TMR3081

High Performance Automotive TMR Angle Sensor

Description

The TMR3081 high-precision magnetic angle sensor adopts two orthogonal push-pull Wheatstone bridge design, and each bridge contains four high-sensitivity TMR sensing elements. Such design effectively compensates thermal drift ensuring high performance in harsh conditions.

The voltage signals generated by the two sensor axes exhibit a sinusoidal relationship with the angle of the magnetic field in general angle sensor applications, when a magnet is positioned above the TMR3081 to provide a magnetic field parallel to sensor surface.

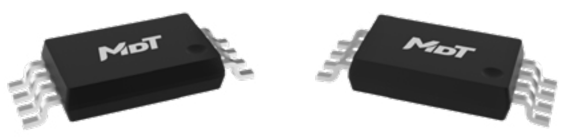
The TMR3081 achieves low angle error under 0.8 degree for applied magnetic field between 200 Gs and 800 Gs. The TMR3081 is available in TSSOP8 with P/N TMR3081TP.

Features and Benefits

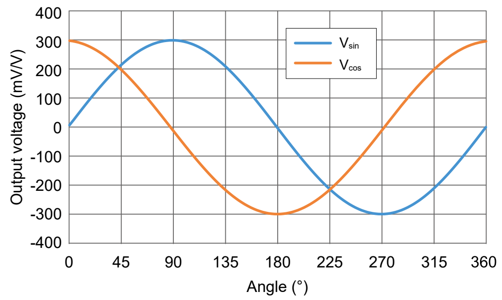
- Tunneling magnetoresistance (TMR) technology
- SIN/COS differential analog output
- Wide range supply voltage
- Excellent temperature stability
- Excellent resistance to external magnetic field interference
- Two bridges in one package
- RoHS and REACH compliant

Applications

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



TSSOP8



TMR3081 Output curve

Selection Guide

Part Number	Output	Supply Voltage	Peak Voltage Output	Package	Packing Form
TMR3081TP	Differential analog	1.0 V to 5.5 V	600 mV/V	TSSOP8	Tape & Reel

Catalogue

1. Functional Block Diagram

The TMR3081 consist of TMR (Tunnel Magnetoresistance) Wheatstone bridge structures, which enhance the sensor's output signal amplitude, improve the temperature characteristics of the sensor, and enhance the sensors' anti-interference performance. The functional block diagram of the TMR3081 is shown in Figure 1.

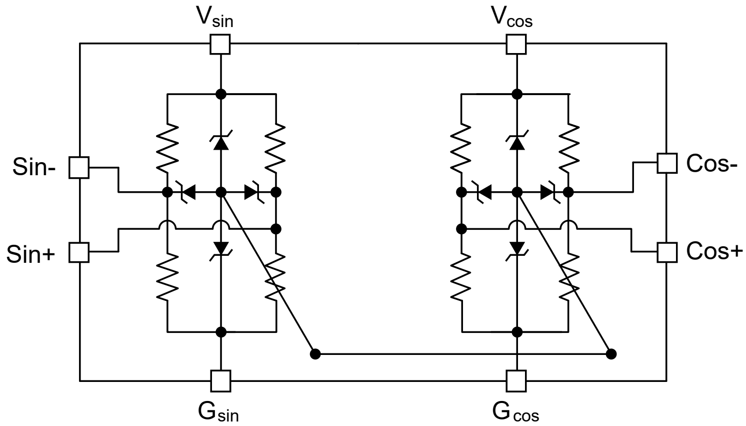


Figure 1. Block diagram

2. Pin Configuration

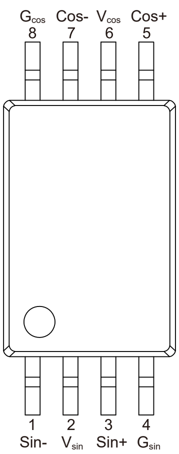


Figure 2. Pin configuration (TSSOP8)

Number	Name	Function
1	Sin-	Reverse sin signal output
2	V_{sin}	Sin bridge supply voltage
3	Sin+	Forward sin signal output
4	G_{sin}	Sin bridge ground
5	Cos+	Forward cos signal output
6	V_{cos}	Cos bridge supply voltage
7	Cos-	Reverse cos signal output
8	G_{cos}	Cos bridge ground

3. Operating Principle

The sensing direction is parallel to the sensor surface as shown in Figure 3.

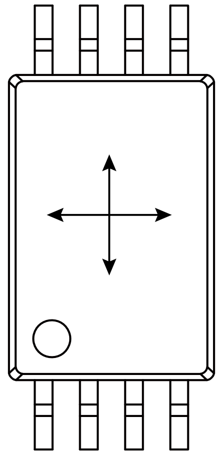


Figure 3. Sensing direction (TSSOP8)

By rotating a small magnet placed on top of TMR3081, a rotating magnetic field parallel to the surface of the magnetic is generated and is at the same angle as the magnet. Figure 4 shows the typical output signals of the TMR3081 in response to a rotating field.

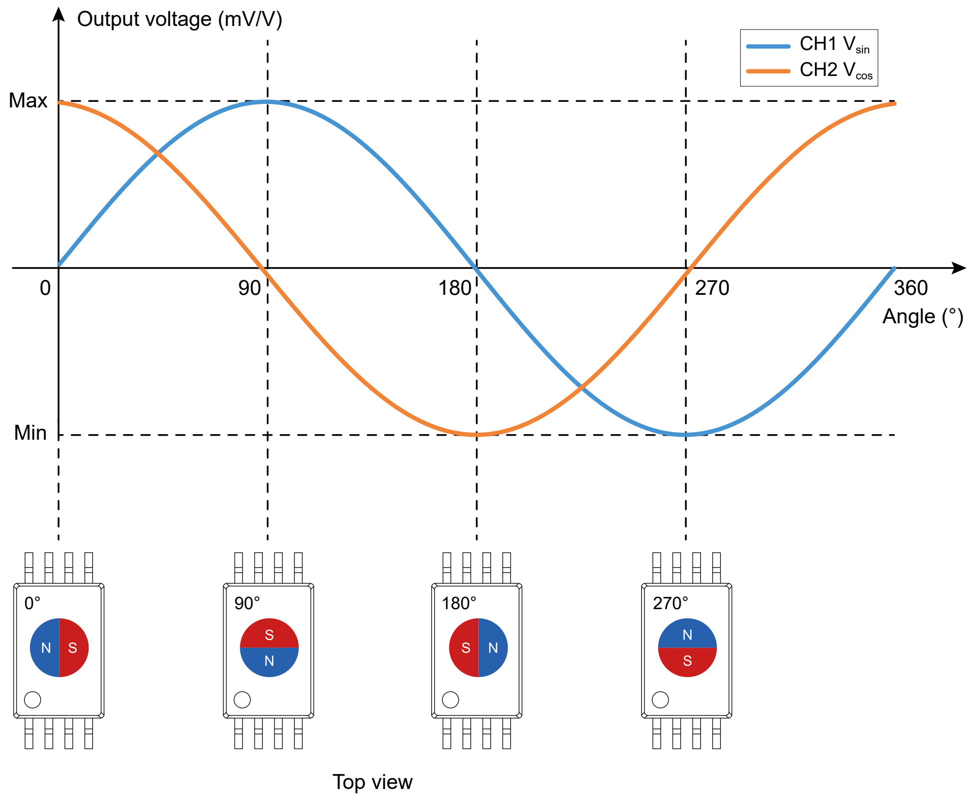


Figure 4. Typical TMR3081 output curve in response to magnet

4. Absolute Maximum Ratings

Parameters	Symbol	Min.	Max.	Unit
Supply voltage	V_{CC}	-	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	150	°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

T_A = 25 °C, B = 200 Gs, V_{CC} = 5 V, a 0.1 μF capacitor is connected between V_{CC} and GND unless specified otherwise

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	operating	1	5	5.5	V
Bridge resistance	R_B	T_A = 25 °C, B = 200 Gs	3	5	7	kΩ
Peak voltage	V_{PEAK}	T_A = 25 °C, B = 200 Gs	-	300	-	mV/V_{CC}
Peak peak voltage	V_{PP}	T_A = 25 °C, B = 200 Gs	-	600	-	mV/V_{CC}
Offset voltage	V_{OFFSET}	T_A = 25 °C, B = 200 Gs	-5	-	5	mV/V_{CC}
Angular error 1)	Δθ	T_A = -40 °C to 150 °C, B = 200 Gs to 800 Gs	-	-	0.8	deg
Phase error	-	T_A = 25 °C, B = 200 Gs to 800 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	%
Operation 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
Operation 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
Peak synchronization temperature coefficient	TCk	T_A = -40 °C to 150 °C, B = 200 Gs to 800 Gs	-0.015	-	0.015	%/°C
Operation coefficient of offset voltage	TV_{OFFSET}	T_A = -40 °C to 150 °C, B = 200 Gs to 800 Gs	-5	-	5	mV/V_{CC}

Notes:

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

6. Specification Definitions

6.1 Bridge resistance R_B

The resistance between pins V_{sin} and G_{sin} or the resistance between pins V_{cos} and G_{cos}

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

$$V_{PP} = V_{Max} - V_{Min}$$

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

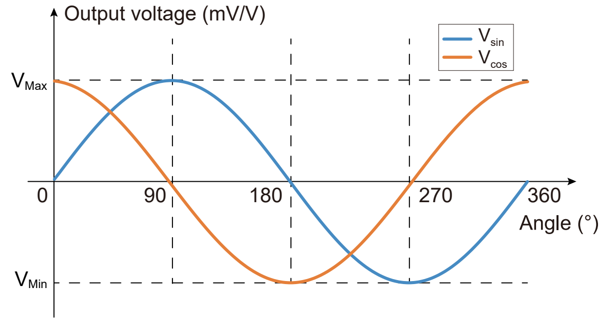


Figure 5. Output curve

6.3 Offset voltage V_{OFFSET}

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

6.4 Peak synchronization coefficient k

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

6.5 Operation coefficient of peak voltage TCV_{PEAK}

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

$T1 = T_A(Min) = -40°C$, $T2 = T_A(Max) = 150°C$

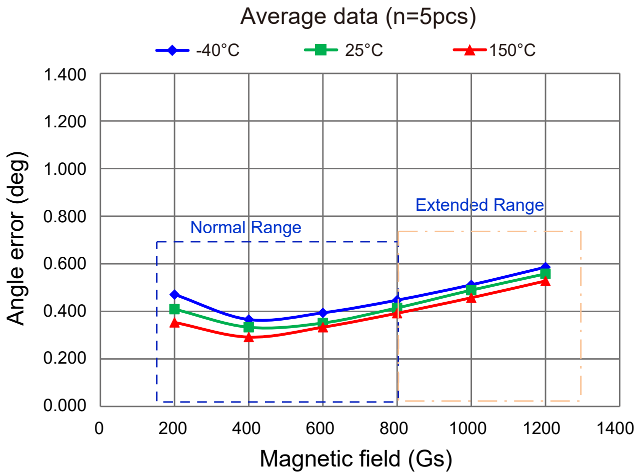


Figure 6. Magnetic field diagram

6.6 Peak synchronization temperature coefficient TCR_B

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

$T1 = T_A(Min) = -40°C$, $T2 = T_A(Max) = 150°C$

6.7 Peak synchronization temperature coefficient TCk

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

$T1 = T_A(Min) = -40°C$, $T2 = T_A(Max) = 150°C$

6.8 Operation coefficient of offset voltage TV_{OFFSET}

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

$T1 = T_A(Min) = -40°C$, $T2 = T_A(Max) = 150°C$

7. Dimensions

TSSOP8 Package

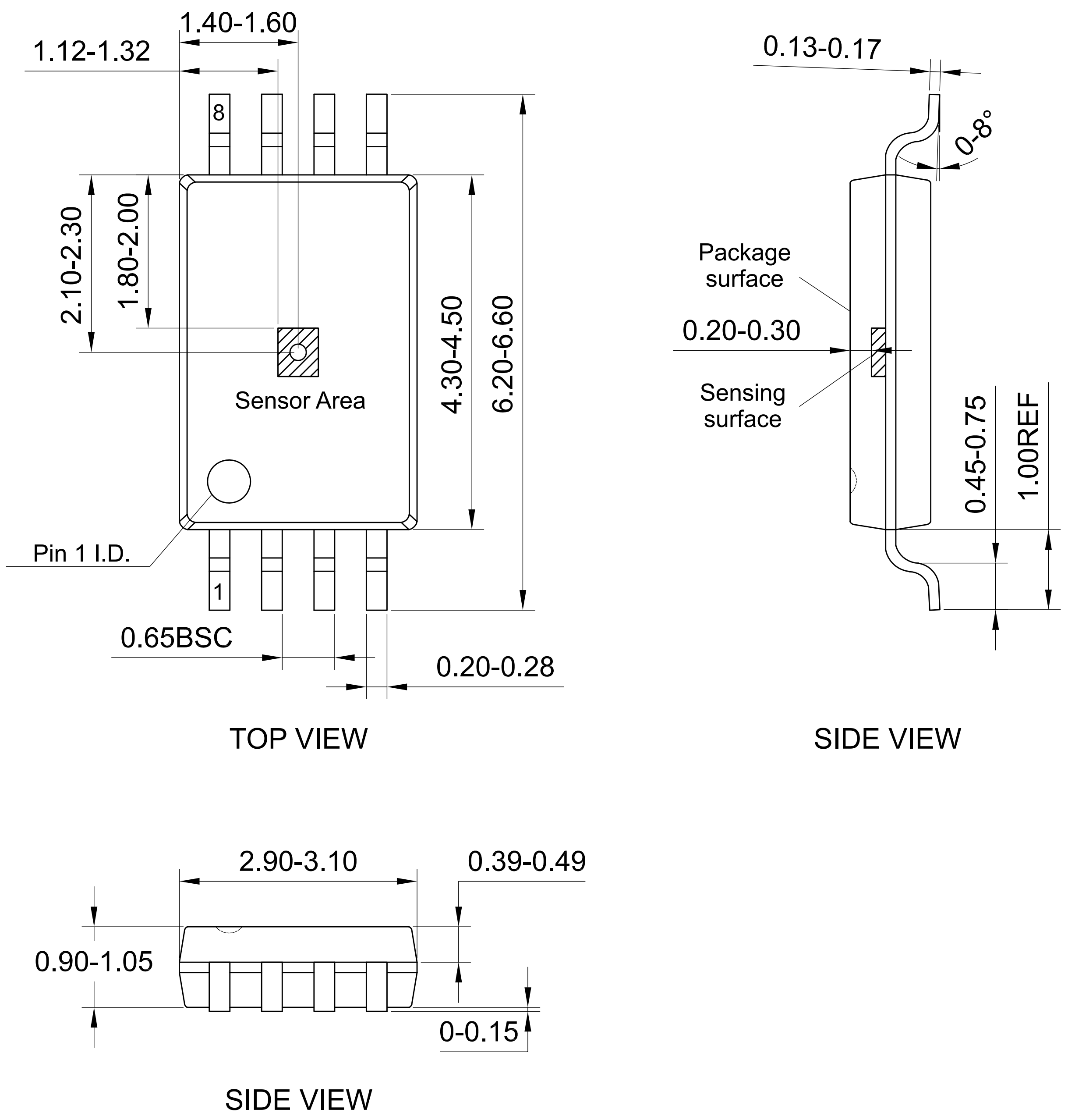


Figure 7. Package outline of TSSOP8 (unit: mm)

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Recycling

The product(s) in this document need to be handed over to a qualified solid waste management services company for recycling in accordance with relevant regulations on waste classification after the end of the product(s) life.

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