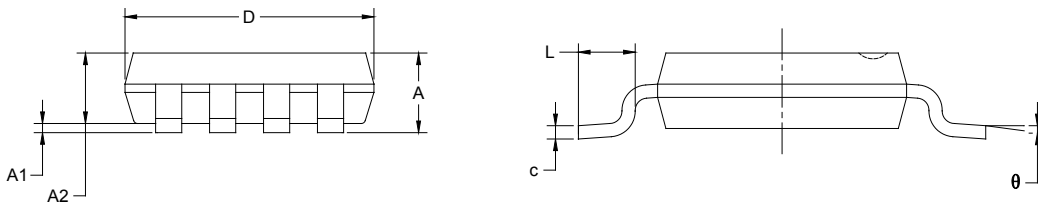
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

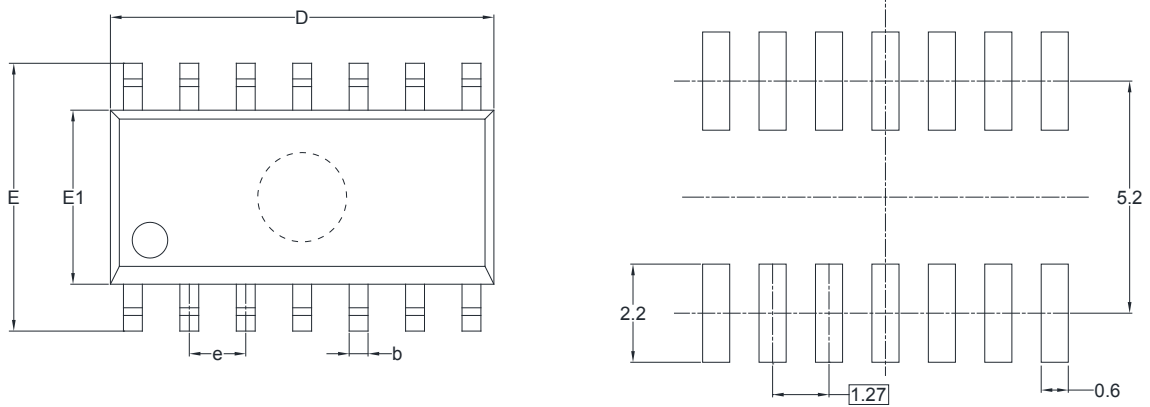


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026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

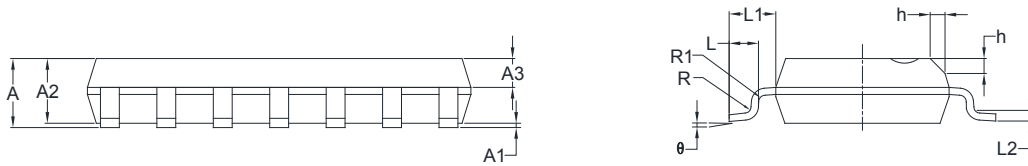
PACKAGE INFORMATION

PACKAGE OUTLINE DIMENSIONS

SOIC-14



RECOMMENDED LAND PATTERN (Unit: mm)

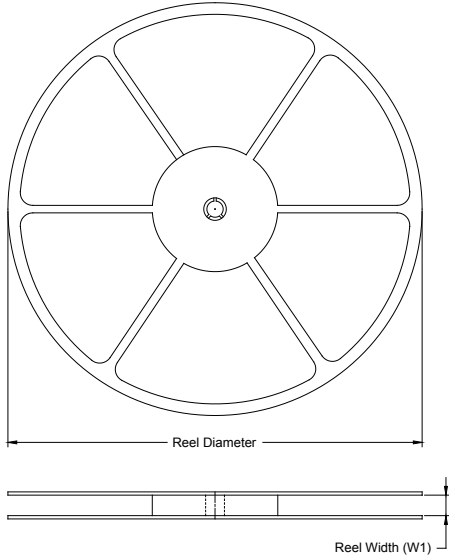


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
A2	1.25	1.65	0.049	0.065
A3	0.55	0.75	0.022	0.030
b	0.36	0.49	0.014	0.019
D	8.53	8.73	0.336	0.344
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
L	0.45	0.80	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°

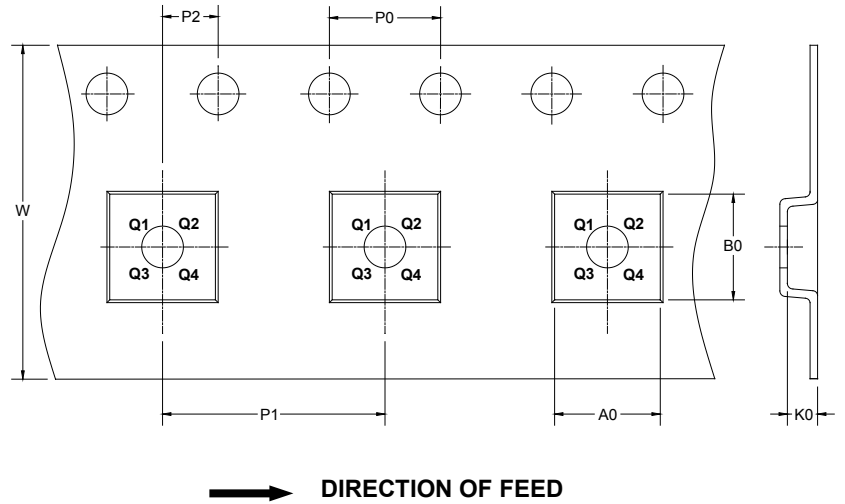
PACKAGE INFORMATION

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

DD0001

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