



# SGM8142

## 350nA, Dual Rail-to-Rail I/O Operational Amplifier

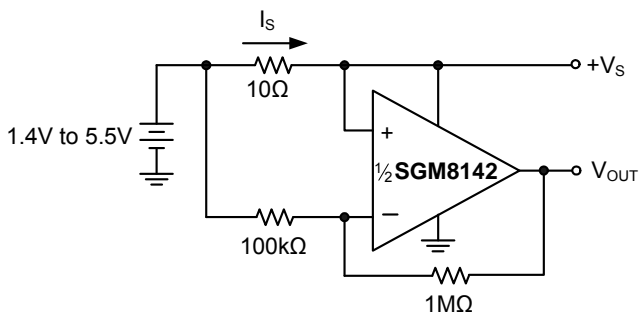
### PRODUCT DESCRIPTION

The SGM8142 is guaranteed to operate with a single supply voltage as low as 1.4V, while drawing less than 350nA (TYP) of quiescent current per amplifier. 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 SGM8142 has a gain-bandwidth product of 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 SGM8142 is offered in dual configuration. It is specified for the extended industrial (-40°C to +85°C) temperature range. The SGM8142 is available in the Green SOIC-8 and MSOP-8 packages.

### TYPICAL APPLICATION



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

High Side Battery Current Sensor

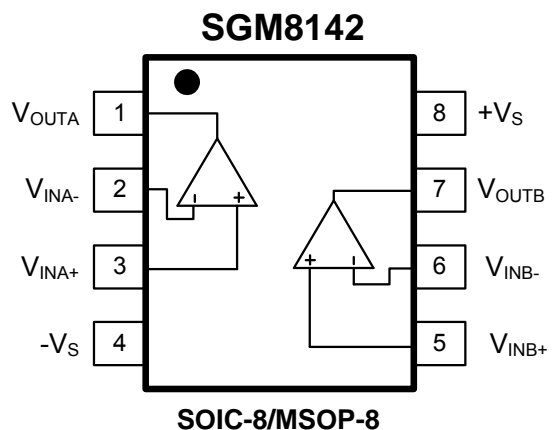
### FEATURES

- Low Quiescent Current: 350nA/Amplifier (TYP)
- Rail-to-Rail Input and Output
- Gain-Bandwidth Product: 5kHz at  $V_S = 5V$  (TYP)
- Wide Supply Voltage Range: 1.4V to 5.5V
- Unity Gain Stable
- -40°C to +85°C Operating Temperature Range
- Available in Green SOIC-8 and MSOP-8 Packages

### APPLICATIONS

- Toll Booth Tags
- Wearable Products
- Temperature Measurement
- Battery Powered System

### PIN CONFIGURATIONS (TOP VIEW)



**SGM8142**

**PACKAGE/ORDERING INFORMATION**

MODEL	ORDER NUMBER	PACKAGE DESCRIPTION	PACKAGE OPTION	MARKING INFORMATION
SGM8142	SGM8142YS8G/TR	SOIC-8	Tape and Reel, 2500	SGM8142YS8
	SGM8142YMS8G/TR	MSOP-8	Tape and Reel, 3000	SGM8142YMS8

**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 . . . . .  $-65^{\circ}C$  to  $+150^{\circ}C$   
 Junction Temperature . . . . .  $150^{\circ}C$   
 Operating Temperature Range . . . . .  $-40^{\circ}C$  to  $+85^{\circ}C$   
 Lead Temperature (Soldering 10sec)  
 . . . . .  $260^{\circ}C$   
 ESD Susceptibility  
 HBM . . . . . 3000V  
 MM . . . . . 400V

**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  $+5.0V$ ,  $-V_S = GND$ ,  $T_A = +25^\circ C$ ,  $V_{CM} = +V_S/2$ ,  $V_{OUT} \approx +V_S/2$  and  $R_L = 1M\Omega$  to  $+V_S/2$  <sup>(1)</sup>, unless otherwise noted.

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNITS
<b>DC ELECTRICAL CHARACTERISTICS</b>						
Input Offset Voltage ( $V_{OS}$ )		$V_{CM} = +V_S/2$		0.4	2.5	mV
Input Offset Voltage Drift ( $\Delta V_{OS}/\Delta T$ )		$V_{CM} = +V_S/2$ , $-40^\circ C \leq T_A \leq +85^\circ C$		2		$\mu V/^\circ C$
Power Supply Rejection Ratio (PSRR)		$+V_S = 1.4V$ to $5.5V$	69	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 $5.1V$	69	83		dB
		$+V_S = 5.0V$ , $V_{CM} = 2.5V$ to $5.1V$	67	82		
		$+V_S = 5.0V$ , $V_{CM} = -0.1V$ to $2.5V$	63	77		
Large Signal Voltage Gain ( $A_{VO}$ )		$+V_S = 1.4V$ , $R_L = 50k\Omega$ , $V_{OUT} = +V_S - 0.1V$	75	80		dB
		$+V_S = 2.5V$ , $R_L = 50k\Omega$ , $V_{OUT} = +V_S - 0.1V$		87		
		$+V_S = 5.0V$ , $R_L = 50k\Omega$ , $V_{OUT} = +V_S - 0.1V$	87	93		
Input Bias Current ( $I_B$ )				1		pA
Input Offset Current ( $I_{OS}$ )				1		pA
Maximum Output Voltage Swing	$V_{OH}$	$+V_S = 1.4V$ , $R_L = 50k\Omega$	1.39	1.395		V
		$+V_S = 2.5V$ , $R_L = 50k\Omega$		2.497		
		$+V_S = 5.0V$ , $R_L = 50k\Omega$	4.99	4.996		
	$V_{OL}$	$+V_S = 1.4V$ , $R_L = 50k\Omega$		4.6	10	mV
		$+V_S = 2.5V$ , $R_L = 50k\Omega$		3.1	10	
		$+V_S = 5.0V$ , $R_L = 50k\Omega$		3.6		
Short Circuit Current ( $I_{SC}$ )		$+V_S = 2.5V$		5.6		mA
		$+V_S = 5.0V$	22	24		
Supply Voltage			1.4		5.5	V
Quiescent Current/Amplifier ( $I_Q$ )		$+V_S = 1.4V$		300		nA
		$+V_S = 2.5V$		320		
		$+V_S = 5.0V$		350	800	

## SGM8142

### ELECTRICAL CHARACTERISTICS

$+V_S = +1.4V$  to  $+5.0V$ ,  $-V_S = GND$ ,  $T_A = +25^\circ C$ ,  $V_{CM} = +V_S/2$ ,  $V_{OUT} \approx +V_S/2$  and  $R_L = 1M\Omega$  to  $+V_S/2$ ,  $C_L = 60pF$  <sup>(1)</sup>, unless otherwise noted.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
<b>AC ELECTRICAL CHARACTERISTICS</b>					
Gain-Bandwidth Product (GBP)	$+V_S = 1.4V$		4.3		kHz
	$+V_S = 2.5V$		4.7		
	$+V_S = 5.0V$		5		
Slew Rate (SR)	$+V_S = 1.4V, V_{OUT} = 1V$ Step		1.3		V/ms
	$+V_S = 2.5V, V_{OUT} = 1V$ Step		1.5		
	$+V_S = 5.0V, V_{OUT} = 2V$ Step		1.6		
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 $10Hz$		4.4		$\mu V_{P-P}$
	$+V_S = 2.5V, f = 0.1Hz$ to $10Hz$		3.9		
	$+V_S = 5.0V, f = 0.1Hz$ to $10Hz$		4.0		
Input Voltage Noise Density ( $e_n$ )	$+V_S = 1.4V, f = 1kHz$		135		$nV/\sqrt{Hz}$
	$+V_S = 2.5V, f = 1kHz$		140		
	$+V_S = 5.0V, f = 1kHz$		130		

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".

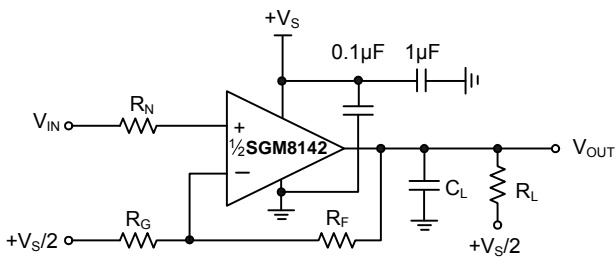


Figure 1. AC and DC Test Circuit for Most Non-Inverting Gain Conditions.

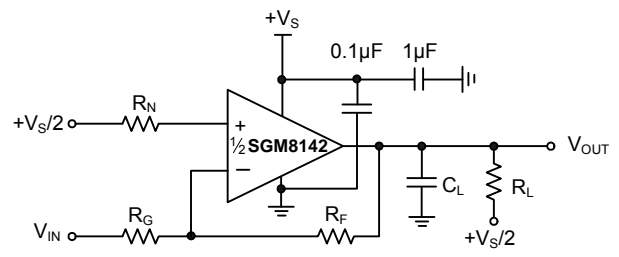
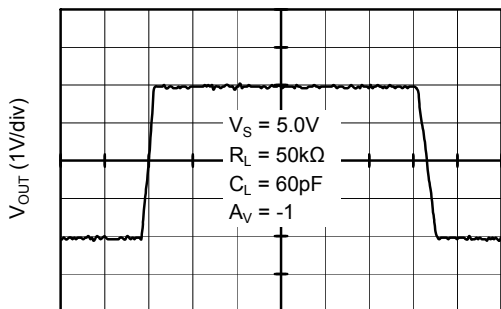


Figure 2. AC and DC Test Circuit for Most Inverting Gain Conditions.

**TYPICAL PERFORMANCE CHARACTERISTICS**

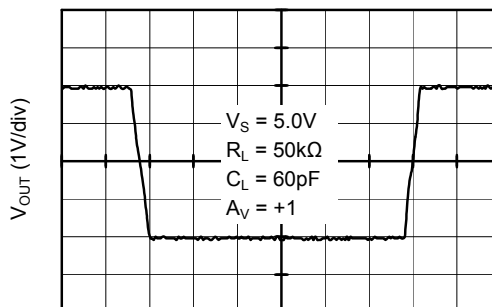
$T_A = +25^\circ\text{C}$ ,  $+V_S = +1.4\text{V}$  to  $+5.0\text{V}$ ,  $-V_S = \text{GND}$ ,  $V_{\text{CM}} = +V_S/2$ ,  $V_{\text{OUT}} \approx +V_S/2$  and  $R_L = 1\text{M}\Omega$  to  $+V_S/2$ ,  $C_L = 60\text{pF}$ , unless otherwise noted.

Large Signal Inverting Pulse Response



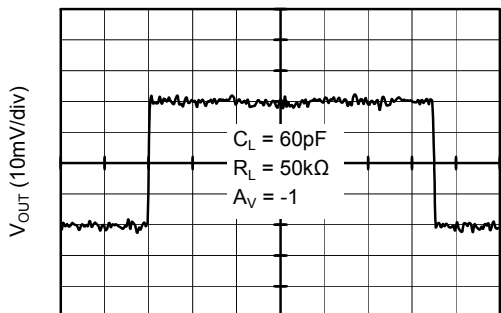
Time (5ms/div)

Large Signal Non-Inverting Pulse Response



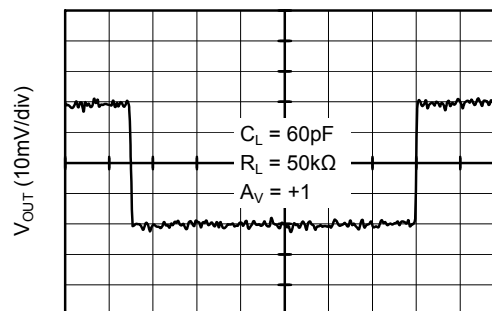
Time (5ms/div)

Small Signal Inverting Pulse Response



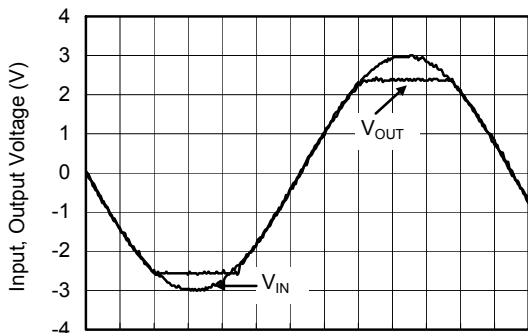
Time (5ms/div)

Small Signal Non-Inverting Pulse Response



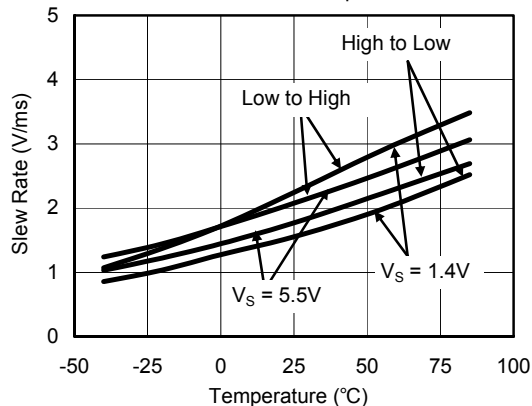
Time (5ms/div)

No Phase Reversal



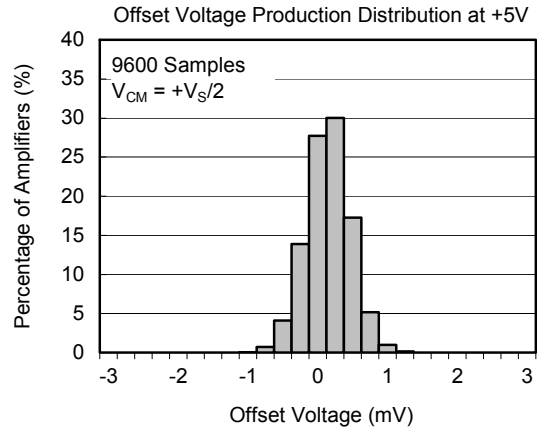
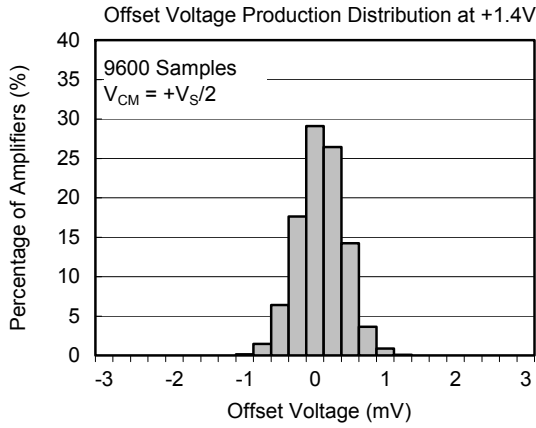
Time (5ms/div)

Slew Rate vs. Temperature



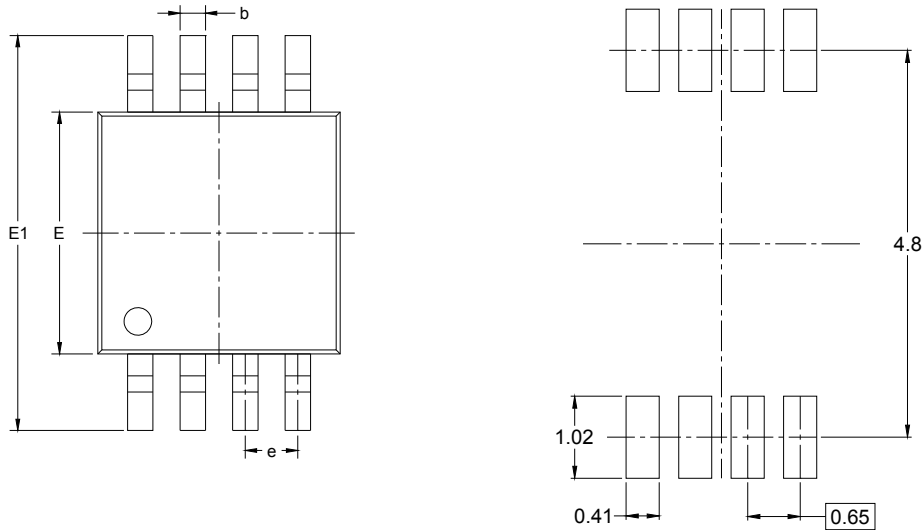
**TYPICAL PERFORMANCE CHARACTERISTICS**

$T_A = +25^\circ\text{C}$ ,  $+V_S = +1.4\text{V to } +5.0\text{V}$ ,  $-V_S = \text{GND}$ ,  $V_{CM} = +V_S/2$ ,  $V_{OUT} \approx +V_S/2$  and  $R_L = 1\text{M}\Omega$  to  $+V_S/2$ ,  $C_L = 60\text{pF}$ , unless otherwise noted.

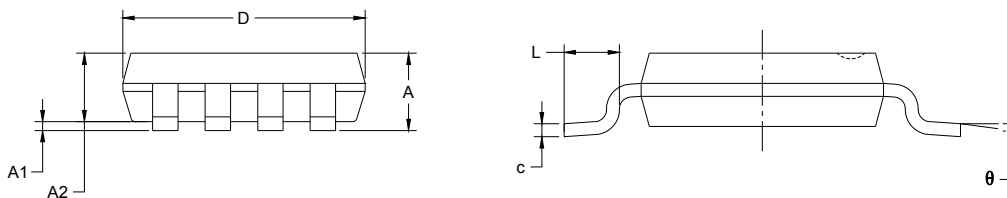


PACKAGE OUTLINE DIMENSIONS

MSOP-8



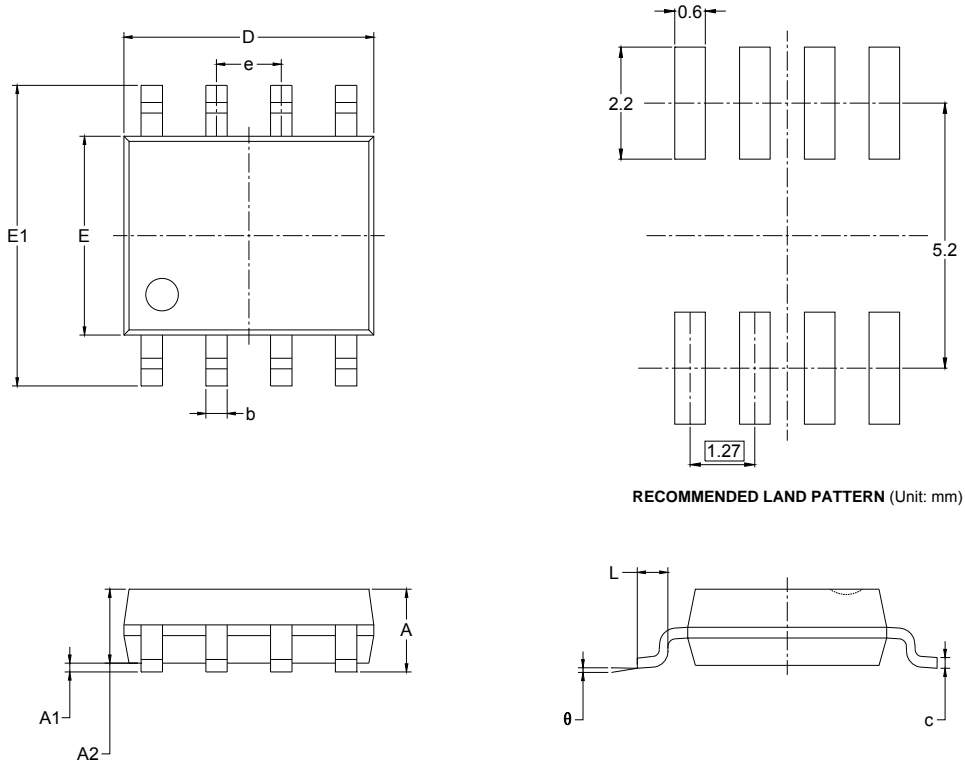
RECOMMENDED LAND PATTERN (Unit: mm)



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



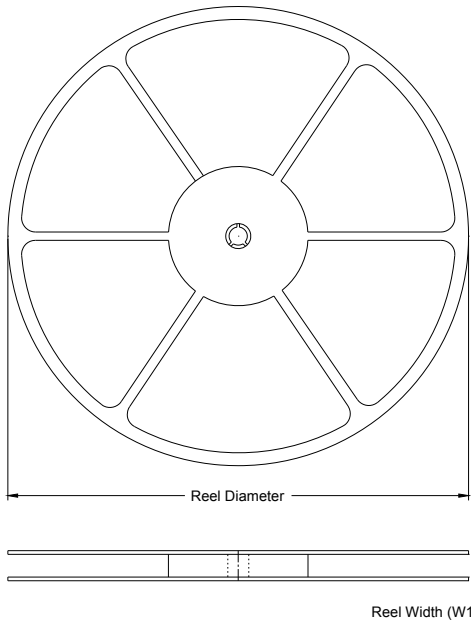
RECOMMENDED LAND PATTERN (Unit: mm)

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
$\theta$	0°	8°	0°	8°

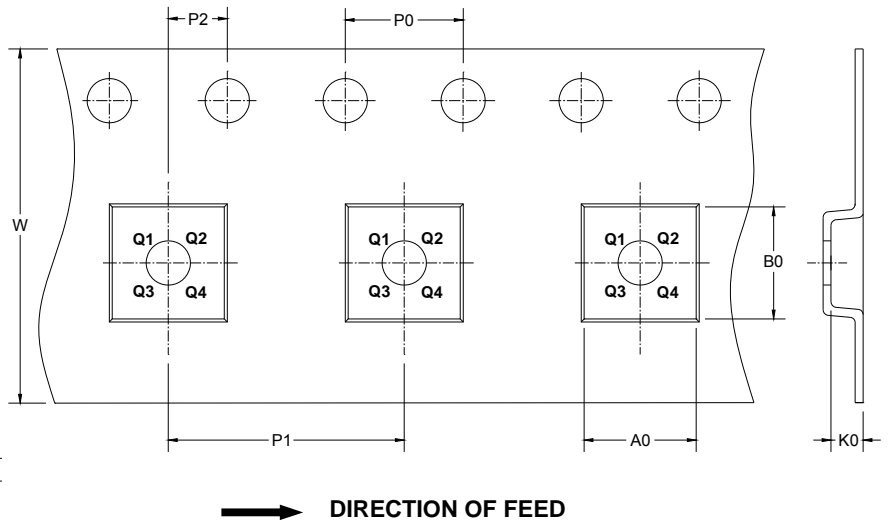


**TAPE AND REEL INFORMATION**

**REEL DIMENSIONS**



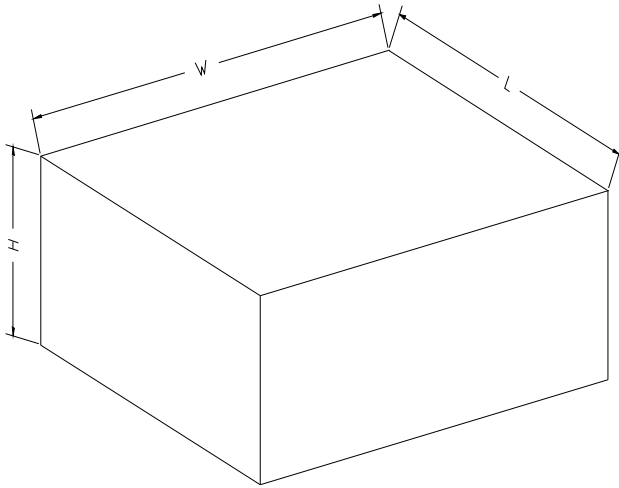
**TAPE DIMENSIONS**



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
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
13"	386	280	370	5