VCE1715
Angular Sensor Series

GENERAL DESCRIPTION

The VCE1715 is one type of surface-mount sensors for angle and rotary speed measurement designed for magnetic saturating field sensing. The VCE1715 contains dual saturated-mode Wheatstone bridge elements co-located to provide a high accuracy and a wide range of angle measurement. Applications for VCE1715 include position sensing, rotary speed and angle detection, and non-contact precision location measurement systems.

VCE1715 is based on Anisotropic Magnetoresistive (AMR) technology that provides advantages over Hall-effect based magnetic sensors. The sensor's absolute angular accuracy can reach 0.1°. Meanwhile, it is immune to airgap variations, and resistant to hits and vibrations.

VCE1715 is among the most accurate and reliable angular sensors in the industry. Highly reliability and excellent performance are guaranteed when delivered.

The VCE1715 is available in a Green SOIC-8 package.

FEATURES

- **Absolute Angle Position Measuring**
- **180° Angle Measuring Range**
- **<0.01° Angle Resolution**
- **Low Voltage Operations (1.0V)**
- **High Tolerance for the Variation of Magnetic Field Amplitude**
- **Low Noise Passive Element Design**
- **ROHS Compatible and Suitable for High Speed SMT Assembly**
- **Software and Algorithm Support Available**
- **Available in a Green SOIC-8 Package**

INTERNAL SCHEMATIC DIAGRAMS

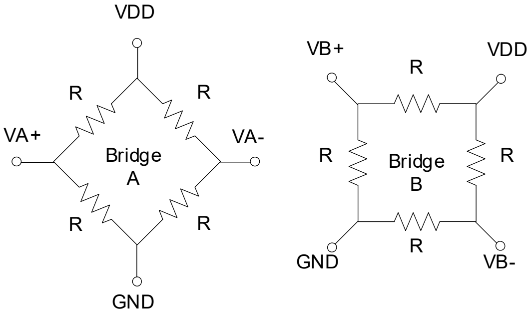


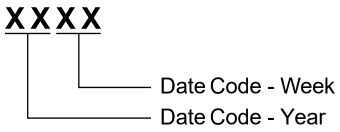
Figure 1. Internal Schematic Diagram

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
VCE1715	SOIC-8	-40℃ to +125℃	VCE1715S	XXXX	Tape and Reel, 4000

MARKING INFORMATION

NOTE: XXXX = Date 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

Junction Temperature ....+150℃
Storage Temperature Range........................-50℃ to +150℃
Lead Temperature (Soldering, 10s) ....+260℃
ESD Susceptibility (1) (2)
HBM...±2000V
CDM ....±2000V

NOTES:

1. For human body model (HBM), all pins comply with ANSI/ESDA/JEDEC JS-001 specifications.
2. For charged device model (CDM), all pins comply with ANSI/ESDA/JEDEC JS-002 specifications.

RECOMMENDED OPERATING CONDITIONS

Supply Voltage, V_{DD}..1V to 9V
Operating Ambient Temperature Range......-40℃ to +125℃

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.

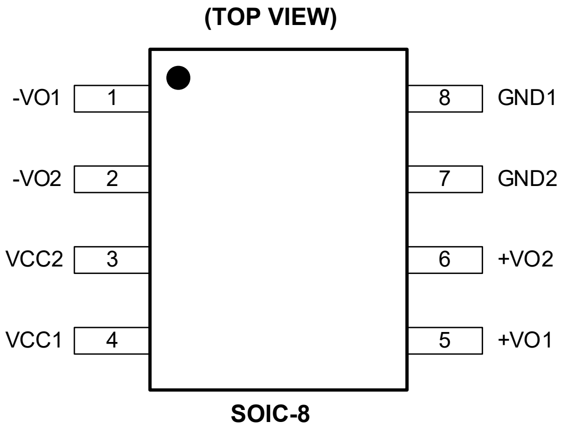
ESD SENSITIVITY CAUTION

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 CONFIGURATION



PIN DESCRIPTION

PIN	NAME	FUNCTION
1	-VO1	Negative Output of Bridge A.
2	-VO2	Negative Output of Bridge B.
3	VCC2	Power Supply of Bridge B.
4	VCC1	Power Supply of Bridge A.
5	+VO1	Positive Output of Bridge A.
6	+VO2	Positive Output of Bridge B.
7	GND2	Ground.
8	GND1	Ground.

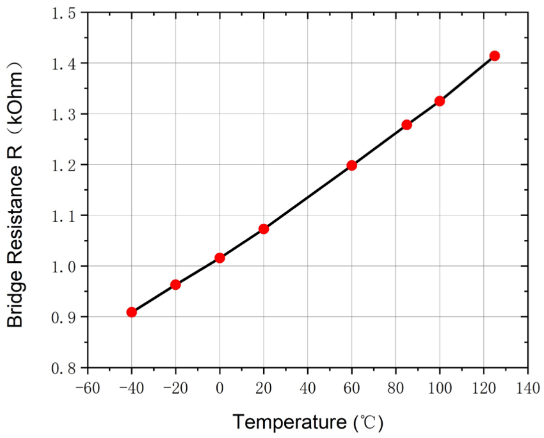
ELECTRICAL CHARACTERISTICS

(Tested and specified at +25℃ except stated otherwise.)

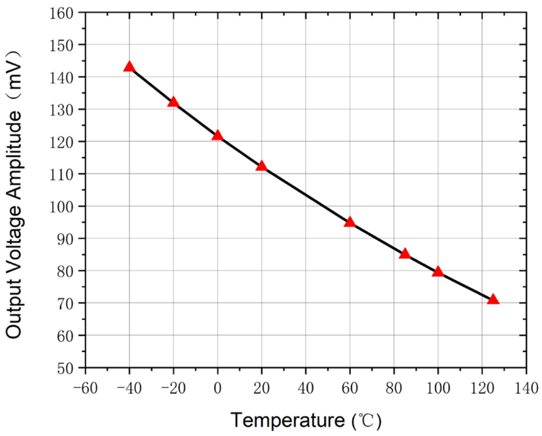
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage	V_{DD}	VDD	1.0	5.0	9.0	V
Saturation Field	Bs	T_A = -40℃ to +125℃	80		unlimited	G
Bridge Resistance	R	Bridge current = 1mA (Bridge A or B)	800	1050	1300	Ω
Angle range		>Saturation Field	0		180	Deg
Sensitivity	S	V_{DD} = 5V, Field = 80G @ zero crossing		2.1		mV/º
Output Voltage Amplitude Vamp		V_{DD} = 5V, Field = 80G Peak-to-Peak	95	120	140	mV
Bridge Offset		Field = 80G (Bridge A or B)	-3	0	+3	mV/V
Resolution		Band Width = 10Hz, V_{DD} = 5V		0.01		Deg
Noise Density		@1Hz, V_{DD} = 5V		6.0		$nV/\sqrt{Hz}$
Operating Temperature		Ambient Temperature	-40		+125	℃
Storage Temperature		Ambient, unbiased	-50		+150	℃
Temperature Coefficient of Bridge Resistance	TCR	V_{DD} = 5V, T_A = -40℃ to +125℃		2800		ppm/℃
Temperature Coefficient of Output Amplitude	TCS	V_{DD} = 5V, T_A = -40℃ to +125℃		-3900		ppm/℃
Temperature Coefficient of Bridge Offset	TCO	T_A = -40℃ to +125℃		±2		μV/V/℃
Mismatch of Bridge Output Amplitude		(Vamp-A/Vamp-B) × 100	97	100	103	%

TYPICAL PERFORMANCE CHARACTERISTICS

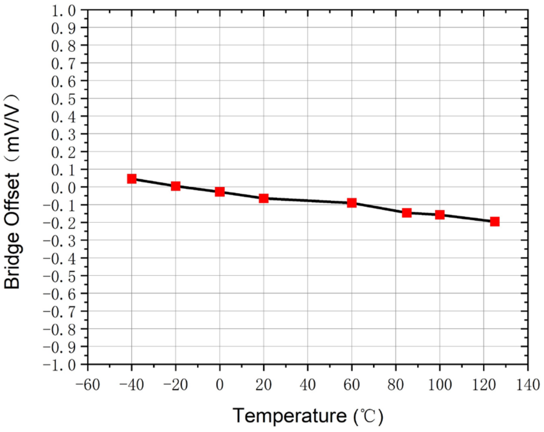
T_A = -40℃ to +125℃, unless otherwise noted.



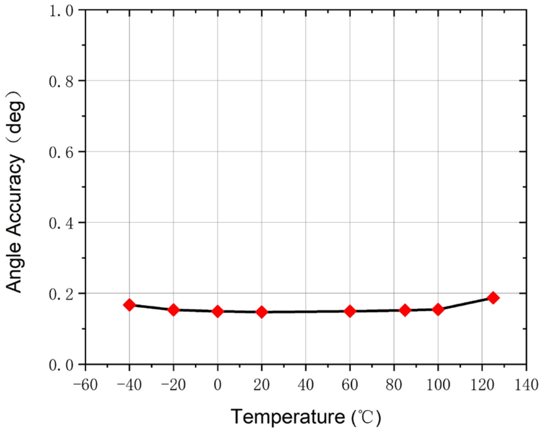
Bridge Resistance R VS Temperature



Output Voltage Amplitude VS Temperature



Bridge Offset VS Temperature



Angle Accuracy VS Temperature

DETAILED DESCRIPTION

Basic Operations

VCE1715 has dual Wheatstone bridges to measure magnetic field direction. The resistance of bridge elements changes when a magnetic field is applied across the thin films of magneto-resistive ferrous material forming the resistive elements. The magnetoresistance is a function of cos2θ, where θ is the angle between the magnetization (M) and the current flow direction in the thin film.

When the applied magnetic field intensity is larger than 80 Gauss, the magnetization of the thin films aligns almost in the same direction as the applied field and becomes the saturation mode. In this mode, θ is also the angle between the direction of the applied field and the bridge current flow, and the magnetoresistive sensor is only sensitive to the direction of the applied field (not the intensity). Therefore, in the saturation mode, the sensor is insensitive to the vibration and airgap fluctuation, which provides much better robustness than those angle sensors based on Hall effect.

As shown in the Figure 2, basic angular sensing is sketched. A radically magnetized permanent magnet is mounted on the end of shaft of electrical motors or other detected moving objects. The rotating axis, center of magnet and center of the sensor should be aligned in order to have the best accuracy. The permanent magnet generates the magnetic field parallel to the surface of the sensor. Make sure the magnetic field intensity applied is larger than the saturated field 80 Gauss by selecting a suitable magnet or adjusting the airgap between magnet and the sensor surface. When the permanent magnet rotates, the magnetic field changes its direction and the sensor provides two channel differential cosine and sine outputs of the rotation angle θ. Subsequently, the cosine and sine output can be processed by the arctangent function to get the actual rotation angle θ.

The sensor has the relatively low saturated field, so the common ferrite magnet and small-sized rare earth magnet can be used for low cost of the solution.

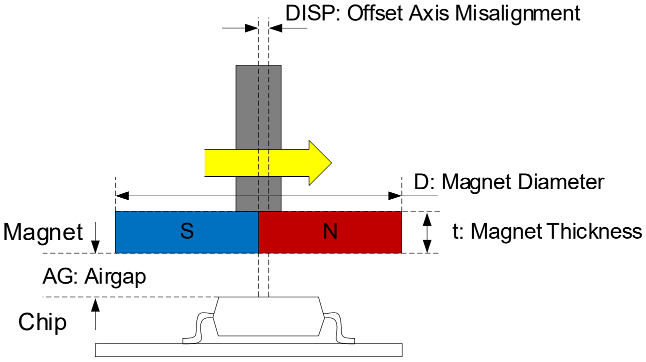


Figure 2. Basic Angle Sensing Schematics

This product uses cylindrical magnets, radial magnetization, with a pair of N/S poles, the parameters are as follows:

Table 1. External Magnetic Field Parameters

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Airgap	AG	The distance between the magnet and the chip surface			3	mm
Offset	DISP	The offset between the magnet center and the chip center			0.3	mm
Magnet Diameter	D	1-pole pair magnet, radial magnetization		10		mm
Magnet Thickness	t			2.5		mm
Magnetic Field	H	Parallel magnetic field between two surfaces of the chip	80			Gauss

DETAILED DESCRIPTION (continued)

Signal Output

The two bridges orient 45° from each other, and the differential output voltage for sensor bridge A is:

$$V_A = V_{DD} \times S \times \cos 2\theta$$

And for sensor bridge B, the differential output voltage is:

$$V_B = V_{DD} \times S \times \sin 2\theta$$

Where V_{DD} is the supply voltage, S is output amplitude, the typical S is about 12mV/V, and the angle θ is the rotation angle.

The signal output of the bridge A and B are plotted versus angle θ, and the below Figure 3 depicts the two-cycle waveform in 0~360° angle range.

As shown in the Figure 3, both the output of bridge A and B have a period of 180°. In the angle range of 0~180° and 180°~360° , the identical waveform reduplicates for bridge A and B. Therefore, combining with the output of bridge A and B, we can solely deduce the angle θ in the range of 0~180°. With Hall switches or other ways indicate North or South poles of the magnet, the angle range can be extended to 0~360° range.

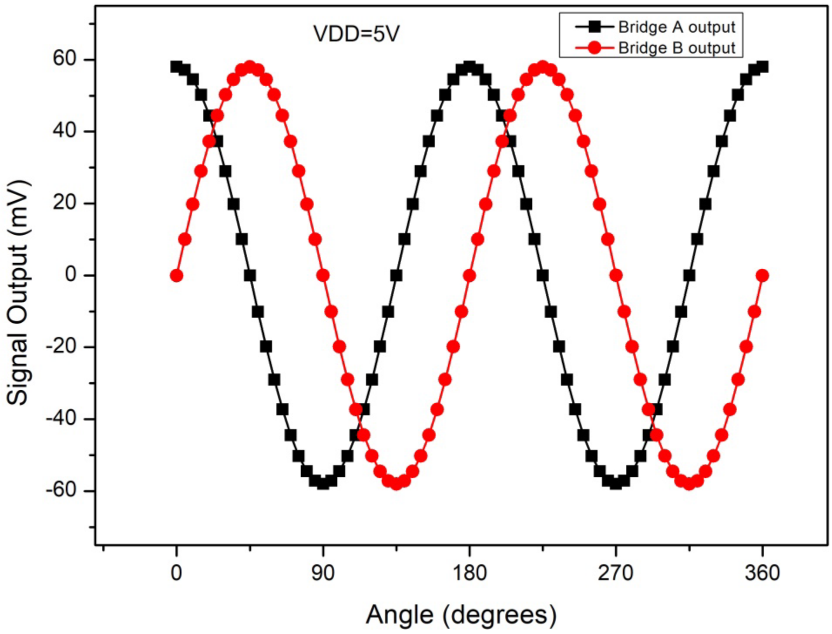


Figure 3. Output of Bridge A & B Versus Field Angle θ

APPLICATION INFORMATION

Application Circuit

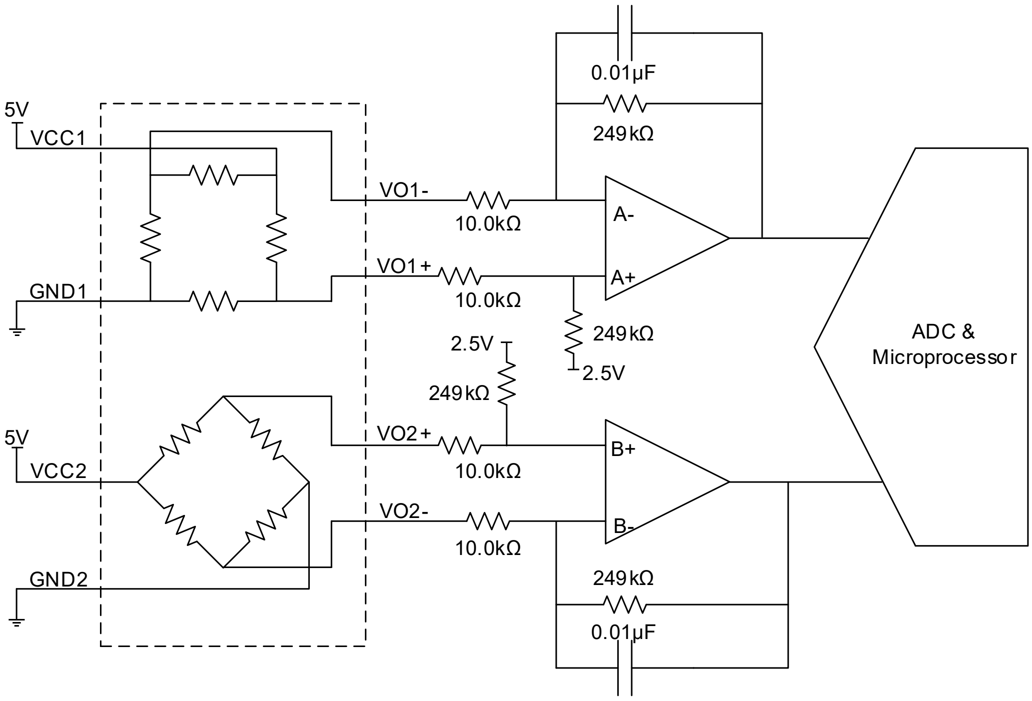


Figure 4. Application Circuit Diagram

As shown in the Figure 4, a suggested application circuit is provided. To process the output, an operational amplifier can be used as a differential amplifier. The 10kΩ resistors serve as a high input impedance, and the 249kΩ resistor set the amplifier gain and bias at 25V/V and 2.5V respectively. The 0.01μF capacitor is placed in the feedback loop to further exclude noise outside the sensor and amplifier circuits. The analog output voltage of the amplifier is typically fed to an Analog-to-Digital Converter (ADC) stand-alone or within a microprocessor. A recommendation of 12-bit ADC circuits or higher is expected.

Assembly Considerations

Besides keeping all components that may contain ferrous materials (nickel, iron, cobalt, etc.) away from the sensor on both sides of the PCB, it is also recommended that there is no conducting copper line under/near the sensor in any PCB layers.

100% paste coverage is recommended for the electrical contact pins.

The sensor is classified as MSL 3 with 260℃ peak reflow temperature. As specified by JEDEC, parts with an MSL 3 rating require baking prior to soldering, if the part is not kept in a continuously dry (< 10% RH) environment before assembly. Refer to IPC/JEDEC standard J-STD-033 for additional information.

No special reflow profile is required for the sensor, which is compatible with lead eutectic and lead-free solder paste reflow profiles. Hand soldering is not recommended.

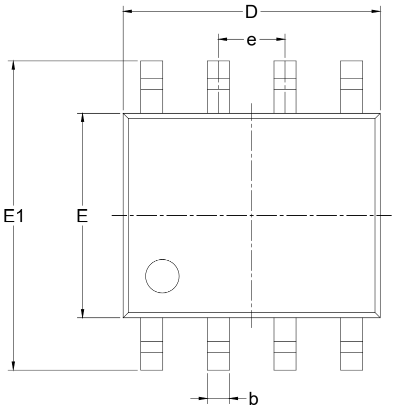
REVISION HISTORY

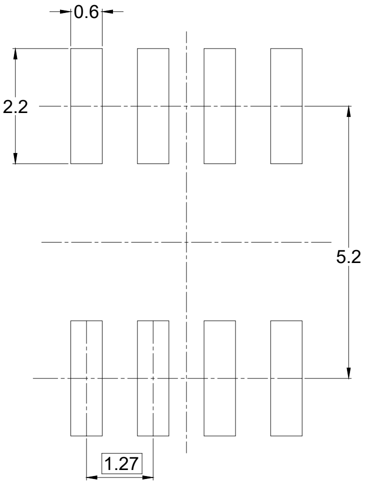
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original to REV.A (AUGUST 2025)	Page
Changed from product preview to production data	All

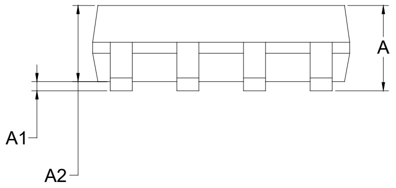
PACKAGE OUTLINE DIMENSIONS

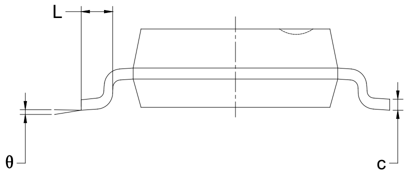
SOIC-8





RECOMMENDED LAND PATTERN (Unit: mm)



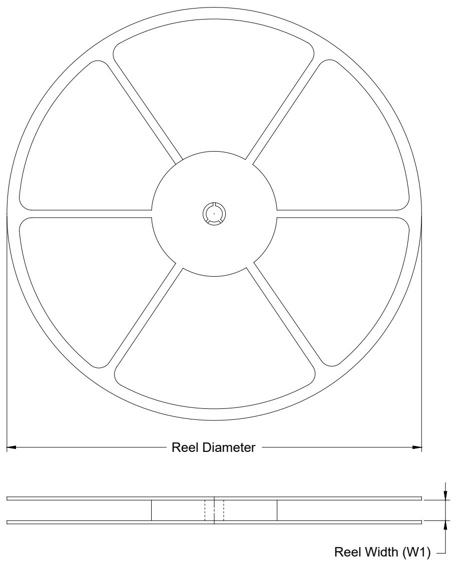


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

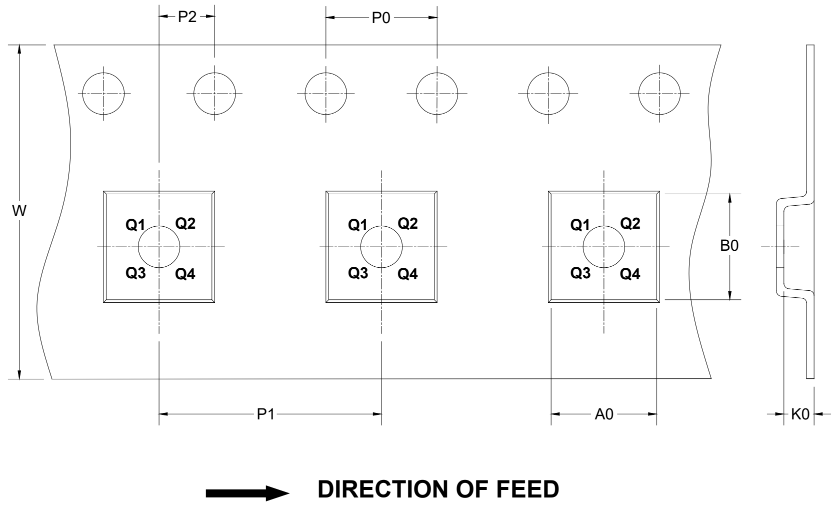
NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



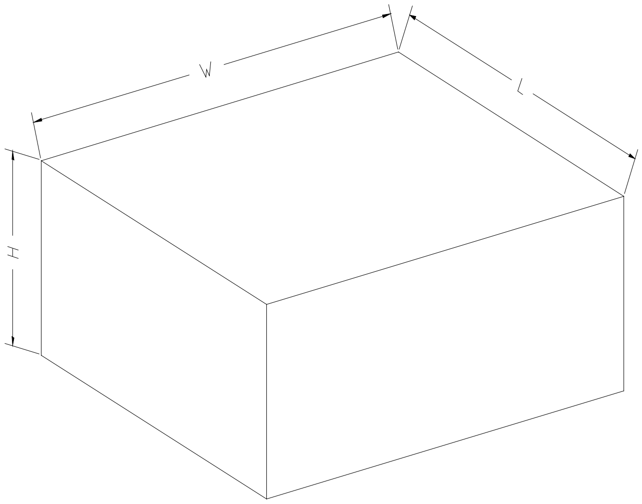
NOTE: The picture is only for reference. Please make the object as the standard.

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

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