SGM8041
710nA, Single Rail-to-Rail I/O Operational Amplifier

GENERAL DESCRIPTION

The SGM8041 is guaranteed to operate with a single supply voltage as low as 1.4V, while drawing less than 710nA (TYP) of quiescent current. This device is also designed to support rail-to-rail input and output operation. This combination of features supports battery-powered and portable applications.

The SGM8041 has a gain-bandwidth product of 14.5kHz (TYP) and is unity gain stable. These specifications make this operational amplifier appropriate for low frequency applications, such as battery current monitoring and sensor conditioning.

The SGM8041 is offered in single configuration. The SGM8041 is available in Green SOT-23-5, SOIC-8 and MSOP-8 packages. It operates over an ambient temperature range of -40℃ to +85℃.

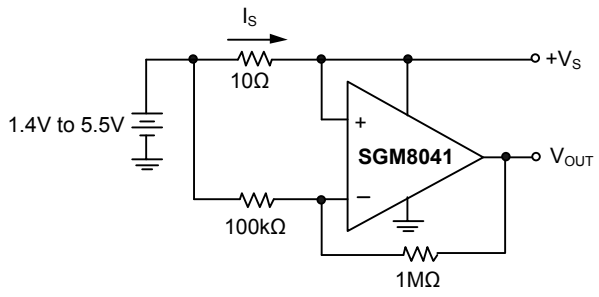
FEATURES

- **Low Quiescent Current: 710nA (TYP)**
- **Rail-to-Rail Input and Output**
- **Gain-Bandwidth Product: 14.5kHz at V_S = 5V (TYP)**
- **Wide Supply Voltage Range: 1.4V to 5.5V**
- **Unity Gain Stable**
- **-40℃ to +85℃ Operating Temperature Range**
- **Available in Green SOT-23-5, SOIC-8 and MSOP-8 Packages**

APPLICATIONS

Toll Booth Tags
Wearable Products
Temperature Measurement
Battery Powered System

TYPICAL APPLICATION

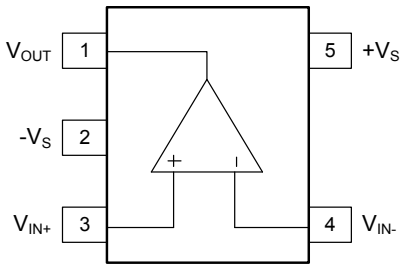


$$I_S = \frac{+V_S - V_{OUT}}{(10V/V) \cdot (10\Omega)}$$

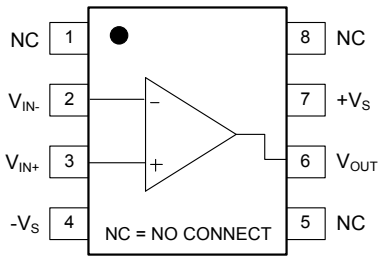
High-side Battery Current Sensor

PIN CONFIGURATIONS

SGM8041 (TOP VIEW)



SOT-23-5



SOIC-8/MSOP-8

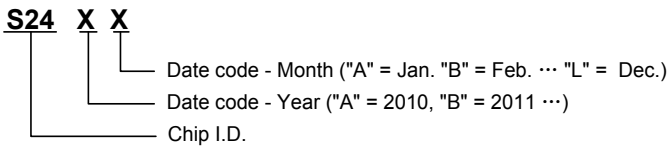
PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8041	SOT-23-5	-40℃ to +85℃	SGM8041YN5G/TR	S24XX	Tape and Reel, 3000
	SOIC-8	-40℃ to +85℃	SGM8041YS8G/TR	SGM8041YS8 XXXXX	Tape and Reel, 2500
	MSOP-8	-40℃ to +85℃	SGM8041YMS8G/TR	SGM8041 YMS8 XXXXX	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: S24GA (2016, January)

ABSOLUTE MAXIMUM RATINGS

Supply Voltage.....6V
Analog Inputs (V_{IN+}, V_{IN-})..... ($-V_S$) - 0.1V to ($+V_S$) + 0.1V
Differential Input Voltage..... | ($-V_S$) - ($+V_S$) |
Storage Temperature Range .....-65℃ to +150℃
Junction Temperature.....+150℃
Lead Temperature (Soldering 10sec)
.....+260℃
ESD Susceptibility
HBM.....3000V
MM.....300V

RECOMMENDED OPERATING CONDITIONS

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

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.

ELECTRICAL CHARACTERISTICS

($+V_S$ = 1.4V to 5.0V, $-V_S$ = 0V, T_A = +25℃, 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	74	80		dB
Common Mode Input 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	72	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	76	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	I_Q	$+V_S$ = 1.4V		600		nA
		$+V_S$ = 2.5V		660		
		$+V_S$ = 5.0V		710	1500	

ELECTRICAL CHARACTERISTICS (continued)

(+V_S = 1.4V to 5.0V, -V_S = 0V, T_A = +25℃, 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		13.5		kHz
		+V_S = 2.5V		14.3		
		+V_S = 5.0V		14.5		
Slew Rate	SR	+V_S = 1.4V, V_{OUT} = 1V Step		3.0		V/ms
		+V_S = 2.5V, V_{OUT} = 1V Step		3.0		
		+V_S = 5.0V, V_{OUT} = 2V Step		3.3		
Phase Margin	PM	+V_S = 1.4V to 5.5V		60		°
Input Voltage Noise		+V_S = 1.4V, f = 0.1Hz to 10Hz		3.7		μV_{P-P}
		+V_S = 2.5V, f = 0.1Hz to 10Hz		3.5		
		+V_S = 5.0V, f = 0.1Hz to 10Hz		3.4		
Input Voltage Noise Density	e_n	+V_S = 1.4V, f = 1kHz		143		$nV/\sqrt{HZ}$
		+V_S = 2.5V, f = 1kHz		144		
		+V_S = 5.0V, f = 1kHz		135		

NOTE1: Refer to Figure 1 and Figure 2.

TEST CIRCUITS

The test circuits used for the DC and AC tests are shown in Figure 1 and Figure 2.

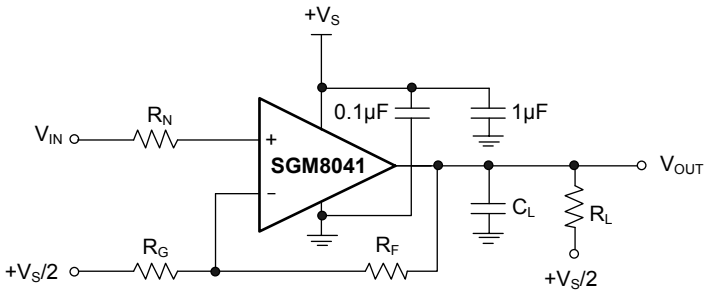


Figure 1. AC and DC Test Circuit for Most Non-Inverting Gain Configurations

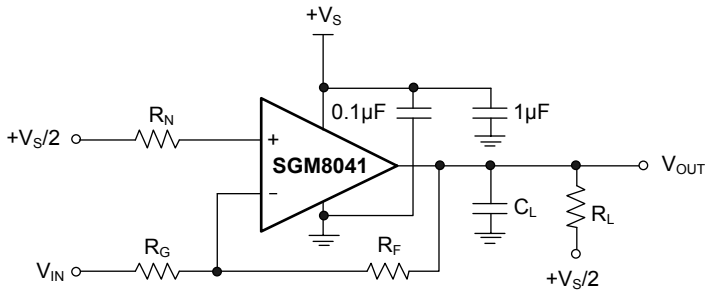
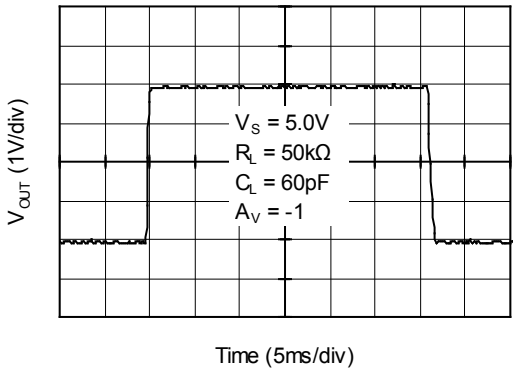


Figure 2. AC and DC Test Circuit for Most Inverting Gain Configurations

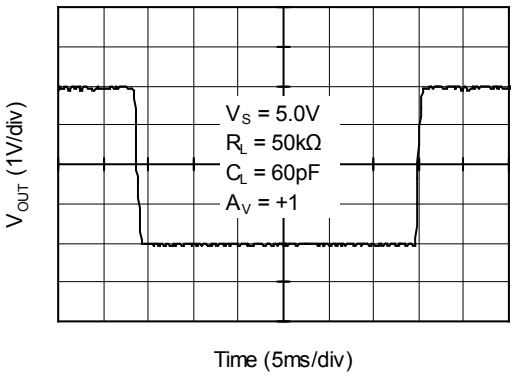
TYPICAL PERFORMANCE CHARACTERISTICS

T_A = +25℃, $+V_S$ = 1.4V to 5.0V, $-V_S$ = 0V, V_{CM} = $+V_S/2$, V_{OUT} = $+V_S/2$ and R_L = 1MΩ to $+V_S/2$, C_L = 60pF, unless otherwise noted.

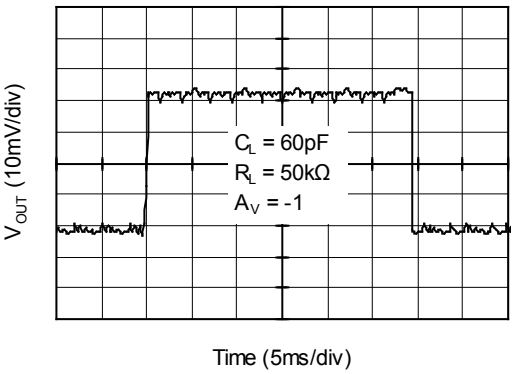
Large Signal Inverting Pulse Response



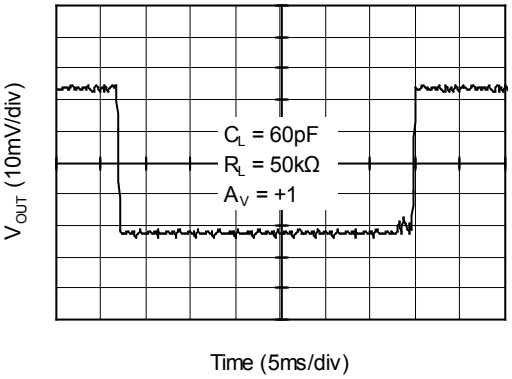
Large Signal Non-Inverting Pulse Response



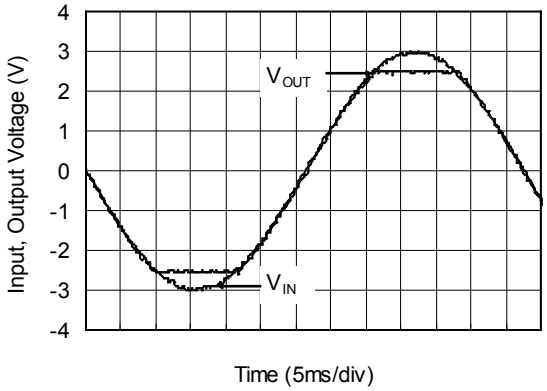
Small Signal Inverting Pulse Response



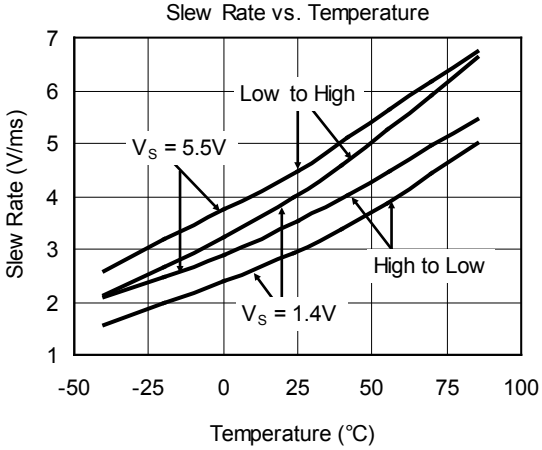
Small Signal Non-Inverting Pulse Response



No Phase Reversal

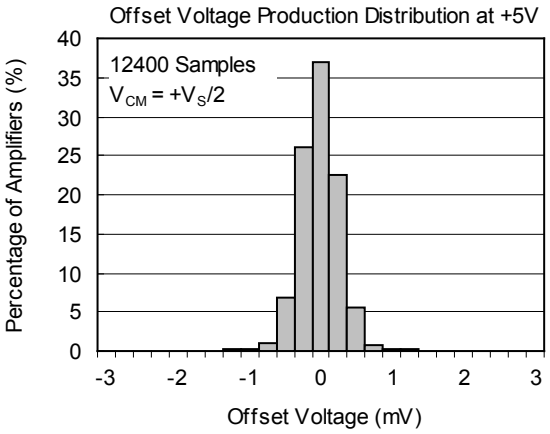


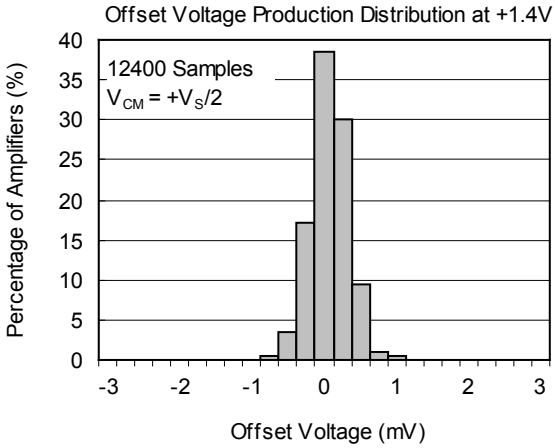
Slew Rate vs. Temperature



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T_A = +25℃, $+V_S$ = 1.4V to 5.0V, $-V_S$ = 0V, V_{CM} = $+V_S$/2, V_{OUT} = $+V_S$/2 and R_L = 1MΩ to $+V_S$/2, C_L = 60pF, unless otherwise noted.





APPLICATION INFORMATION

Figure 3 illustrates the simplified input ESD structures contained in the SGM8041.

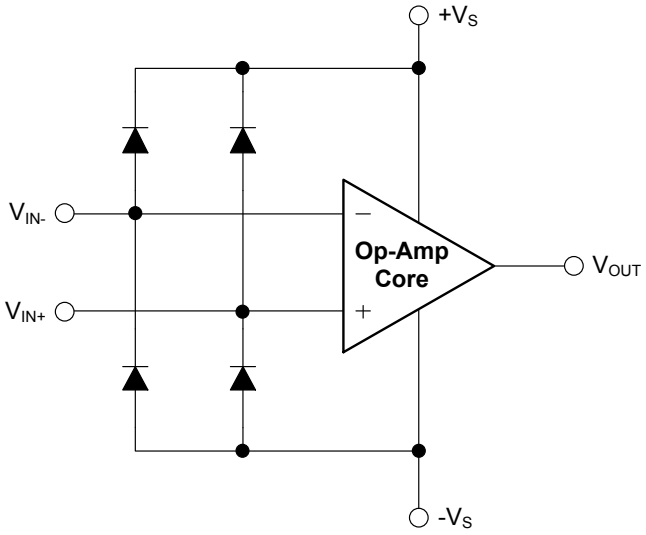


Figure 3. Simplified Input ESD Structures

REVISION HISTORY

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

JUNE 2017 – REV.A.2 to REV.A.3

Added Application Information section 6

JANUARY 2013 – REV.A.1 to REV.A.2

Added Tape and Reel Information section ..... 11~12

MAY 2011 – REV.A to REV.A.1

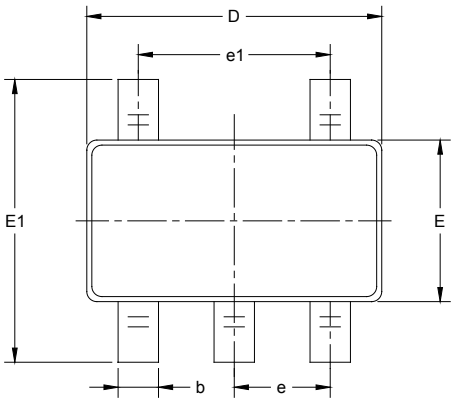
Updated Package Description ..... All

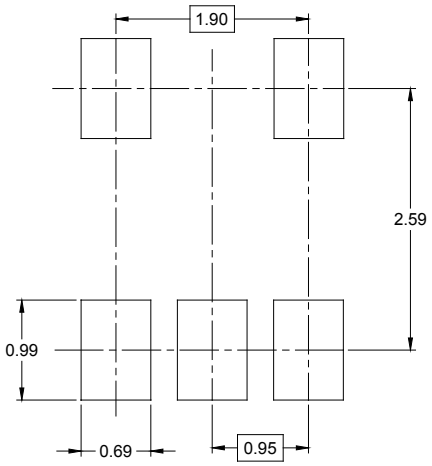
Changes from Original (APRIL 2010) to REV.A

Changed from product preview to production data ..... All

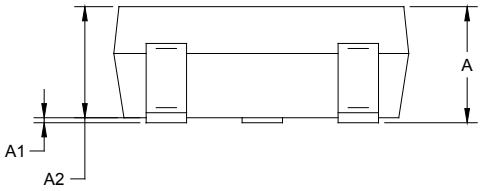
PACKAGE OUTLINE DIMENSIONS

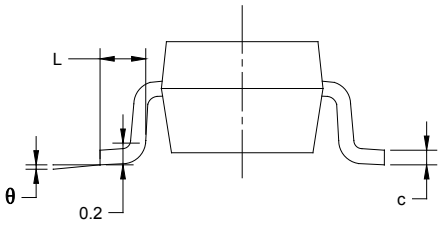
SOT-23-5





RECOMMENDED LAND PATTERN (Unit: mm)

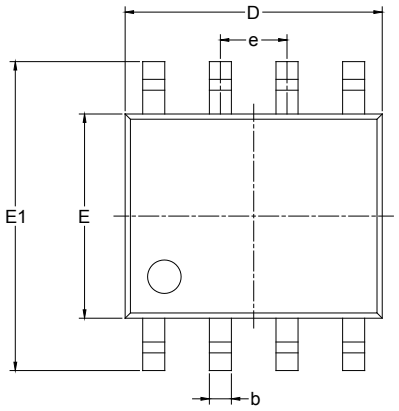


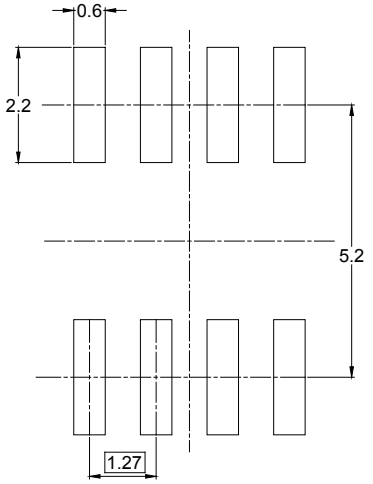


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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

SOIC-8





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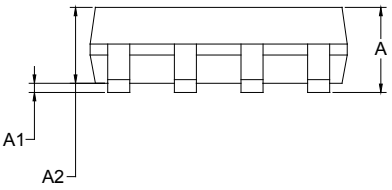
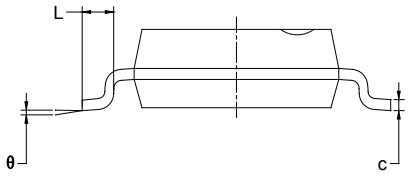
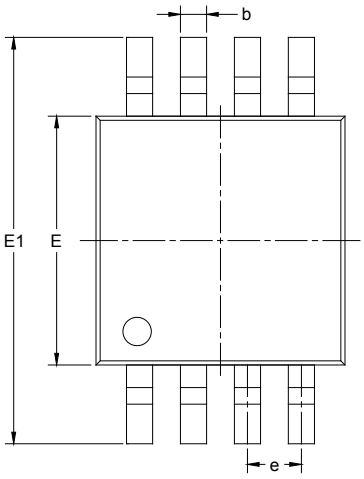


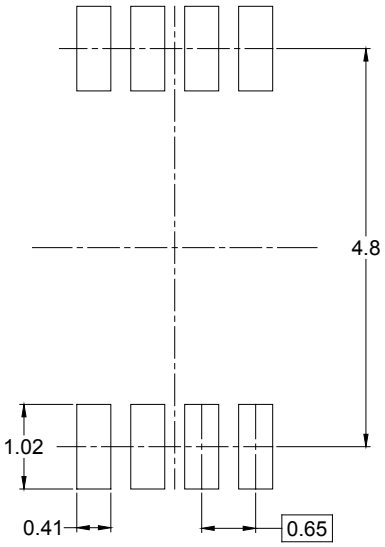


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

PACKAGE OUTLINE DIMENSIONS

MSOP-8





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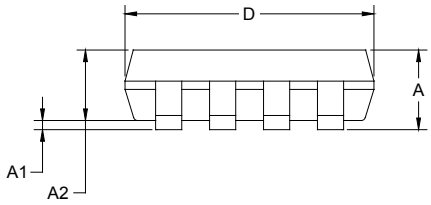
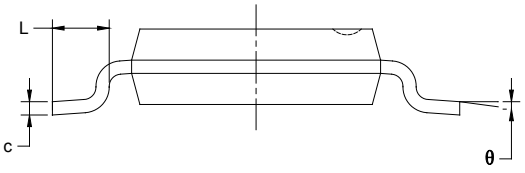
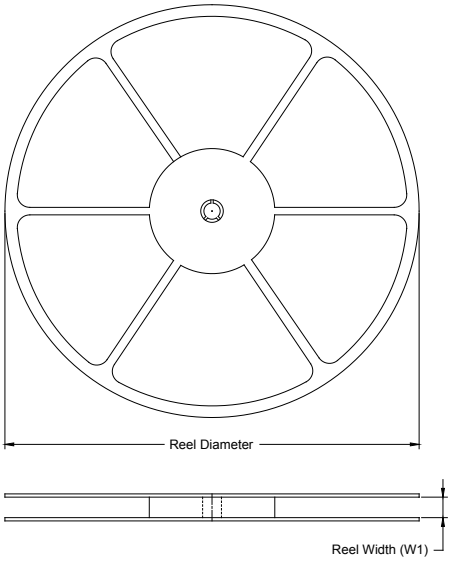




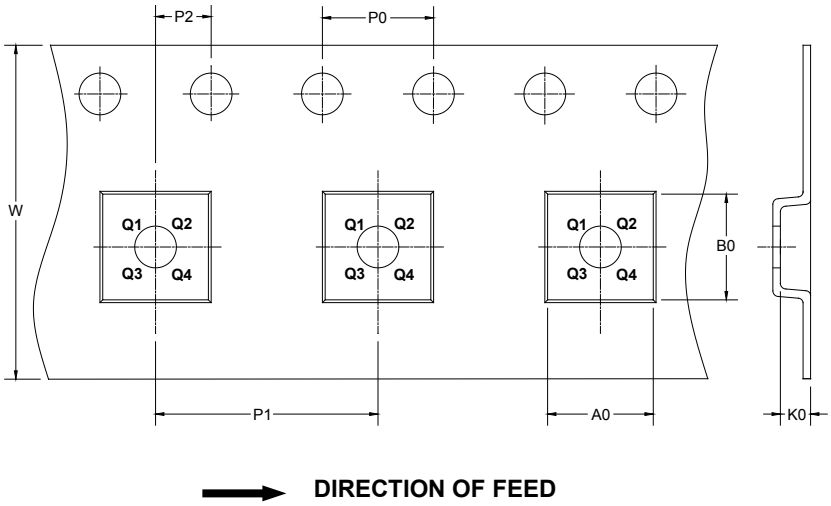
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026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

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



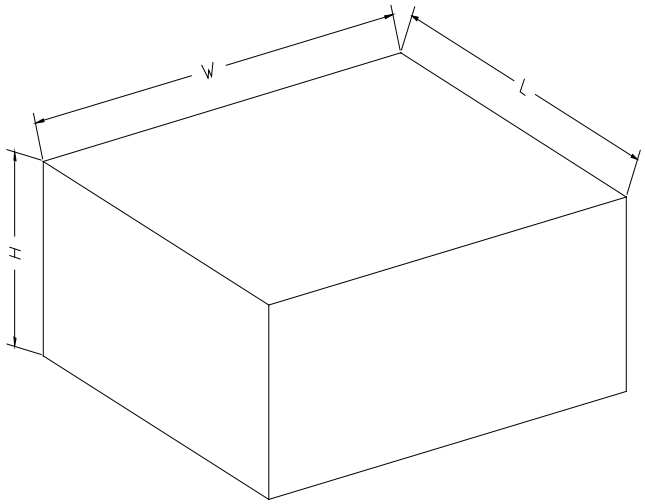
NOTE: The picture is only for reference. Please make the object as the standard.

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
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

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