TMR3617

Low Power, High Output Amplitude TMR Angle Sensor

Description

The TMR3617 is a low-voltage, low-power, high-output-amplitude TMR programmable analog output angle sensor developed by MultiDimension Technology.

The sensor integrates a tunnel magnetoresistance (TMR) sensing element and a low-noise programmable operational-amplifier signal conditioning circuit. The built-in dedicated signal conditioning circuit allows adjustment and programming of offset, gain, and other parameters of the raw signal detected by the TMR sensor, and outputs corrected Sin/Cos voltage signals that vary with the external magnetic field angle. The signal period and phase are shown in the figure below. The sensor is suitable for various position detection applications and meets customer requirements for low-voltage operation, high resolution, and high signal-to-noise ratio.

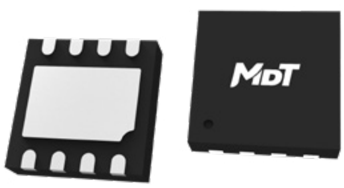
This product is available in a DFN8L package (3.0 mm × 3.0 mm × 0.75 mm).

Features and Benefits

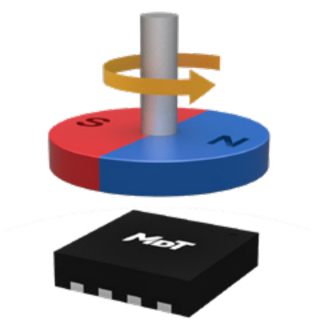
- Tunneling magnetoresistance (TMR) technology
- Supply voltage: 2.4 V to 5.0 V
- V_{OUT} Max = 95%V_{DD}
- Static power consumption: < 300 μA
- Programmable gain: 4x to 11.75x (Step = 0.25)
- Output offset calibration range: -15 mV to +15 mV
- Low noise, low power consumption
- RoHS & REACH compliant

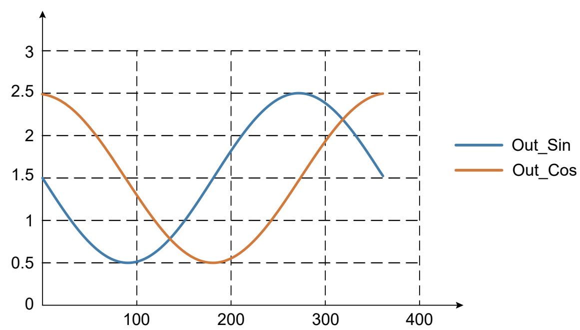
Applications

- High-precision joystick
- Electric toothbrush
- Angular displacement sensing



DFN8L





Selection Guide

Part Number	Supply Voltage	Operating Temperature	Static Power Consumption	Output Amplitude	Package	Packing Form
TMR3617D-AAC	2.4 V to 5.5 V	-40 °C to 85 °C	< 300 μA	Customer customized	DFN8L	Tape

Product Model Description

TMR3617D — X X X

First X:
- A: Factory preset sensitivity and offset voltage
- B: User-programmable sensitivity and offset voltage

Second X:
- A: No attributes
- B: Attribute 1
- C: Attribute 2

Third X:
- C: Consumer
- I: Industrial

Catalogue

1. Functional Block Diagram

The TMR3617 is a tunnel magnetoresistance (TMR) magnetic angle sensor with an integrated dedicated signal conditioning circuit. It consists of a TMR sensing element and a dedicated signal conditioning ASIC with a programmable OTP unit. The TMR sensing element outputs a set of Sin & Cos signals over a 0 to 360° range that vary with the external magnetic field. The built-in dedicated signal conditioning circuit conditions the raw signal from the TMR sensing element by programming offset gain, and other parameters, and finally outputs corrected and amplified Sin/Cos signals. The angle can then be calculated and detected from the Sin/Cos signals.

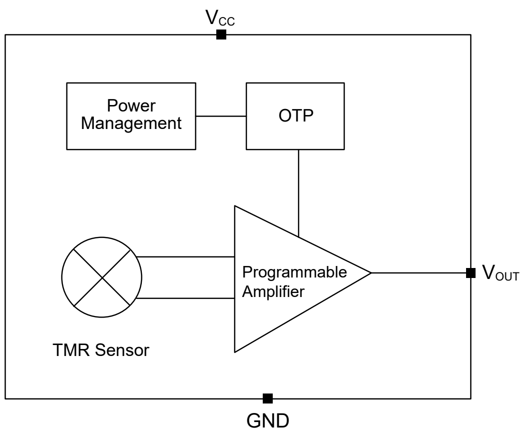


Figure 1. Block diagram

2. Sensing Direction

The sensing direction is parallel to the X-Y plane of the package top-marking surface, as shown in Figure 2.

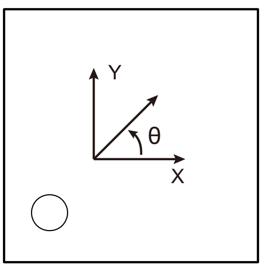


Figure 2. Sensing direction

3. Pin Configuration

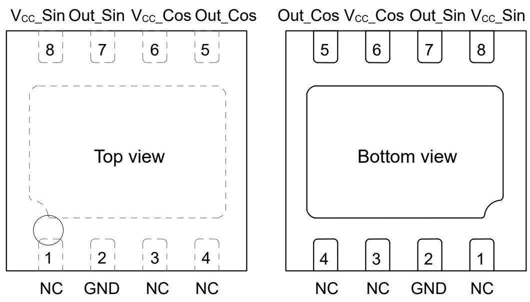


Figure 3. Pin configuration

Pin No.	Name	Function
1, 3, 4	NC	Not connected
2	GND	Ground
5	Out_Cos	Cos output
6	V_{CC}_Cos	Cos power supply
7	Out_Sin	Sin output
8	V_{CC}_Sin	Sin power supply

4. Absolute Maximum Ratings

Parameters	Symbol	Min.	Max.	Unit
Supply voltage	V_{CC}	2	6	V
External magnetic field	B	-	3000	Gs
V_{OUT} current driving capability	-	-	-	mA
ESD (HBM)	V_{ESD} (HBM)	-	3000	V
ESD (CDM)	V_{ESD} (CDM)	-	2000	V
Operating ambient temperature	T_A	-40	85	°C
Storage ambient temperature	T_{STG}	-50	150	°C

Note: The absolute maximum ratings define the limits beyond which the sensor may suffer permanent damage. For normal operating conditions, please refer to the “Electrical Performance Characteristics” section.

5. Electrical Specifications

V_{CC} = 3 V, T_A = 25 °C, 100 nF capacitor connected between V_{CC} and GND unless specified otherwise

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	-	2.4	3.3	5	V
Supply current	I_{CC}	-	-	150	-	μA
TMR element output amplitude	$V_{PP}1$, $V_{PP}2$	-	-	150	-	mV/V
Median voltage	V_M1, V_M2	-	-	500	-	mV/V
Sensor output amplitude	PP	Gain or PP, V_{DD}	Customer customized or user-programmed calibration			mV/V
Angular error	AE	300 Gs	-	1.5	-	Degree
Peak voltage temperature drift	TCV_{PEAK}	T_A = -40 °C to 125 °C	-	5000	-	%/°C

6. Magnetic Specifications

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Magnetic Field	B	-	200	-	800	Gs

Note: 1 Gauss in air = 0.1 millitesla = 79.8 A/m

7. Parameter Definition

The default gain magnification is set to 3X. If the magnification is ≥ 4X, the peaks and troughs of the output waveform may be clipped.

7.1 Peak voltage V_{PEAK}

$$V_{PEAK}1 = \frac{V_{MAX}1 - V_{MIN}1}{2} \qquad V_{PP}1 = V_{MAX}1 - V_{MIN}1$$

$$V_{PEAK}2 = \frac{V_{MAX}2 - V_{MIN}2}{2} \qquad V_{PP}2 = V_{MAX}2 - V_{MIN}2$$

7.2 Median voltage V_{Mid}

$$V_{Mid}1 = \frac{V_{MAX}1 + V_{MIN}1}{2}$$

$$V_{Mid}2 = \frac{V_{MAX}2 + V_{MIN}2}{2}$$

7.3 Offset voltage V_{OFFSET}

$$V_{OFFSET} = V_{Mid}1 - V_{Mid}2$$

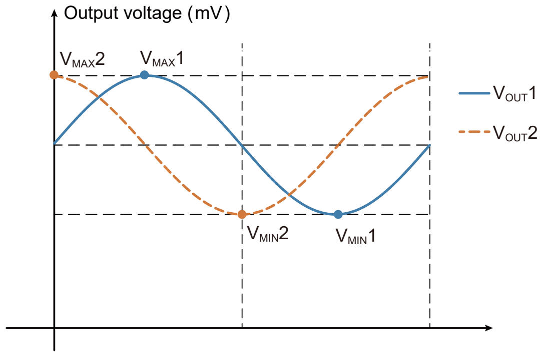


Figure 4. Output signal V_{MIN} and V_{MAX} definition

7.4 Peak voltage temperature coefficient TCV_{PEAK}

$V_{PEAKH}1$: $V_{OUT}1$ output amplitude at high temperature

$V_{PEAKL}1$: $V_{OUT}1$ output amplitude at low temperature

$V_{PEAKN}1$: $V_{OUT}1$ output amplitude at 25°C room temperature

$V_{PEAKH}2$: $V_{OUT}2$ output amplitude at high temperature

$V_{PEAKL}2$: $V_{OUT}2$ output amplitude at low temperature

$V_{PEAKN}2$: $V_{OUT}2$ output amplitude at 25°C room temperature

T_H: High temperature $\quad$ T_L: Low temperatur $\quad$ T_N: 25°C

$$TCV_{PEAK}1 = \frac{V_{PEAKH}1 - V_{PEAKL}1}{V_{PEAKN}1\,(T_H - T_L)} \times 100\% \qquad TCV_{PEAK}2 = \frac{V_{PEAKH}2 - V_{PEAKL}2}{V_{PEAKN}2\,(T_H - T_L)} \times 100\%$$

8. Typical Output

As shown in Figures 5 below, the output curve of the TMR3617 sensor varies with the angle of the applied in-plane magnetic field.

- When the magnetic field angle is 0°, the V_{OUT} output is equal to V_{CC} / 2.
- The actual output curve of the TMR3617 sensor depends on the programmed amplification factor.

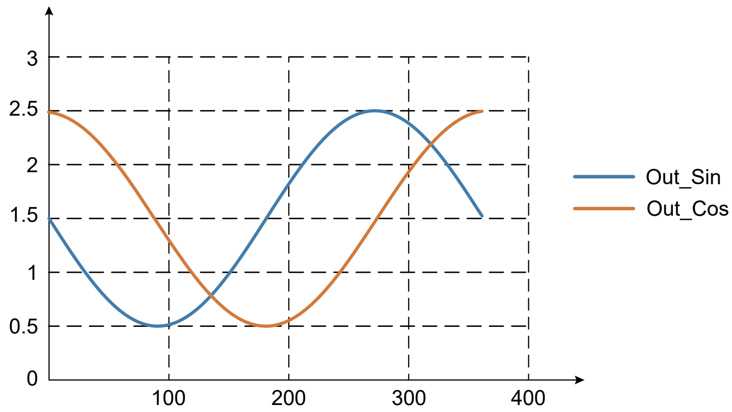


Figure 5. TMR+ASIC V_{OUT} output curve (3 V power supply)

9. Dimensions

DFN8L Package

Figure 6. Package outline of DFN8L (unit: mm)

Product Packaging Mark Description

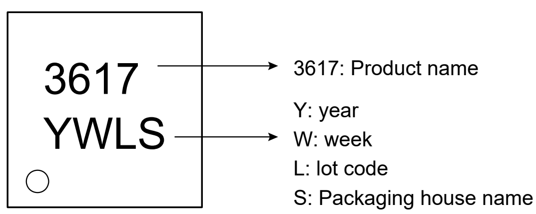
“3617” stands for product name.

"Y" represents the feeding year, with one character for every half year, and 26 characters for 13 years;

"W" stands for feeding week, and 26 letters represent 26 weeks;

"L" represents the batch, and each wafer is assigned one character each time;

“S” stands for the packaging house name.



Absolute maximum ratings are the extreme limits the device will withstand without damage to the MDT product. However, the electrical and mechanical characteristics are not guaranteed as the maximum limits (above recommended operating conditions) are approached. MDT disclaims any and all warranties and liabilities of the MDT product will operate at absolute maximum ratings.

Specifications may change without notice.

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Recycling

The product(s) in this document should be disposed of at the end of the product(s) life using a qualified waste management company for recycling in accordance with local regulations.

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