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

PRODUCT 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. It is specified for the extended industrial (-40℃ to +85℃) temperature range. The SGM8041 is available in the Green SOT-23-5, SOIC-8 and MSOP-8 packages.

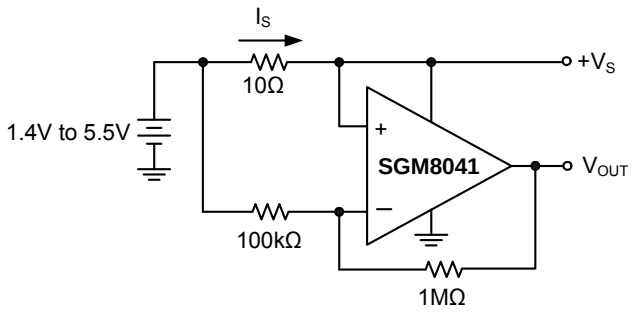
FEATURES

- **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

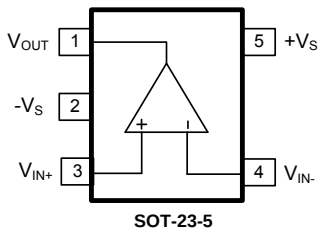


$$I_S = \frac{+Vs - V_{OUT}}{(10V/V) \cdot (10\Omega)}$$

High Side Battery Current Sensor

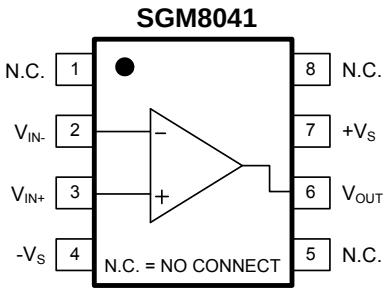
PIN CONFIGURATIONS (TOP VIEW)

SGM8041



SOT-23-5

SGM8041



SOIC-8/MSOP-8

PACKAGE/ORDERING INFORMATION

MODEL	ORDER NUMBER	PACKAGE DESCRIPTION	PACKAGE OPTION	MARKING INFORMATION
SGM8041	SGM8041YN5G/TR	SOT-23-5	Tape and Reel, 3000	S24XX
	SGM8041YS8G/TR	SOIC-8	Tape and Reel, 2500	SGM8041YS8
	SGM8041YMS8G/TR	MSOP-8	Tape and Reel, 3000	SGM8041YMS8

NOTE: Order number and package marking are defined as the follow:

ORDER NUMBER

SGM8041 X X G / TR

- **Tape and Reel**
- **Green Product**
- **Package Type**
  - N5 SOT-23-5
  - S8 SOIC-8
  - MS8 MSOP-8
- **Operating Temperature Range**
  - Y -40℃ to +85℃

MARKING INFORMATION

S24 X X

- Date code - month ("A" = Jan. "B" = Feb. ⋯ "L" = Dec.)
- Date code - year ("9" = 2009, "A" = 2010 ⋯)
- Chip I.D.

For example: S249A (2009, 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℃
Operating Temperature Range . . . . . -40℃ to +85℃
Lead Temperature (Soldering 10sec)
. . . . . 260℃
ESD Susceptibility
HBM 3000V
MM 300V

NOTE:
Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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.

SGMICRO reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact SGMICRO sales office to get the latest datasheet.

ELECTRICAL CHARACTERISTICS

$+V_S$ = +1.4V to +5.0V, $-V_S$ = GND, T_A = +25°C, V_{CM} = $+V_S/2$, V_{OUT} ≈ $+V_S/2$ and R_L = 1MΩ to $+V_S/2$ (1), unless otherwise noted.

PARAMETER		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/°C
Power Supply Rejection Ratio (PSRR)		$+V_S$ = 1.4V to 5.5V	74	80		dB
Common Mode Input Range (V_{CMR})			-Vs - 0.1		+Vs + 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			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

$+V_S$ = +1.4V to +5.0V, $-V_S$ = GND, T_A = +25°C, 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	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 (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		3.5		
	$+V_S$ = 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. The bypass capacitors are laid out according to the rules discussed in **"Supply Bypass"**.

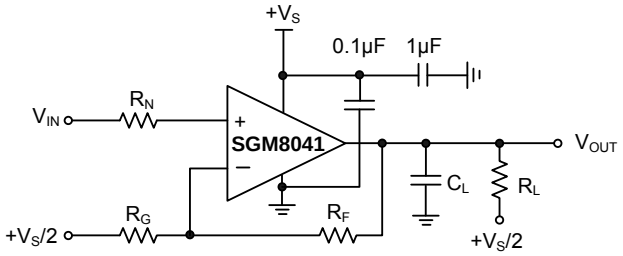


Figure 1. AC and DC Test Circuit for Most Non-Inverting Gain Conditions.

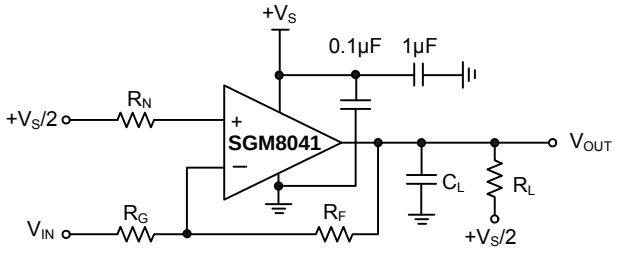
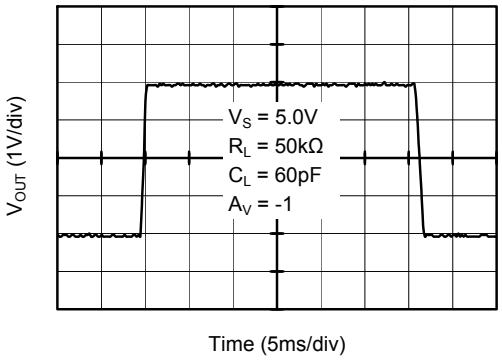


Figure 2. AC and DC Test Circuit for Most Inverting Gain Conditions.

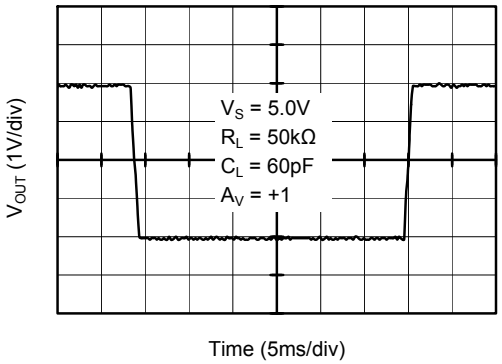
TYPICAL PERFORMANCE CHARACTERISTICS

T_A = +25°C, $+V_S$ = +1.4V to +5.0V, $-V_S$ = 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.

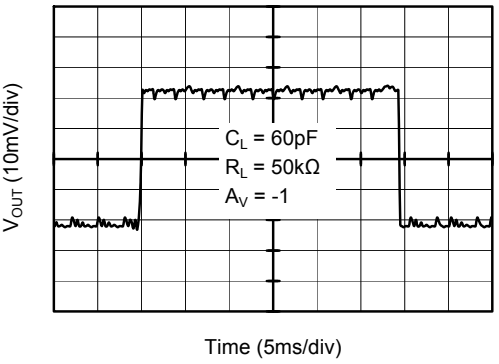
Large Signal Inverting Pulse Response



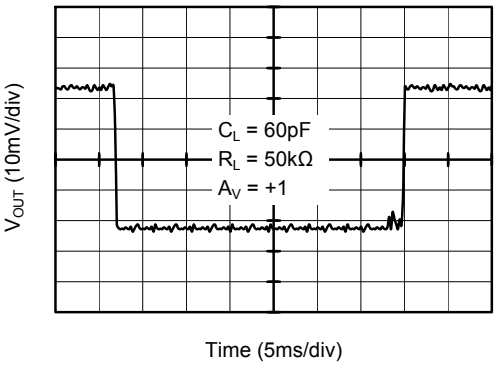
Large Signal Non-Inverting Pulse Response



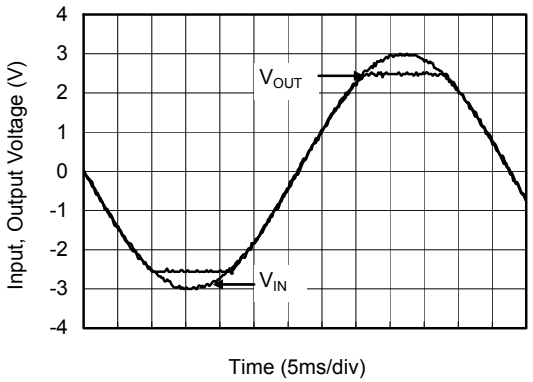
Small Signal Inverting Pulse Response



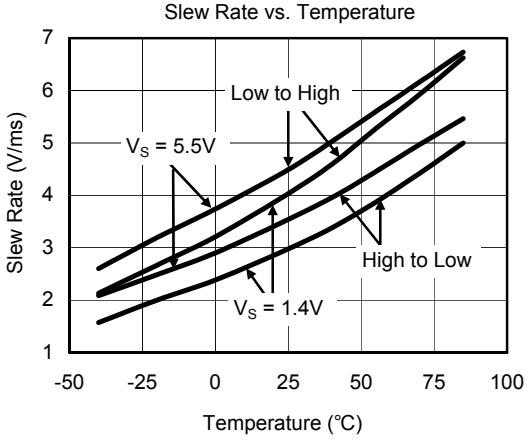
Small Signal Non-Inverting Pulse Response



No Phase Reversal

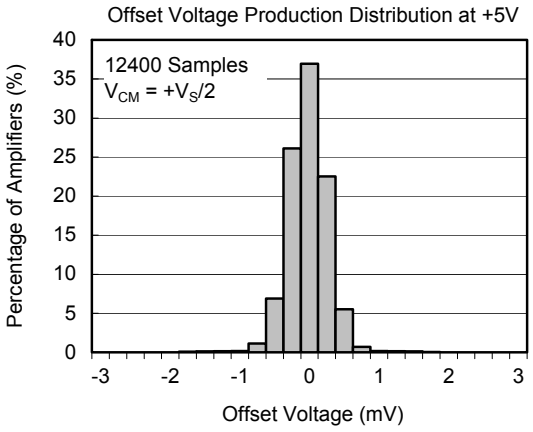


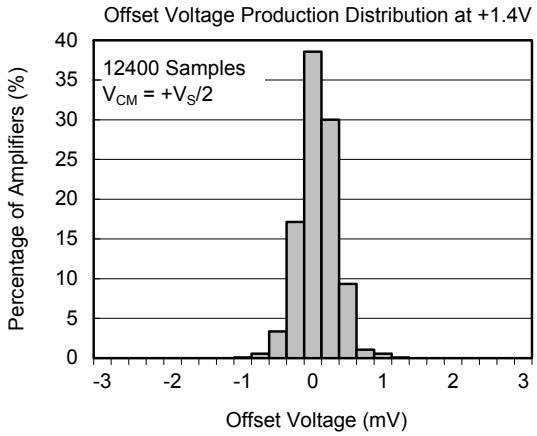
Slew Rate vs. Temperature



TYPICAL PERFORMANCE CHARACTERISTICS

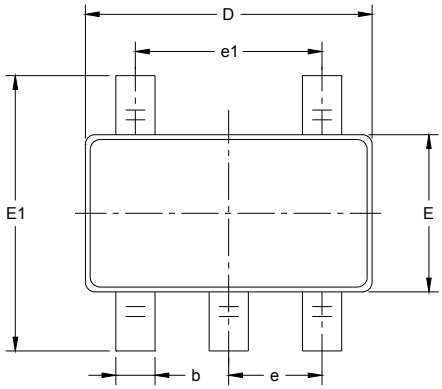
T_A = +25°C, $+V_S$ = +1.4V to +5.0V, $-V_S$ = GND, V_{CM} = $+V_S/2$, V_{OUT} ≈ $+V_S/2$ and R_L = 1MΩ to $+V_S/2$, C_L = 60pF, unless otherwise noted.

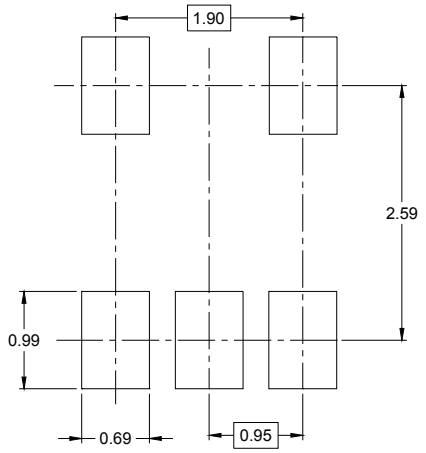




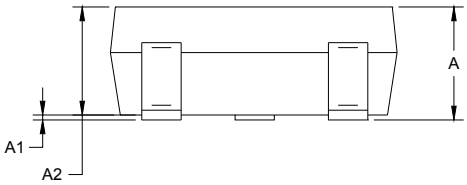
PACKAGE OUTLINE DIMENSIONS

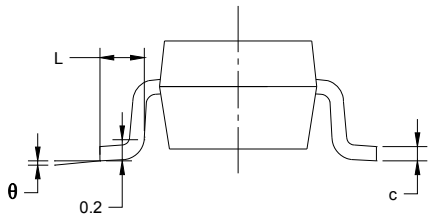
SOT-23-5





RECOMMENDED LAND PATTERN (Unit: mm)

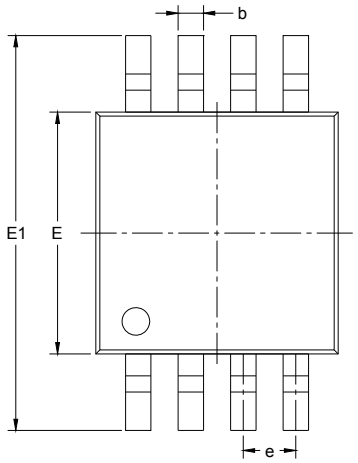


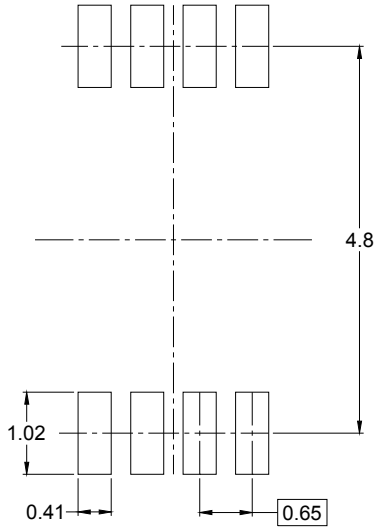


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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

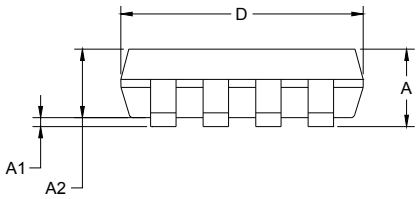
PACKAGE OUTLINE DIMENSIONS

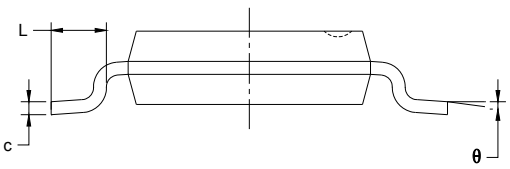
MSOP-8





RECOMMENDED LAND PATTERN (Unit: mm)

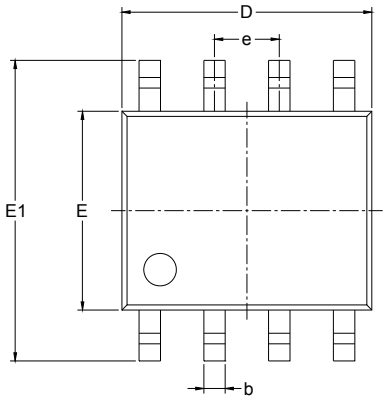


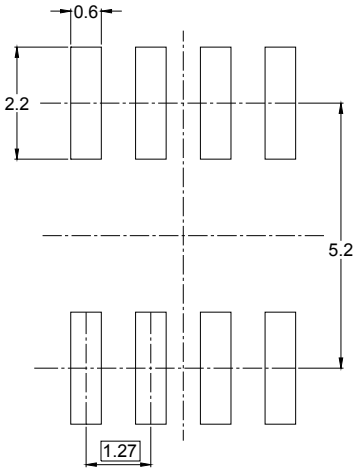


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026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

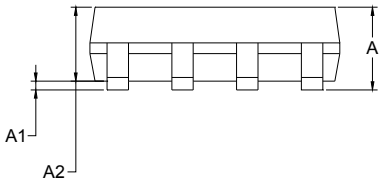
PACKAGE OUTLINE DIMENSIONS

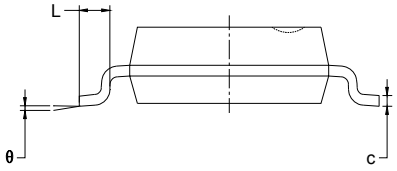
SOIC-8





RECOMMENDED LAND PATTERN (Unit: mm)

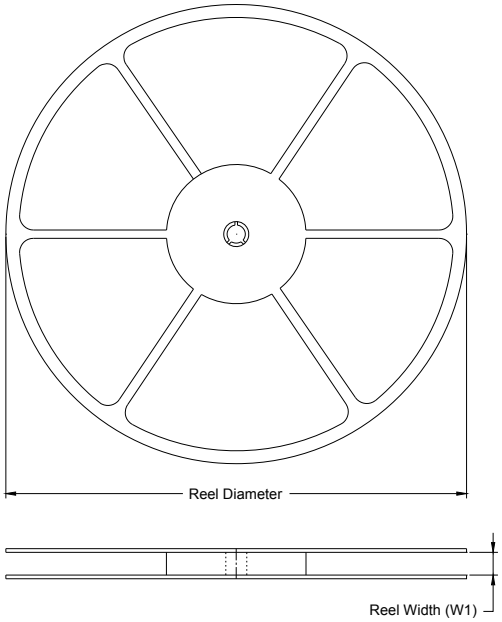




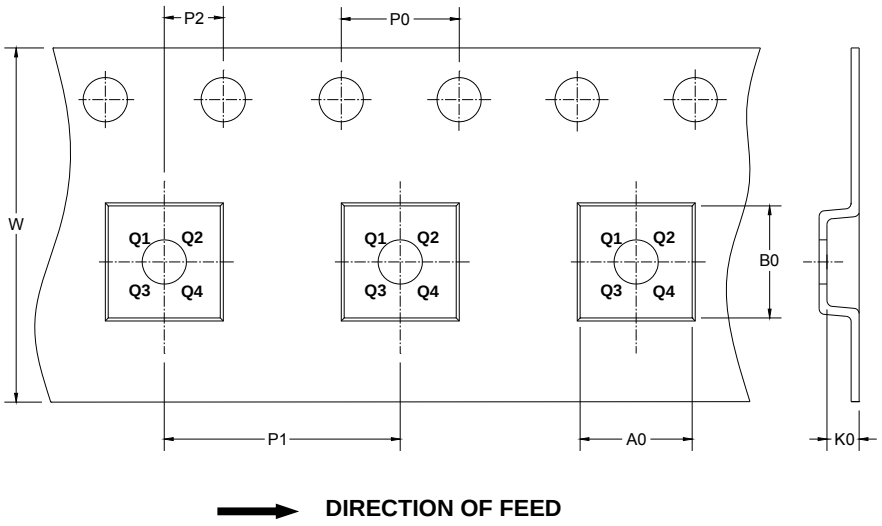
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS

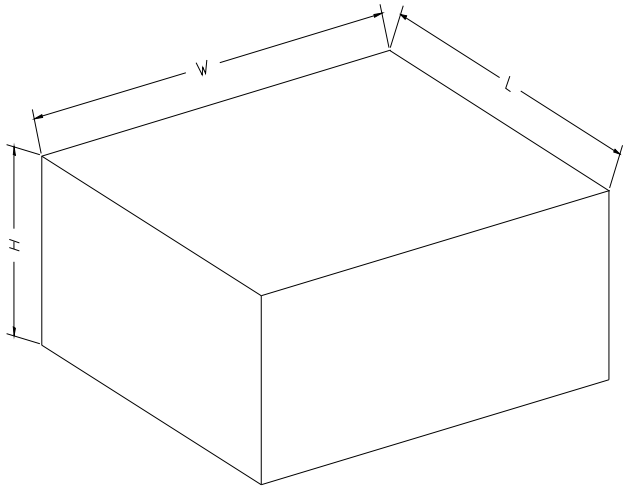


NOTE: The picture is only for reference. Please make the object as the standard.

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	3.2	3.2	1.4	4.0	4.0	2.0	8.0	Q3
SOIC-8	13″	12.4	6.4	5.4	2.1	4.0	8.0	2.0	12.0	Q1
MSOP-8	13″	12.4	5.2	3.3	1.5	4.0	8.0	2.0	12.0	Q1

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