# TMR265xDD

## High Frequency Response Programmable TMR Linear Magnetic Sensor

## Description

The TMR265xDD is a tunneling magnetoresistance (TMR) linear sensor with a dedicated signal conditioning circuit built in. The integrated signal conditioning circuit of TMR265xDD is able to calibrate zero offset, gain, temperature coefficient of sensitivity (TCS) and temperature coefficient of zero offset (TCO) of the TMR bridge circuit, and outputs the conditioned voltage signals.

In addition to TMR's intrinsic advantages of high resolution, high signal-to-noise ratio, and low power consumption, TMR265xDD series linear sensors also provide the following characteristics:

1. Fixed voltage output range in linear range
2. Excellent sensitivity consistency
3. Minimal zero drift
4. Low temperature coefficient of sensitivity
5. Low temperature coefficient of offset

This improvement greatly enhances the convenience of design and use of TMR linear sensor products.

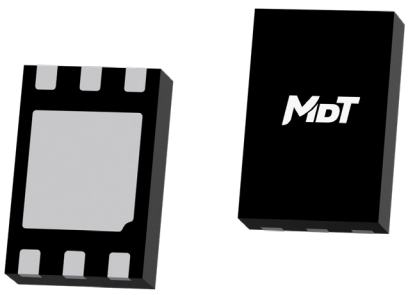
The TMR265xDD linear magnetic sensor is available in DFN6L (3 mm × 2 mm × 0.75mm) package with P/N of TMR2651DD, TMR2652DD and TMR2653DD.

## Features and Benefits

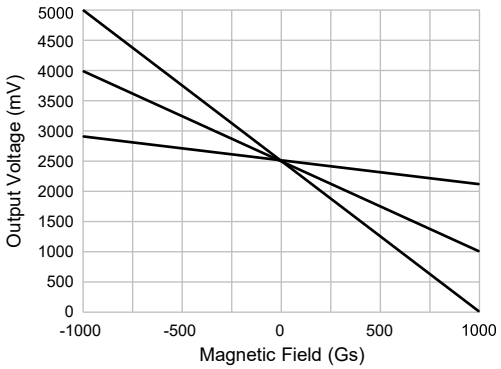
- Tunneling magnetoresistance (TMR) technology
- High frequency response: DC to 2 MHz
- Large dynamic range: TMR2651DD: ±1000Gs
  TMR2652DD: ±500Gs, TMR2653DD ±200Gs
- Wide range supply voltages: 3.3V / 5V
- Nonlinearity: 0.5%FS
- Programmable sensitivity and zero offset
- Programmable temperature compensation
- RoHS & REACH compliant

## Applications

- Current sensor
- Linear position sensor
- Gaussmeter
- Encoder



DFN6L




TMR265xDD Output Curve ($V_{CC}$ = 5V)

## Selection Guide

| Part Number | Supply Voltage | Linear Range | Package | Packing Form |
|---|---|---|---|---|
| TMR2651DD | 3.3V / 5V | ±1000Gs | DFN6L | Tape & Reel |
| TMR2652DD | 3.3V / 5V | ±500Gs | DFN6L | Tape & Reel |
| TMR2653DD | 3.3V / 5V | ±200Gs | DFN6L | Tape & Reel |

## Product Model Description

**TMR265xDD — X — X — XX.XX — X — C**

- **TMR265xDD**: Package: DFN6L
- **X**: A: Factory calibrated sensitivity and offset voltage; B: Customer programming sensitivity and offset voltage
- **X**: Supply voltage: 3 = 3.3V; 5 = 5V
- **XX.XX**: Sensitivity: 01.50 to 40.00 Programmable (Unit: mV/Gs)
- **X**: Optional output format: D = $V_{OUT}$ - $V_{REF}$ differential output; S = Single-ended output
- **C**: Optional temperature compensation range: A: -40°C to 85°C; B: -40°C to 105°C; C: -40°C to 125°C; N: No temperature compensation is required

Note: A sensitivity value of 01.88 corresponds to 1.88 mV/Gs, please refer to the X axis output curve diagram on the home page.

## Catalogue

## 1. Functional Block Diagram

TMR265xDD integrates a linear TMR magnetic sensor and a dedicated signal conditioning chip with a single-ended analog voltage output signal. The $V_{OUT}$ pin can be reused as the OWI (one-wire-interface) protocol programming interface, to adjust zero-point, sensitivity, reference voltage $V_{REF}$ and other parameters in a targeted manner.

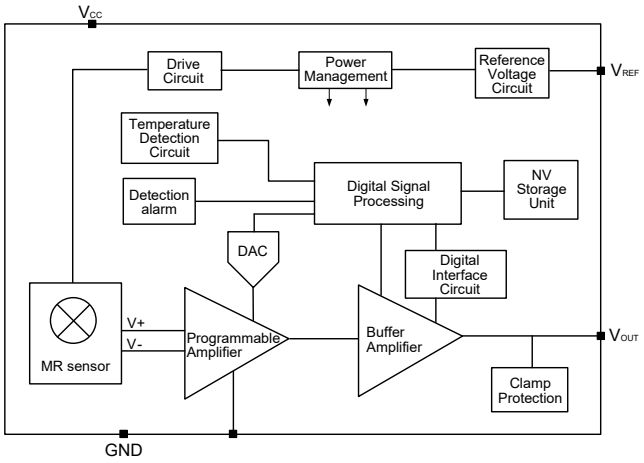



Figure 1. Block diagram of TMR265xDD

## 2. Pin Configuration

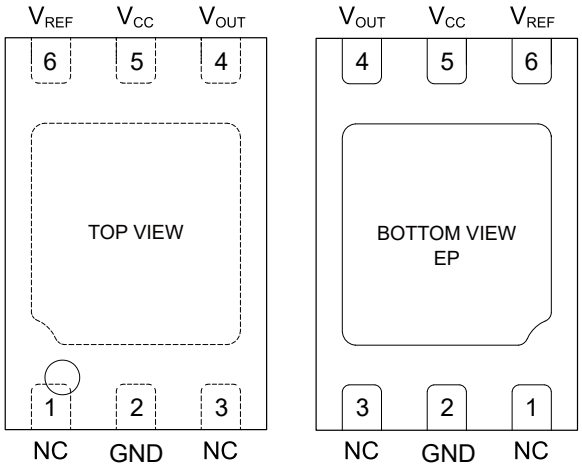



Figure 2. Pin configuration

| Number | Name | Function |
|---|---|---|
| 1 | NC | Not connected |
| 2 | GND | Ground |
| 3 | NC | Not connected |
| 4 | $V_{OUT}$ | Analog voltage output |
| 5 | $V_{CC}$ | Power supply |
| 6 | $V_{REF}$ | Reference voltage output |
| - | EP | Heat dissipation |

## 3. Operating Principle

The TMR265xDD sensing axis is perpendicular to the package top-marking surface; the sensing axis is defined from the N pole toward the S pole, as indicated by the arrow in the figure below.

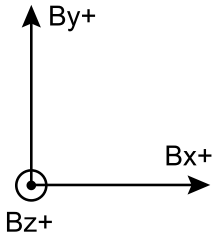



Figure 3-1. Definition of axis

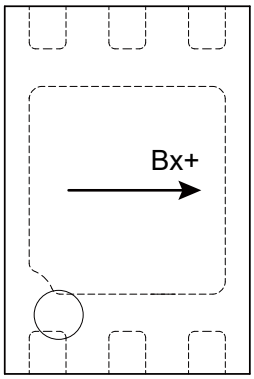



Figure 3-2. Axial diagram (DFN6L top view)

The TMR265xDD output voltage varies linearly with the magnetic field along the sensing axis.

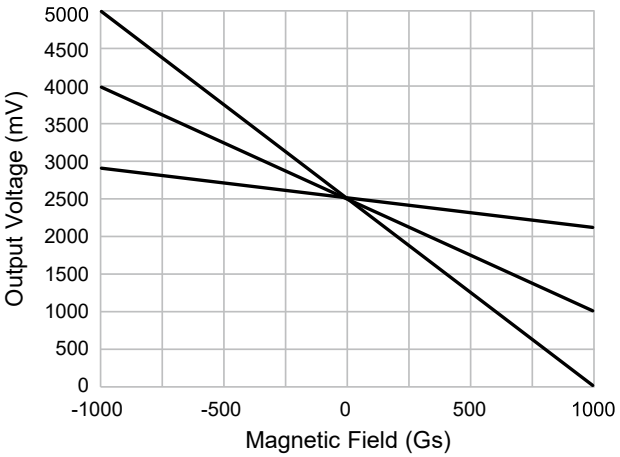



Figure 4. TMR265xDD output curve

## 4. Absolute Maximum Ratings

| Parameters | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Supply voltage | $V_{CC}$ | - | 6 | V |
| External magnetic field | B | - | 4000 | Gs |
| ESD performance (HBM) | $V_{ESD}$ | - | 4 | kV |
| Operating ambient temperature | $T_A$ | -40 | 125 | °C |
| Storage ambient temperature | $T_{STG}$ | -40 | 125 | °C |

## 5. Electrical Specifications

$V_{CC}$ = 3.3V or 5V, $T_A$ = 25°C, B = ±100 Gs

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit | Applicable Part Number |
|---|---|---|---|---|---|---|---|
| Supply voltage | $V_{CC}$ | $T_A$ = 25°C | - | 3.3 / 5 | - | V | All parts |
| Supply current | $I_{CC}$ | $V_{CC}$ = 5V | - | 5 | 10 | mA | All parts |
| Power-on time | $t_{PO}$ | From $V_{CC}$ ≥ 2.5V to $V_{OUT}$ reaching a stable level | - | 200 | - | μs | All parts |
| Output resistive load | $R_L$ | Between $V_{OUT}$ and GND | 1 | 10 | - | kΩ | All parts |
| Output capacitive load | $C_L$ | Between $V_{REF}$ and GND | - | - | 10 | nF | All parts |
| Linear range | $B_{LIN}$ | - | -1000 | - | 1000 | Gs | TMR2651DD |
| | | - | -500 | - | 500 | Gs | TMR2652DD |
| | | - | -200 | - | 200 | Gs | TMR2653DD |
| Sensitivity | SEN[1)] | $V_{CC}$ = 3.3V | -02.70 to -01.50 | | | mV/Gs | TMR2651DD |
| | | $V_{CC}$ = 5V | -04.00 to -01.50 | | | mV/Gs | |
| | | $V_{CC}$ = 3.3V | -06.75 to -02.70 | | | mV/Gs | TMR2652DD |
| | | $V_{CC}$ = 5V | -10.00 to -04.00 | | | mV/Gs | |
| | | $V_{CC}$ = 3.3V | -27.00 to -06.75 | | | mV/Gs | TMR2653DD |
| | | $V_{CC}$ = 5V | -40.00 to -10.00 | | | mV/Gs | |
| Zero offset | $V_{OFFSET}$ | $V_{CC}$ = 5V | - | 2.5 | - | V | All parts |
| | | $V_{CC}$ = 3.3V | - | 1.65 | - | V | All parts |
| Reference voltage | $V_{REF}$ | $V_{CC}$ = 5V | - | 2.5 | - | V | All parts |
| | | $V_{CC}$ = 3.3V | - | 1.65 | - | V | All parts |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hysteresis | HYS[4)] | B = ±1000Gs | - | ±5 | - | Gs | TMR2651DD |
| | | B = ±500Gs | - | ±2.5 | - | Gs | TMR2652DD |
| | | B = ±200Gs | - | ±1 | - | Gs | TMR2653DD |
| Nonlinearity | NONL[4)] | B = ±100Gs | - | 0.5 | - | %FS | All parts |
| Temperature coefficient of sensitivity | TCS[2)] | -40°C to 125°C | - | 150 | 500 | PPM/°C | All parts, after temperature calibration |
| Temperature coefficient of Zero offset | TCO[3)] | -40°C to 125°C | - | 0.2 | - | mV/°C | All parts |
| Noise | Noise | 1Hz | - | 5 | - | μT/rtHz | All parts |
| Bandwidth | BW | BW is inversely proportional to sensitivity | DC to 2 MHz | | | | All parts |

1) The typical value of sensitivity is programmable via OWI protocol.

2) The sensor can be programmed to perform multi-point temperature measurement to calibrate TCS for better performance.

3) The sensor can be programmed to perform multi-point temperature measurement to calibrate TCO for better performance.

4) Hysteresis and nonlinearity: The test field is the same as the analysis field.

## 6. Parameter Definition

### 6.1 Sensitivity

$SEN = (V_{max} - V_{min}) / (H_{max} - H_{min})$

### 6.2 Zero offset

Single-ended output：$V_{OE} = V_{OUT}$ (B = 0 Gs) - $V_{CC}/2$,
Differential output：$V_{OE} = V_{OUT}$ (B = 0 Gs) - $V_{REF}$

### 6.3 Hysteresis

$$HYS = \Delta V_{Hmax} / SEN$$

$\Delta V_H$ is the difference in the actual output of the sensor during the up and down strokes under the same test magnetic field. The maximum value is taken and recorded as $\Delta V_{Hmax}$

### 6.4 Nonlinearity

$$NONL = (\Delta V_{Lmax}) / (V_{max} - V_{min}) \times 100\%$$

$\Delta V_L$ is the difference between the actual output curve and the curve fitted by the least squares method. The maximum value is taken and denoted as $\Delta V_{Lmax}$, $V_{max}$ and $V_{min}$ they are respectively the maximum and minimum output values of the fitting curve

### 6.5 Temperature coefficient of sensitivity

$$TCS = \frac{SEN\,(T2) - SEN\,(T1)}{SEN\,(25°C) \times (T2-T1)} \times 1000000$$

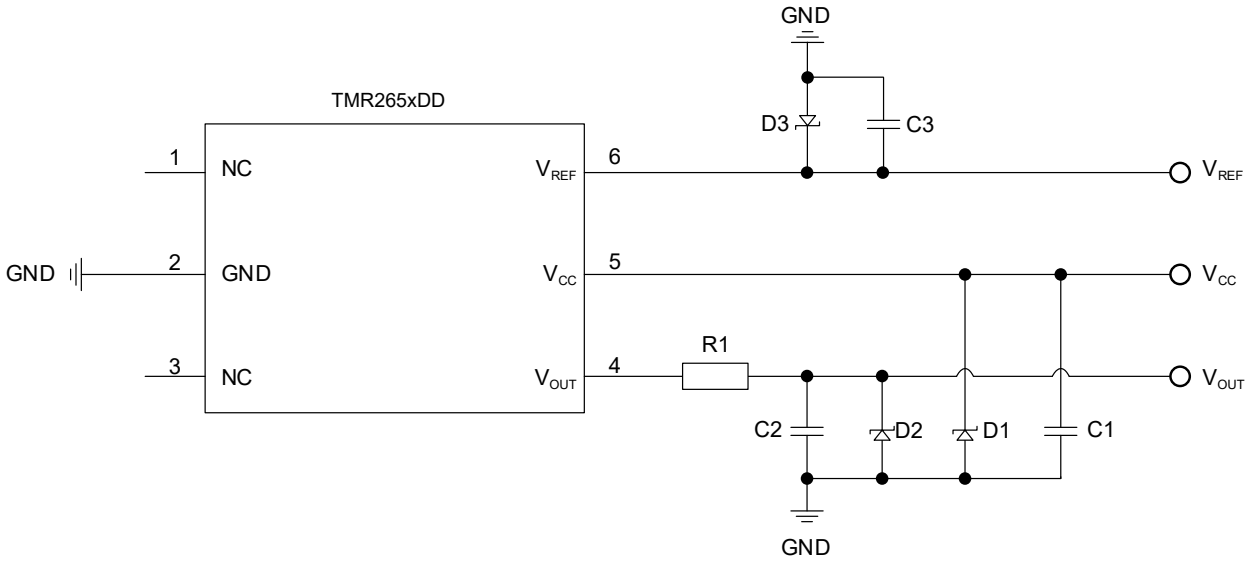
$T1 = T_{Amin} = -40°C$, $T2 = T_{Amax} = 125°C$

### 6.6 Temperature coefficient of Zero offset

$$TCO = \frac{V_{OFFSET}\,(T2) - V_{OFFSET}\,(T1)}{(T2-T1)}$$

$T1 = T_{Amin} = -40°C$, $T2 = T_{Amax} = 125°C$

## 7. Application Information




Note:

| | | |
|---|---|---|
| R1 | - | According to the bandwidth, the noise needs to be configured with R1 and C2 as the output pins for RC filtering |
| C1 | 0.1 μF | Connects $V_{CC}$ to GND for supply voltage filtering |
| C2 | - | According to the bandwidth, the noise needs to be configured with R1 and C2 as the output pins for RC filtering |
| C3 | 20 pF | Connects $V_{REF}$ to GND for reference voltage filtering |
| D1 | ESD5341N_5V/NA | Dual lead bidirectional 5V transient voltage suppression devices for ESD/surge protection. |
| D2 | ESD5341N_5V/NA | Dual lead bidirectional 5V transient voltage suppression devices for ESD/surge protection. |
| D3 | ESD5341N_5V/NA | Dual lead bidirectional 5V transient voltage suppression devices for ESD/surge protection. |

Figure 5. Typical application circuit

Please refer to the TMR265xDD product application manual for more product applications.

## 8. Dimensions

### DFN6L Package

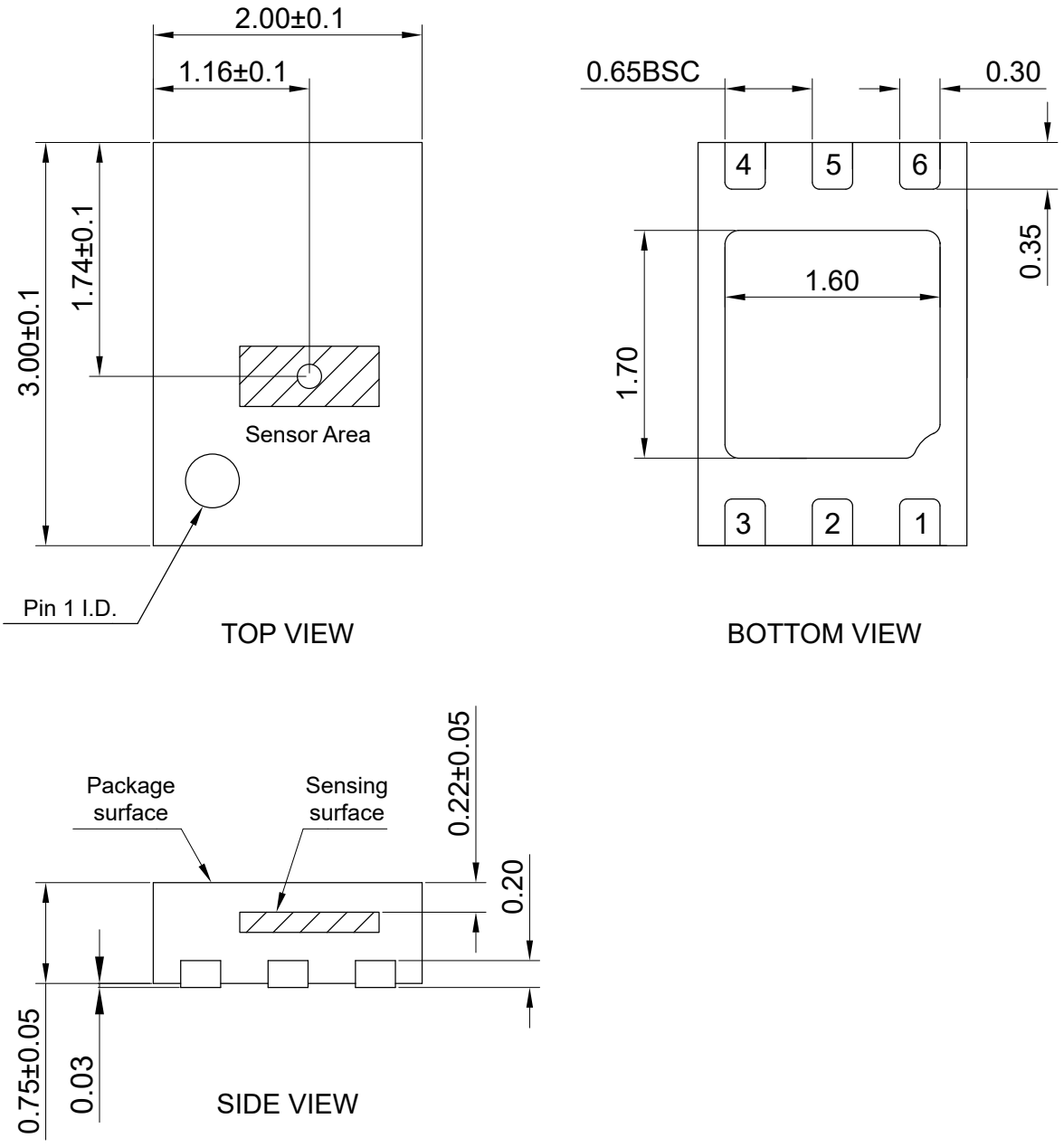



Figure 6. Package outline of DFN6L (unit: mm)

## 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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