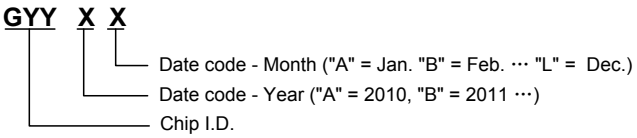
PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8240-1	SC70-5	-40℃ to +125℃	SGM8240-1XC5G/TR	G88XX	Tape and Reel, 3000
	SOT-23-5	-40℃ to +125℃	SGM8240-1AXN5G/TR	G1CXX	Tape and Reel, 3000
	SOT-23-5	-40℃ to +125℃	SGM8240-1BXN5G/TR	G89XX	Tape and Reel, 3000
SGM8240-2	SOIC-8	-40℃ to +125℃	SGM8240-2XS8G/TR	SGM 82402XS8 XXXXX	Tape and Reel, 2500
	MSOP-8	-40℃ to +125℃	SGM8240-2XMS8G/TR	SGM82402 XMS8 XXXXX	Tape and Reel, 4000
	TDFN-2×3-8L	-40℃ to +125℃	SGM8240-2XTDC8G/TR	G8C XXXX	Tape and Reel, 3000
SGM8240-4	SOIC-14	-40℃ to +125℃	SGM8240-4XS14G/TR	SGM82404XS14 XXXXX	Tape and Reel, 2500

NOTE: XX = Date Code. XXXX = 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: G88FA (2015, January)

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, $+V_S$ to $-V_S$ 26V
Signal Input Terminals, Voltage
..... $(-V_S)$ - 0.3V to $(+V_S)$ + 0.3V
Signal Input Terminals, Current ..... ±10mA
Output Short-Circuit Current ..... ±20mA
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 8000V
MM 200V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range ..... 2.7V to 24V
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.

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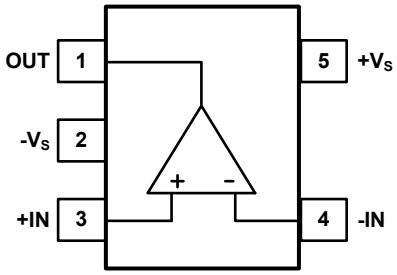
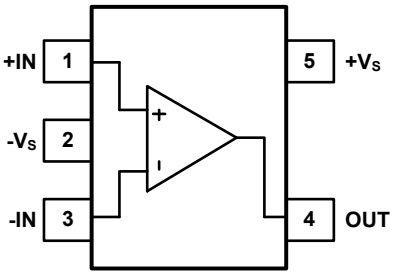
PIN CONFIGURATIONS

SGM8240-1AXN5G (TOP VIEW)



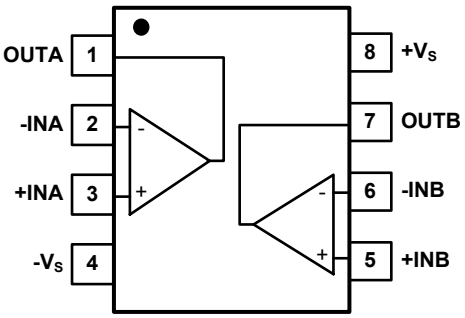
SOT-23-5

SGM8240-1BXN5G/SGM8240-1XC5G
(TOP VIEW)



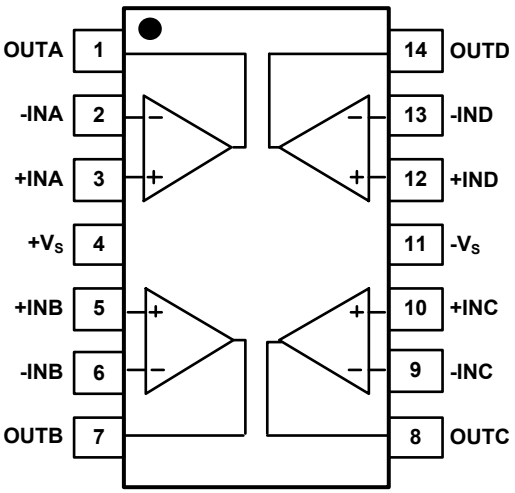
SOT-23-5/SC70-5

SGM8240-2 (TOP VIEW)



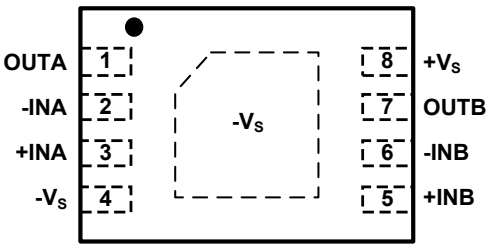
SOIC-8/MSOP-8

SGM8240-4 (TOP VIEW)



SOIC-14

SGM8240-2 (TOP VIEW)



TDFN-2×3-8L

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ELECTRICAL CHARACTERISTICS

(At T_A = +25℃, V_S = 2.7V to 24V, R_L = 25kΩ connected to V_S/2, and V_{CM} < (+V_S) - 1V, Full = -40℃ to +125℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS							
Input Offset Voltage	V_{OS}		+25℃		0.4	1	mV
			Full			4.8	
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$		+25℃		3		μV/℃
Input Bias Current	I_B	$V_{CM} = V_S/2$	+25℃		±5		pA
Input Offset Current	I_{OS}	$V_{CM} = V_S/2$	+25℃		±5		pA
Input Common Mode Voltage Range	V_{CM}		+25℃	(-V_S) - 0.1		(+V_S) + 0.1	V
Common Mode Rejection Ratio	CMRR	V_S = 24V, (-V_S) < V_{CM} < (+V_S) - 1V	+25℃	96	110		dB
			Full	57			
Open-Loop Voltage Gain	A_{OL}	R_L = 25kΩ, (-V_S) + 0.2V < V_O < (+V_S) - 0.2V	+25℃	98	120		dB
			Full	60			
		R_L = 5kΩ, (-V_S) + 0.6V < V_O < (+V_S) - 0.6V	+25℃	94	110		
			Full	63			
OUTPUT CHARACTERISTICS							
Output Voltage Swing from Rail	V_{OUT}	V_S = 24V, R_L = 25kΩ	+25℃		55	98	mV
			Full			130	
		V_S = 24V, R_L = 5kΩ	+25℃		230	345	
			Full			475	
Output Short-Circuit Current	I_{SC}		+25℃	±11	±20		mA
POWER SUPPLY							
Operating Voltage Range	V_S		+25℃	2.7		24	V
Quiescent Current/Amplifier	I_Q	I_O = 0	+25℃		2.8	4.2	μA
			Full			5.5	
Power Supply Rejection Ratio	PSRR		+25℃	97	116		dB
			Full	73			
DYNAMIC PERFORMANCE (C_L = 30pF)							
Gain-Bandwidth Product	GBP		+25℃		100		kHz
Slew Rate	SR	G = +1	+25℃		0.05		V/μs
Overload Recovery Time		V_{IN} × GAIN > V_S	+25℃		40		μs
NOISE							
Input Voltage Noise		f = 0.1Hz to 10Hz	+25℃		3		μV_{P-P}
Input Voltage Noise Density	e_n	f = 1kHz	+25℃		100		$nV/\sqrt{Hz}$
Input Current Noise Density	i_n	f = 1kHz	+25℃		3.5		$pA/\sqrt{Hz}$

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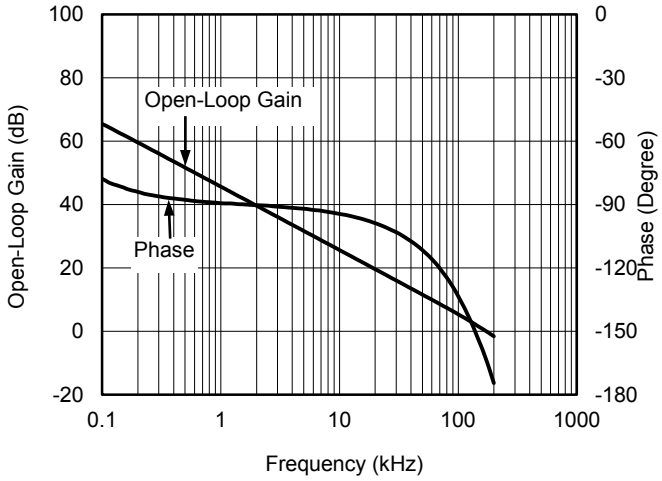
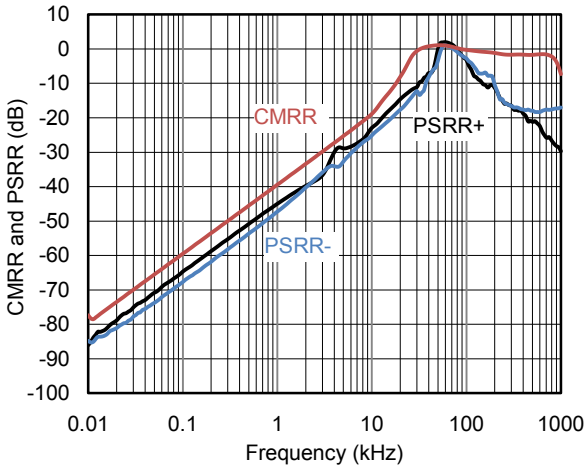
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, V_S = 24V, R_L = 25kΩ, unless otherwise noted.

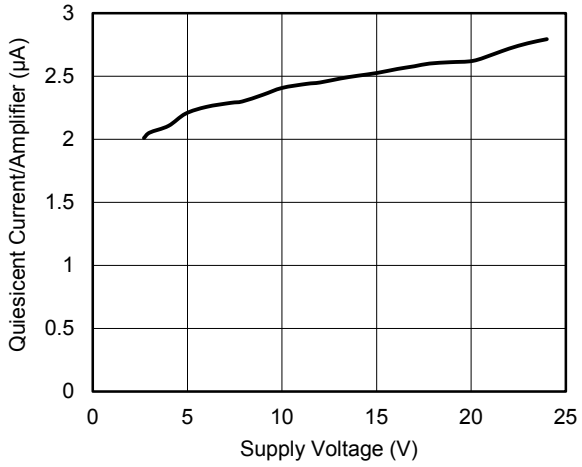
Open-Loop Gain and Phase vs. Frequency



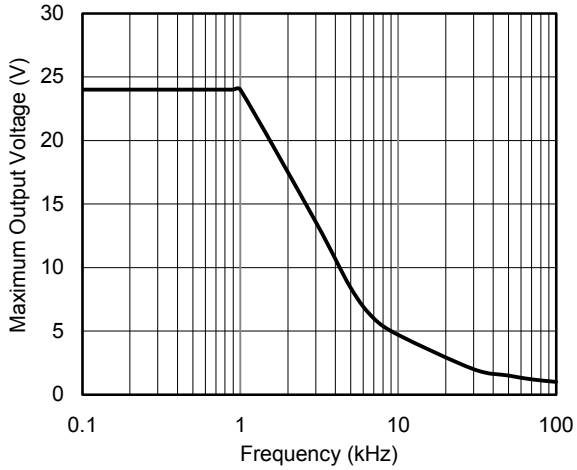
CMRR and PSRR vs. Frequency



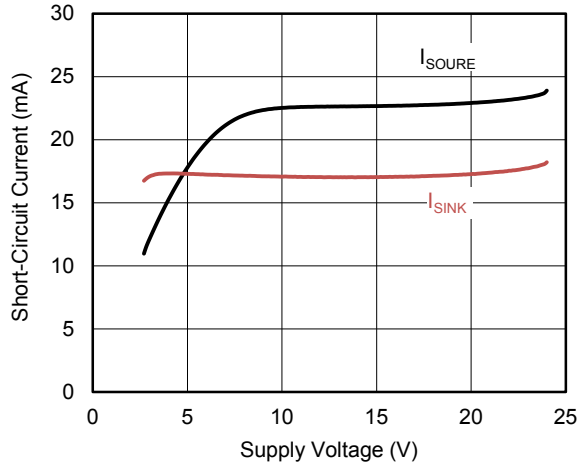
Quiescent Current vs. Supply Voltage



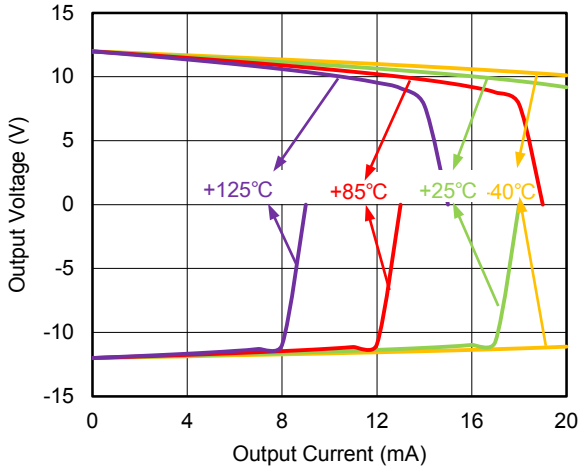
Maximum Output Voltage vs. Frequency



Short-Circuit Current vs. Supply Voltage



Output Voltage vs. Output Current



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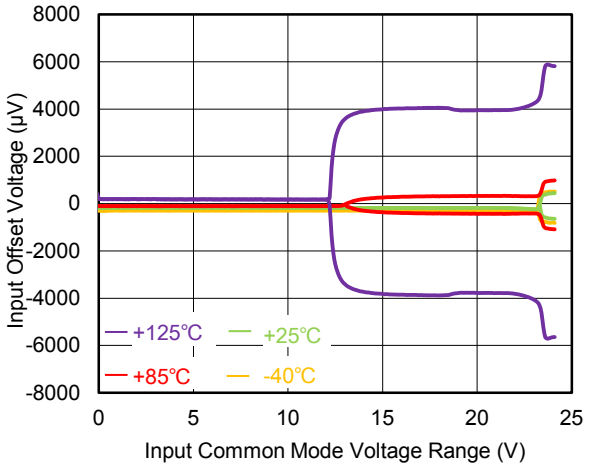
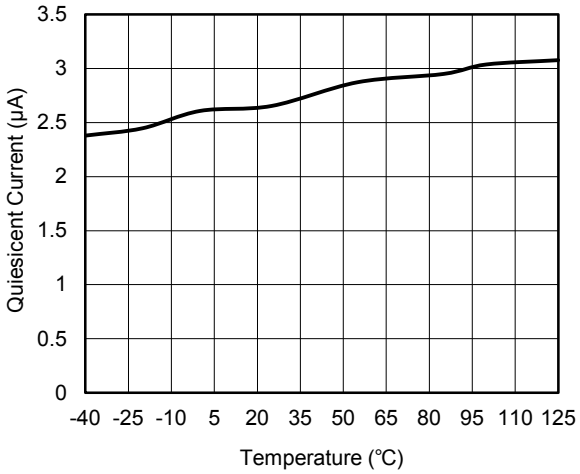
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_S = 24V, R_L = 25kΩ, unless otherwise noted.

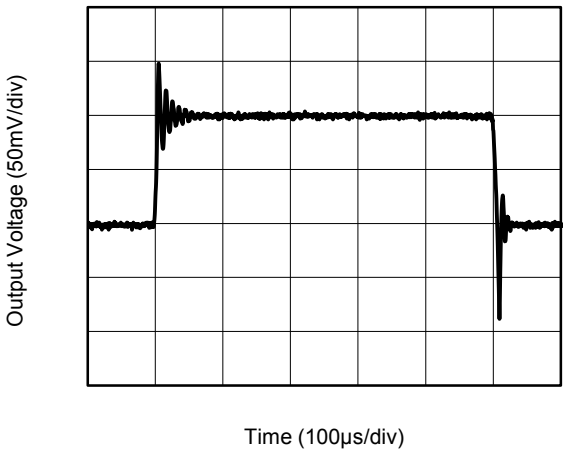
Offset Voltage vs. Input Common Mode Voltage



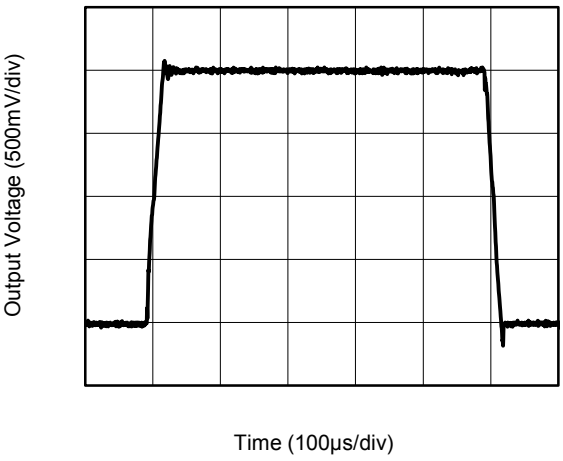
Quiescent Current vs. Temperature



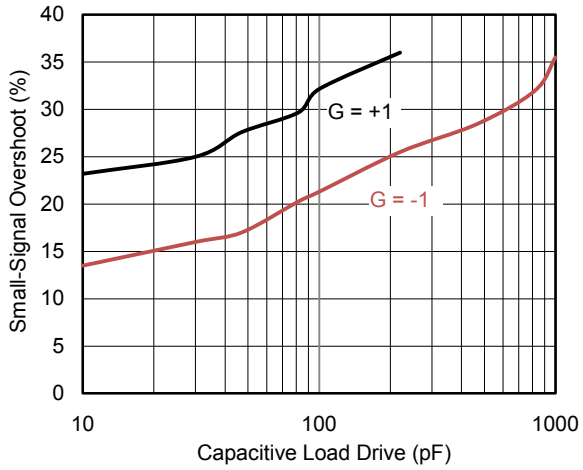
Small-Signal Step Response



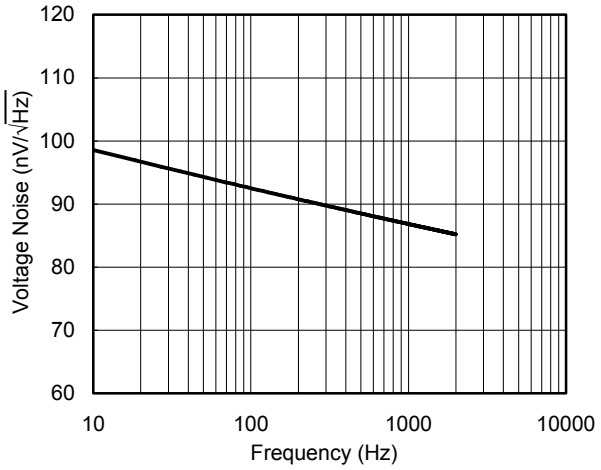
Large-Signal Step Response



Small-Signal Overshoot vs. Capacitive Load



Voltage Noise Density vs. Frequency



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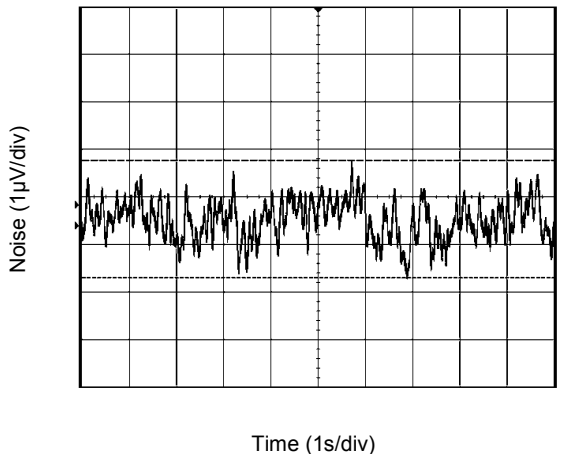
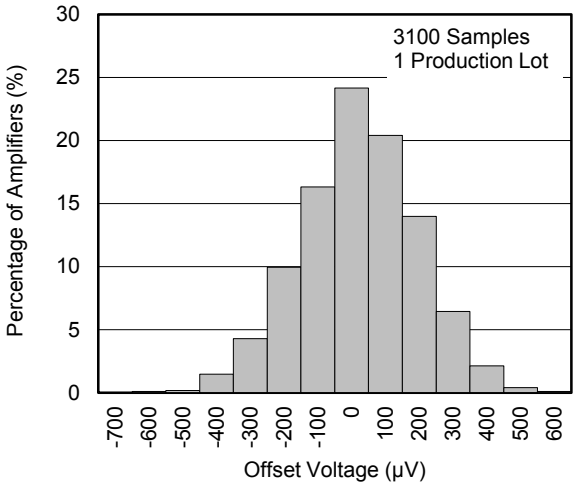
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_S = 24V, R_L = 25kΩ, unless otherwise noted.

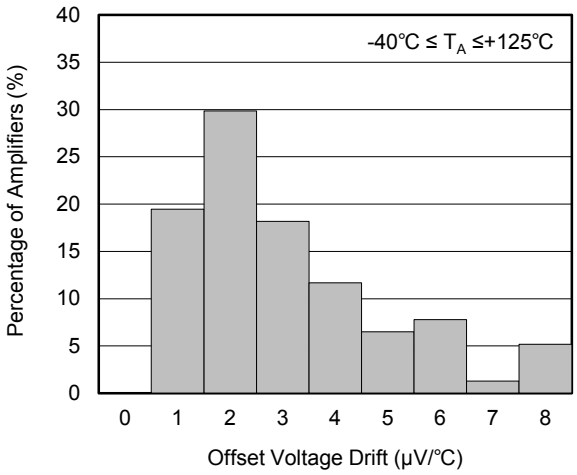
0.1Hz to 10Hz Noise



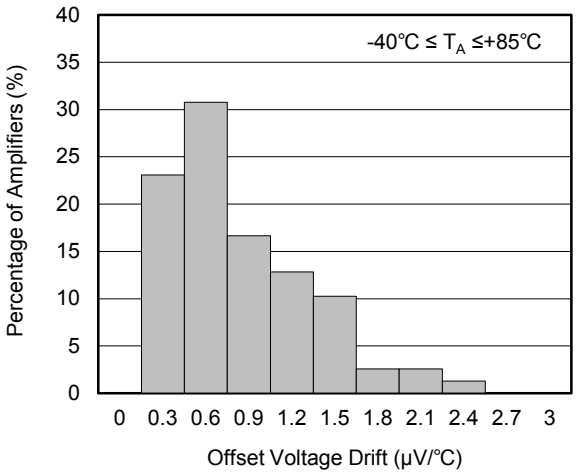
Offset Voltage Production Distribution



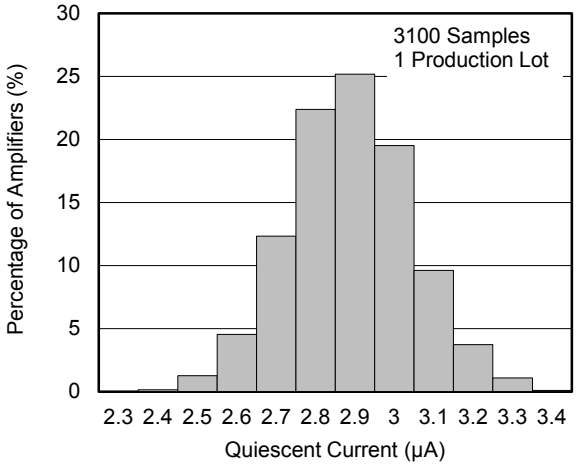
Offset Voltage Drift Distribution



Offset Voltage Drift Distribution



Quiescent Current Production Distribution



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APPLICATION INFORMATION

The SGM8240-1/2/4 operational amplifiers minimize power consumption without compromising bandwidth or noise. Typical values of power supply rejection ratio (PSRR), common mode rejection ratio (CMRR), and open-loop gain (A_{OL}) are 110dB or better.

When designing for ultra low power applications, choose system components carefully. To minimize current consumption, select large-value resistors. Any resistors will react with stray capacitance in the circuit and the input capacitance of the operational amplifier. These parasitic RC combinations can affect the stability of the overall system. A feedback capacitor may be required to ensure stability and limit overshoot or gain peaking.

Good layout practice mandates the use of a 0.1μF bypass capacitor placed closely across the supply pins.

Operating Voltage

SGM8240-1/2/4 operational amplifiers are fully specified and tested from +2.7V to +24V or (±1.35V to ±12V).

Input Common Mode Voltage Range

The input common mode voltage range of the SGM8240-1/2/4 typically extends 100mV beyond each supply rail. This rail-to-rail input is achieved by using a complementary input stage. CMRR is specified from the negative rail to 1V below the positive rail. Between ($-V_S$) - 0.1V and ($+V_S$) + 0.1V, the amplifier operates with lower CMRR because of the transition region of the input stage.

Protecting Inputs from Over-Voltage

Normally, input currents are 5pA. However, a large voltage input (greater than 500mV beyond the supply rails) can cause excessive current to flow in or out of the input pins. Therefore, as well as keeping the input voltage below the maximum rating, it is also important to limit the input current to less than 10mA. This limiting is easily accomplished with an input voltage resistor, as shown in Figure 1.

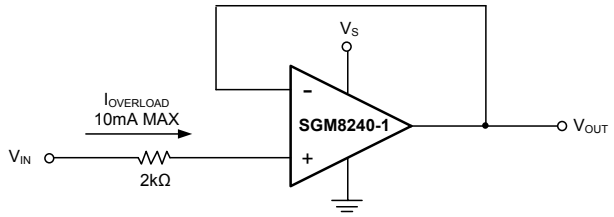

Figure 1. Input Current Protection for Voltages Exceeding the Supply Voltage

Capacitive Load and Stability

Follower configurations with load capacitance in excess of 30pF can produce extra overshoot and ringing in the output signal. Increasing the gain enhances the ability of the amplifier to drive greater capacitive loads. In unity-gain configurations, capacitive load drive can be improved by inserting a small (10Ω to 20Ω) resistor, R_S, in series with the output, as shown in Figure 2. This resistor significantly reduces ringing while maintaining direct current (dc) performance for purely capacitive loads. However, if there is a resistive load in parallel with the capacitive load, a voltage divider is created, introducing a dc error at the output and slightly reducing the output swing. The error introduced is proportional to the ratio R_S/R_L, and is generally negligible.

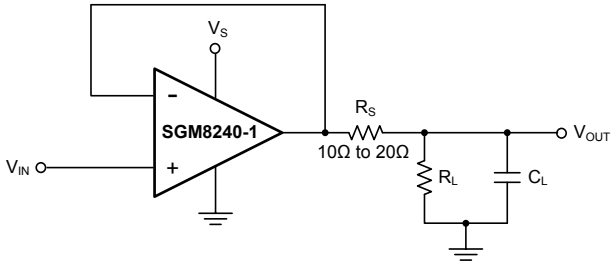

Figure 2. Series Resistor in Unity-Gain Buffer Configuration Improves Capacitive Load Drive

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APPLICATION INFORMATION (continued)

In unity-gain inverting configuration, phase margin can be reduced by the reaction between the capacitance at the operational amplifier input and the gain setting resistors. Best performance is achieved by using smaller valued resistors. However, when large valued resistors cannot be avoided, a small (4pF to 6pF) capacitor, C_{FB}, can be inserted in the feedback, as shown in Figure 3. This configuration significantly reduces overshoot by compensating the effect of capacitance, C_{IN}, which includes the amplifier input capacitance and printed circuit board (PCB) parasitic capacitance.

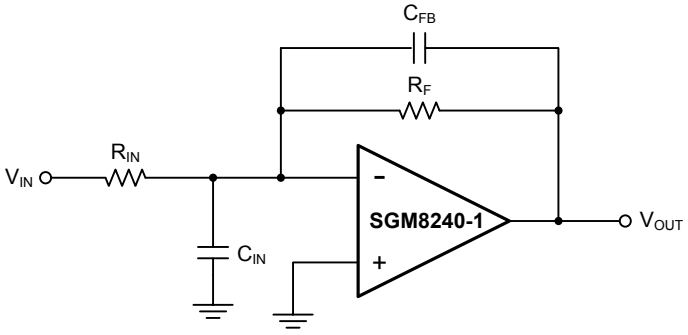


Figure 3. Improving Stability for Large R_F and R_{IN}

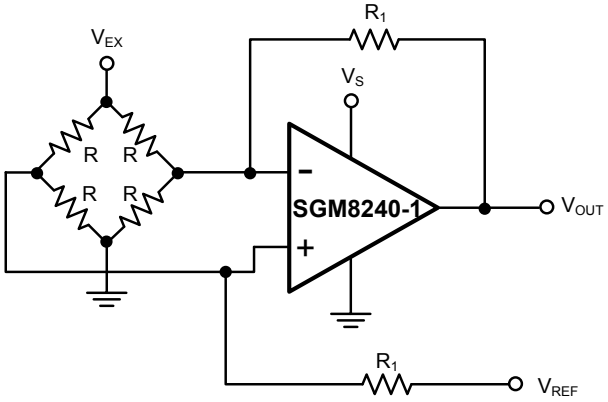
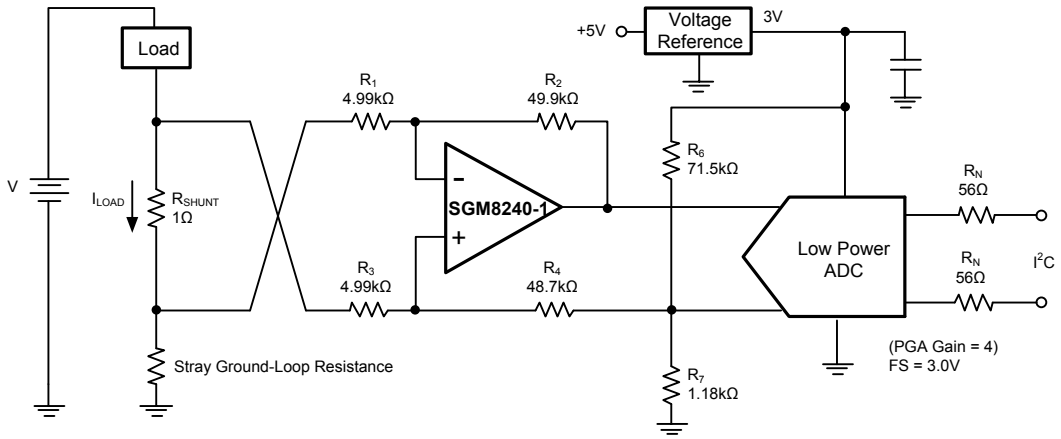


Figure 4. Single Opamp Bridge Amplifier



NOTE: 1% resistors provide adequate common mode rejection at small ground-loop errors.

Figure 5. Low-side Current Monitor

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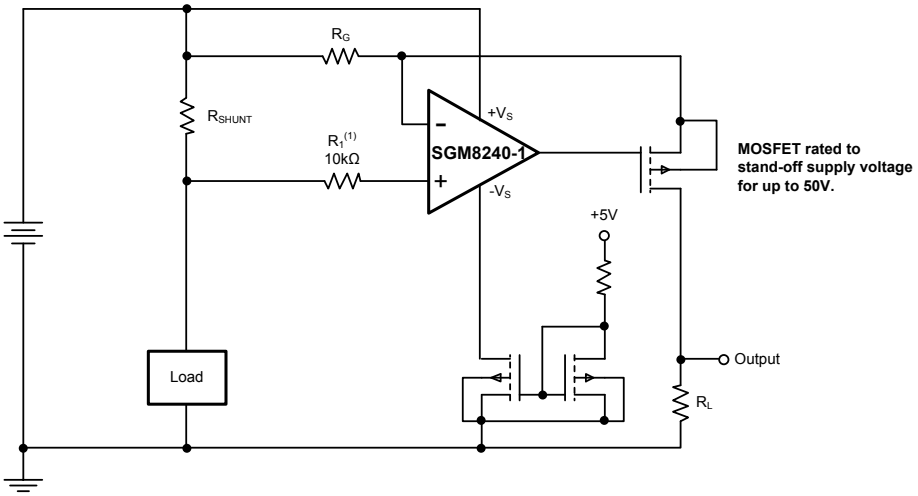
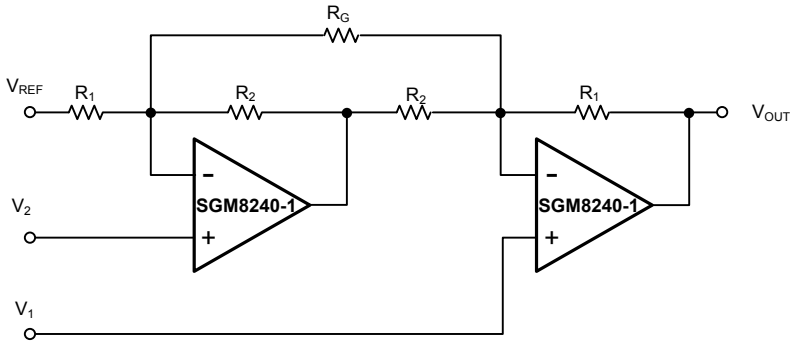
APPLICATION INFORMATION (continued)



NOTE:
1. Current-limiting resistor.

Figure 6. High-side Current Measurement



$$V_{OUT} = (V_1 - V_2)\ (1 + R_1/R_2 + 2R_1/R_G) + V_{REF}$$

Figure 7. Two Opamp Low Power Instrumentation Amplifier

REVISION HISTORY

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

Changes from Original (DECEMBER 2016) to REV.A

Changed from product preview to production data	All

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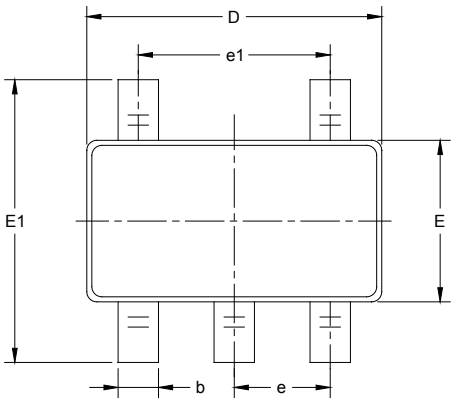
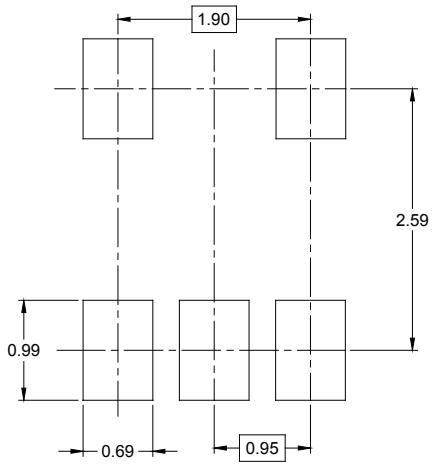
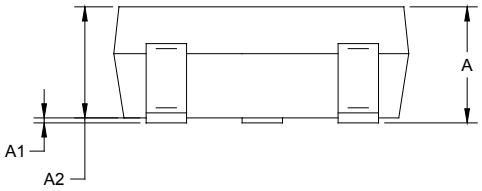
PACKAGE OUTLINE DIMENSIONS

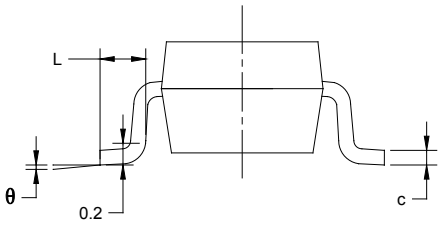
SOT-23-5





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
θ	0°	8°	0°	8°

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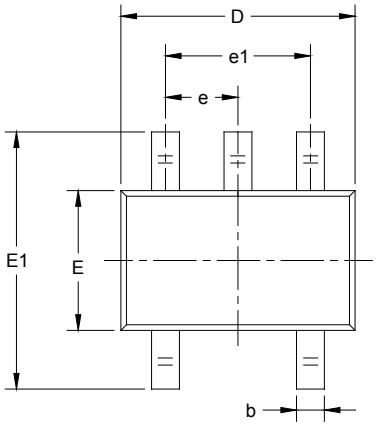
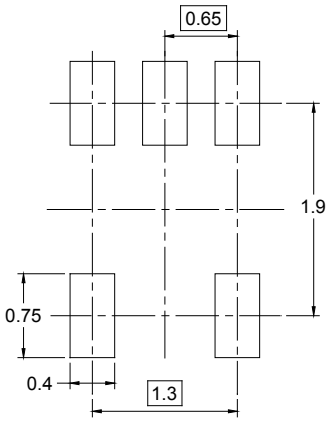
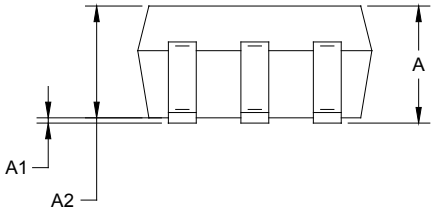
PACKAGE OUTLINE DIMENSIONS

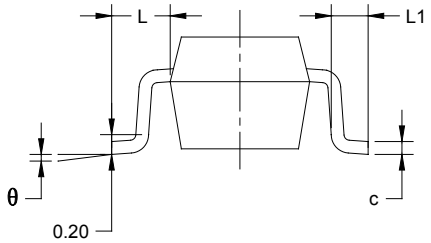
SC70-5





RECOMMENDED LAND PATTERN (Unit: mm)





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
c	0.080	0.150	0.003	0.006
D	2.000	2.200	0.079	0.087
E	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.65 TYP		0.026 TYP	
e1	1.300 BSC		0.051 BSC	
L	0.525 REF		0.021 REF	
L1	0.260	0.460	0.010	0.018
θ	0°	8°	0°	8°

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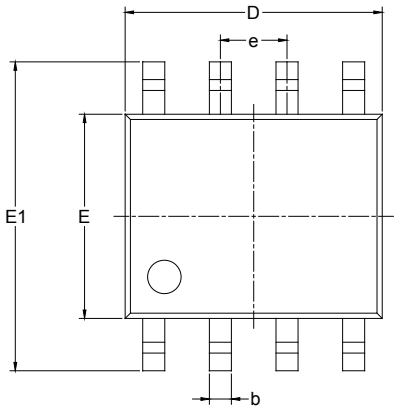
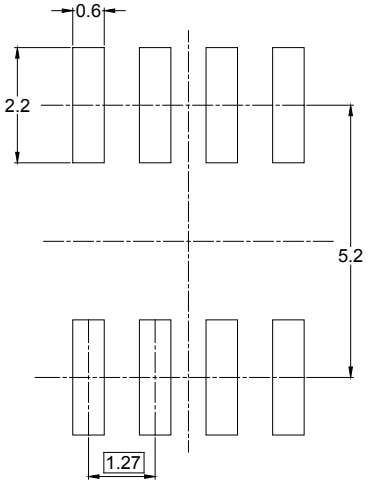
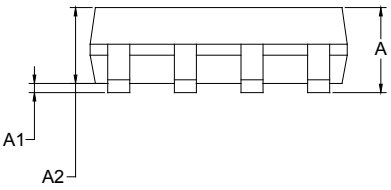
PACKAGE OUTLINE DIMENSIONS

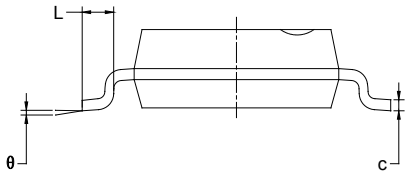
SOIC-8





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°

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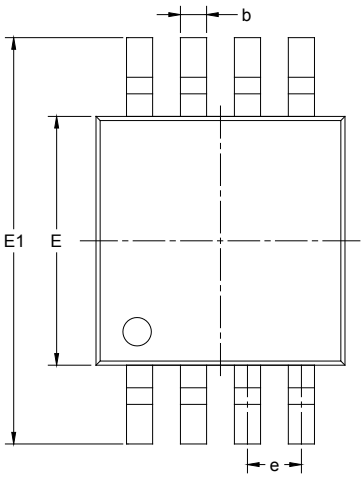
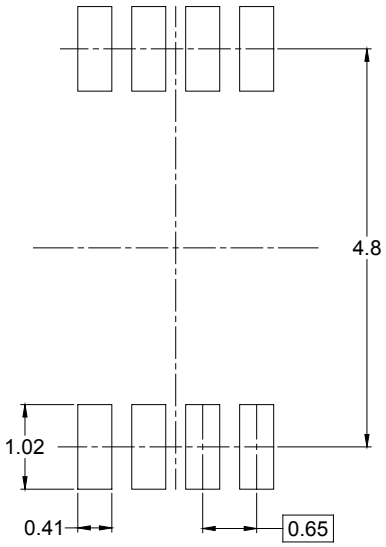
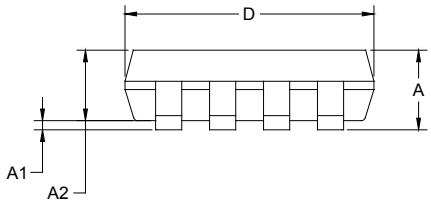
PACKAGE OUTLINE DIMENSIONS

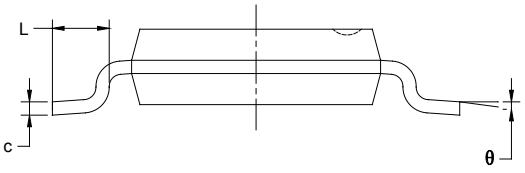
MSOP-8





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°

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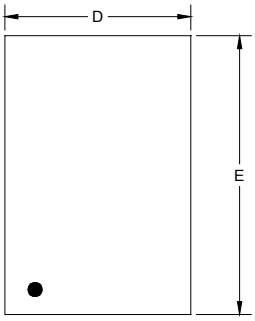
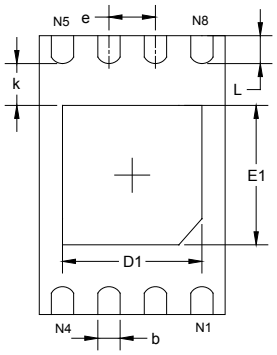
PACKAGE OUTLINE DIMENSIONS

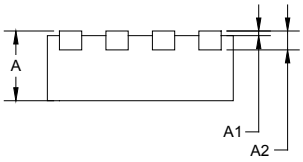
TDFN-2×3-8L



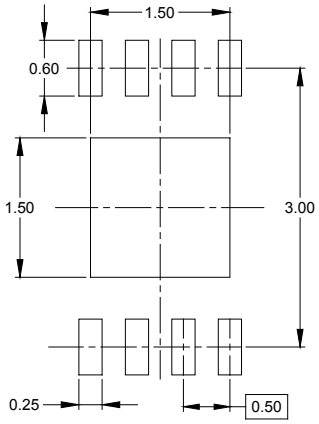
TOP VIEW



BOTTOM VIEW



SIDE VIEW



RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
D	1.924	2.076	0.076	0.082
D1	1.400	1.600	0.055	0.063
E	2.924	3.076	0.115	0.121
E1	1.400	1.600	0.055	0.063
k	0.200 MIN		0.008 MIN	
b	0.200	0.300	0.008	0.012
e	0.500 TYP		0.020 TYP	
L	0.224	0.376	0.009	0.015

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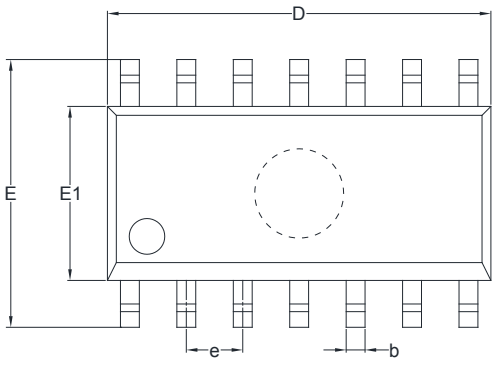
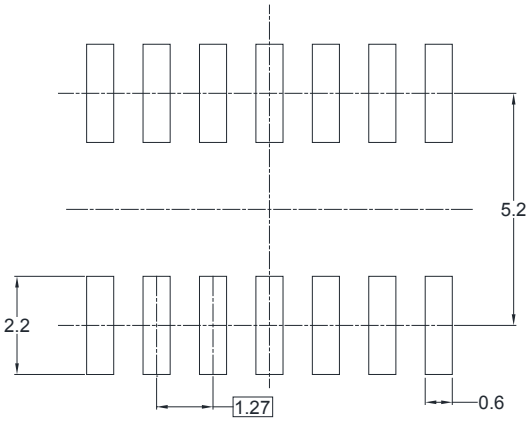
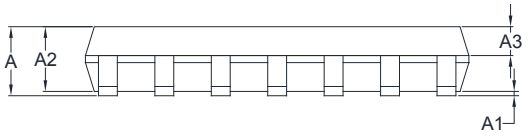
PACKAGE OUTLINE DIMENSIONS

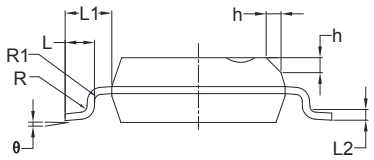
SOIC-14





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°

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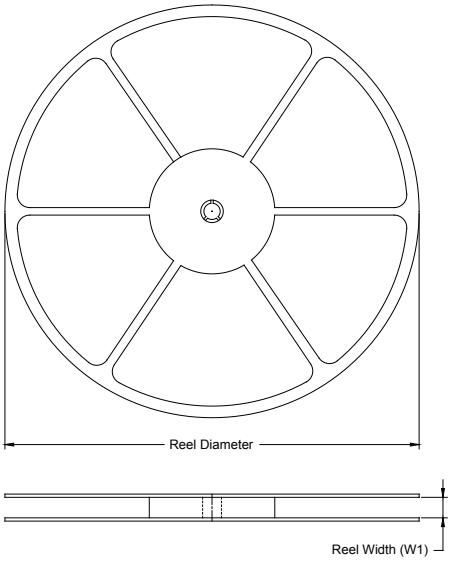
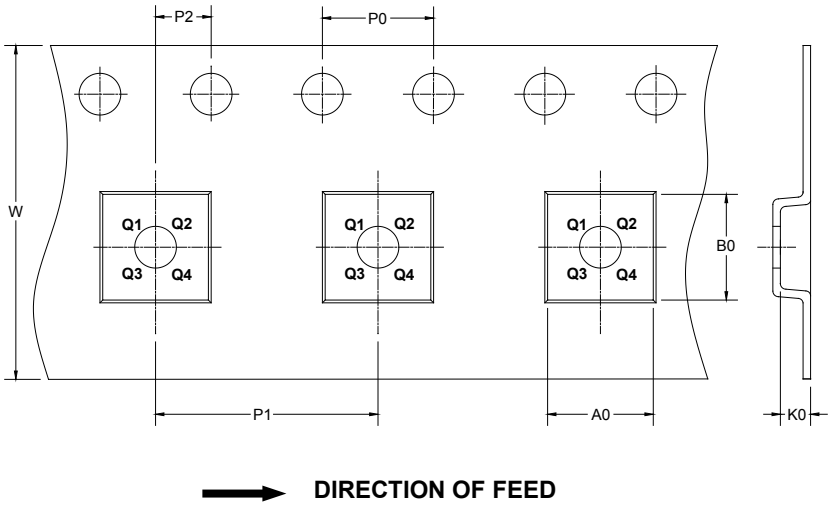
TAPE AND REEL INFORMATION

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
SC70-5	7″	9.5	2.25	2.55	1.20	4.0	4.0	2.0	8.0	Q3
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
TDFN-2×3-8L	7″	9.5	2.30	3.30	1.10	4.0	4.0	2.0	8.0	Q2
SOIC-14	13″	16.4	6.60	9.30	2.10	4.0	8.0	2.0	16.0	Q1

DD0001

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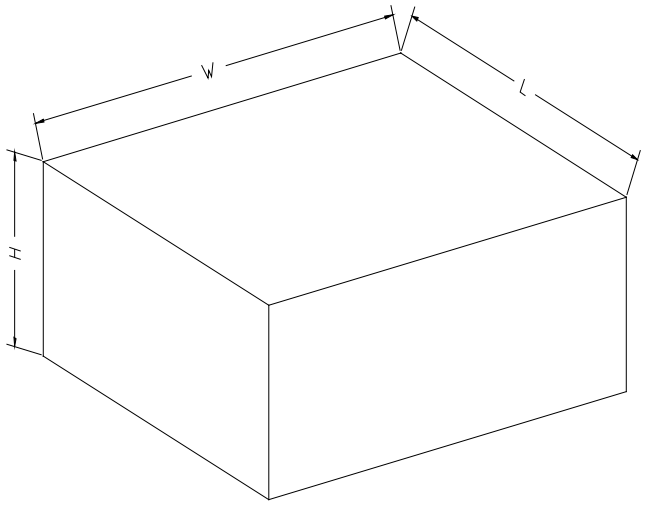
CARTON BOX DIMENSIONS



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

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