# SPECIFICATION

SPECIFICATION No.

DATE: 2019.10.23

## TDK TMR Angle Sensor

Product name

TAS4140-BAAC

( HHS-TAS4140BAAC-0010 )

Product code

432A1700

## 【 Changes】

| Date | Rev | changes |
|---|---|---|
| 2017.06.08 | 00 | New Release |
| | 01 | Update “13. Package Dimension” in page.9 |
| 2019.02.15 | 02 | Add MSL (Moisture Sensitivity Level) in “13. Package Dimension” |
| 2019.10.23 | 03 | TCoutput in 12. Characteristics<br>Product name, Product code in page.1 |
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# 1. General description

The TAS4140-BAAC TDK Angle Sensor is Tunneling Magneto Resistance (TMR) sensor which consists of 4 Wheatstone bridges in TSSOP16 package, which output creates 1.5Vp-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 x 2 full bridge (Sine and Cosine Outputs) in inside of TSSOP-16 package.
- Sine and Cosine Outputs.
- Good redundancy performance
- Very High Output Signal without Amplification.

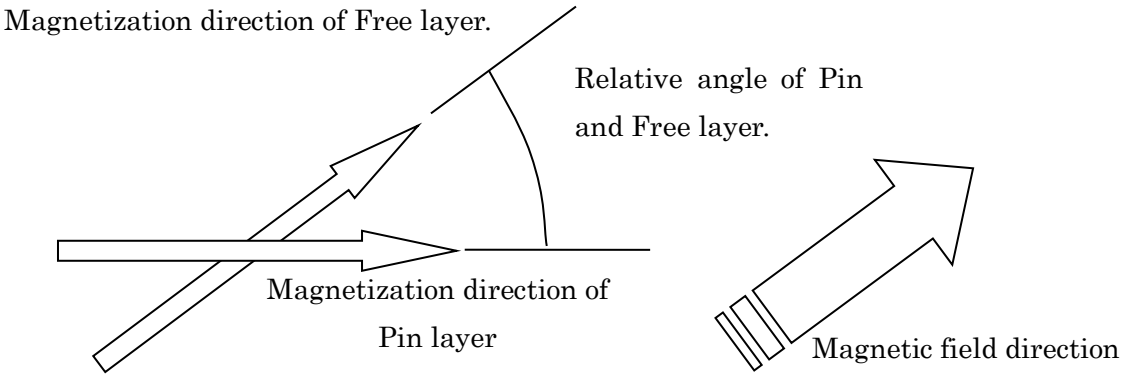
# 3. Typical Applications

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

# 4. Operation

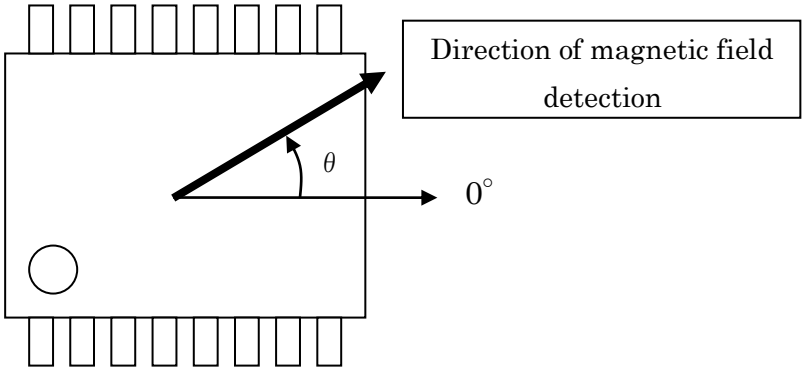
Free layer aligns with Applied Magnetic Field.

Angle between Pin and Free layers determines resistance.




# 5. Definition of Angle and Direction

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




# 6. Absolute Maximum Ratings

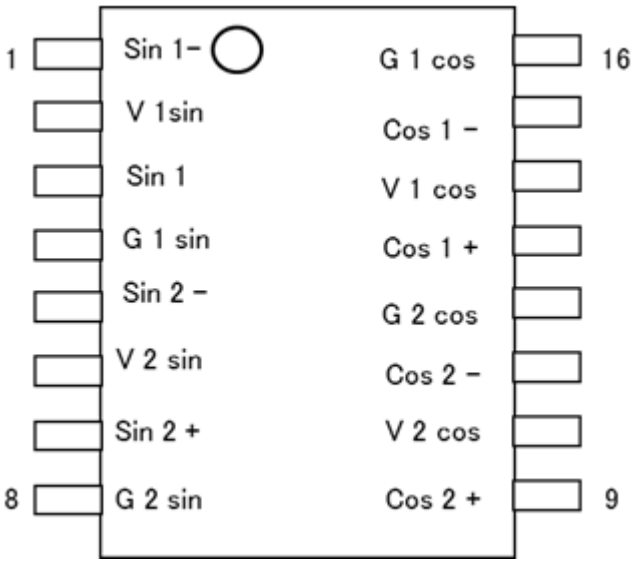
| Items | Parameter | Conditions | Min | Typ | Max | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| Vcc | Supply Voltage | | | | 6.5 | Volt | |
| Hex | External Magnetic field | Max. 5min @25degC | | | 200 | mT 1) | 1) |
| ESD HBM | ESD tolerance : Human Body Model | | | | 4000 | Volt | |
| ESD MM | ESD tolerance : Machine Model | | | | 400 | Volt | |
| Topt | Operating Ambient Temperature | | -40 | | 150 | deg C | |
| Tstg | Storage Temperature | | -55 | | 150 | deg C | |
| Treflow | Reflow Temperature | | | | 260 | deg C | |

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

# 7. Thermal Characteristics

| Items | Parameter | Conditions | Min | Typ | Max | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| Rth(j-a) | Thermal Resistance from junction to ambient | | | 91 | | K/W | |

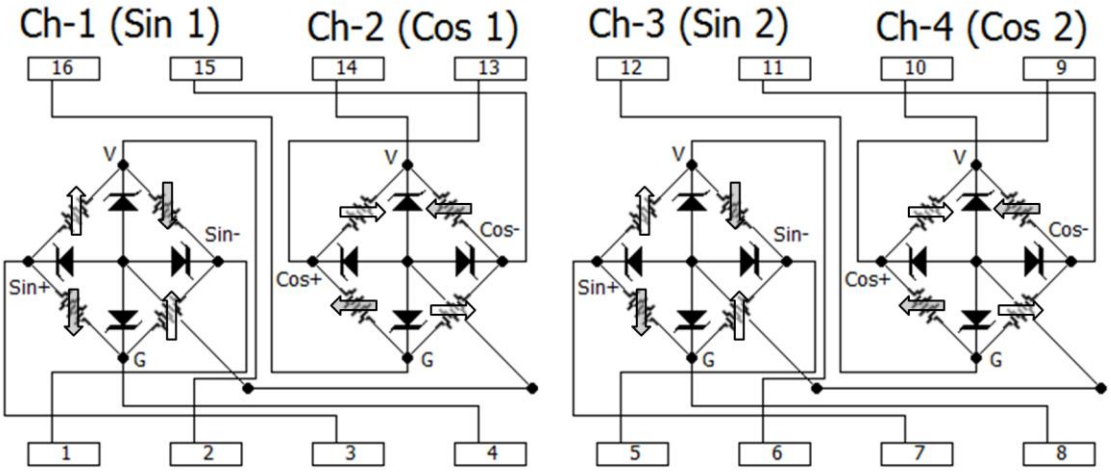
# 8. Pin assignment



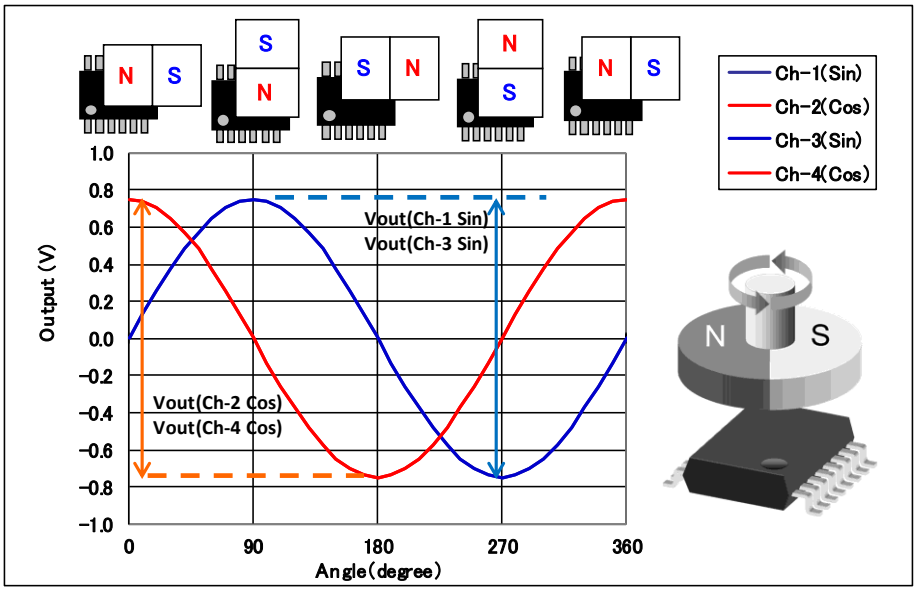

| No. | Function |
|---|---|
| 1 | Sin 1 − |
| 2 | V 1sin |
| 3 | Sin 1 + |
| 4 | G 1 sin |
| 5 | Sin 2 − |
| 6 | V 2 sin |
| 7 | Sin 2 + |
| 8 | G 2 sin |
| 9 | Cos 2 + |
| 10 | V 2 cos |
| 11 | Cos 2 − |
| 12 | G 2 cos |
| 13 | Cos 1 + |
| 14 | V 1 cos |
| 15 | Cos 1 − |
| 16 | G 1 cos |

# 9. Internal circuit and Pin direction

White and gray arrows indicate magnetization direction of Pin layer.



## 10. Output Signal (Differential Output Voltage )




## 11. 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 | | 80 | mT | |

## 12. Characteristics

TOPT=25° C, BEXT=30mT, VSIN=2.7 to 5,5V, VCOS=2.7 to 5,5V unless otherwise specified

| Items | Parameter | Conditions | Min | Typ | Max | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| Rbridge | Bridge Resistance | Topt=25degC, Hex=20mT | 4 | 5 | 6 | KΩ | |
| Vout | Differential output voltage peak to peak per Vcc | Topt=25degC, Hex=20mT | 0.24 | 0.3 | 0.36 | V/V | 1) |
| Angle Error (After Compensation) | | Topt=−40degC to 150degC<br>Nominal magnetic Range: 20mT to 80mT<br>1000h | | | 0.6 | deg | 2) |
| Orthogonality | | Topt=−40degC to 150degC<br>20mT to 80mT<br>0h | 87 | 90 | 93 | deg | 3) |
| Voffset | Differential Output Offset as an “initial offset” | per supply voltage<br>20mT to 80mT | −5 | − | 5 | mV/V | |
| TCoutput | Temperature Coefficient of Differencial Output | Topt=−40degC to 150degC<br>20mT to 80mT | −0.145 | −0.125 | −0.105 | %/K | 4) |
| TCRbridge | Temperature Coefficient of Bridge Resistance | Topt=−40degC to 150degC<br>20mT to 80mT | −0.070 | −0.050 | −0.030 | %/K | 5) |
| Off.TD | Offset Temperature Drift | Topt=−40degC to 150degC<br>20mT to 80mT | −0.5 | 0 | 0.5 | mV/V | 6) |
| Hyst | Hysteresis of Output Voltage | more than Hex=20mT | No Hysteresis | | | | |
| k | Amplitude Synchronism ratio | Topt=25degC, Hex=20mT | 97 | 100 | 103 | % | 7) |
| TCk | Temperature Coefficient of Amplitude Synchronism | Topt=−40degC to 150degC<br>20mT to 80mT | −0.015 | | 0.015 | %/K | 8) |

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

1) Vp-p=differential output voltage peak to peak

$$Vout = \frac{Vp-p}{Vcc}$$

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. EAZ00010)

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

4)
$$TCoutput = \frac{(Vout(150degC) - Vout(-40degC))}{Vout(25degC) * (150degC - (-40degC))} * 100$$

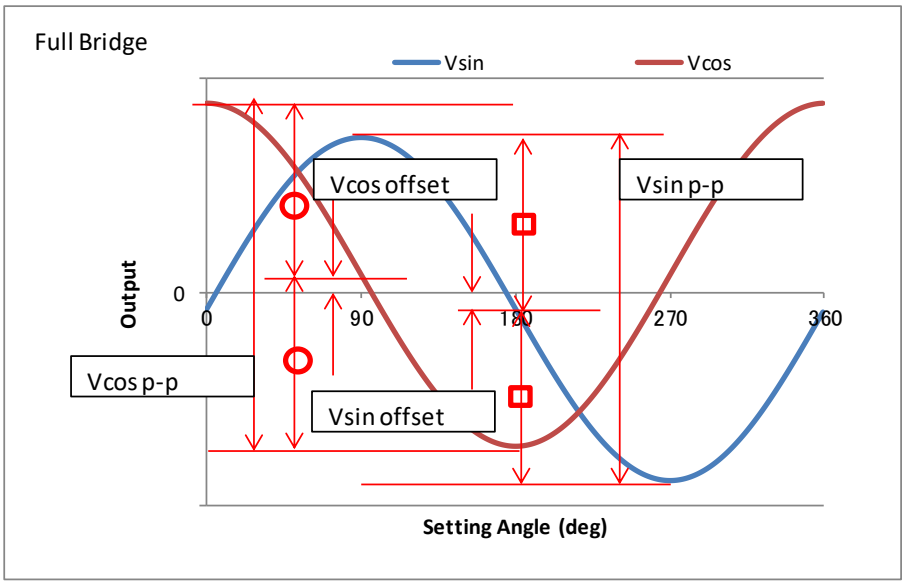
5)
$$TCrbridge = \frac{(Rbridge(150degC) - Rbridge(-40degC))}{Rbridge(25degC) * (150degC - (-40degC))} * 100$$

6)
$$Off.TD = Voffset@Ta - Voffset@25degC$$

※Ta = -40, 150degC

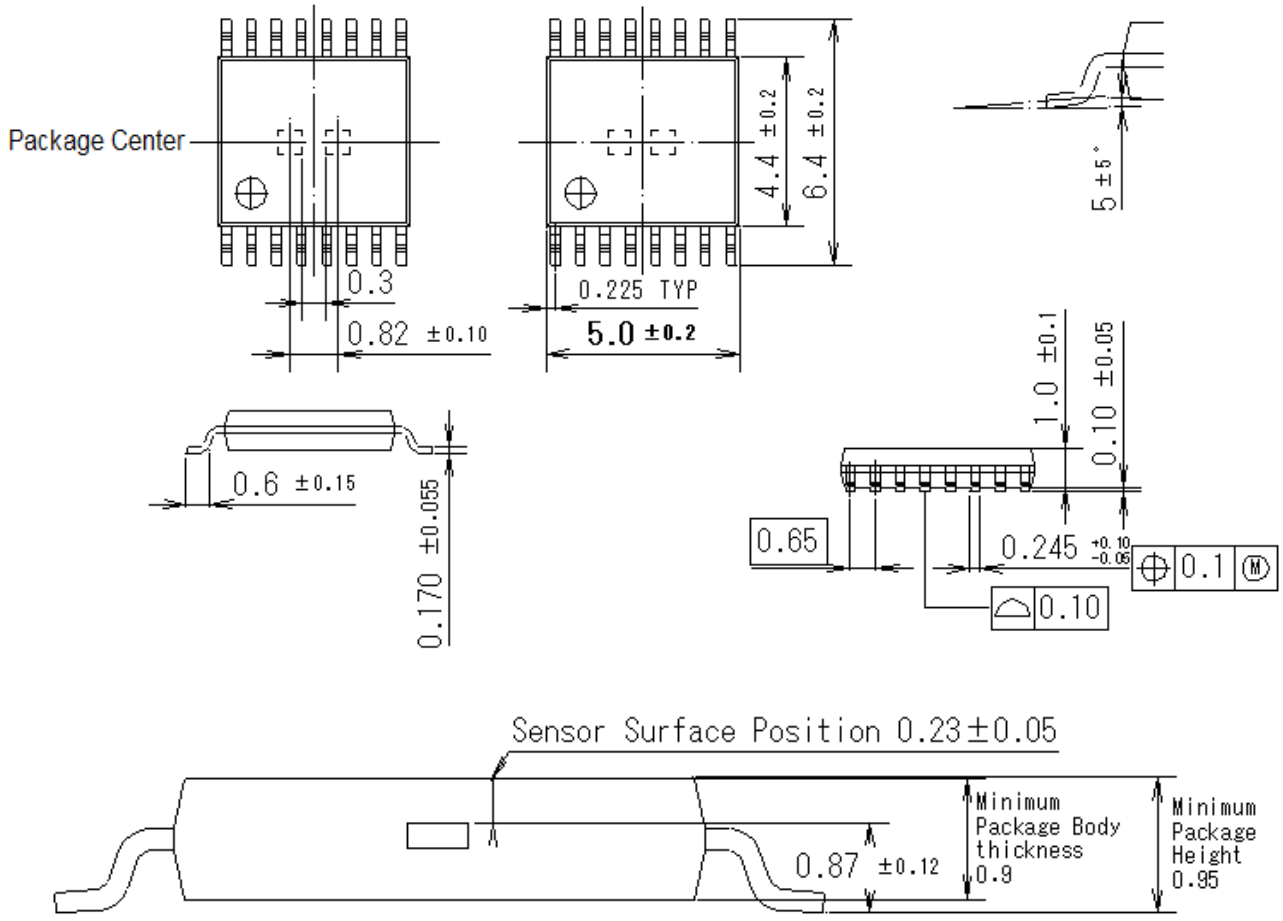
7)
$$k = \frac{Vcos\ peak}{Vsin\ peak}$$

8)
$$TCk = \frac{k(150degC) - k(-40degC)}{150degC - (-40degC)}$$



# 13. Package dimension unit: mm

2 x 2 full bridges / 1 package (TSSOP 16pin package 5.0mm x 4.4mm x 1.0mm)







MSL (Moisture Sensitivity Level): 1

# Matters to be attended to

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