

Datasheet

To

SPECIFICATION No.

DATE: 2021.09.09

CUSTOMER'S PRODUCT NAME :

PRODUCT NAME:
TMR Angle Sensor
TAS2142-AAAC
(HHS-TAS2142AAAC-0010)

Product code
432A3200

RECEIPT CONFIRMATION

Sales :

APPROVED	

Engineering : TDK Asama Techno Factory

APPROVED	CHECKED	Person in charge
T. Kagami	K. Nogami	S. Koide

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1 General description

The TAS2142-AAAC TDK Angle Sensor is Tunneling Magneto Resistance (TMR) sensor which consists of 2 Wheatstone bridges in TSSOP8 package, which output creates 3.0Vp-p @ Vcc 5V.

The output can be configured to represent one pair of sine and cosine functions by applied magnetic field in x-y plane and its sensor can detect 360deg/ 1 rotation. Sine and cosine bridges are layout 90deg to one another. More than 20mT magnetic field is suitable for high precision angle measurement.

2 Key Features

- Magnetic field sensor, employing the TMR (Tunneling Magnet Resistance) effect.
- 2 full bridge (Sine and Cosine Outputs) in inside of TSSOP-8 package.
- Sine and Cosine Outputs.
- 2 element (2 full bridge each) /1 bare chip
- Very High Output Signal without Amplification.
- AEC-Q100 Grade0
- MSL 1

3 Typical Applications

- Absolute Rotary Angle Sensor.
- EPS Motor-shaft Angle Sensor.
- Steering Wheel Angle Sensor.
- Pedal Position Sensor.
- Throttle Position Sensor.

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4 Pin assignment [ESP000001]

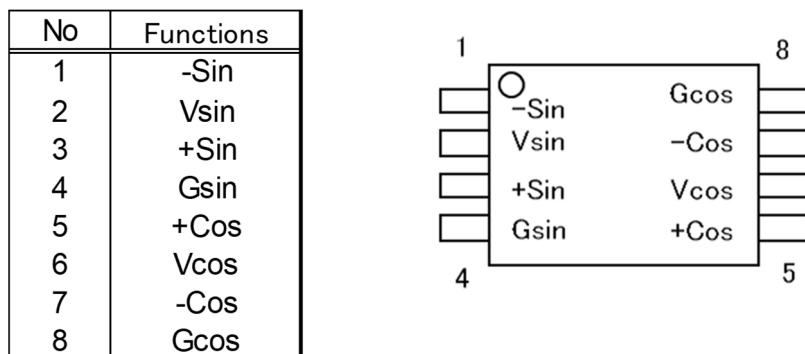


Figure 1: Pin assignment

5 Block diagram [ESP000002]

White and gray arrows indicate magnetization direction of Pin layer.

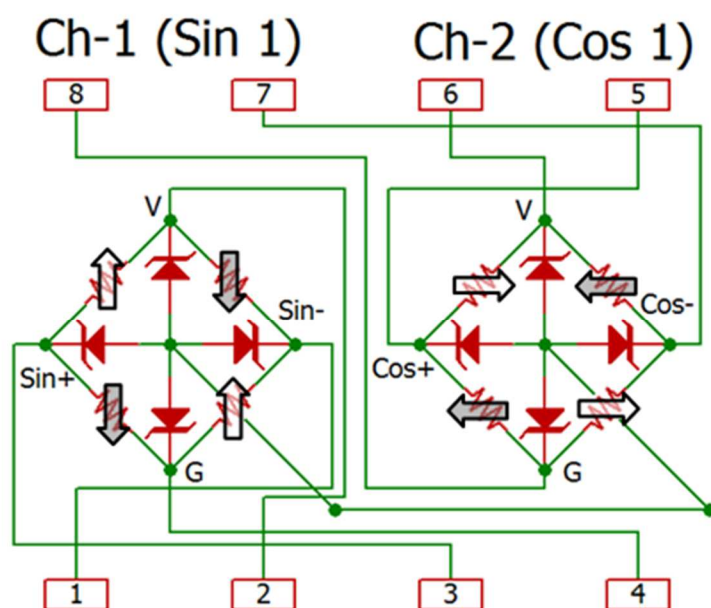


Figure 2: Block diagram

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6 Definition

6.1 TMR basic principle [ESP000003]

Free layer aligns with Applied Magnetic Field.

Angle between Pin and Free layers determine resistance.

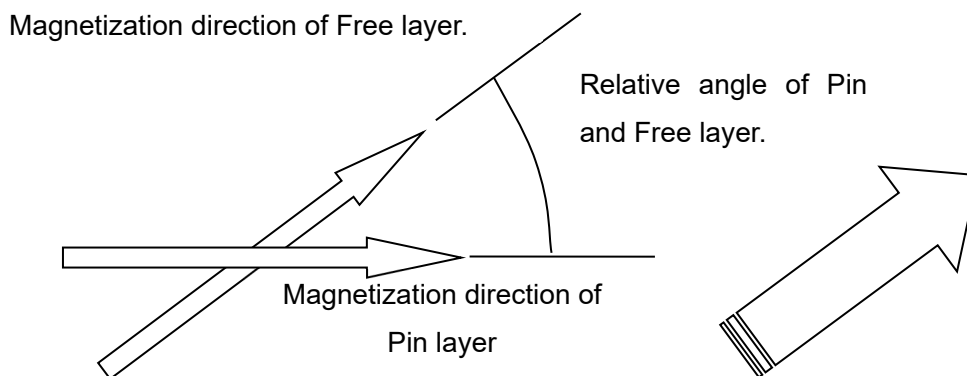


Figure 3: TMR operation principle

6.2 Definition of Angle and Direction [ESP000004]

The definition of Direction of magnetic field detection is as follows.

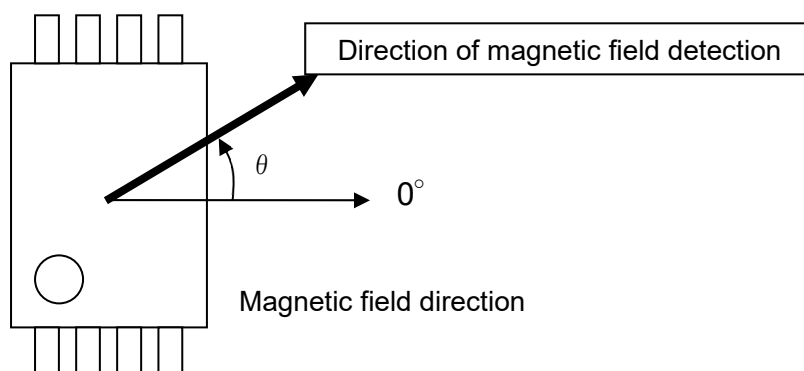


Figure 4: Definition of angle and magnetic field direction

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6.3 Output Signal [ESP000005]

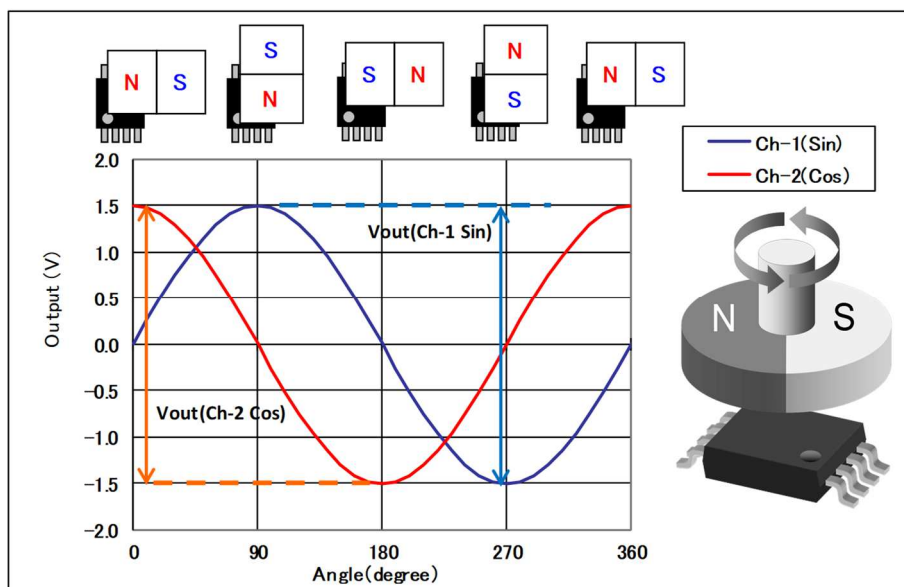


Figure 5: Output signal (after differential operation)

7 Characteristics

7.1 Absolute Maximum Rating [ESP000006]

Table 1: Absolute maximum rating

Absolute Maximum Rating

Items	Parameter	Conditions	Min	Typ	Max	Unit	Remarks
Vcc	Supply Voltage				6.5	Volt	
Hex	External Magnetic field	Max. 5min @25degC			200	mT	1)
ESD HBM	ESD tolerance : Human Body Model		4000			Volt	Classification H3A
ESD CDM	ESD tolerance : Charged Device Model		750			Volt	Classification C5
Topt	Operating Ambient Temperature		-40		150	deg C	
Tstg	Storage Temperature		-55		150	deg C	
Treflow	Reflow Temperature				260	deg C	
Tj	Junction Temperature				175	deg C	

1) 1mT = 795.8A/m. in air

7.2 Recommended Operating Conditions [ESP000007]

Table 2: Recommended operating conditions

Recommended Operating Conditions

Items	Parameter	Conditions	Min	Typ	Max	Unit	Remarks
Vcc	Supply Voltage		3	5	5.5	Volt	
Topt	Operating Temperature		-40	25	150	degC	
Hex	External Magnetic Field	Recommended Range	20	30	80	mT	
		Extended Range	80		120	mT	1)

1) See possible angle error on Characteristics table (For angle error definition, see table 11. Characteristics Note 2).

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7.3 Electrical characteristics [ESP000008]

Table 3: Electrical characteristics

TOPT=25° C, BEXT=30mT, VSIN=3.0 to 5.5V, VCOS=3.0 to 5.5V unless otherwise specified

Items	Parameter	Conditions	Min	Typ	Max	Unit	Remarks
Rbridge	Bridge Resistance	Topt=25degC, Hex=30mT 0h	4	5	6	KΩ	
Vout	Differential output voltage peak to peak per Vcc	Per supply voltage Topt=25degC, Hex=30mT 1000h	0.54	0.6	0.67	V/V	1)
Angle Error (After Compensation)		Topt=-40degC to 150degC Nominal magnetic Range: 20mT to 80mT 1000h			0.6	deg	2)
		Topt=-40degC to 150degC Extended magnetic Range: 80mT to 120mT 1000h			1.2	deg	2) 9)
Orthogonality		Topt=25degC, Hex=30mT 0h	87	90	93	deg	3)
Voffset	Differential Output Offset as an "initial offset"	Per supply voltage Topt=25degC, Hex=30mT 1000h	-5	-	5	mV/V	
TCoutput	Temperature Coefficient of Differencial Output	Topt=-40degC to 150degC 20mT to 120mT	-0.115	-0.095	-0.075	%/K	4)
TCRbridge	Temperature Coefficient of Bridge Resistance	Topt=-40degC to 150degC 20mT to 120mT	-0.070	-0.050	-0.030	%/K	5)
Off.TD	Offset Temperature Drift	Topt=-40degC to 150degC 20mT to 120mT	-0.5	0	0.5	mV/V	6)
Hyst	Hysteresis of Output Voltage	more than Hex=20mT 0h			0.04	deg	
k	Amplitude Synchronism ratio	Topt=25degC, Hex=30mT 0h	97	100	103	%	7)
Tck	Temperature Coefficient of Amplitude Synchronism	Topt=-40degC to 150degC 20mT to 120mT	-0.015		0.015	%/K	8)

* LT=-40degC., RT=25degC., HT=150degC.

* Testing in production line is carried on 25degC & 150degC.

Tcoutput, TCRbridge, Off. TD and Tck are assessed by measurement result at 25degC & 150degC.

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1) V_{p-p} =differential output voltage peak to peak

$$V_{out} = \frac{V_{p-p}}{V_{cc}}$$

2) Angle error is defined by zero-to-peak.

Angle error of either LT or HT is compensated using the correction factor at RT
(Offset, Gain and Phase compensation according TDK application note No. EAZ00011)

3) Orthogonality is defined by reference to the 90 deg.

$$TC_{output} = \frac{(V_{out}(150degC) - V_{out}(-40degC))}{V_{out}(25degC) * (150degC - (-40degC))} * 100$$

$$TC_{rbridge} = \frac{(R_{bridge}(150degC) - R_{bridge}(-40degC))}{R_{bridge}(25degC) * (150degC - (-40degC))} * 100$$

$$Off.TD = V_{offset@Ta} - V_{offset@25degC}$$

$$k = \frac{V_{cos peak}}{V_{sin peak}}$$

$$TCk = \frac{k(150degC) - k(-40degC)}{150degC - (-40degC)}$$

9) This value is verified by design & characterization, not subject to production test.

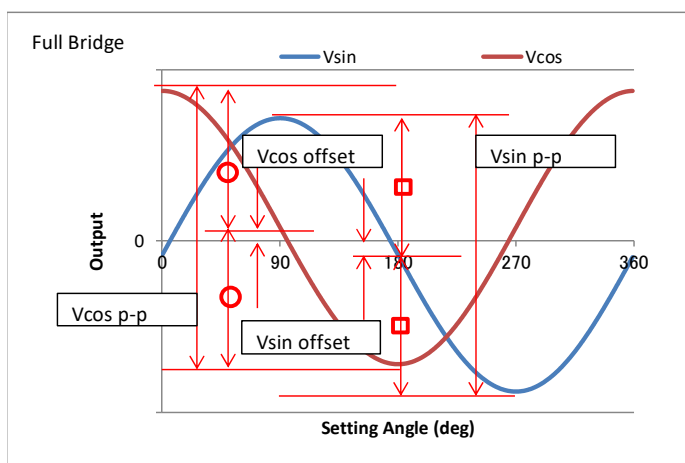


Figure 6: Definition of Full bridge signal

The following figure shows typical magnetic field dependency for Reference. (Extended Range information is only Reference.)

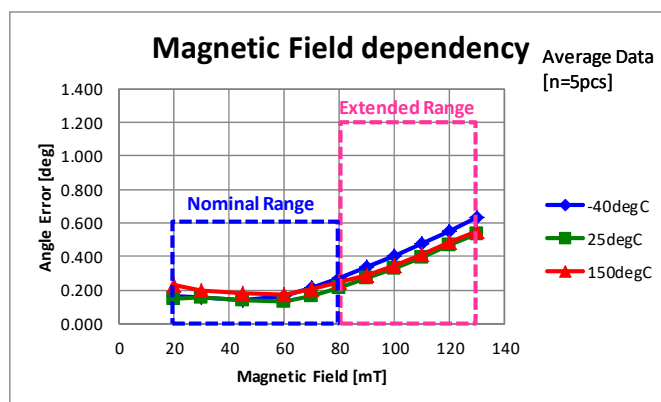


Figure 7: Typical magnetic field dependency

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8 Package information

8.1 TAS2142-AAAC : Package dimension [ESP000009]

2 full bridge / 1 package (TSSOP 8pin package 4.4mm x 3.0mm x 1.0mm) unit: mm

Dimension does not include resin fines, resin burrs and gate remainders.

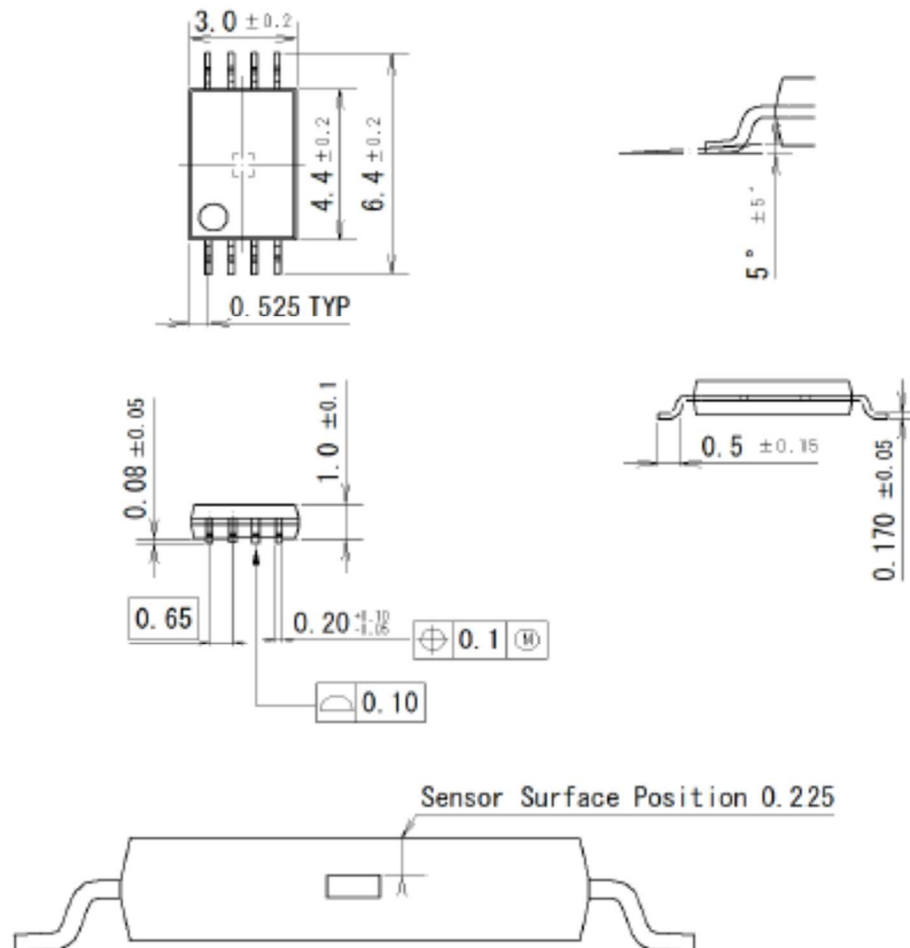


Figure 8: Package drawing

MSL (Moisture Sensitivity Level): 1

8.2 Thermal Characteristic [ESP000010]

Table 4: Thermal characteristic

Items	Parameter	Conditions	Min	Typ	Max	Unit	Remarks
Rth(j-a)	Thermal Resistance from junction to ambient			200		K/W	

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8.3 Device marking [ESP000011]

2 types of marking per package supplier

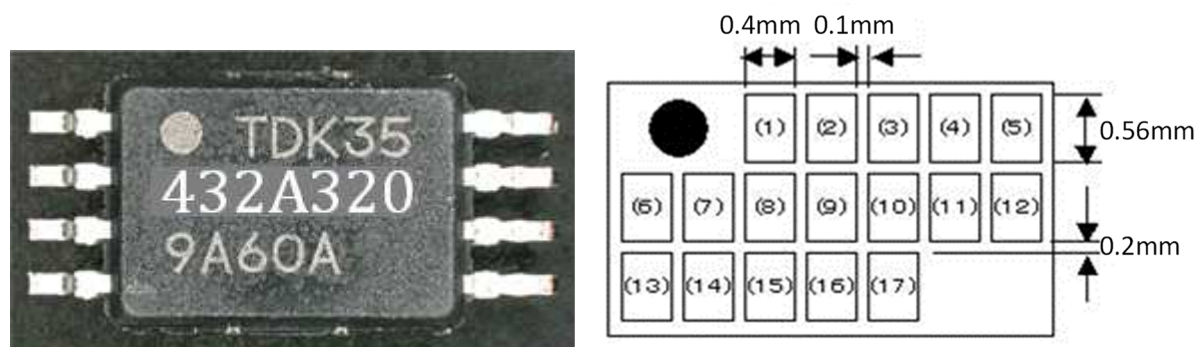


Figure 9: TSSOP8 package photo & Device marking (Supplier-A)

Marking definitions

First: ●TDK35 => 1 pin mark (2 digits) + Company name (TDK) + Lot (2digits)

Second: 432A320 => Device number of TAS2142-AAAC MTEX packaging

Third: 9A60A => Wafer lot number

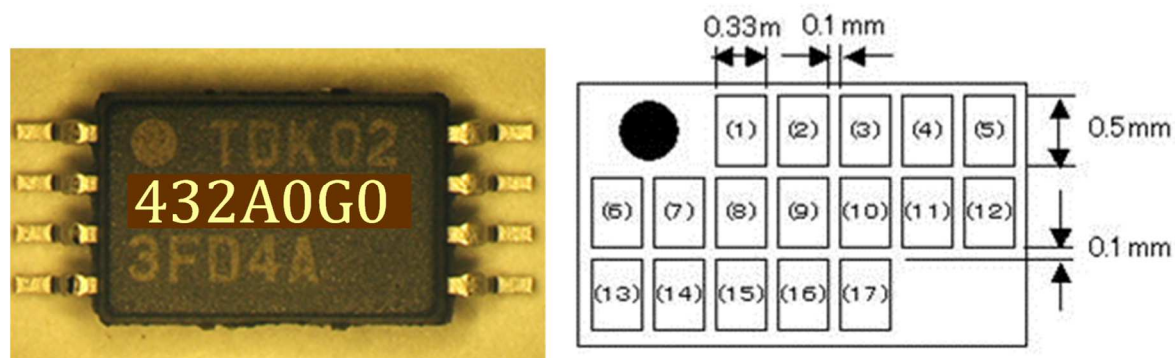


Figure 10: TSSOP8 package photo & Device marking (Supplier-B)

Marking definitions

First: ●TDK02 => 1 pin mark (2 digits) + Company name (TDK) + Lot (2digits)

Second: 432A0G0 => Device number of TAS2142-AAAC HCA packaging

Third: 3FD4A => Wafer lot number

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8.4 Recommended Footprint [ESP000012]

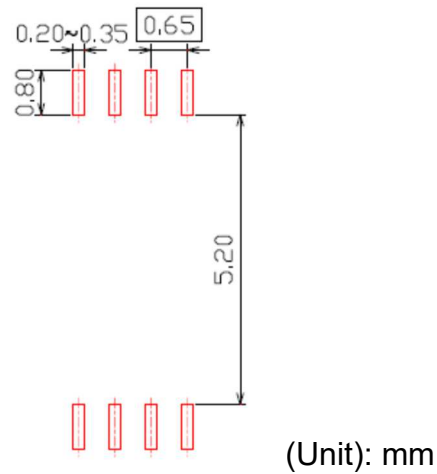


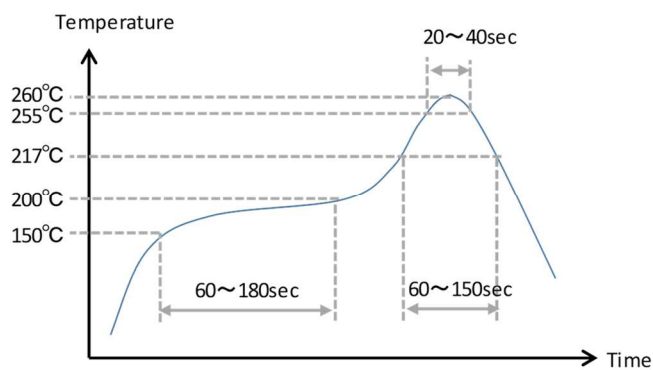
Figure 11: Foot Print

This land pattern is a reference value conforming to EIAJ, please optimize the design according to actual mounting conditions and mounting equipment.

8.5 Reflow profile (Reference) [ESP000013]

Peak temperature should not exceed 260degC.

Reflow Profile: JEDEC IPC/JEDEC J-STD-020D



Item	Contents
Peak temperature	260°C
Peak temperature time	20~40sec, 255~260°C
Reflow time	60~150sec, 217°C or more
Residual heat condition	60~180sec, 150~200°C
Heating rate	3°C/sec Max, 217~255°C
Cooling rate	6°C/sec Max
Total heating time	8min or less
Number of reflows	3times Max

Figure 12: Recommended reflow profile and conditions

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9 Tape & Reel [ESP000014]

9.1 Taping Specification

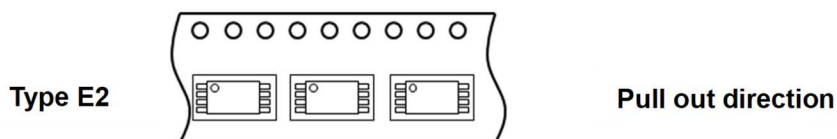


Figure 13: Tape specification

9.2 Package storage method

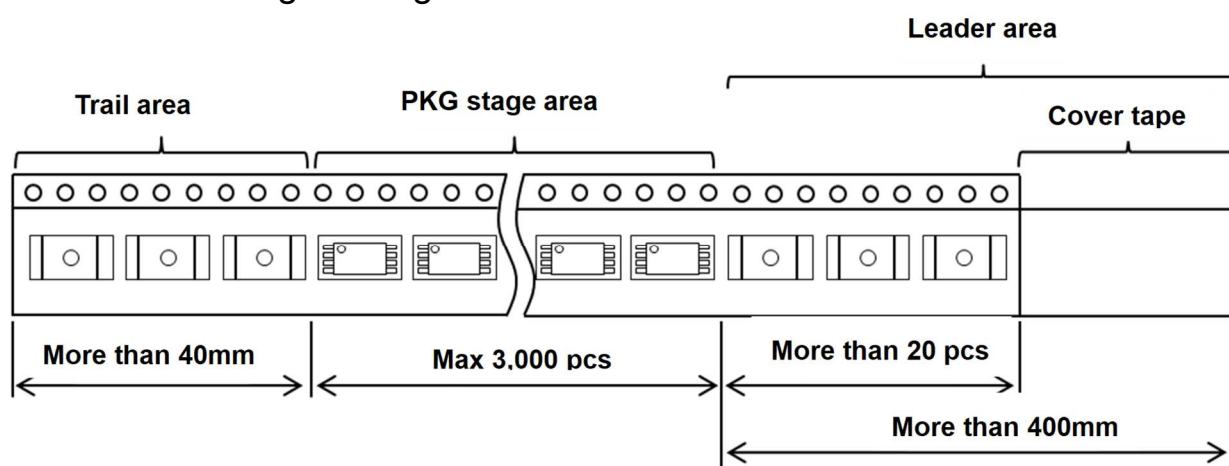


Figure 14: Package storage method

Table 5: Definition of Trail, Package, and leader area (Typical value for Reference)

Trailing area (vacant pocket)	Package area (fill pocket)	Leader area (vacant pocket)
68pcs= 68 * 8mm 544mm	3000 pcs	60 pcs

- Package quantity is 3,000pcs/ Reel.
- Up to two lots can be combined for each lot reel.

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9.3 Carrier tape

Material: Polystyrene with carbon

Surface resistance : $1 \times 10^7 \Omega/10\text{cm}$

Color: Black

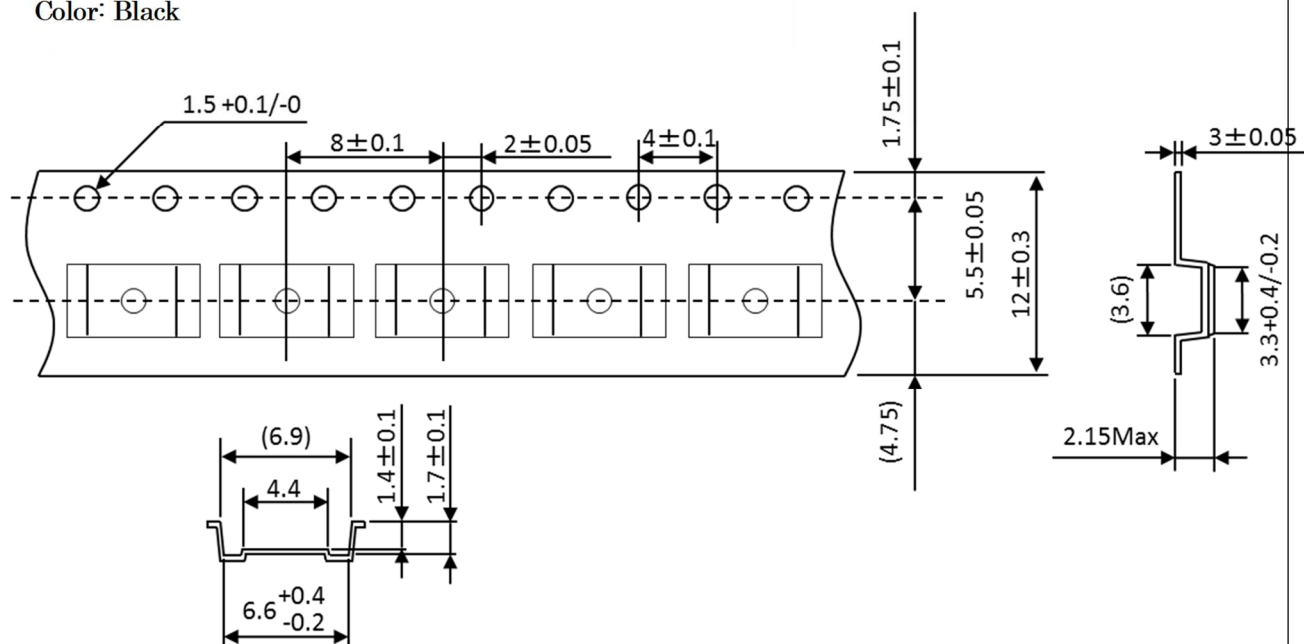


Figure 15: Taping Drawing

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9.4 Reel specification

Material: Polystyrene

Surface resistance : $1 \times 10^7 \Omega/10\text{cm}$

Color: Black

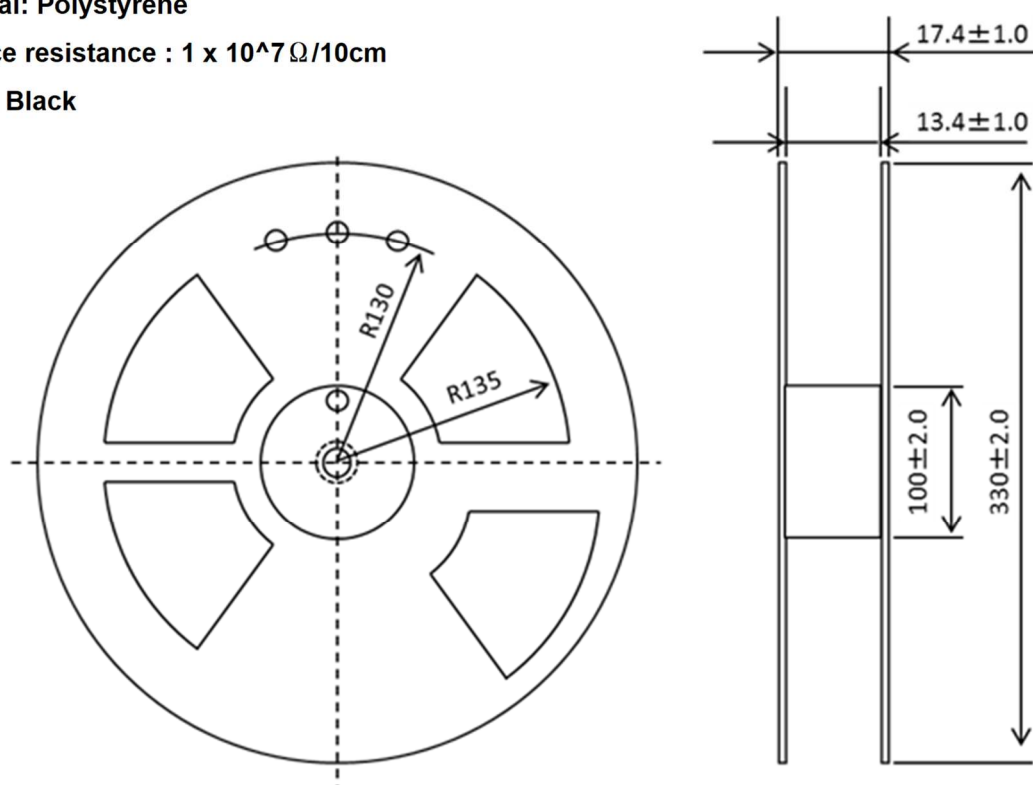


Figure 16: Reel Drawing

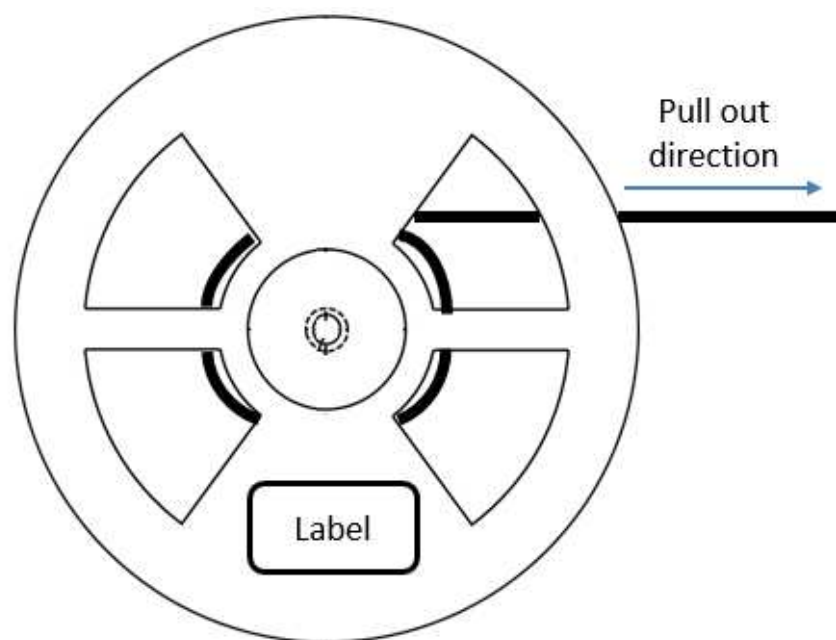


Figure 17: Tape Real Pull out direction

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10 Instruction for use

A) Instruction for Use

- ① Before using of this product, please read this specification.

B) Instruction for Safety

- ① Please pay attention to each notice when designs safety application.

C) Notice :

- ① The recommended storage period should be:
 1. Less than 12 months with packing condition in Tape and Reel.
 2. Less than 30 days without packing condition.
 3. Less than 12 months by combined with and without packing condition.
- ② Please be careful of storage conditions:
 1. The temperature should be from 5degC to 40degC.
 2. The humidity should be less than 75%RH in a packing state.
 3. Prevent the formation of any condensation by sudden temperature change.
- ③ If exceed the recommended storage period, there is a possibility that solderability of the terminal may deteriorate.
- ④ The storage for a long time in a magnetic field may affect the sensor characteristics, so please keep it in a weak magnetic field condition less than 0.3mT or no magnetic field condition without any generating a magnetic field nearby.
- ⑤ The starting date of the storage period should be the date of displayed in the label attached to the reel.
- ⑥ The storage to affect some stress to package is dangerous. Do not apply a load of 5 N or more to the product top side (printed side). Please prevent the load to package under storage because there are some risk like the deformation of package pin and the change of sensor characteristics.
- ⑦ Please do not store or use in the environment (salt, acid, alkali, etc.) accompanied by gas corrosion (chlorine, acid, alkali, etc.)
- ⑧ When do re-soldering after mounting on PCB, there is a possibility of a short circuit, performance deterioration, and a decrease of lifetime by excessively heating.
- ⑨ When incorporate the PCB with sensor package to the set module, do not apply residual stress of this process to the sensor package.
- ⑩ Avoid to use the adhesion due to protection material. It may affect to the sensor performance by residual stress.
- ⑪ Please pay attention layout of sensor package on PCB or the placement in set module.

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There is some risk of malfunction by magnetic interference, which may come from the neighbor magnetic materials (Fe, Ni, etc.).

- ⑫ The induced electromotive force may interfere with the sensor performance. Please measure against the induced electromotive force at circuit design.
- ⑬ Please do not use to exceed the absolute maximum ratings. If placed the sensor package at the exceeded magnetic field environment, please do not use it and scrap the sensor package.
- ⑭ Please do not use the dropped products.

D) Remarks

- ① Products described in this specification are mounted on automobiles or automotive products and are used in standard applications in automobiles according to the scope and conditions stated in this specification and are also used for automobiles or automotive products including this product it is intended to be used in normal operation and usage. In addition to automobiles, a high degree of safety or reliability is required, or failure, malfunction, or malfunction of the equipment may cause damage to life, body, property, etc. to people, or cause serious social impacts It does not guarantee compatibility, performance demonstration and quality to the following applications (hereinafter referred to as "specific applications") that may be given.

We are not responsible for the damage, etc. caused by exceeding the scope and condition of this specification, or being used for specific purposes. If you exceed the scope and conditions of this specification, or if you are planning to use it for a specific purpose, please contact us beforehand. We will discuss about specifications different from those specified in this specification according to customer's application.

- ① Aviation, Space Equipment
- ② Transportation equipment (train, ship, etc.)
- ③ medical equipment
- ④ Equipment for power generation control
- ⑤ Nuclear related equipment
- ⑥ submarine equipment
- ⑦ Transportation control equipment
- ⑧ Information processing equipment with high public nature
- ⑨ Military equipment
- ⑩ Electrical heating equipment, combustion equipment
- ⑪ Disaster prevention and crime prevention equipment
- ⑫ Various safety devices
- ⑬ Other use recognized as specific use

Before designing the equipment that uses this product, please secure the protection

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circuit / equipment and backup circuit according to the intended use and mode of the equipment.

In addition, although the products described in this specification are assumed to be used in automobiles or automotive products as described above, it is not required for advanced safety and reliability as much as automobiles, or it is not required for life, body, It is not a prohibition to use it for general electronic equipment with little fear of damaging property etc. and having a serious impact on society. Therefore, in the case where the product described in this specification is used for general purpose electronic equipment for general purpose standard use, and the general electronic equipment is used in normal operation and usage method, for use in such equipment Also the description of this common notice will be applied.

- ② We assume no responsibility that the infringement of third party rights caused by the information in this document.
- ③ Please note. We assume no responsibility If you have damage from its use without our agreement.
- ④ Our warranty for this product is limited to conformity with the value and description expressly stated in this document. Please note we cannot warrant suitability and fitness for your particular intended purpose.

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Appendix. C Changes

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2021.02.04	00	Initial Release
2021.09.09	01	Update 7.1 Absolute Maximum Rating ; Change ESD MM to ESD CDM Update 7.2 Recommended Operating Conditions ; Add extended external magnetic field range 80~120mT Update 7.3 Electrical characteristics ; Add Angle Error for 80~120mT Update 8.3 Device marking Update 10 Instruction for use

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