

# Datasheet

To

SPECIFICATION No.

DATE: 2021.09.17

CUSTOMER'S PRODUCT NAME :

PRODUCT NAME:

**TMR Angle Sensor**

**TAS4240-AAAA**

(TDK name: HHS-TAS4240AAAA-0010)

(TDK code: W432A3500)

## RECEIPT CONFIRMATION

Sales : TDK sales

Engineering : TDK Asama Techno Factory

APPROVED	Person in charge

APPROVED	CHECKED	Person in charge
T. Kagami	S. Koide	H. Naganuma

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## **1 General description**

The TAS4240-AAAA TDK Angle Sensor is Tunneling Magneto Resistance (TMR) sensor which consists of 2 Wheatstone bridges in TSSOP8 package, which output creates 1.5Vp-p @ Vcc 5V. The output can be configured to represent two pairs 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. The recommended field is 50mT +/- 30mT.

## **2 Key Features**

- Magnetic field sensor, employing the TMR (Tunneling Magneto Resistance) effect.
- 2 x Wheatstone Bridges inside of TSSOP-8 package.
- Sine and Cosine Outputs.
- Good redundancy performance
- High Output Signal without Amplification.

## **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

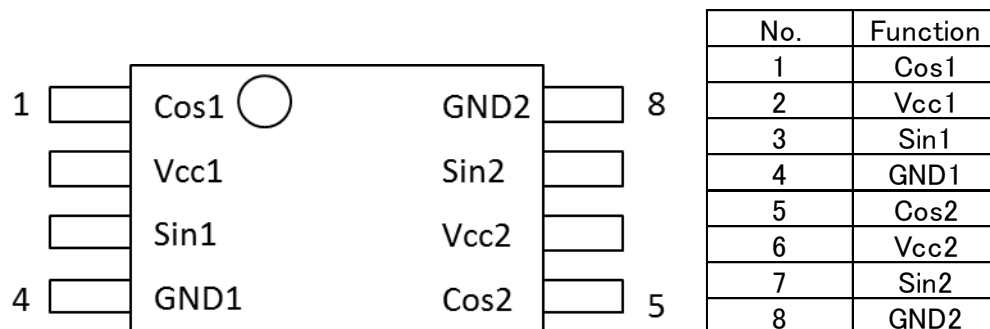


Figure 1: Pin assignment

## 5 Block diagram

White and gray arrows indicate magnetization direction of Pin layer.

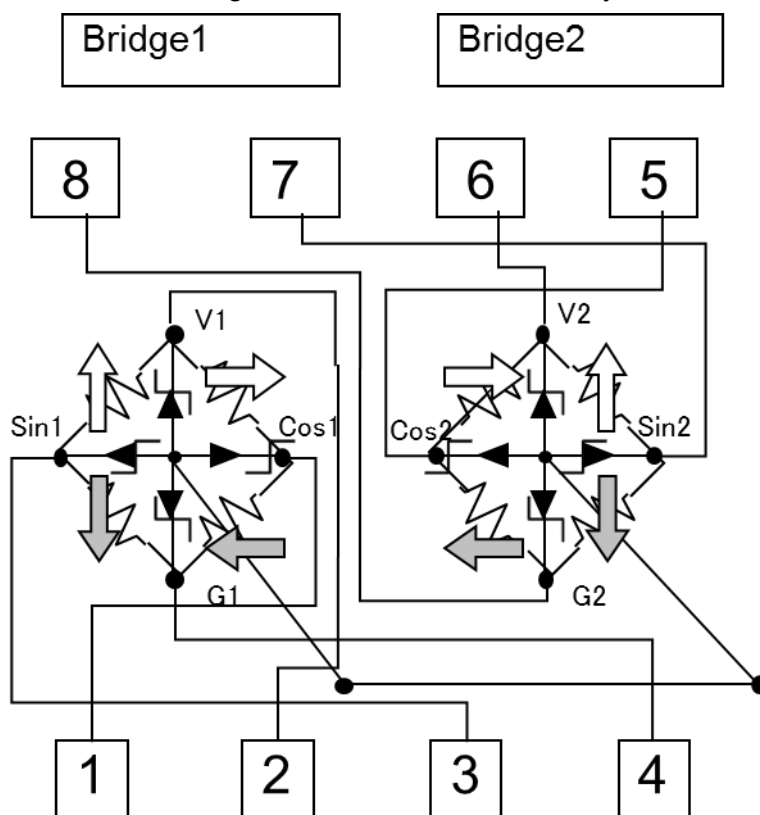


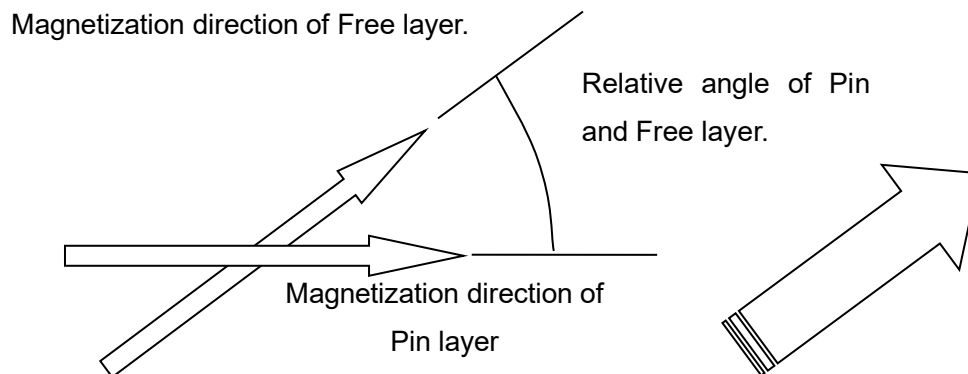
Figure 2: Block diagram

## 6 Definitions

### 6.1 TMR basic principle

Free layer aligns with Applied Magnetic Field.

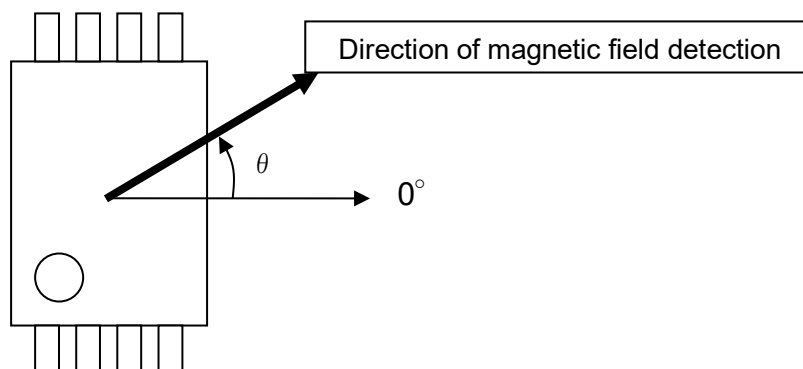
Angle between Pin and Free layers determines resistance.



**Figure 3: TMR operation principle**

### 6.2 Definition of Angle and Direction

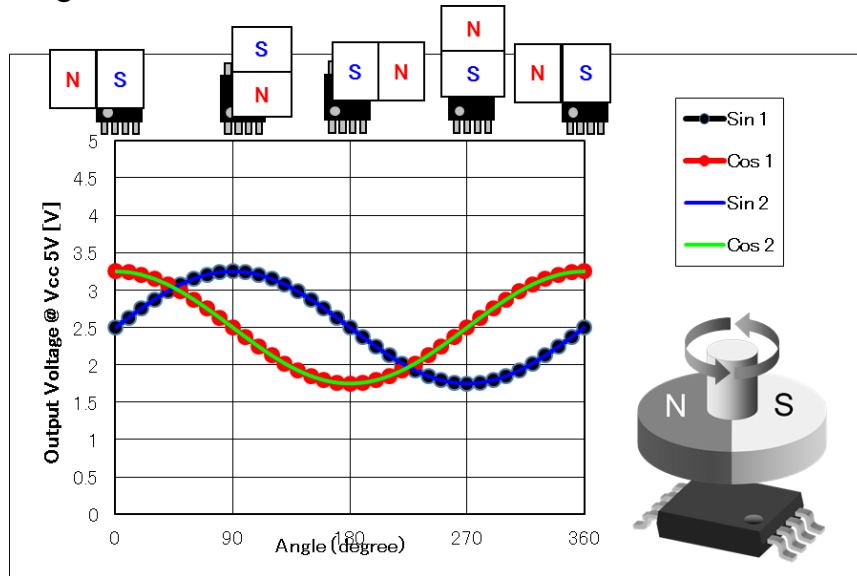
The definition of Direction of magnetic field detection is as follows.



**Figure 4: Definition of angle and magnetic field direction**

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### 6.3 Output Signal



**Figure 5: Output signal at Vcc 5V**

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## 7 Characteristics

### 7.1 Absolute Maximum Rating

**Table 1: Absolute maximum rating**

Items	Symbol	Conditions	Min	Typ	Max	Unit	Remarks
Supply Voltage	Vcc				6.5	V	
Ambient Temperature	Ta		-40		150	degC	
Storage Temperature	Tstg		-55		150	degC	
Junction Temperature	Tj		-55		175	degC	
Reflow Temperature	Treflow				260	degC	
External Magnetic Field	Hex	Max 5min @ 25degC			200	mT	1)

1) 1mT = 795.8A/m in air

### 7.2 Recommended Operating Conditions

**Table 2: recommended operating conditions**

Items	Symbol	Conditions	Min	Typ	Max	Unit	Remarks
Supply Voltage	Vcc		3	5	5.5	V	
Ambient Temperature	Ta		-40		150	degC	
External Magnetic Field	Hex	Recommended range	20		80	mT	
		Extended range	80		120	mT	1)

1) See possible angle error on characteristics table.

### 7.3 ESD Protection Level

**Table 3: ESD protection level**

Items	Symbol	Conditions	Min	Typ	Max	Unit	Remarks
Human body model	ESD	AEC Q100-002	4000			V	Classification H3A
	HBM						
Charged device model	ESD	AEC Q100-011	750			V	Classification C5
	CDM						

## 7.4 Electrical characteristics

**Table 4: Electrical characteristics**

Ta=25degC, Hex=20mT, Vcc=5V unless otherwise specified.

Items	Symbol	Conditions	Min	Typ	Max	Unit	Remarks
<b>Bridge Resistance</b>	Rbridge	Ta = 25degC Hex = 20mT	4	5	6	kOhm	
<b>Output voltage</b>	Vout	Peak to peak Ta=25degC, Hex=20mT	0.27	0.3	0.335	V/Vcc	1)
<b>Angle error</b>	AE	Ta = -40 to 150degC, Hex = 20 to 80 mT			1.0	deg	2)
		Ta = -40 to 150degC, Hex = 80 to 120 mT			1.4	deg	2), 9)
<b>Orthogonality</b>	Orth	Ta = 25degC, Hex = 20mT	87	90	93	deg	3)
<b>Offset voltage</b>	Voffset	Ta = 25degC Hex = 20mT	-5		5	mV/Vcc	
<b>Amplitude synchronism ratio</b>	k	Ta = 25degC Hex = 20mT	97	100	103	%	4)
<b>Temperature Coefficient of Vout</b>	TCoutput	Ta = -40 to 150degC, Hex = 20 to 80 mT	-0.115	-0.095	-0.075	%/degC	5)
<b>Temperature Coefficient of Rbridge</b>	TCRbridge	Ta = -40 to 150degC, Hex = 20 to 80 mT	-0.09	-0.05	-0.01	%/degC	6)
<b>Voffset Temperature Drift</b>	Off.TD	Ta = -40 to 150degC, Hex = 20 to 80 mT	-0.5		0.5	mV/Vcc	7)
<b>Temperature Coefficient of Amplitude synchronism ratio</b>	Tck	Ta = -40 to 150degC, Hex = 20 to 80 mT	-0.015		0.015	%/K	8)
<b>Hysteresis of Output voltage</b>	Hyst	More than 20mT	No Hysteresis				

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

1)  $V_{p-p}$ : Output voltage peak to peak

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

2) Angle error of either LT or HT is compensated using the correction value at RT.

Offset, Gain and Phase compensation according to TDK application note No. EAZ00011

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

$$k = \frac{V_{out@V_{cos}}}{V_{out@V_{sin}}}$$

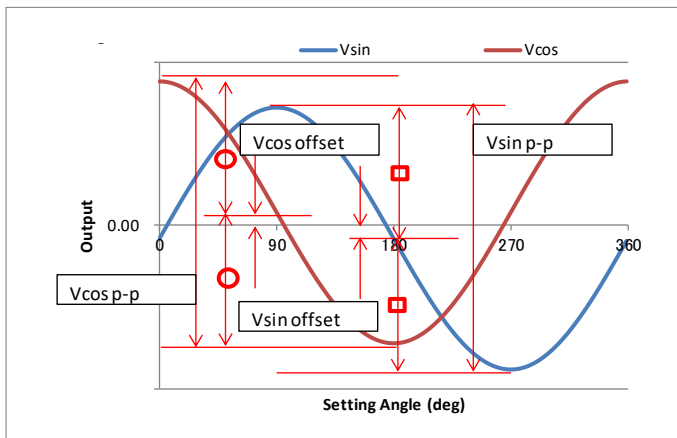
$$TC_{Output} = \frac{(V_{out@HT}) - (V_{out@LT})}{(V_{out@RT}) * (HT - LT)} * 100$$

$$TC_{Rbridge} = \frac{(R_{bridge@HT}) - (R_{bridge@LT})}{(R_{bridge@RT}) * (HT - LT)} * 100$$

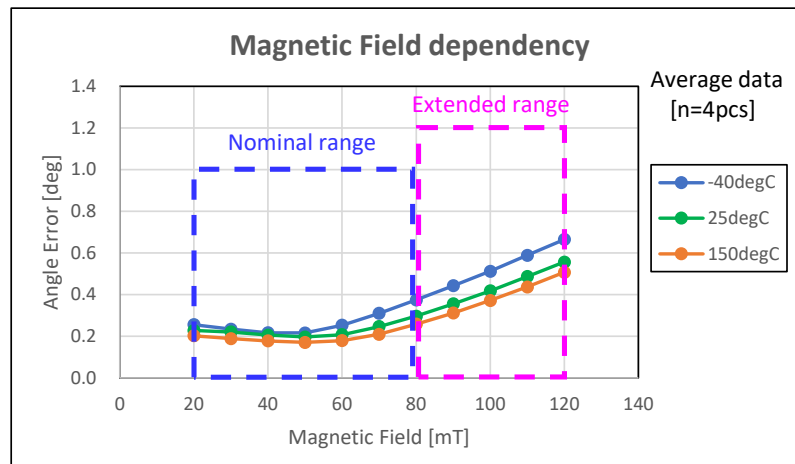
7) Off. TD =  $V_{offset@Ta} - V_{offset@RT}$

$$TC_k = \frac{(k@HT) - (k@LT)}{(HT - LT)}$$

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



The following figure shows typical magnetic field dependency for reference.



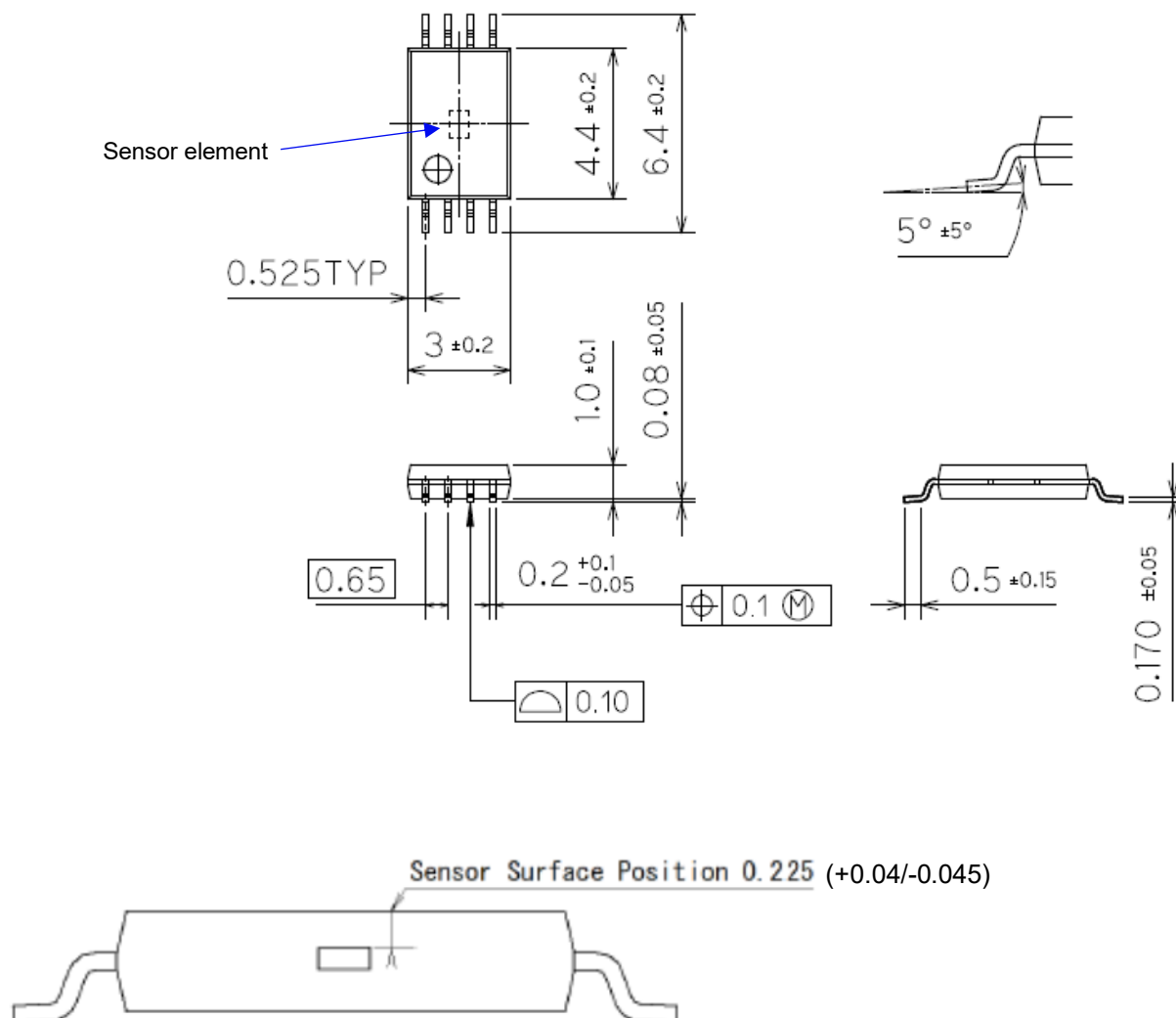
**Figure 6: typical magnetic field dependency**

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## 8 Package information

### 8.1 TAS4240-AAAA: Package dimension

unit: mm



**Figure 7: Package drawing**

MSL (Moisture Sensitivity Level): 1

### 8.2 Thermal Characteristic

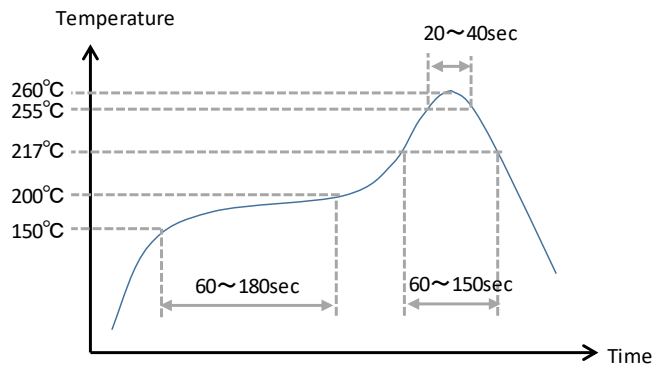
**Table 5: Thermal characteristic**

Items	Symbol	Conditions	Min	Typ	Max	Unit	Remarks
Thermal resistance	Rth	From junction to ambient		91		K/W	

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### 8.3 Reflow profile (Reference)

Peak temperature should not exceed 260degC.



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 8: recommended reflow profile**

## 9 Tape & Reel

### 9.1 Taping Specification

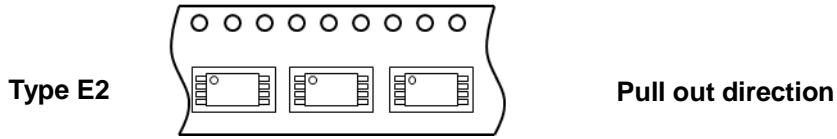


Figure 9: Tape specification

### 9.2 Package storage method

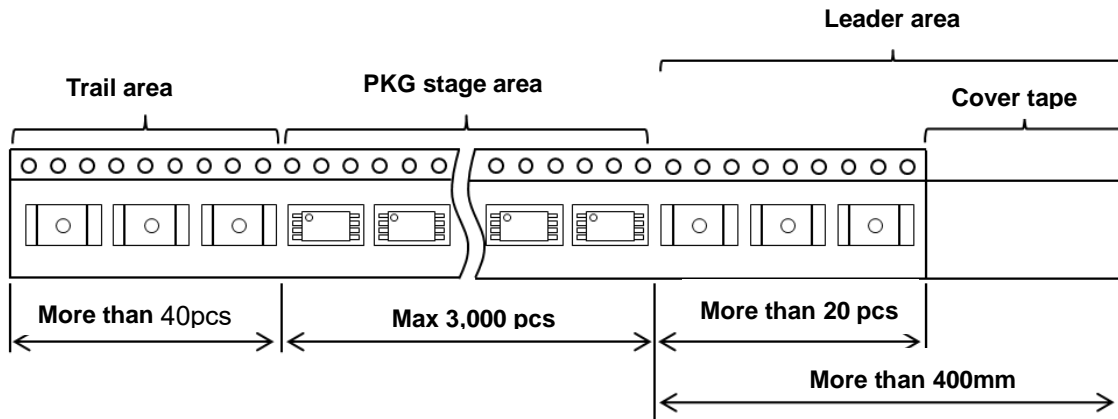


Figure 10: Package storage method

- Products can be empty (missing) within 3 consecutive lines.
- Empty pocket should be maximum 3 pockets per reel.

### 9.3 Carrier tape

Material: Polystyrene with carbon

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

Color: Black

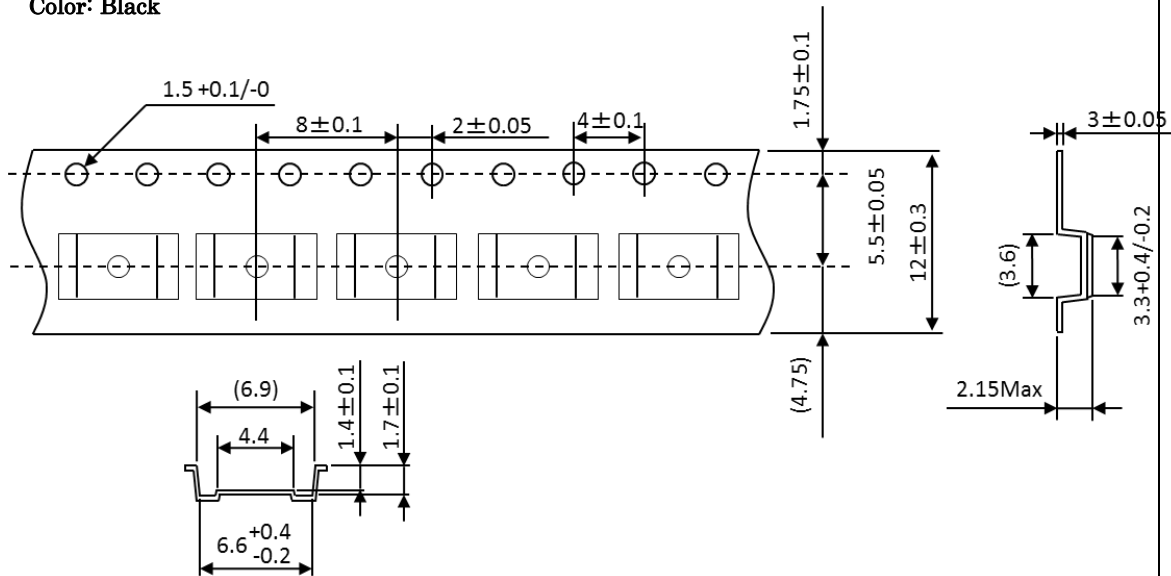


Figure 11: Taping Drawing

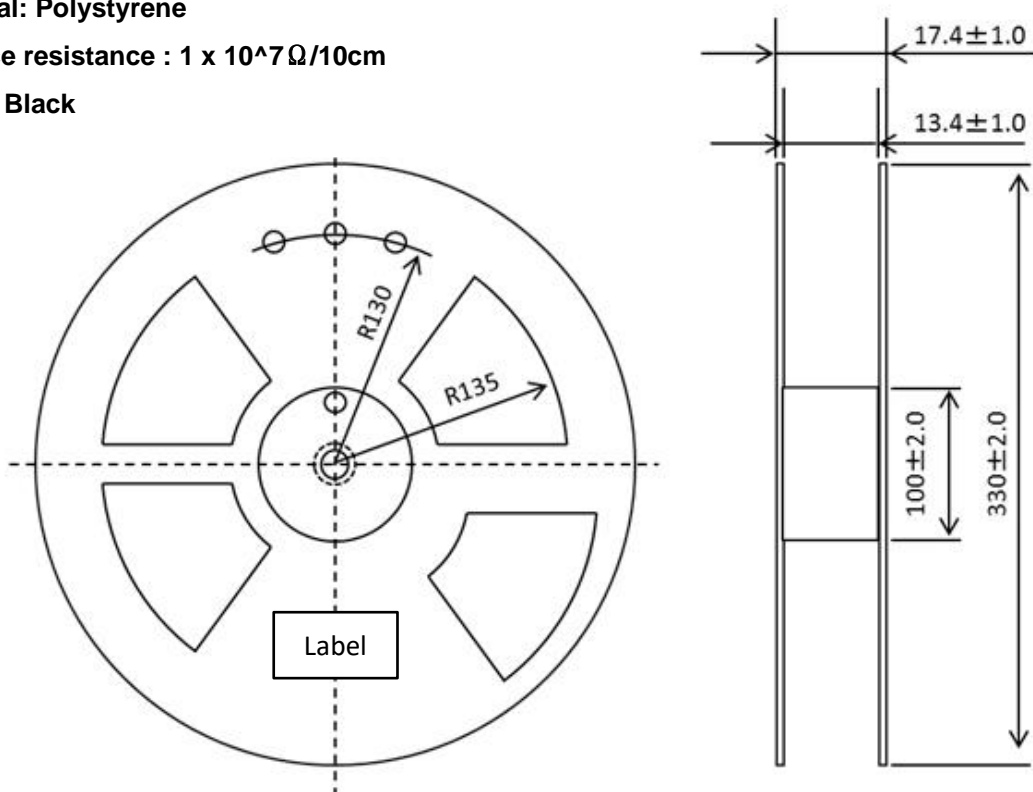
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## 9.4 Reel specification

**Material: Polystyrene**

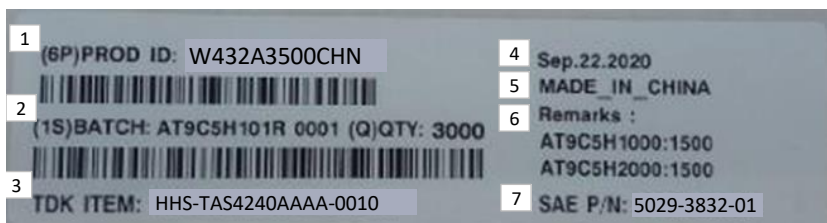
**Surface resistance :  $1 \times 10^7 \Omega/10\text{cm}$**

**Color: Black**



**Figure 12: Reel Drawing**

Label format (example)



1. PROD ID : TDK Product Item Code + Country of Origin Ex) **W432A3500CHN**
2. BATCH : Batch number + Serial number + QTY  
 Batch number : **AT + 9C5H1**(wf lot) + **01**(A'ssy lot) + **R**(Reel serial character)  
 Serial number : **0001** (fix)  
 QTY : **3000** (Package quantity in reel)
3. TDK ITEM : TDK Item Name Ex) **HHS-TAS4240AAAA-0010**
4. Date : TDK ITEM : Production date (Tape&Reel date) Ex) **Sep.22.2020**
5. Country of Origin : **MADE IN CHINA**
6. REMARKS : In case of mixing 2wafers in one reel, indicate wafer number & quantity  
**AT + 9C5H1**(wf lot) + **000**(fix) + ":" + **1500** (quantity)  
**AT + 9C5H2**(wf lot) + **000**(fix) + ":" + **1500** (quantity)
7. SAE P/N : SAE product number Ex) **5029-3832-01**

MOQ ; 3,000pcs

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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 less than 12 months, and please be careful of storage conditions (the temperature should be from 5degC to 40degC, the humidity should be less than 75%RH in a packing state, avoid the place condensing dew by sudden temperature change). If you exceed the safekeeping time period, there is a possibility that solderability of the terminal may deteriorate. Because there are some risk like the deformation of package pin and the change of sensor characteristics, the storage to affect some stress to package is dangerous. Please prevent the load to package under storage.
- ② Please do not store or use in the environment accompanied by the corroded gas.

### 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

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

- 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

Date	Rev	Changes
2019.02.15	00	Initial Release
2019.07.17	01	Correct description about output signal
2019.08.30	02	Change order of content
2019.12.18	03	Update tape & reel drawing
2020.07.06	04	Update specification value of Orthogonality and Amplitude Synchronism ratio
2020.09.02	05	Update specification value of Vout, TCbridge and Off TD
2021.07.08	06	Update 10. Instruction for Use D) remarks
2021.07.19	07	Update 7.2. Recommended Operating Conditions Update 7.3 Electrical characteristics Update 8.1 TAS4240-AAAA : Package dimension Update 9 Tape & Reel
2021.09.17	08	Add 7.3 ESD Protection Level Update 8.2 Thermal Characteristic

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