

# TMR3081

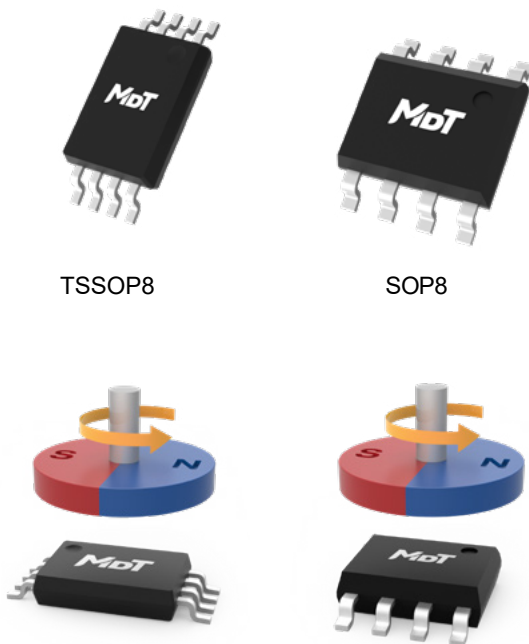
## High Performance Automotive TMR Angle Sensor

### 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 SOP8 with P/N TMR3081P and TSSOP8 with P/N TMR3081TP.

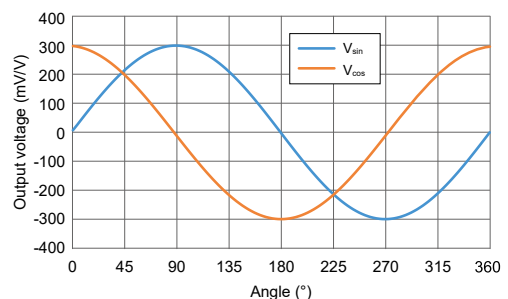


### Features and Benefits

- 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
- AEC-Q100 under qualification
- 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



TMR3081 Output curve

## Selection Guide

Part Number	Output	Supply Voltage	Peak Voltage Output	Package	Packing Form
TMR3081P	Differential analog	1.0 V to 5.5 V	600 mV/V	SOP8	Tape & Reel
TMR3081TP	Differential analog	1.0 V to 5.5 V	600 mV/V	TSSOP8	Tape & Reel

## Catalogue

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## 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.

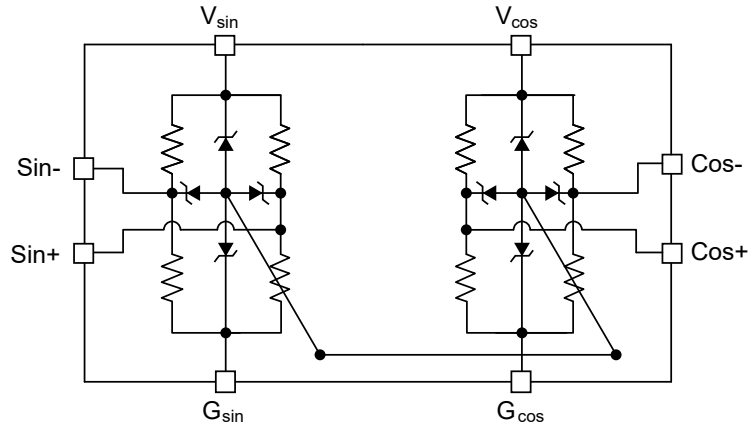


Figure 1. Block diagram

## 2. Pin Configuration

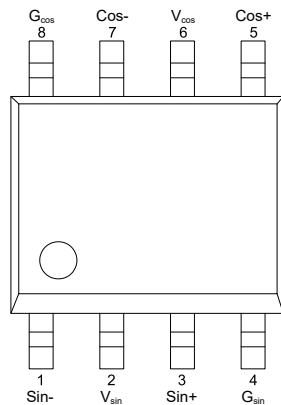


Figure 2-1. Pin configuration (SOP8)

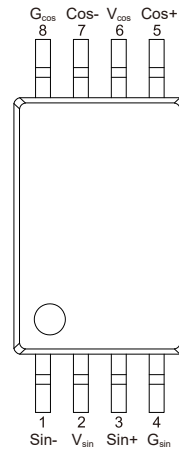


Figure 2-2. Pin configuration (TSSOP8)

Number	Name	Function
1	Sin-	Reverse sin signal output
2	V <sub>sin</sub>	Sin bridge supply voltage
3	Sin+	Forward sin signal output
4	G <sub>sin</sub>	Sin bridge ground
5	Cos+	Forward cos signal output
6	V <sub>cos</sub>	Cos bridge supply voltage
7	Cos-	Reverse cos signal output
8	G <sub>cos</sub>	Cos bridge ground

### 3. Operating Principle

The sensing direction is parallel to the sensor surface as shown in Figure 3-1 and Figure 3-2.

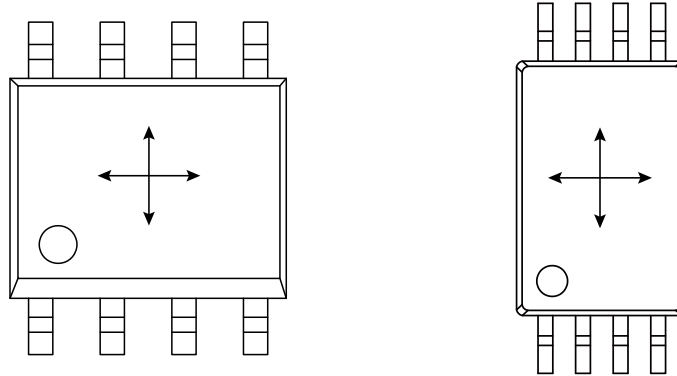


Figure 3-1. Sensing direction (SOP8)      Figure 3-2. Sensing direction (TSSOP8)

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.

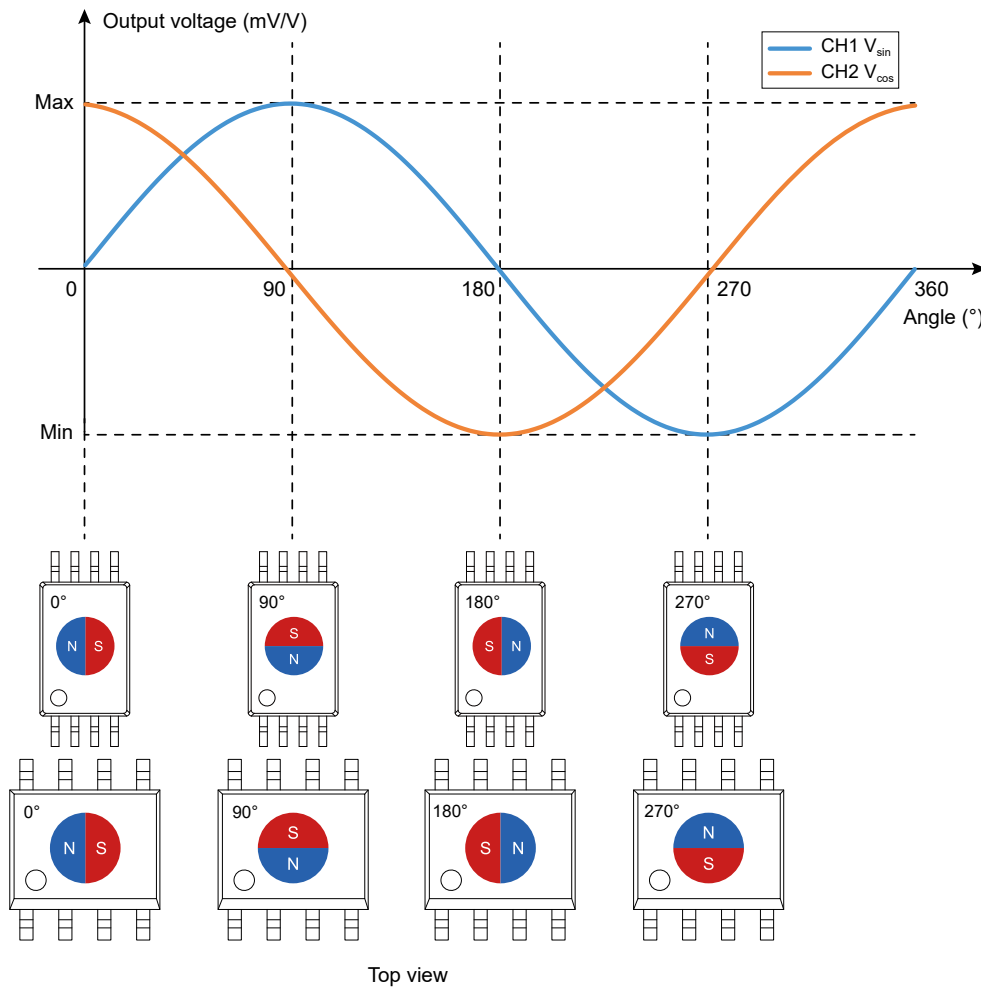


Figure 4. Typical TMR3081 output curve in response to magnet

## 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

$T_A = 25\text{ °C}$ ,  $B = 200\text{ Gs}$ ,  $V_{CC} = 5\text{ V}$ , a  $0.1\text{ }\mu\text{F}$  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	$R_B$	$T_A = 25\text{ °C}$ , $B = 200\text{ Gs}$	3	5	7	k $\Omega$
Peak voltage	$V_{PEAK}$	$T_A = 25\text{ °C}$ , $B = 200\text{ Gs}$	-	300	-	mV/ $V_{CC}$
Peak peak voltage	$V_{PP}$	$T_A = 25\text{ °C}$ , $B = 200\text{ Gs}$	-	600	-	mV/ $V_{CC}$
Offset voltage	$V_{OFFSET}$	$T_A = 25\text{ °C}$ , $B = 200\text{ Gs}$	-5	-	5	mV/ $V_{CC}$
Angular error <sup>1)</sup>	$\Delta\theta$	$T_A = -40\text{ °C}$ to $150\text{ °C}$ , $B = 200\text{ Gs}$ to $800\text{ Gs}$	-	-	0.8	deg
Phase error	-	$T_A = 25\text{ °C}$ , $B = 200\text{ Gs}$ to $800\text{ Gs}$	87	90	93	deg
Hysteresis	Hyst	$T_A = 25\text{ °C}$ , $B > 200\text{ Gs}$	-	0	-	Gs
Peak synchronization coefficient	k	$T_A = 25\text{ °C}$ , $B = 200\text{ Gs}$	95	100	105	%
Operation coefficient of peak voltage	$TCV_{PEAK}$	$T_A = -40\text{ °C}$ to $150\text{ °C}$ , $B = 200\text{ Gs}$ to $800\text{ Gs}$	-0.2	-0.15	-0.1	%/ $^{\circ}\text{C}$
Operation coefficient of bridge resistance	$TCR_B$	$T_A = -40\text{ °C}$ to $150\text{ °C}$ , $B = 200\text{ Gs}$ to $800\text{ Gs}$	-0.09	-0.07	-0.05	%/ $^{\circ}\text{C}$
Peak synchronization temperature coefficient	$TCk$	$T_A = -40\text{ °C}$ to $150\text{ °C}$ , $B = 200\text{ Gs}$ to $800\text{ Gs}$	-0.015	-	0.015	%/ $^{\circ}\text{C}$
Operation coefficient of offset voltage	$TV_{OFFSET}$	$T_A = -40\text{ °C}$ to $150\text{ °C}$ , $B = 200\text{ Gs}$ to $800\text{ Gs}$	-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 $V_{PP}$

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

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

### 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 $TCV_{PEAK}$

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

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

### 6.6 Peak synchronization temperature coefficient $TCR_B$

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

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

### 6.7 Peak synchronization temperature coefficient $TCk$

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

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

### 6.8 Operation coefficient of offset voltage $TV_{OFFSET}$

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

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

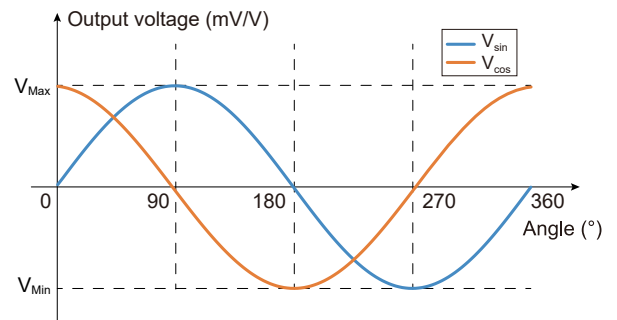


Figure 5. Output curve

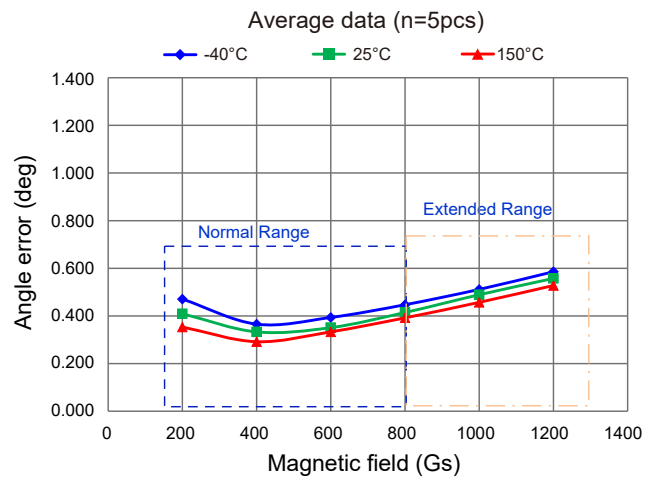


Figure 6. Magnetic field diagram



TSSOP8 Package

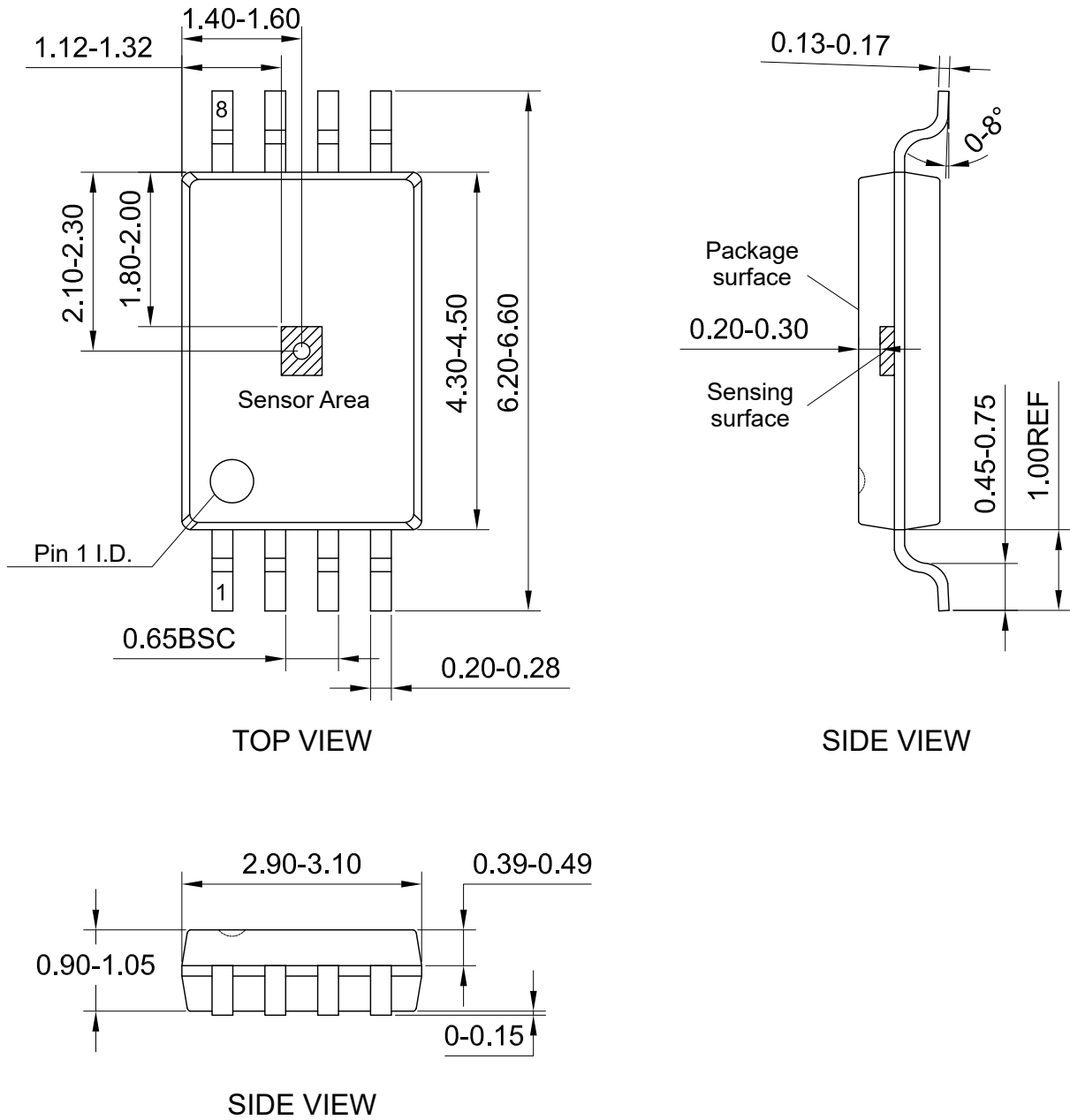


Figure 8. Package outline of TSSOP8 (unit: mm)



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