

TMR3026

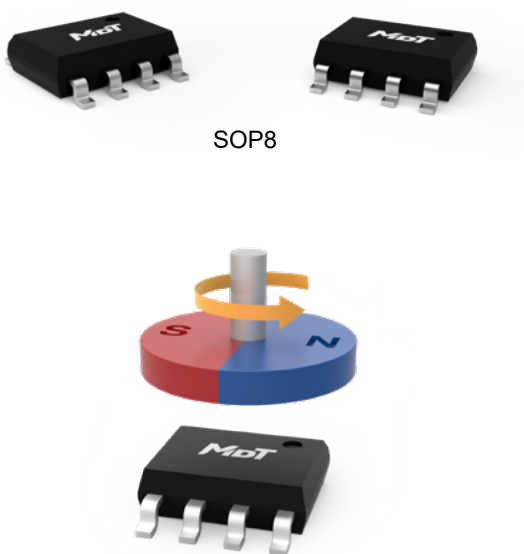
High Performance Automotive TMR Angle Sensor

Description

The TMR3026 angle sensor IC is designed with two sets of redundant Wheatstone bridge structures. Each Wheatstone bridge consists of four high-sensitivity tunneling magnetoresistance (TMR) sensing elements, forming two half-bridge structures that output single-ended SIN and COS voltages respectively. The TMR Wheatstone bridge structure effectively compensates for sensor thermal drift.

In angle sensor applications, a magnet is placed above the TMR3026 angle sensor IC to provide an operating magnetic field parallel to the chip surface. When the magnet rotates, the IC outputs voltage signals with sine and cosine relationships to the magnetic field angle.

The redundant design of the TMR3026 improves application system safety. It maintains very low angle error when the magnetic field varies within the range of 200 Gs to 800 Gs. The IC is available in an SOP8 package.

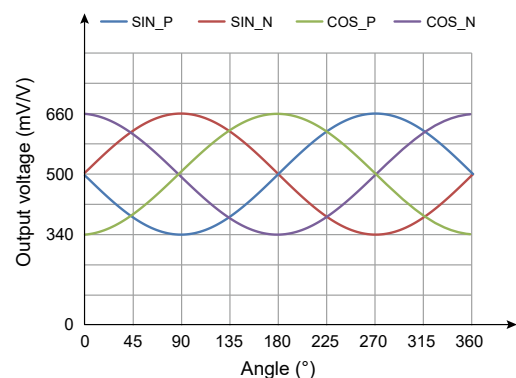


Features and Benefits

- Tunneling magnetoresistance (TMR) technology
- Two sets of redundant SIN/COS single-ended voltage outputs
- Wide range supply voltage
- Excellent temperature stability
- Excellent resistance to external magnetic field interference
- Single-chip redundancy with 4 half-bridges
- Compliant with the AEC-Q100 standard for automotive
- RoHS and REACH compliant

Applications

- Absolute angle sensor
- Electric power steering motor shaft angle sensor
- Steering wheel angle sensor
- Pedal position sensor
- Throttle position sensor



Selection Guide

| Part Number | Output | Supply Voltage | Peak Voltage Output | Package | Packing Form |
|-------------|--------------------------|----------------|---------------------|---------|--------------|
| TMR3026BP | Dual analog single ended | 1.0 V to 5.5 V | 320 mV/V | SOP8 | Tape & Reel |

Catalogue

| | |
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1. Functional Block Diagram

The TMR3026BP IC uses TMR sensors to form Wheatstone bridge structures, increasing the sensor output signal amplitude, improving the temperature characteristics, and enhancing the IC immunity to interference. The redundant design improves application system safety. The internal magnetoresistive electrical connections of the IC are shown in Figure 1.

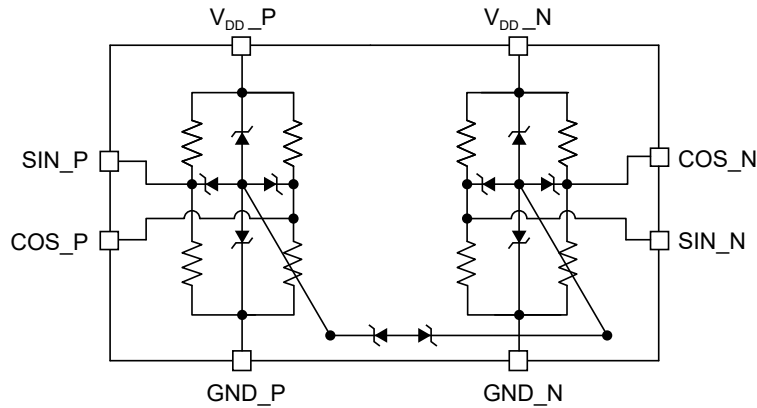


Figure 1. TMR3026 functional block diagram

2. Pin Configuration

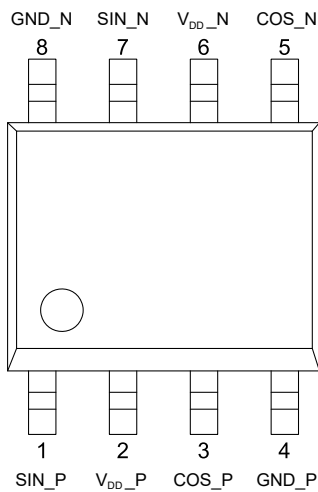


Figure 2. Pin configuration

| Number | Name | Function |
|--------|-------------------|-----------------------------|
| 1 | SIN_P | Channel 1 SIN signal output |
| 2 | V _{DD_P} | Channel 1 bridge supply |
| 3 | COS_P | Channel 1 COS signal output |
| 4 | GND_P | Channel 1 bridge ground |
| 5 | COS_N | Channel 2 COS signal output |
| 6 | V _{DD_N} | Channel 2 bridge supply |
| 7 | SIN_N | Channel 2 SIN signal output |
| 8 | GND_N | Channel 2 bridge ground |

3. Operating Principle

The sensing direction of the IC is parallel to the X-Y plane of the package marking surface, as shown in Figure 3.

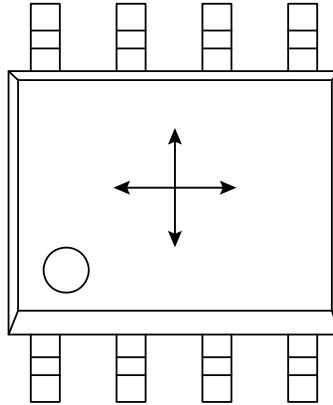


Figure 3. Sensing direction

A small magnet is placed above the top surface of the TMR3026BP IC. By rotation, the magnet can generate a magnetic field in any direction parallel to the surface of the TMR3026BP IC. When the angle of the applied magnetic field changes, the output voltage waveforms of the sensor follow sine and cosine curves.

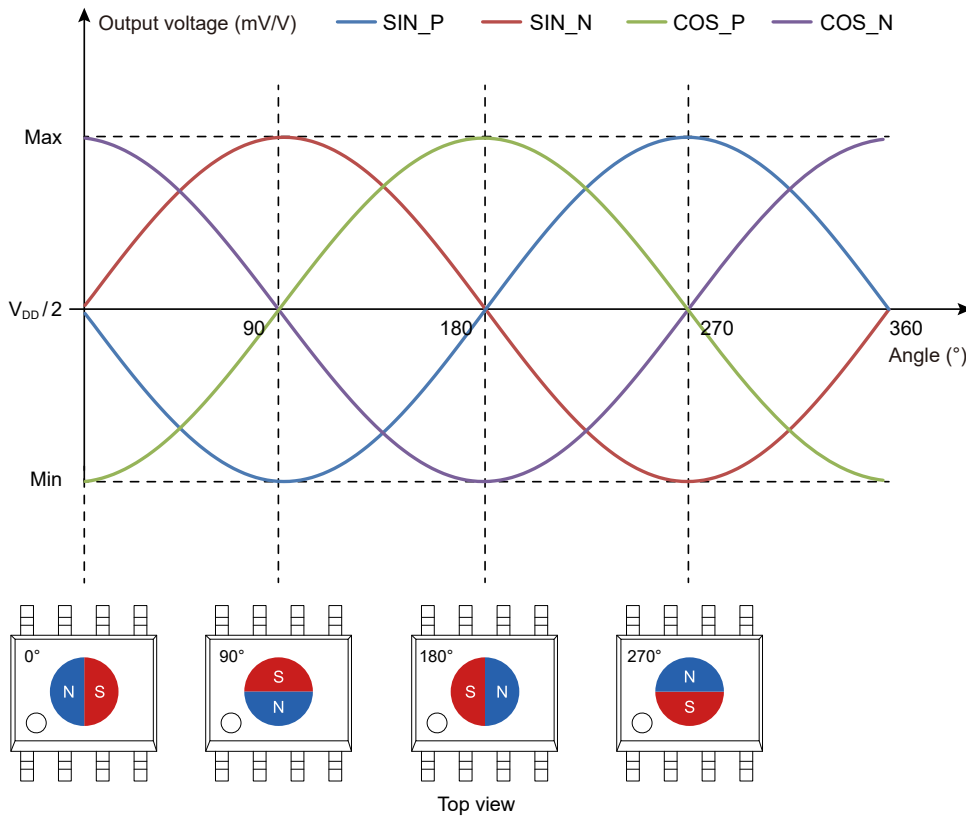


Figure 4. Typical TMR3026 output curve in response to magnet

4. Absolute Maximum Ratings

| Parameters | Symbol | Min. | Max. | Unit |
|-------------------------------|----------------|------|------|------|
| Supply voltage | V_{DD} | - | 6.5 | V |
| Magnetic flux density | B | - | 4000 | Gs |
| ESD performance (HBM) | $V_{ESD(HBM)}$ | - | 4000 | V |
| ESD performance (CDM) | $V_{ESD(CDM)}$ | - | 750 | V |
| Operating ambient temperature | T_A | -40 | 150 | °C |
| Storage ambient temperature | T_{STG} | -55 | 175 | °C |
| Reflow temperature | T_{reflow} | - | 260 | °C |

Note: The absolute maximum rating only lists the conditions under which the sensors are not permanently damaged. For normal operations please refer to Specifications.

5. Electrical Specifications

$V_{DD} = 5$ V, a 0.1 μ F capacitor is connected between V_{CC} and GND unless specified otherwise

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|----------------|--|--------|------------|----------------------|------------|
| Supply voltage | V_{DD} | Operating | 1.0 | - | 5.5 | V |
| Bridge resistance | R_B | $T_A = 25$ °C, $B = 200$ Gs | 4 | 6 | 8 | k Ω |
| Peak voltage | V_{PEAK} | $T_A = 25$ °C, $B = 200$ Gs | 135 | 160 | 185 | mV/V |
| Peak to peak voltage | V_{PP} | $T_A = 25$ °C, $B = 200$ Gs | 270 | 320 | 370 | mV/V |
| Bias voltage | V_{bias} | See Section 6.3 | - | $V_{DD}/2$ | - | mV/V |
| Offset voltage | V_{OFFSET} | $T_A = 25$ °C, $B = 200$ Gs | -5 | - | 5 | mV/V |
| Angle error ¹⁾ | $\Delta\theta$ | $T_A = -40$ °C to 150 °C, $B = 200$ Gs to 800 Gs | - | - | RT=0.9/ LT&HT=1.1 | deg |
| | | $T_A = -40$ °C to 150 °C, $B = 800$ Gs to 1200 Gs | - | - | 1.4 | deg |
| Phase error | - | $T_A = 25$ °C, $B = 200$ Gs | 87 | 90 | 93 | deg |
| Hysteresis | Hyst | $T_A = 25$ °C, $B > 200$ Gs | - | 0 | - | Gs |
| Peak synchronization coefficient | k | $T_A = 25$ °C, $B = 200$ Gs | 95 | 100 | 105 | % |
| Temperature coefficient of peak voltage | TCV_{PEAK} | $T_A = -40$ °C to 150 °C, $B = 200$ Gs to 800 Gs | -0.2 | -0.15 | -0.1 | %/°C |
| Temperature coefficient of bridge resistance | TCR_B | $T_A = -40$ °C to 150 °C, $B = 200$ Gs to 800 Gs | -0.09 | -0.07 | -0.05 | %/°C |
| Temperature coefficient of peak synchronization coefficient | Tck | $T_A = -40$ °C to 150 °C, $B = 200$ Gs to 800 Gs | -0.145 | -0.12 | 0 | %/°C |
| Temperature coefficient of offset voltage | TV_{OFFSET} | $T_A = -40$ °C to 150 °C, $B = 200$ Gs to 800 Gs | -0.5 | - | 0.5 | mV/V |

Note: 1) The angle error is defined as the angle error from zero point to peak value.

6. Specification Definitions

6.1 Bridge resistance R_B

The resistance between pins V_{CC1} and GND1 or the resistance between pins V_{CC2} and GND2

6.2 Peak peak voltage V_{PP} , Peak voltage V_{PEAK}

$$V_{PP} = V_{Max} - V_{Min} \quad V_{PEAK} = \frac{V_{Max} - V_{Min}}{2}$$

6.3 Bias voltage V_{bias}

$$V_{bias} = \frac{V_{Max} + V_{Min}}{2}$$

6.4 Offset voltage V_{OFFSET}

$$V_{OFFSET} = \frac{V_{Max} + V_{Min}}{2} - \frac{V_{CC}}{2}$$

6.5 Peak synchronization coefficient k

$$k = \frac{V_{COS(PEAK)}}{V_{SIN(PEAK)}}$$

6.6 Temperature coefficient of peak voltage TCV_{PEAK}

$$TCV_{PEAK} = \frac{V_{PEAK}(T2) - V_{PEAK}(T1)}{V_{PEAK}(25^{\circ}C) \times (T2-T1)} \times 100\%$$

$$T1 = T_A(\text{Min}) = -40^{\circ}C, T2 = T_A(\text{Max}) = 150^{\circ}C$$

6.7 Temperature coefficient of bridge resistance TCR_B

$$TCR_B = \frac{R_B(T2) - R_B(T1)}{R_B(25^{\circ}C) \times (T2-T1)} \times 100\%$$

$$T1 = T_A(\text{Min}) = -40^{\circ}C, T2 = T_A(\text{Max}) = 150^{\circ}C$$

6.8 Temperature coefficient of peak synchronization coefficient TCK

$$TCK = \frac{k(T2) - k(T1)}{(T2-T1)} \times 100\%$$

$$T1 = T_A(\text{Min}) = -40^{\circ}C, T2 = T_A(\text{Max}) = 150^{\circ}C$$

6.9 Temperature coefficient of offset voltage TV_{OFFSET}

$$TV_{OFFSET} = V_{OFFSET}(T2) - V_{OFFSET}(T1)$$

$$T1 = T_A(\text{Min}) = -40^{\circ}C, T2 = T_A(\text{Max}) = 150^{\circ}C$$

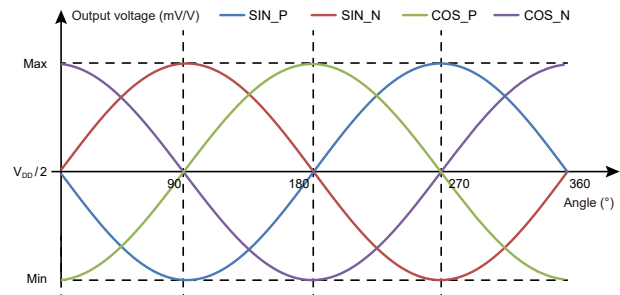


Figure 5. Output voltage

7. Dimensions

SOP8 Package

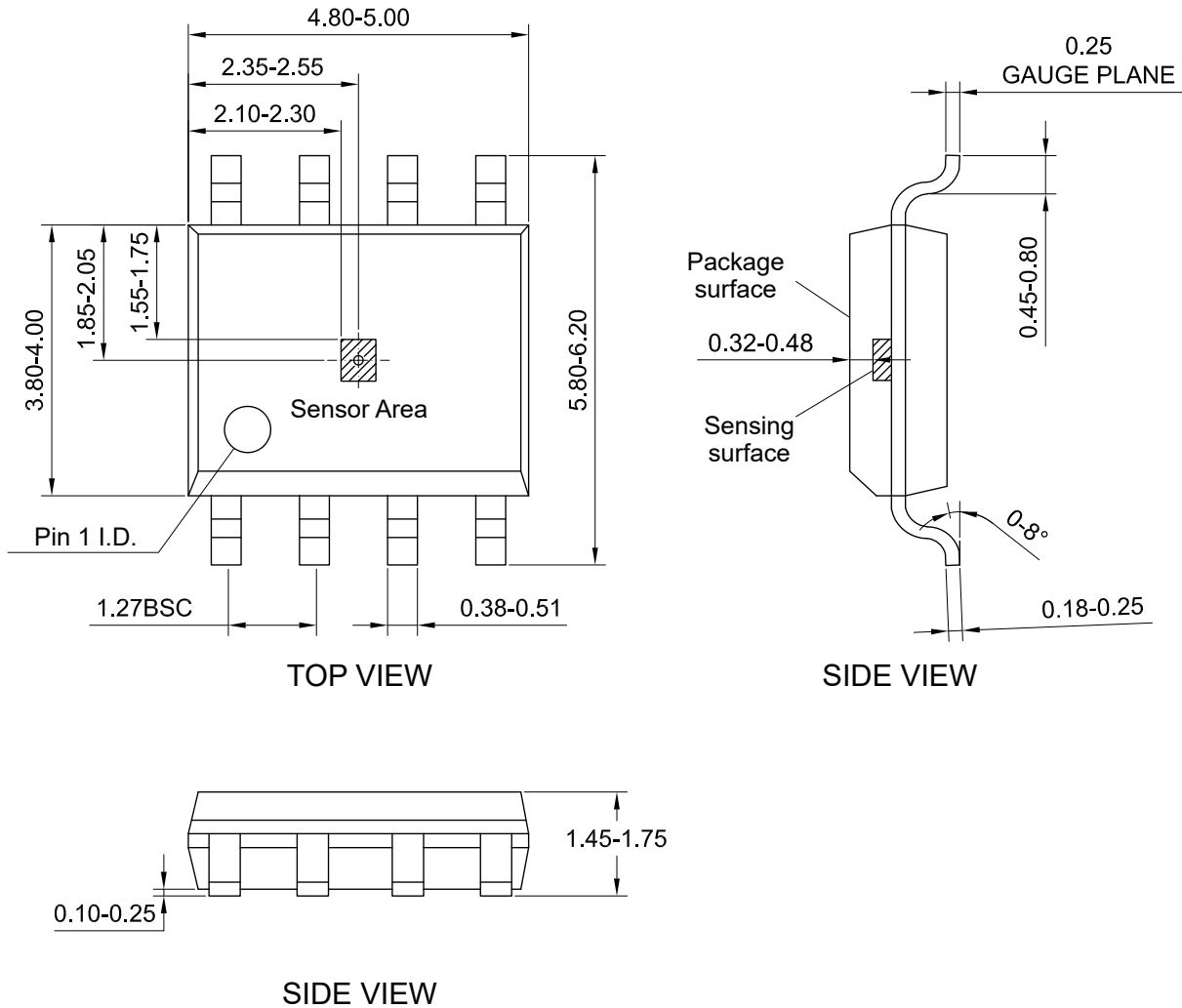


Figure 6. Package outline of SOP8 (unit: mm)

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