TMR308x

High Performance Automotive TMR Angle Sensor

Description

The TMR308x series 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 TMR308x sensor to provide a magnetic field parallel to sensor surface.

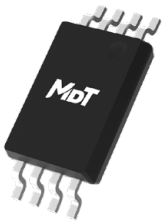
The TMR308x achieves low angle error under 0.8 degree for applied magnetic field between 200 Gs and 800 Gs. The TMR308x series are available in SOP8 with P/N TMR308xP and TSSOP8 with P/N TMR308xTP.

Features and benefits

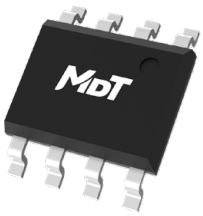
- Tunneling magnetoresistance (TMR) technology
- SIN/COS differential analog output
- Wide range supply voltage
- Excellent temperature stability
- RoHS and REACH compliant
- Excellent resistance to external magnetic field interference
- Two bridges in one package
- AEC-Q100 compliant

Applications

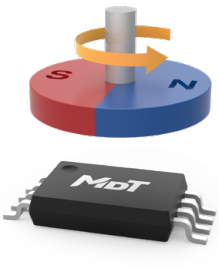
- Absolute angle sensor
- Electric power steering motor shaft angle sensor
- Steering wheel angle sensor
- Pedal position sensor
- Throttle position sensor

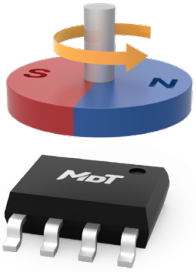


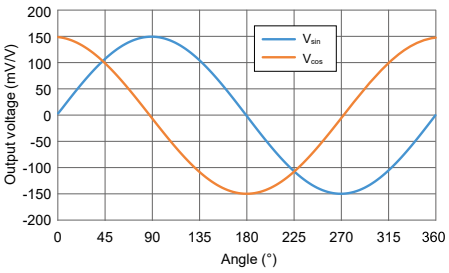
TSSOP8



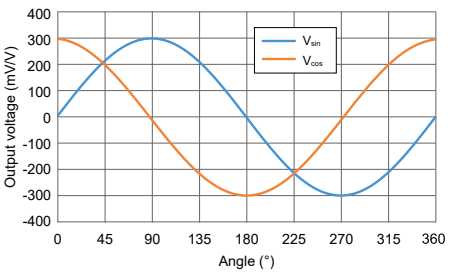
SOP8







TMR3083 Output curve



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
TMR3083P	Differential analog	1.0 V to 5.5 V	300 mV/V	SOP8	Tape & Reel
TMR3083TP	Differential analog	1.0 V to 5.5 V	300 mV/V	TSSOP8	Tape & Reel

Catalogue

1. Functional Block Diagram

The TMR308x series 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 TMR308x is shown in Figure 1.

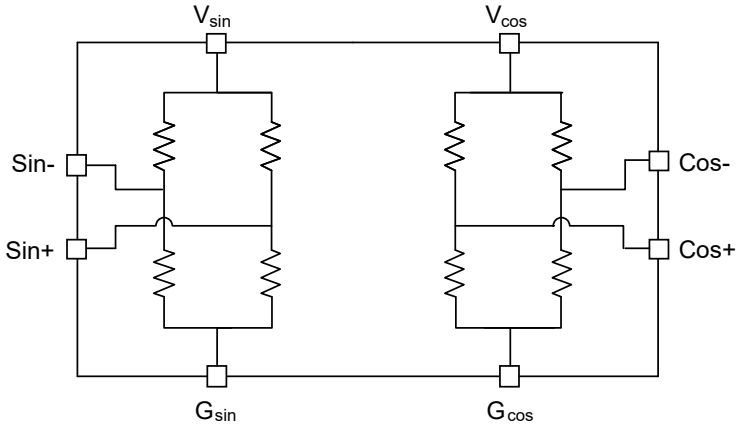


Figure 1. Block diagram

2. Pin Configuration

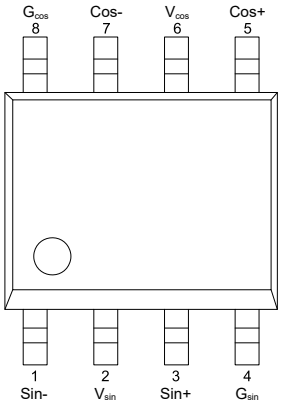


Figure 2-1. Pin configuration (SOP8)

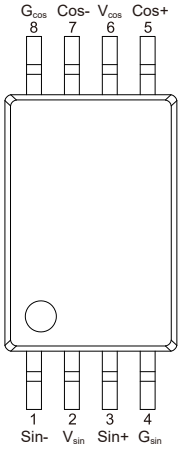


Figure 2-2. Pin configuration (TSSOP8)

Number	Name	Function
1	Sin-	Reverse sin signal output
2	V_{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.

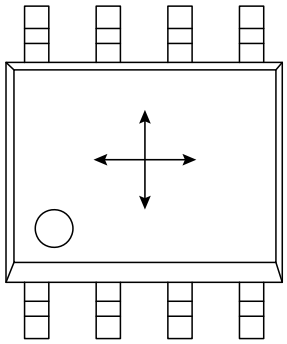


Figure 3-1. Sensing direction (SOP8)

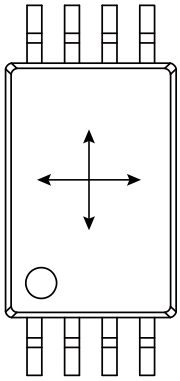


Figure 3-2. Sensing direction (TSSOP8)

By rotating a small magnet placed on top of TMR308x, 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 TMR308x in response to a rotating field.

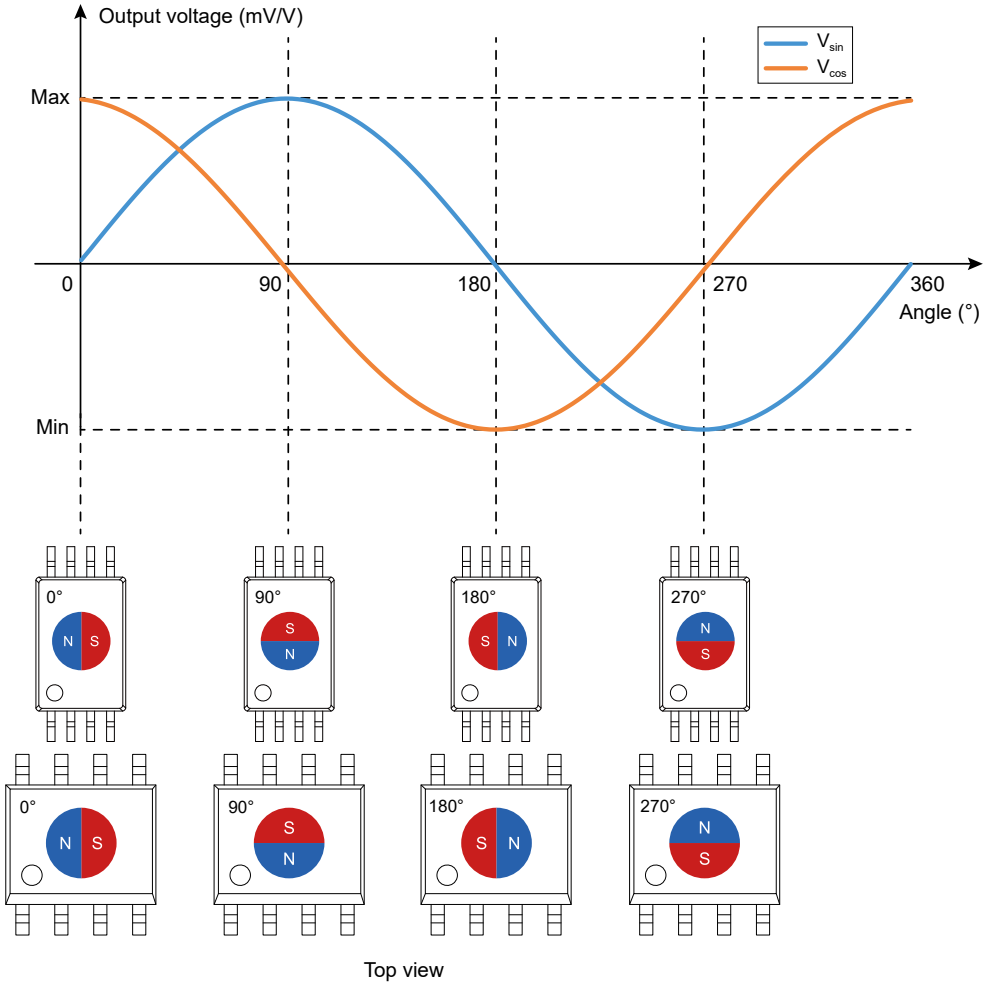


Figure 4. Typical TMR308x output curve in response to magnet

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 (MM)	$V_{ESD(MM)}$	-	400	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

V_{CC} = 1 V, T_A = 25 °C, a 0.1 μF capacitor is connected between V_{CC} and GND unless specified otherwise

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Applicable Part Number
Supply voltage	V_{CC}	operating	-	-	5.5	V	All parts
Bridge resistance	R_B	B = 200 Gs	2	4	6	kΩ	All parts
Peak voltage	V_{PEAK}	B = 200 Gs	-	300	-	mV/V	TMR3081P, TMR3081TP
		B = 200 Gs	-	150	-	mV/V	TMR3083P, TMR3083TP
Peak peak voltage	V_{PP}	B = 200 Gs	-	600	-	mV/V	TMR3081P, TMR3081TP
		B = 200 Gs	-	300	-	mV/V	TMR3083P, TMR3083TP
Offset voltage	V_{OFFSET}	B = 0 Gs	-5	-	5	mV/V	All parts
Angular error	Δθ	B = 200 Gs to 800 Gs	-	-	0.8	deg	TMR3081P, TMR3081TP
		B = 200 Gs to 800 Gs	-	-	0.6	deg	TMR3083P, TMR3083TP
Phase error	-	B = 200 Gs to 800 Gs	87.5	90	92.5	deg	All parts
Hysteresis	Hyst	B > 200 Gs	-	0	-	Gs	All parts
Peak synchronization coefficient	k	B = 200 Gs	95	100	105	%	All parts
Operation coefficient of peak voltage	TCV_{PEAK}	T_A = -40 °C to 150 °C	-0.2	-0.15	-0.1	%/°C	All parts
Operation coefficient of bridge resistance	TCR_B	T_A = -40 °C to 150 °C	-0.09	-0.07	-0.05	%/°C	All parts
Peak synchronization temperature coefficient	TCk	T_A = -40 °C to 150 °C	-0.015	-	0.015	%/°C	All parts
Operation coefficient of offset voltage	TCV_{OFFSET}	T_A = -40 °C to 150 °C	-5	-	5	μV/V/°C	All parts

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}

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

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

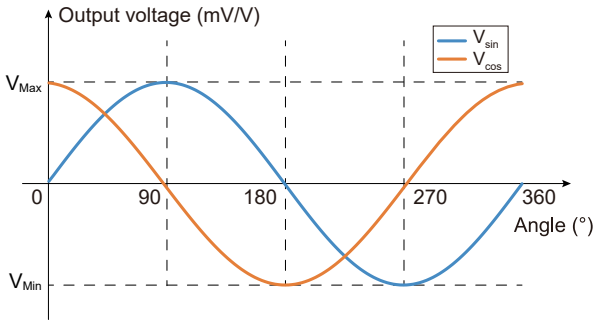


Figure 5. Output curve

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}

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

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

6.6 Peak synchronization temperature coefficient TCR_B

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

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

6.7 Peak synchronization temperature coefficient TCk

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

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

6.8 Operation coefficient of offset voltage TCV_{OFFSET}

$$TCV_{OFFSET} = \frac{V_{OFFSET}(T2) - V_{OFFSET}(T1)}{(T2\text{-}T1)} \times 100\%$$

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

7. Dimensions

SOP8 Package

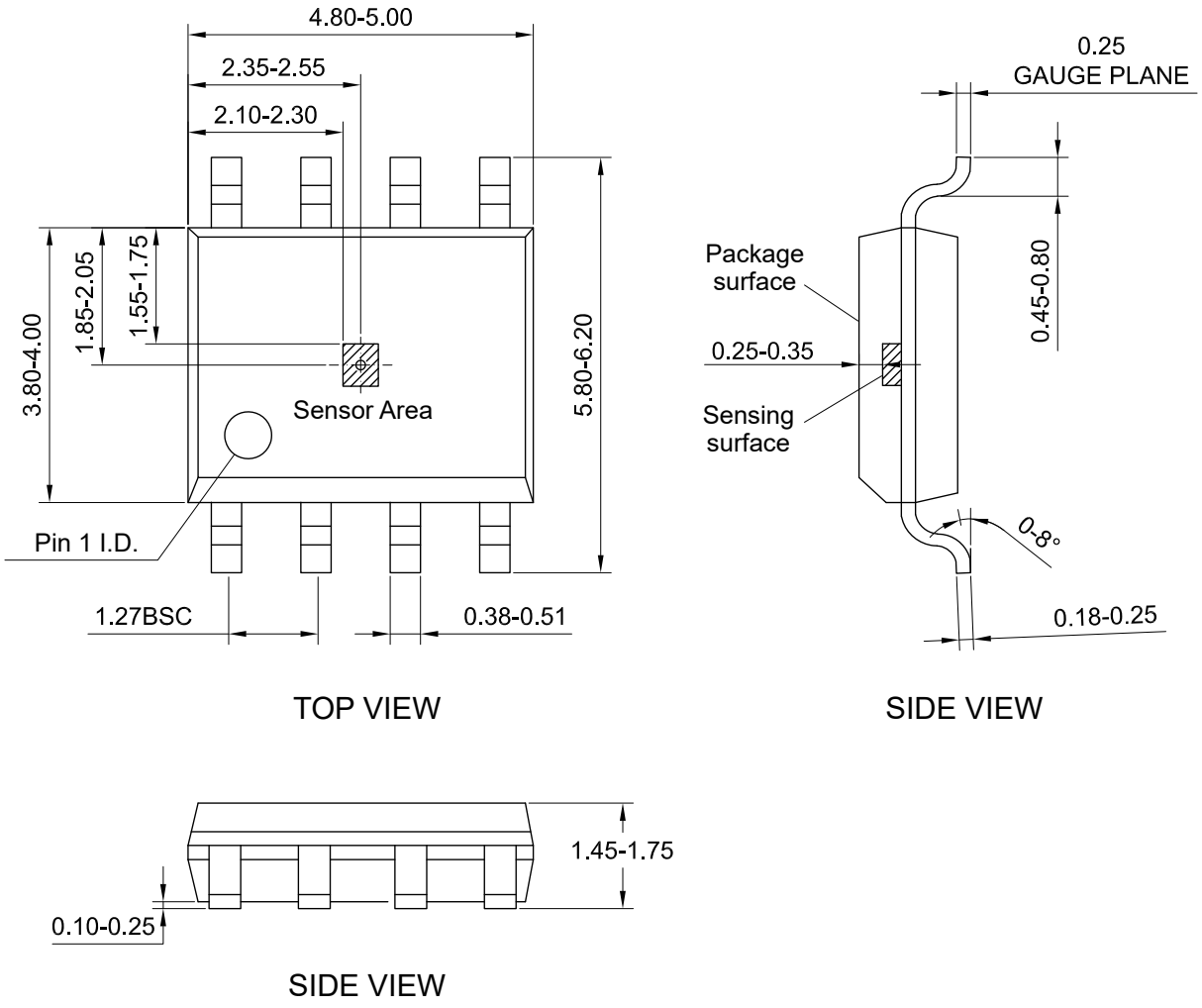


Figure 6. Package outline of SOP8 (unit: mm)

TSSOP8 Package

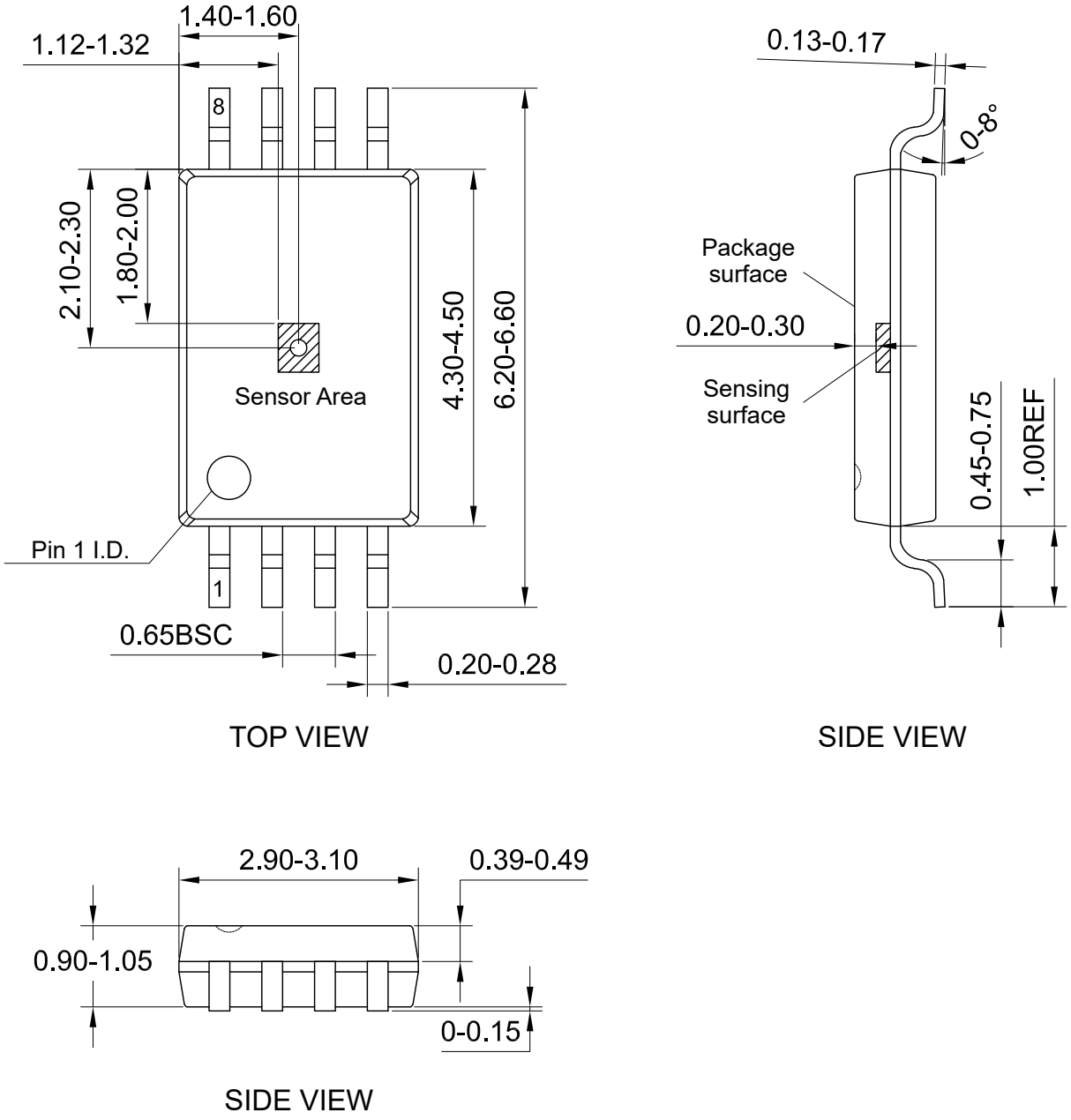


Figure 7. Package outline of TSSOP8 (unit: mm)

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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