SGM8275-1/SGM8275-2/SGM8275-3
3MHz, Low Noise, High Voltage, Precision Operational Amplifiers

GENERAL DESCRIPTION

The SGM8275-1 (single), SGM8275-2 (dual) and SGM8275-3 (single with shutdown) are low noise, low offset voltage and high voltage operational amplifiers, which can be designed into a wide range of applications. The SGM8275-1/2/3 have a high gain-bandwidth product of 3MHz, a slew rate of 4V/μs, and a quiescent current of 0.9mA/amplifier at wide power supply range.

The SGM8275-1/2/3 are designed to provide optimal performance in low noise systems. They provide rail-to-rail output swing into heavy loads.

The SGM8275-3 has shutdown control to enter into shutdown status to save power consumption.

The single version SGM8275-1 is available in Green SOT-23-5 and SOIC-8 packages. The dual version SGM8275-2 is available in Green SOIC-8 and MSOP-8 packages. The single version with shutdown SGM8275-3 is available in Green SOT-23-6 package. They are specified over the extended -40℃ to +125℃ temperature range.

FEATURES

- **Rail-to-Rail Output**
- **Low Bias Current: ±1nA (TYP)**
- **High Open-Loop Gain: 120dB at V_S = ±15V**
- **High PSRR: 142dB**
- **High Gain-Bandwidth Product: 3MHz**
- **Settling Time to 0.1% with 1V Step: 0.5μs**
- **Overload Recovery Time: 10μs**
- **Low Noise: 8.5nV/$\sqrt{Hz}$ at 1kHz**
- **Supply Voltage Range:**
  3.6V to 36V or ±1.8V to ±18V
- **Input Common Mode Voltage Range:**
  ($-V_S$) + 1.5V to ($+V_S$) - 2V
- **Low Quiescent Current:**
  0.9mA/Amplifier (TYP)
  65μA Shutdown Current for SGM8275-3
- **-40℃ to +125℃ Operating Temperature Range**
- **Small Packaging:**
  SGM8275-1 Available in Green SOT-23-5 and SOIC-8 Packages
  SGM8275-2 Available in Green MSOP-8 and SOIC-8 Packages
  SGM8275-3 Available in Green SOT-23-6 Package

APPLICATIONS

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

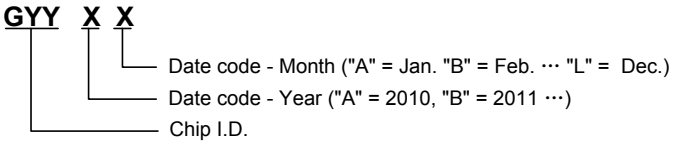
PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8275-1	SOT-23-5	-40℃ to +125℃	SGM8275-1XN5G/TR	G05XX	Tape and Reel, 3000
	SOIC-8	-40℃ to +125℃	SGM8275-1XS8G/TR	SGM 82751XS8 XXXXX	Tape and Reel, 2500
SGM8275-2	MSOP-8	-40℃ to +125℃	SGM8275-2XMS8G/TR	SGM82752 XMS8 XXXXX	Tape and Reel, 4000
	SOIC-8	-40℃ to +125℃	SGM8275-2XS8G/TR	SGM 82752XS8 XXXXX	Tape and Reel, 2500
SGM8275-3	SOT-23-6	-40℃ to +125℃	SGM8275-3XN6G/TR	G63XX	Tape and Reel, 3000

NOTE: XX = Date Code. XXXXX = Date 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.

MARKING INFORMATION



For example: G05FA (2015, January)

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, $+V_S$ to $-V_S$ 40V
SHDN Voltage, SHDN to $-V_S$ 5.5V
Input Common Mode Voltage Range
..... ($-V_S$) - 0.3V to ($+V_S$) + 0.3V
Storage Temperature Range ..... -65℃ to +150℃
Junction Temperature ..... +150℃
Lead Temperature (Soldering 10sec) ..... +260℃
ESD Susceptibility
HBM 2000V
MM 200V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Supply Voltage Range ..... 3.6V to 36V
Operating Temperature Range ..... -40℃ to +125℃

OVERSTRESS CAUTION

Stresses beyond those listed may cause permanent damage to the device. Functional operation of the device at these or any other conditions beyond those indicated in the operational section of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

ESD SENSITIVITY CAUTION

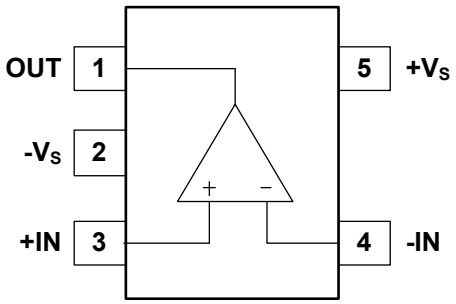
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance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

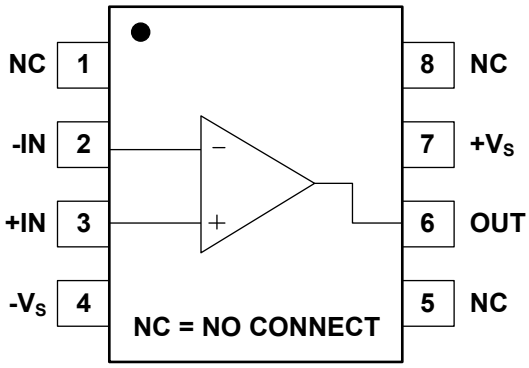
PIN CONFIGURATIONS

SGM8275-1 (TOP VIEW)



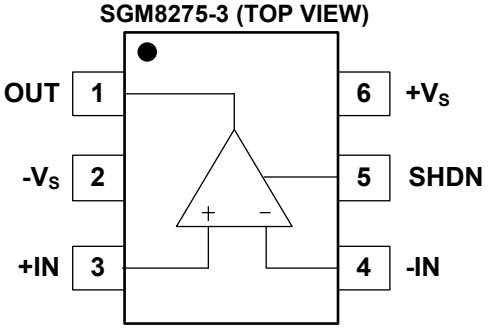
SOT-23-5

SGM8275-1 (TOP VIEW)



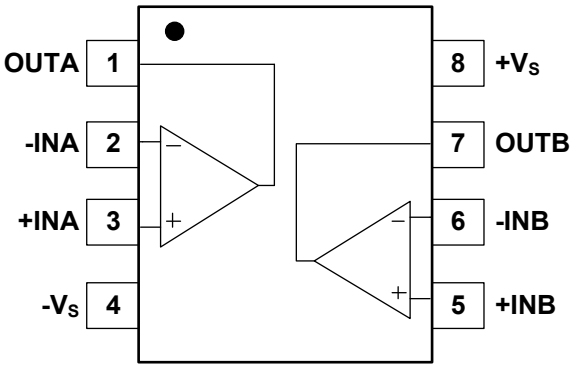
SOIC-8

SGM8275-3 (TOP VIEW)



SOT-23-6

SGM8275-2 (TOP VIEW)



SOIC-8/MSOP-8

ELECTRICAL CHARACTERISTICS

(At T_A = +25℃, V_S = ±5V to V_S = ±15V, V_{CM} = 0V, V_{OUT} = 0V and R_L connected to 0V, Full = -40℃ to +125℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS							
Input Offset Voltage	V_{OS}		+25℃		50	300	μV
			Full			410	
Input Bias Current	I_B	$V_{CM} = V_S/2$	+25℃		±1	±17	nA
			Full			±38	
Input Offset Current	I_{OS}	$V_{CM} = V_S/2$	+25℃		±1	±18	nA
			Full			±50	
Input Common Mode Voltage Range	V_{CM}		Full	$(-V_S) + 1.5$		$(+V_S) - 2$	V
Common Mode Rejection Ratio	CMRR	$(-V_S) + 1.5V \le V_{CM} \le (+V_S) - 2V$	+25℃	120	140		dB
			Full	116			
Open-Loop Voltage Gain	A_{OL}	V_S = ±5V, V_{OUT} = ±2.5V, R_L = 10kΩ	+25℃	114	135		dB
			Full	111			
		V_S = ±15V, V_{OUT} = ±10V, R_L = 10kΩ	+25℃	118	126		
			Full	109			
		V_S = ±5V, V_{OUT} = ±2.5V, R_L = 2kΩ	+25℃	106	112		
			Full	96			
		V_S = ±15V, V_{OUT} = ±10V, R_L = 2kΩ	+25℃	112	120		
			Full	103			
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$		Full		0.5		μV/℃
OUTPUT CHARACTERISTICS							
Output Voltage Swing from Rail	V_{OUT}	V_S = ±15V, R_L = 10kΩ	+25℃		90	175	mV
			Full			220	
		V_S = ±15V, R_L = 2kΩ	+25℃		450	850	
			Full			1060	
Output Short-Circuit Current	I_{SC}		+25℃	±13	±32		mA
POWER SUPPLY							
Operating Voltage Range	V_S		Full	3.6		36	V
Quiescent Current/Amplifier	I_Q	I_{OUT} = 0mA	+25℃		0.9	1.2	mA
			Full			1.3	
Power Supply Rejection Ratio	PSRR	V_S = 3V to 38V	+25℃	125	142		dB
			Full	118			
Supply Current when Shut Down (SGM8275-3 only)		I_{OUT} = 0mA	+25℃		65	82	μA
			Full			88	
POWER-DOWN DISABLE (SGM8275-3 ONLY)							
SHDN Voltage-Off	V_{IH}		Full	1.5			V
SHDN Voltage-On	V_{IL}		Full			0.5	V

ELECTRICAL CHARACTERISTICS (continued)

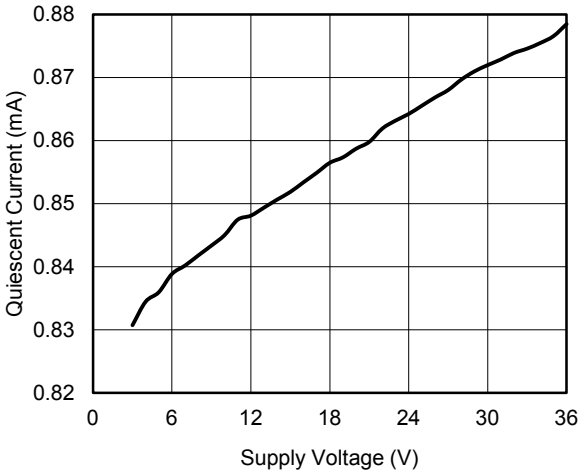
(At T_A = +25℃, V_S = ±5V to V_S = ±15V, V_{CM} = 0V, V_{OUT} = 0V and R_L connected to 0V, Full = -40℃ to +125℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
DYNAMIC PERFORMANCE							
Gain-Bandwidth Product	GBP	V_{OUT} = 100mV_{P-P}, R_L = 2kΩ, C_L = 10pF	+25℃		3		MHz
Slew Rate	SR	R_L = 2kΩ	+25℃		4		V/μs
Settling Time to 0.1%	t_S	V_{IN} = 1V Step, R_L = 2kΩ, G = +1	+25℃		0.5		μs
Overload Recovery Time		R_L = 2kΩ, V_{IN} × G = V_S	+25℃		10		μs
Phase Margin	φ_O	V_{OUT} = 100mV_{P-P}, R_L = 2kΩ, C_L = 10pF	+25℃		55		°
Total Harmonic Distortion + Noise	THD+N	V_{IN} = 1V_{RMS}, G = +1, R_L = 2kΩ, f = 1kHz	+25℃		0.0008		%
NOISE							
Input Voltage Noise		f = 0.1Hz to 10Hz	+25℃		300		nV_{P-P}
Input Voltage Noise Density	e_n	f = 1kHz	+25℃		8.5		$nV/\sqrt{Hz}$
Input Current Noise Density	i_n	f = 1kHz	+25℃		1.5		$pA/\sqrt{Hz}$

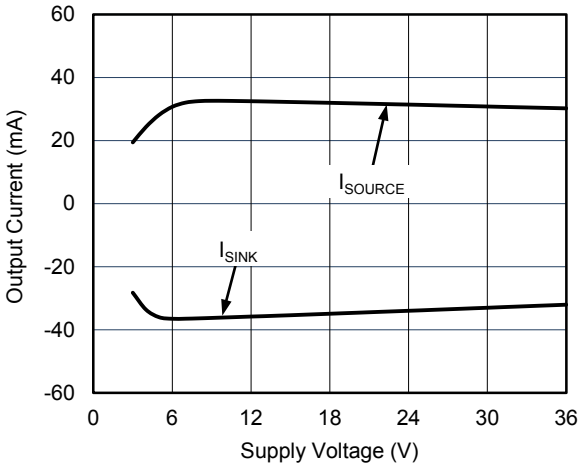
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃ and V_S = ±15V, unless otherwise noted.

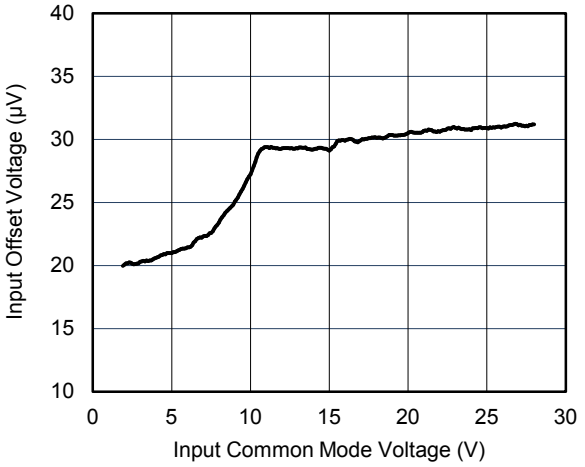
Quiescent Current vs. Supply Voltage



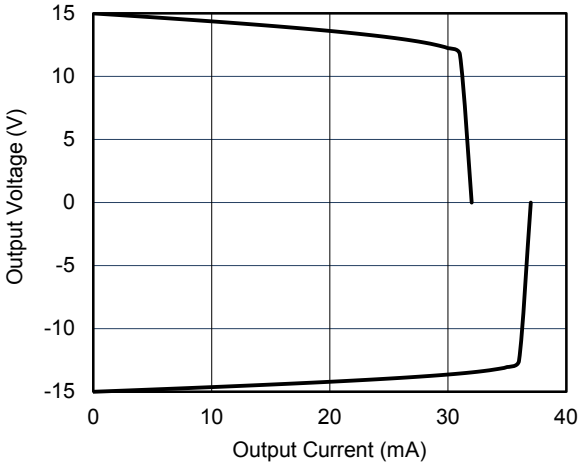
Output Current vs. Supply Voltage



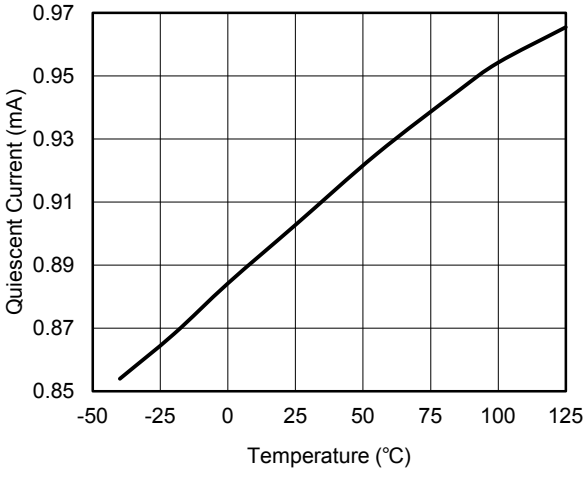
Input Offset Voltage vs. Input Common Mode Voltage



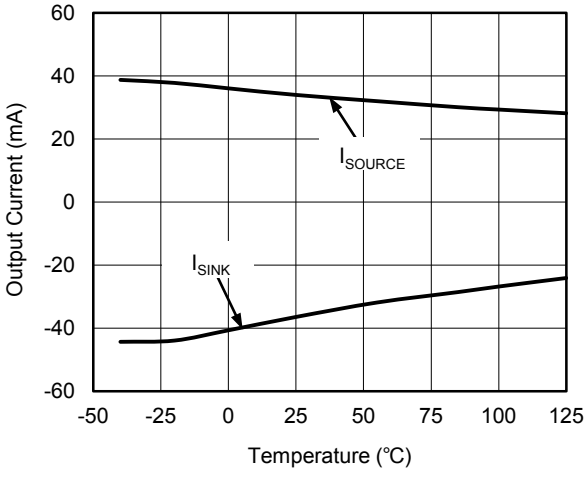
Output Voltage vs. Output Current



Quiescent Current vs. Temperature



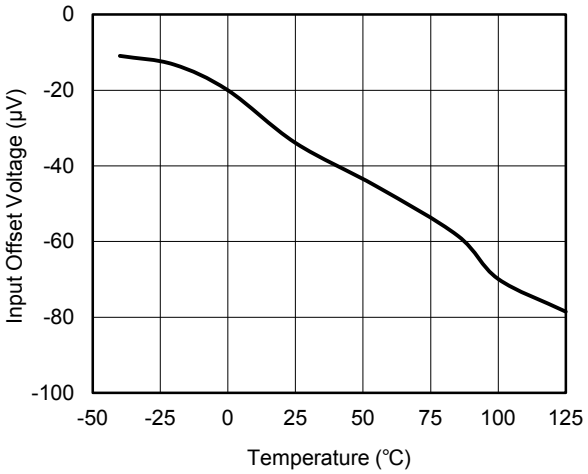
Output Current vs. Temperature



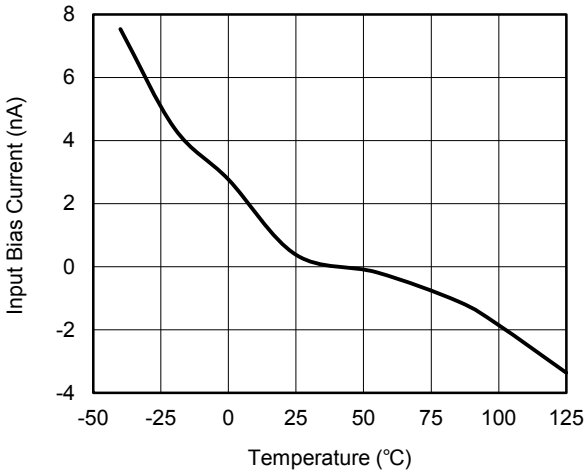
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃ and V_S = ±15V, unless otherwise noted.

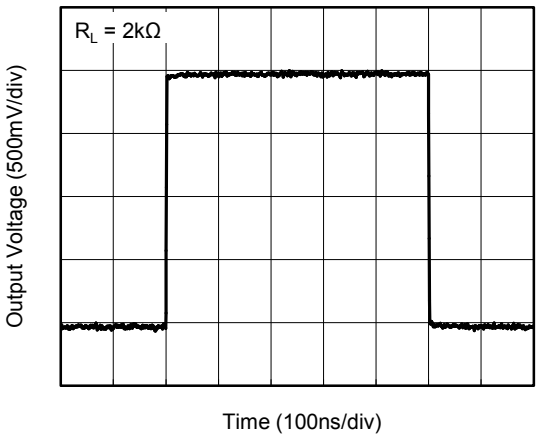
Input Offset Voltage vs. Temperature



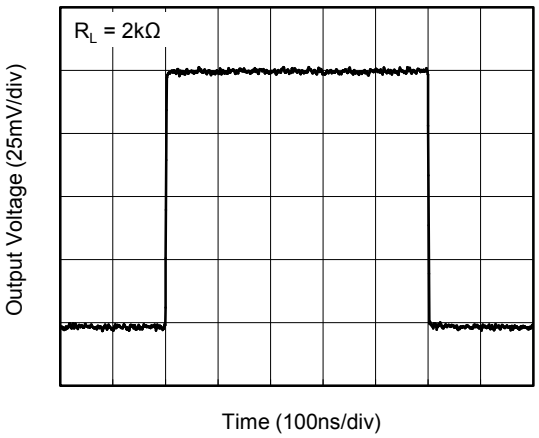
Input Bias Current vs. Temperature



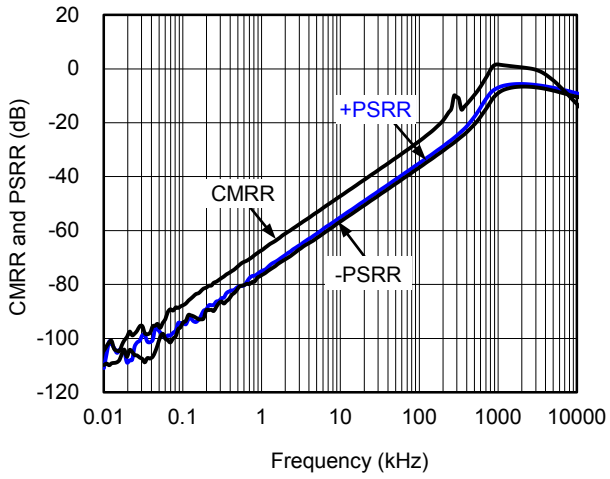
Large-Signal Step Response



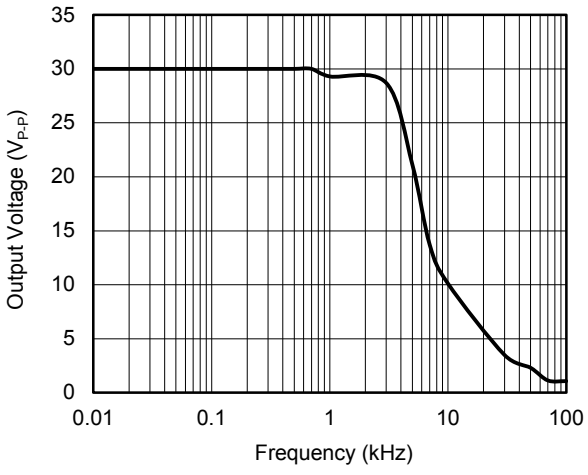
Small-Signal Step Response



CMRR and PSRR vs. Frequency



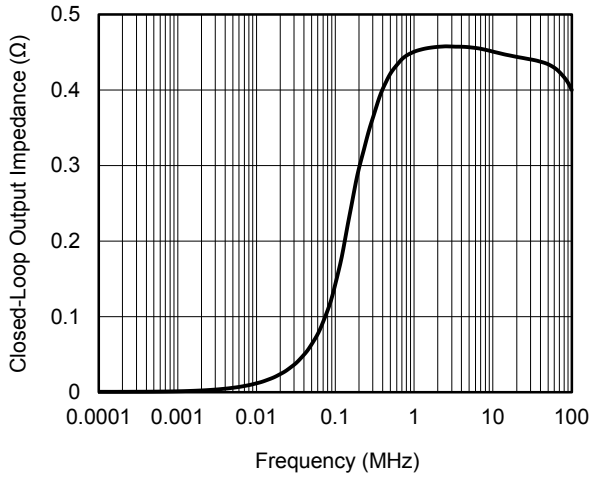
Maximum Output Voltage vs. Frequency



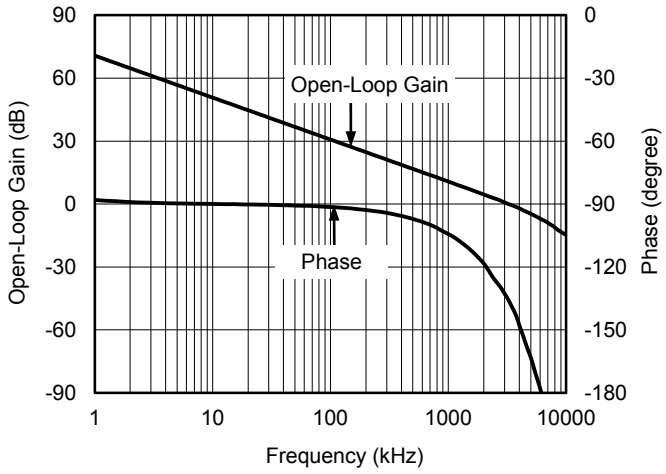
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃ and V_S = ±15V, unless otherwise noted.

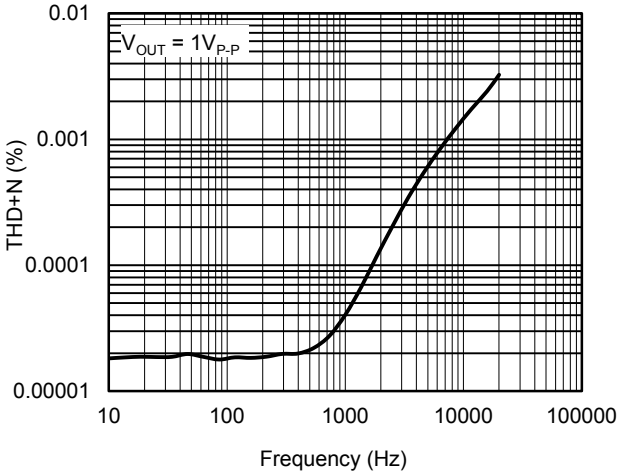
Closed-Loop Output Impedance vs. Frequency



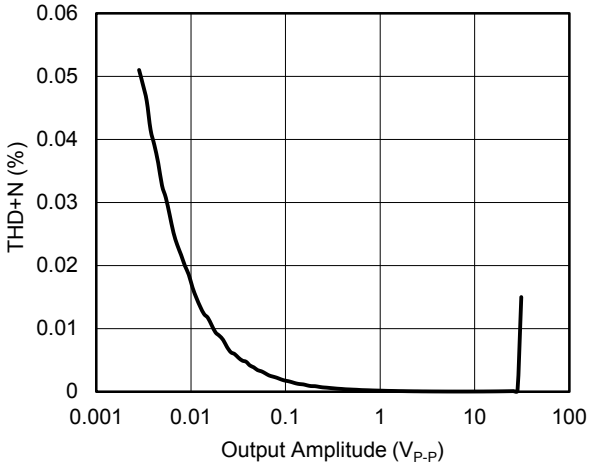
Open-Loop Gain and Phase vs. Frequency



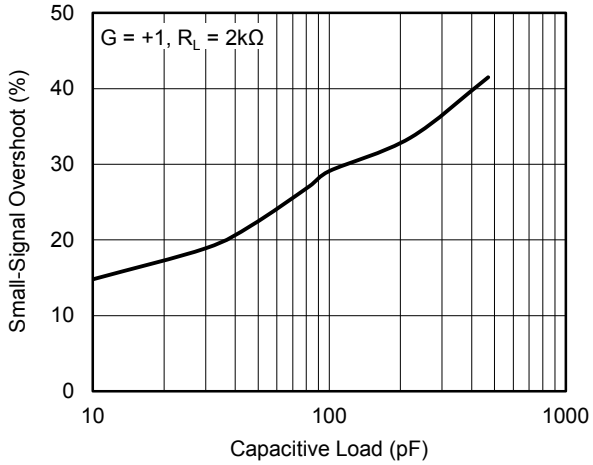
Total Harmonic Distortion + Noise vs. Frequency



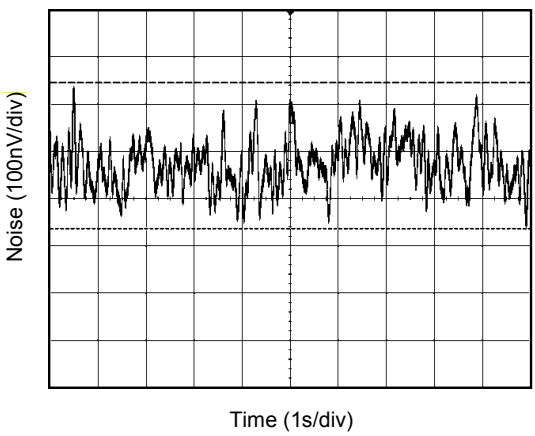
Total Harmonic Distortion + Noise vs. Output Amplitude



Small-Signal Overshoot vs. Capacitive Load



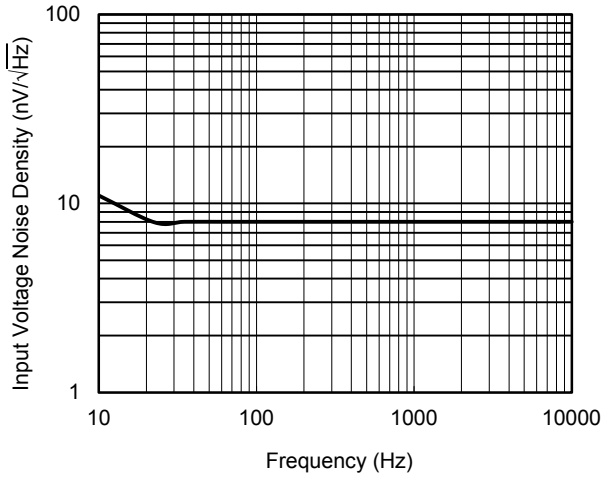
0.1Hz to 10Hz Input Voltage Noise



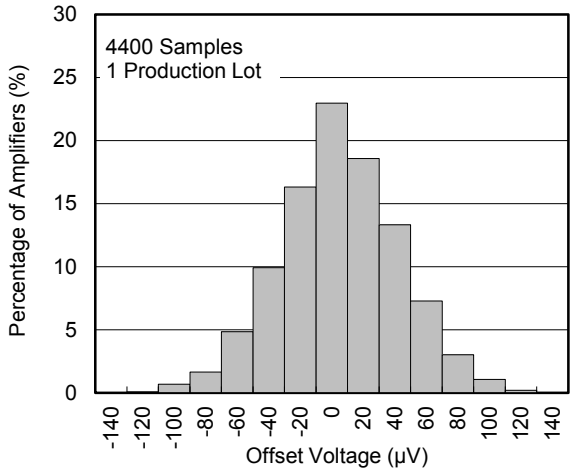
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃ and V_S = ±15V, unless otherwise noted.

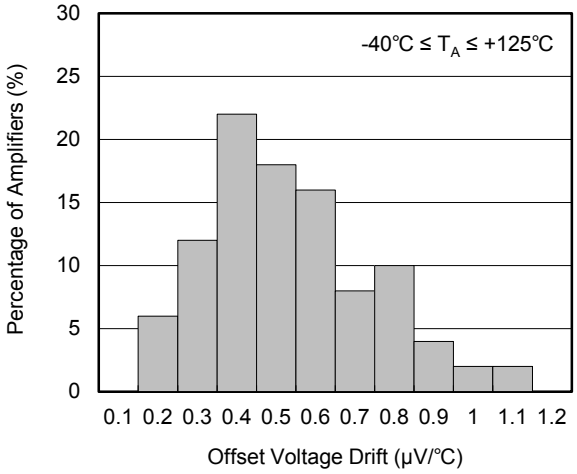
Input Voltage Noise Density vs. Frequency



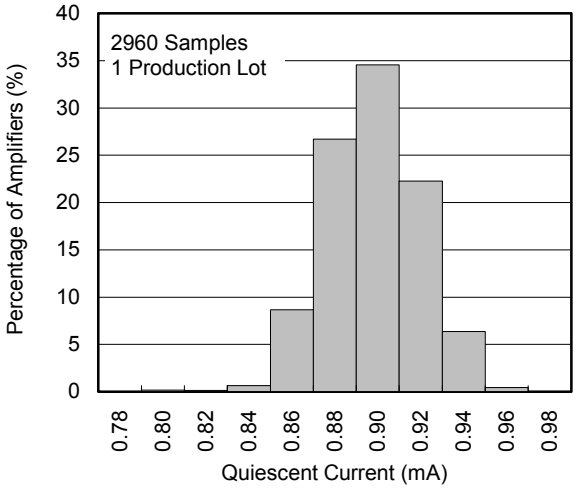
Offset Voltage Production Distribution



Offset Voltage Drift Distribution



Quiescent Current Production Distribution



APPLICATION NOTES

Power-Supply Bypassing and Layout

The SGM8275-1/2/3 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).

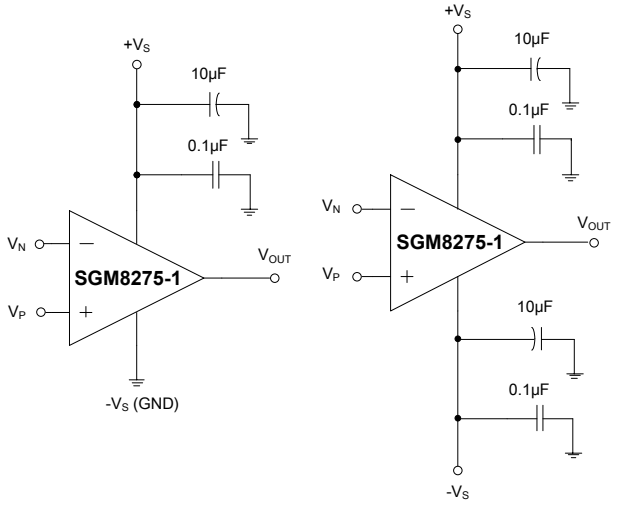


Figure 1. Amplifier with Bypass Capacitors

Grounding

A ground plane layer is important for SGM8275-1/2/3 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 $V_{OUT} = (V_P - V_N) \times R_2/R_1 + V_{REF}$.

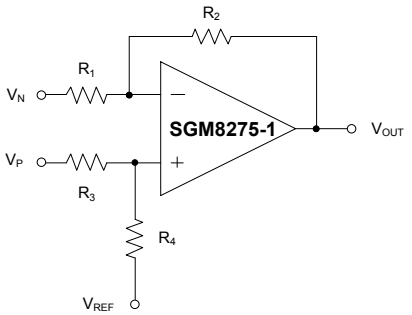


Figure 2. Differential Amplifier

Instrumentation Amplifier

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

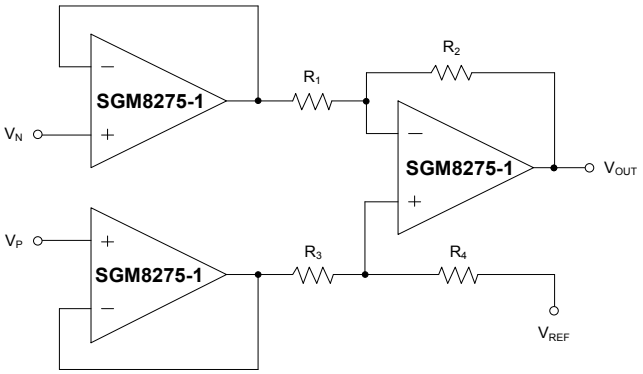


Figure 3. Instrumentation Amplifier

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 $1/2\pi R_2C$. 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.

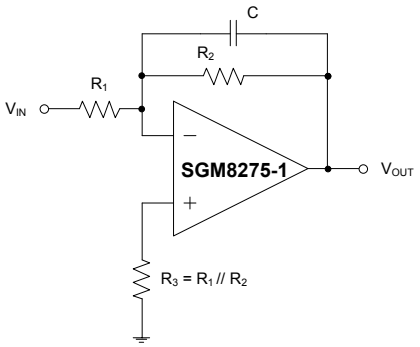


Figure 4. Active Low-Pass Filter

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

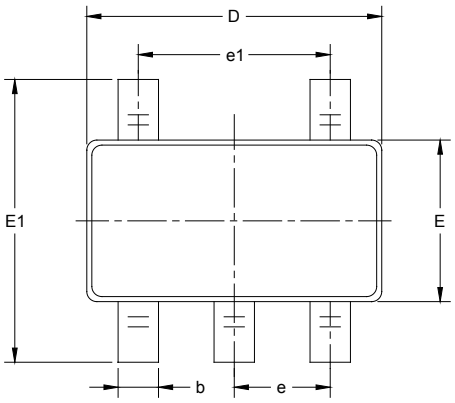
Updated open-loop gain and phase vs. frequency	8

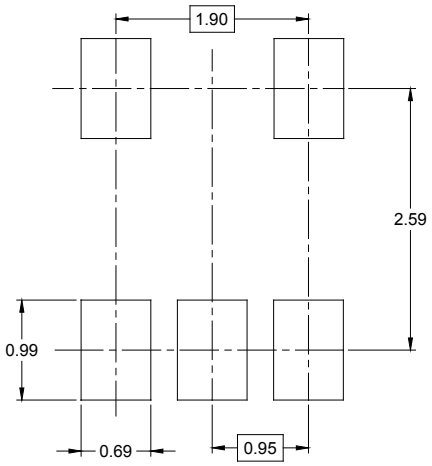
Changes from Original (AUGUST 2017) to REV.A

Changed from product preview to production data	All

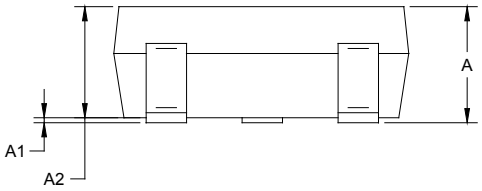
PACKAGE OUTLINE DIMENSIONS

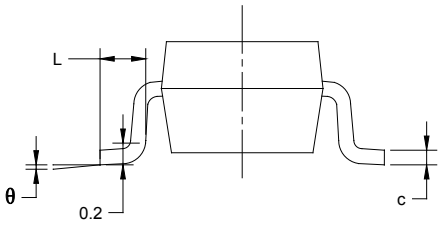
SOT-23-5





RECOMMENDED LAND PATTERN (Unit: mm)

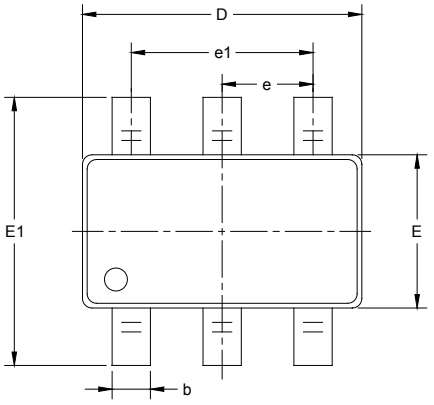


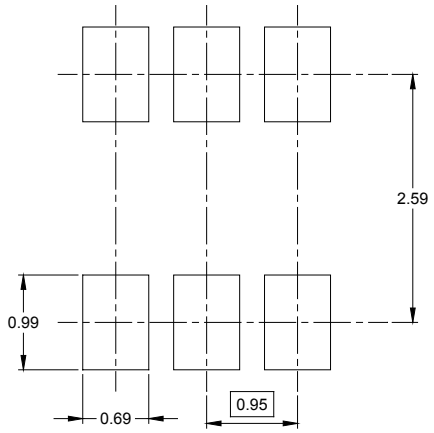


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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

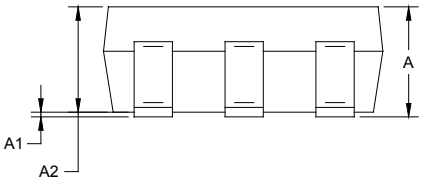
PACKAGE OUTLINE DIMENSIONS

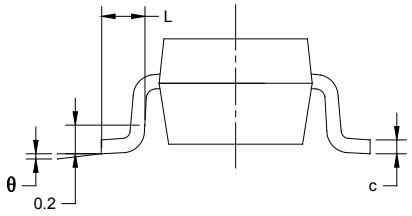
SOT-23-6





RECOMMENDED LAND PATTERN (Unit: mm)

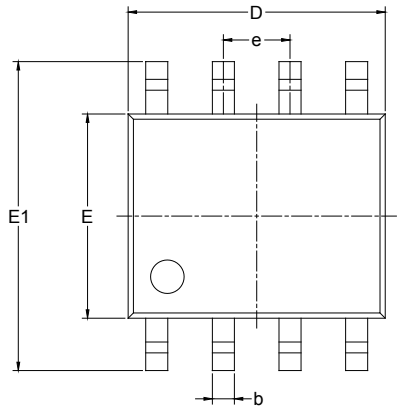


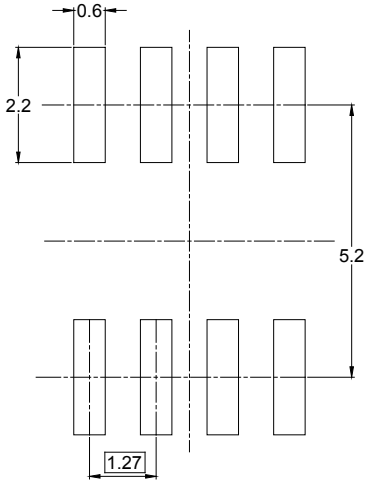


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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

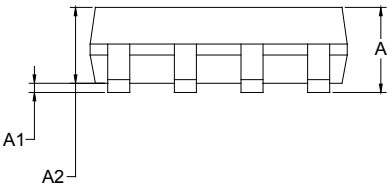
PACKAGE OUTLINE DIMENSIONS

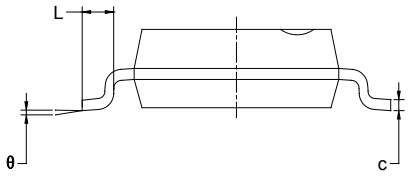
SOIC-8





RECOMMENDED LAND PATTERN (Unit: mm)

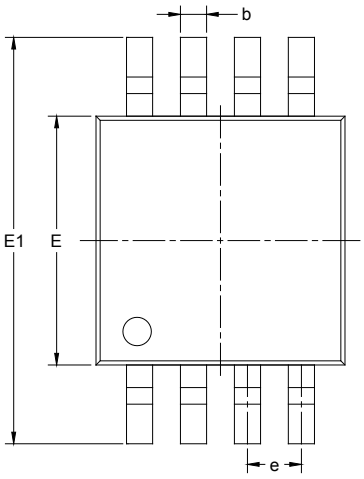


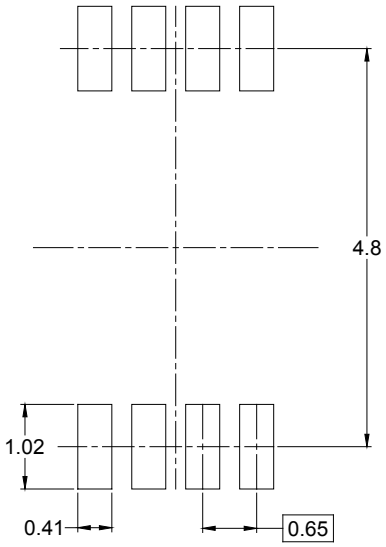


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

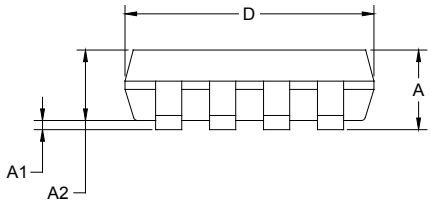
PACKAGE OUTLINE DIMENSIONS

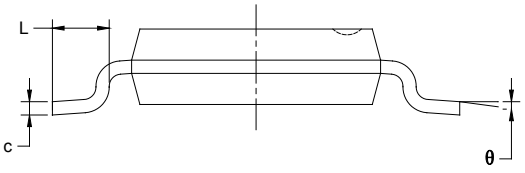
MSOP-8





RECOMMENDED LAND PATTERN (Unit: mm)

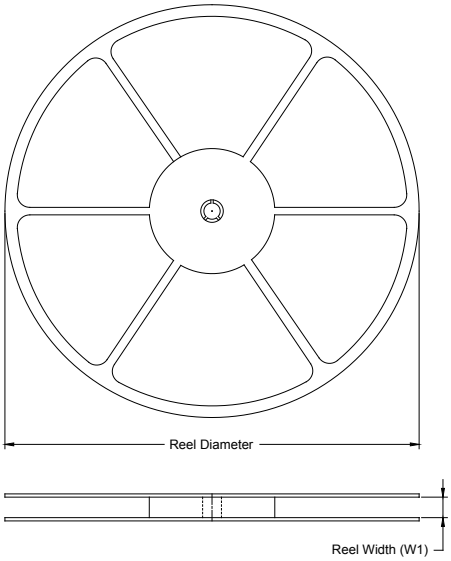




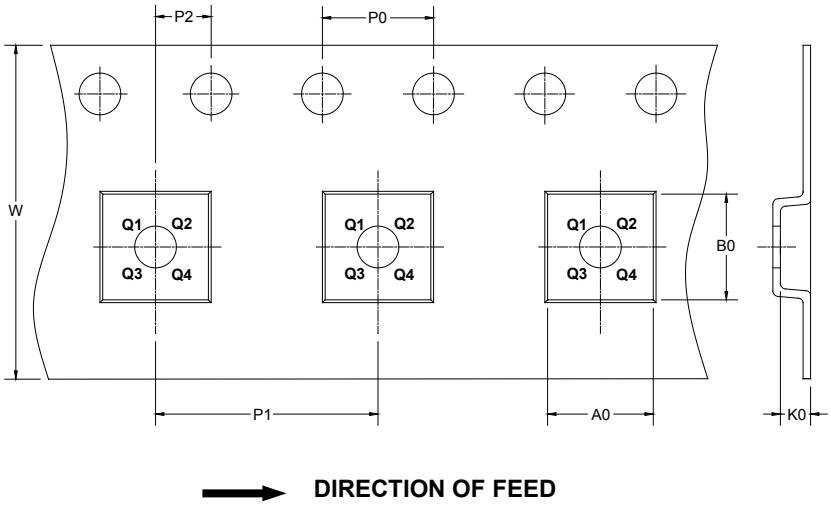
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026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

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



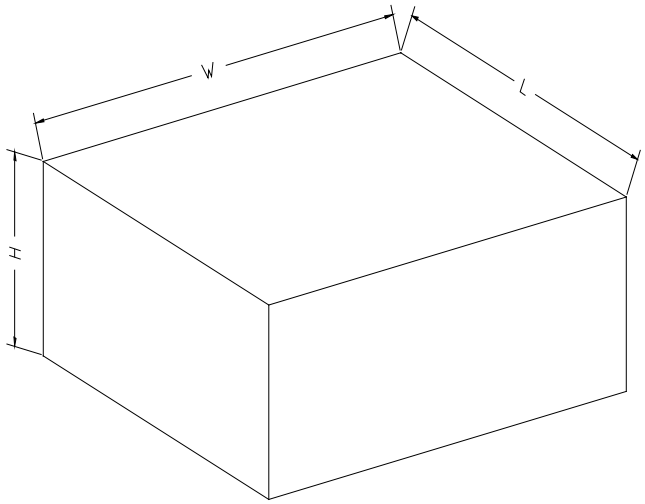
NOTE: The picture is only for reference. Please make the object as the standard.

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
SOT-23-5	7″	9.5	3.20	3.20	1.40	4.0	4.0	2.0	8.0	Q3
SOT-23-6	7″	9.5	3.17	3.23	1.37	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

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

DD0002