SGM8042
670nA, Dual, Rail-to-Rail I/O Operational Amplifier

GENERAL DESCRIPTION

The SGM8042 is a dual, high precision operational amplifier which can operate from 1.4V to 5.5V single supply, while consuming only 670nA quiescent current per amplifier. It is capable of rail-to-rail input and output. Therefore, the SGM8042 is suitable for use in portable instrumentation and battery-powered equipment.

The SGM8042 is unity-gain stable, and features a 14.5kHz gain-bandwidth product. It is designed to provide optimal performance in low-frequency systems, when monitoring battery current and conditioning sensor signal.

The SGM8042 is available in Green SOIC-8 and MSOP-8 packages. It is specified over the extended -40℃ to +85℃ temperature range.

FEATURES

- **Low Quiescent Current: 670nA/Amplifier (TYP)**
- **Unity-Gain Stable**
- **Gain-Bandwidth Product: 14.5kHz at V_S = 5V (TYP)**
- **Rail-to-Rail Input and Output**
- **Supply Voltage Range: 1.4V to 5.5V**
- **-40℃ to +85℃ Operating Temperature Range**
- **Available in Green SOIC-8 and MSOP-8 Packages**

APPLICATIONS

Battery-Powered Equipment
Temperature Measurements
Tollbooth Tags
Wearable Devices

TYPICAL APPLICATION

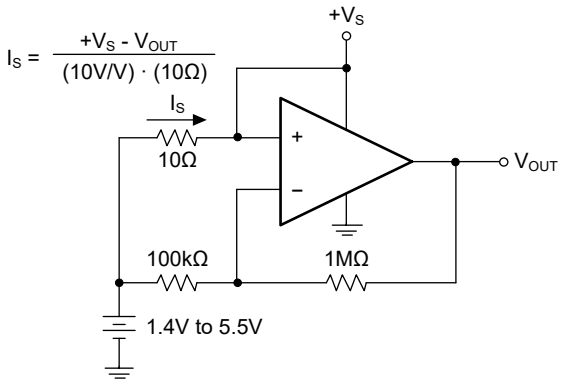


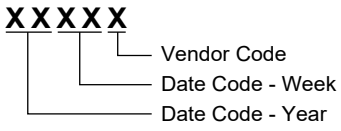
Figure 1. High-side Battery Current Sensor

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8042	SOIC-8	-40℃ to +85℃	SGM8042YS8G/TR	SGM8042YS8 XXXXX	Tape and Reel, 2500
	MSOP-8	-40℃ to +85℃	SGM8042YMS8G/TR	SGM8042 YMS8 XXXXX	Tape and Reel, 3000

MARKING INFORMATION

NOTE: 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.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage 6V
Analog Inputs (+IN, -IN) ..... ($-V_S$) - 0.1V to ($+V_S$) + 0.1V
Differential Input Voltage ..... |($-V_S$) - ($+V_S$)|
Package Thermal Resistance
SOIC-8, θ_{JA} ..... 134.0℃/W
SOIC-8, θ_{JB} ..... 82.1℃/W
SOIC-8, θ_{JC} ..... 75.8℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 4000V
MM 400V

RECOMMENDED OPERATING CONDITIONS

Operating Temperature Range ..... -40℃ to +85℃

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

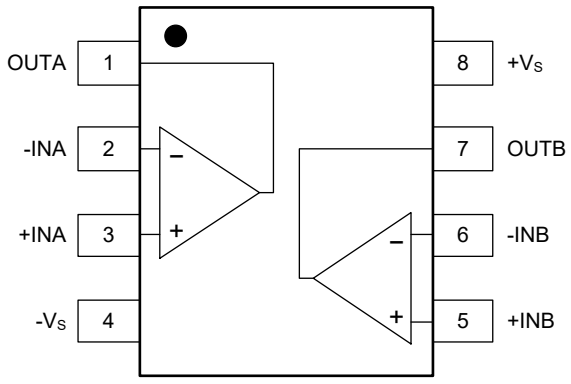
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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

(TOP VIEW)



SOIC-8/MSOP-8

ELECTRICAL CHARACTERISTICS

(At T_A = +25℃, $+V_S$ = 1.4V to 5V, $-V_S$ = GND, V_{CM} = $+V_S$/2, V_{OUT} ≈ $+V_S$/2 and R_L = 1MΩ to $+V_S$/2 (1), unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DC Electrical Characteristics						
Input Offset Voltage	V_{OS}	V_{CM} = $+V_S$/2		0.4	2.5	mV
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	V_{CM} = $+V_S$/2, -40℃ ≤ T_A ≤ +85℃		2.5		μV/℃
Power Supply Rejection Ratio	PSRR	$+V_S$ = 1.4V to 5.5V	77	80		dB
Input Common Mode Voltage Range	V_{CMR}		($-V_S$) - 0.1		($+V_S$) + 0.1	V
Common Mode Rejection Ratio	CMRR	$+V_S$ = 5.0V, V_{CM} = -0.1V to 5.1V	67	84		dB
		$+V_S$ = 5.0V, V_{CM} = 2.5V to 5.1V	70	83		
		$+V_S$ = 5.0V, V_{CM} = -0.1V to 2.5V	66	78		
Large-Signal Voltage Gain	A_{VO}	$+V_S$ = 1.4V, R_L = 50kΩ, V_{OUT} = ($+V_S$) - 0.1V	75	80		dB
		$+V_S$ = 2.5V, R_L = 50kΩ, V_{OUT} = ($+V_S$) - 0.1V		88		
		$+V_S$ = 5.0V, R_L = 50kΩ, V_{OUT} = ($+V_S$) - 0.1V	84	93		
Input Bias Current	I_B			1		pA
Input Offset Current	I_{OS}			1		pA
Maximum Output Voltage Swing	V_{OH}	$+V_S$ = 1.4V, R_L = 50kΩ	1.390	1.395		V
		$+V_S$ = 2.5V, R_L = 50kΩ		2.497		
		$+V_S$ = 5.0V, R_L = 50kΩ	4.990	4.997		
	V_{OL}	$+V_S$ = 1.4V, R_L = 50kΩ		4.5	10	mV
		$+V_S$ = 2.5V, R_L = 50kΩ		3.1		
		$+V_S$ = 5.0V, R_L = 50kΩ		3.5	10	
Output Short-Circuit Current	I_{SC}	$+V_S$ = 2.5V		5.5		mA
		$+V_S$ = 5.0V	22	24		
Supply Voltage	V_{CC}		1.4		5.5	V
Quiescent Current/Amplifier	I_Q	$+V_S$ = 1.4V		570		nA
		$+V_S$ = 2.5V		620		
		$+V_S$ = 5.0V		670	1500	

NOTE: 1. Refer to Figure 2 and Figure 3.

ELECTRICAL CHARACTERISTICS (continued)

(At T_A = +25℃, $+V_S$ = 1.4V to 5V, $-V_S$ = GND, V_{CM} = $+V_S/2$, V_{OUT} ≈ $+V_S/2$ and R_L = 1MΩ to $+V_S/2$, C_L = 60pF (1), unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
AC Electrical Characteristics						
Gain-Bandwidth Product	GBP	$+V_S$ = 1.4V		12		kHz
		$+V_S$ = 2.5V		13.5		
		$+V_S$ = 5.0V		14.5		
Slew Rate	SR	$+V_S$ = 1.4V, V_{OUT} = 1V Step		3.8		V/ms
		$+V_S$ = 2.5V, V_{OUT} = 1V Step		4.0		
		$+V_S$ = 5.0V, V_{OUT} = 2V Step		4.2		
Phase Margin	PM	$+V_S$ = 1.4V to 5.5V		60		°
Input Voltage Noise	$e_{n\ P-P}$	$+V_S$ = 1.4V, f = 0.1Hz to 10Hz		3.7		μV_{P-P}
		$+V_S$ = 2.5V, f = 0.1Hz to 10Hz		3.2		
		$+V_S$ = 5.0V, f = 0.1Hz to 10Hz		3.2		
Input Voltage Noise Density	e_n	$+V_S$ = 1.4V, f = 1kHz		190		$nV/\sqrt{HZ}$
		$+V_S$ = 2.5V, f = 1kHz		180		
		$+V_S$ = 5.0V, f = 1kHz		180		

NOTE: 1. Refer to Figure 2 and Figure 3.

TEST CIRCUITS

Figure 2 and Figure 3 show the AC and DC test circuits.

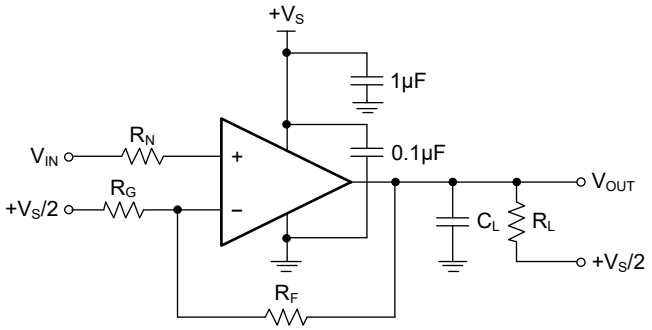


Figure 2. AC and DC Test Circuit for Most Non-Inverting Gain Configurations

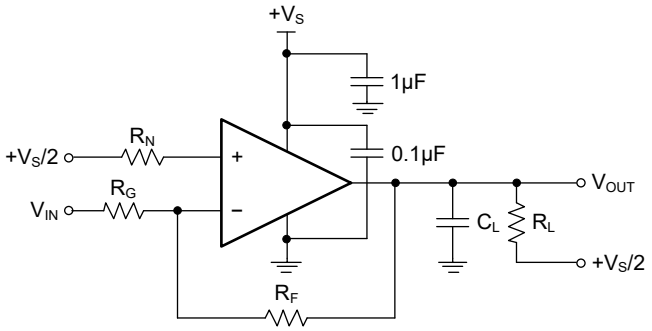
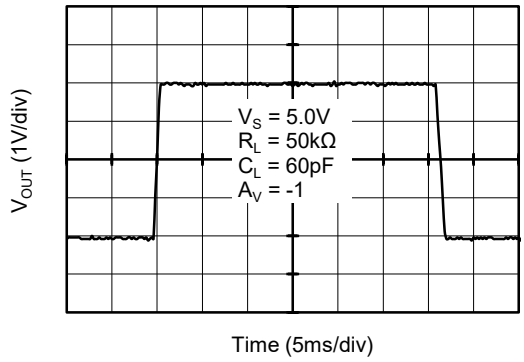


Figure 3. AC and DC Test Circuit for Most Inverting Gain Configurations

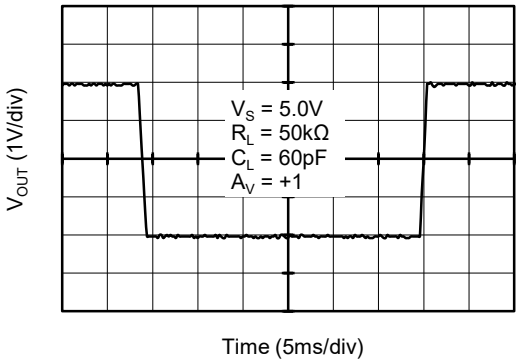
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, $+V_S$ = 1.4V to 5V, $-V_S$ = GND, V_{CM} = $+V_S/2$, V_{OUT} ≈ $+V_S/2$ and R_L = 1MΩ to $+V_S/2$, C_L = 60pF, unless otherwise noted.

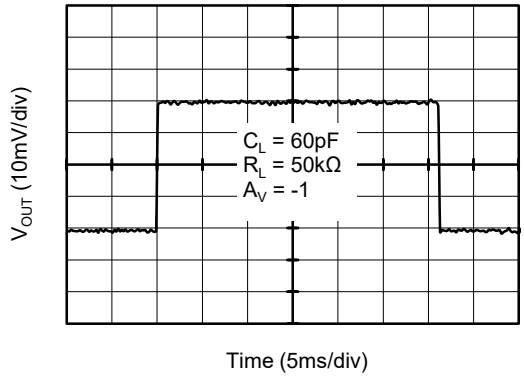
Large-Signal Inverting Pulse Response



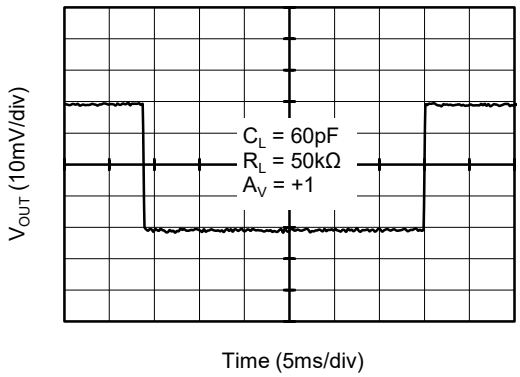
Large-Signal Non-Inverting Pulse Response



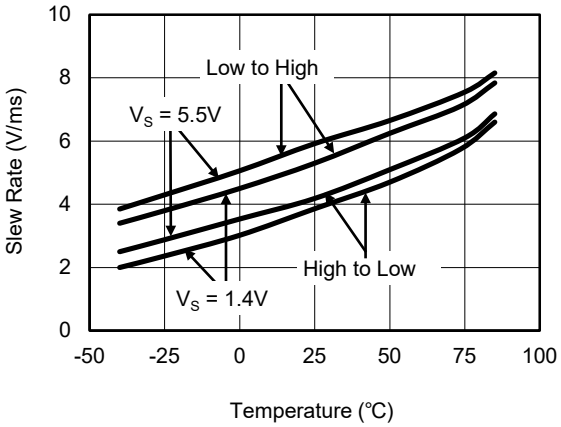
Small-Signal Inverting Pulse Response



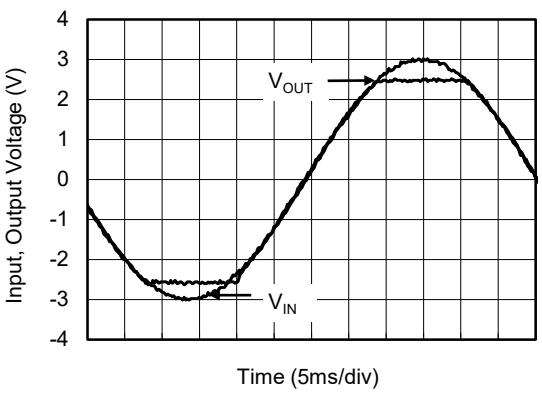
Small-Signal Non-Inverting Pulse Response



Slew Rate vs. Temperature



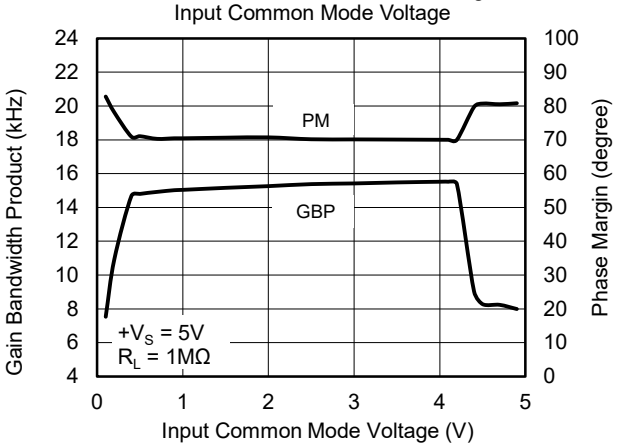
No Phase Reversal



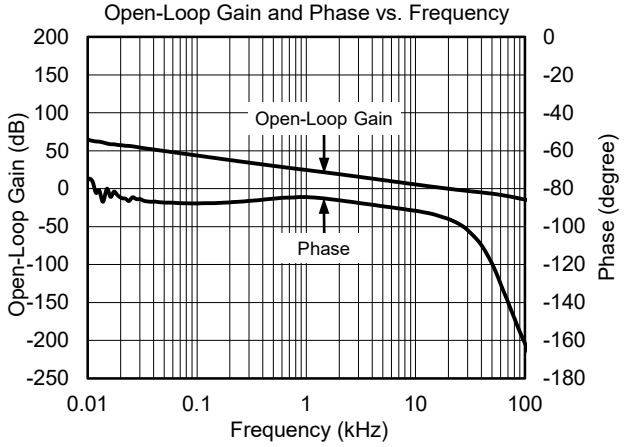
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, $+V_S$ = 1.4V to 5V, $-V_S$ = GND, V_{CM} = $+V_S/2$, V_{OUT} ≈ $+V_S/2$ and R_L = 1MΩ to $+V_S/2$, C_L = 60pF, unless otherwise noted.

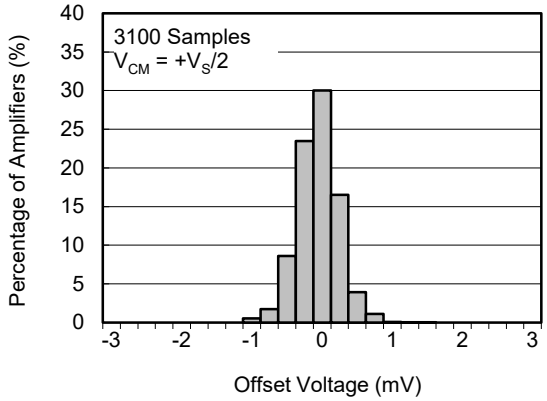
Gain-Bandwidth Product and Phase Margin vs. Input Common Mode Voltage



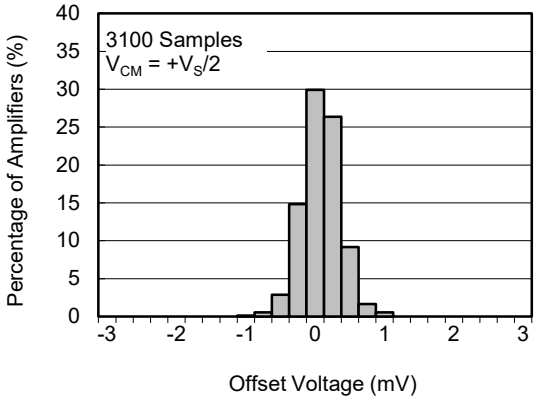
Open-Loop Gain and Phase vs. Frequency



Offset Voltage Production Distribution at +5V



Offset Voltage Production Distribution at +1.4V



REVISION HISTORY

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

NOVEMBER 2024 – REV.A.3 to REV.A.4	Page
Updated Absolute Maximum Ratings section	2

OCTOBER 2017 – REV.A.2 to REV.A.3	Page
Updated Typical Performance Characteristics section	6

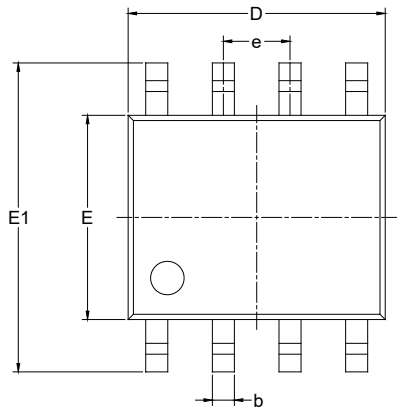
JANUARY 2013 – REV.A.1 to REV.A.2	Page
Added Tape and Reel Information section	9~10

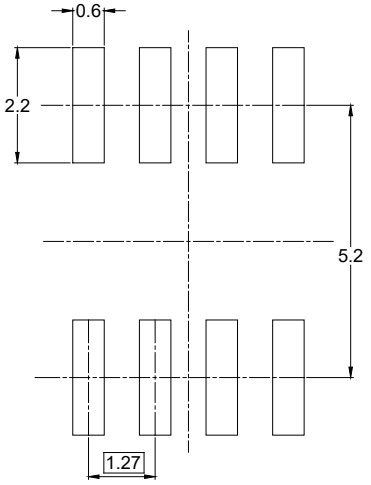
MAY 2011 – REV.A to REV.A.1	Page
Updated Package Description	All

Changes from Original (APRIL 2010) to REV.A	Page
Changed from product preview to production data	All

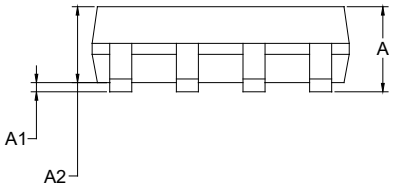
PACKAGE OUTLINE DIMENSIONS

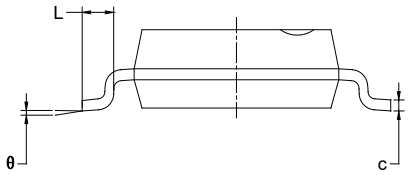
SOIC-8





RECOMMENDED LAND PATTERN (Unit: mm)



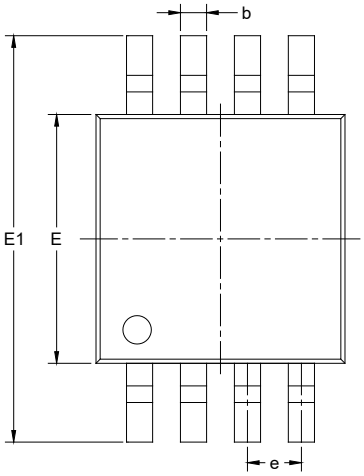


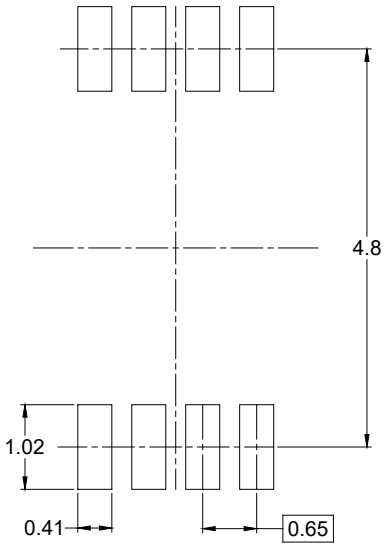
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

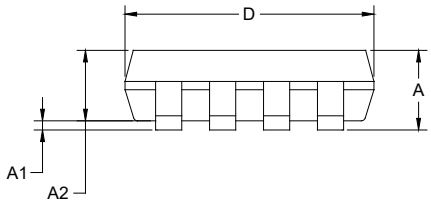
PACKAGE OUTLINE DIMENSIONS

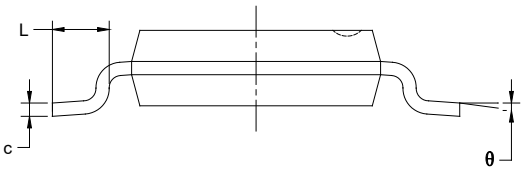
MSOP-8





RECOMMENDED LAND PATTERN (Unit: mm)



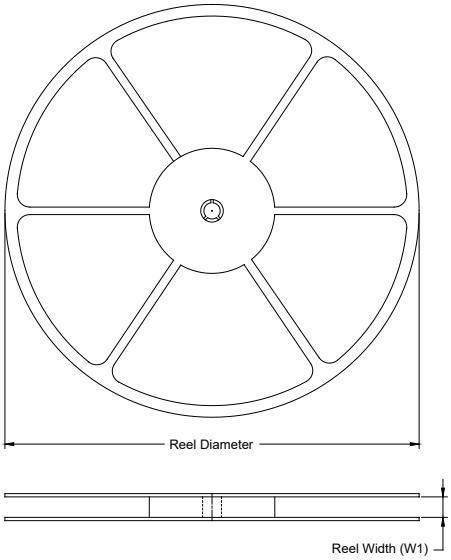


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026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

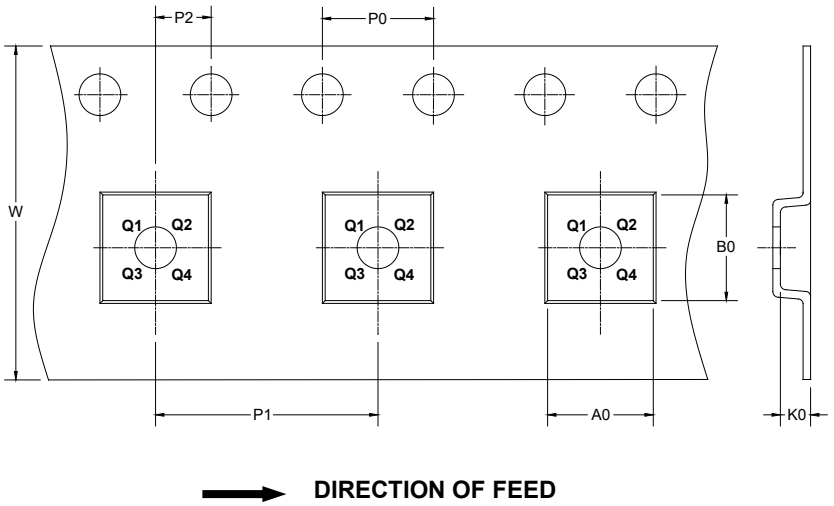
NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



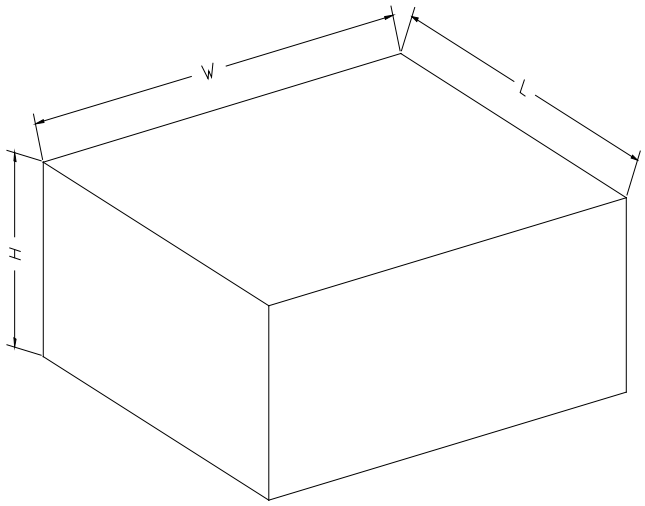
NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOIC-8	13″	12.4	6.40	5.40	2.10	4.0	8.0	2.0	12.0	Q1
MSOP-8	13″	12.4	5.20	3.30	1.50	4.0	8.0	2.0	12.0	Q1

DD0001

CARTON BOX DIMENSIONS



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

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
13″	386	280	370	5

DD0002