# TMR1222 / TMR1228

## MicroAmpere High Frequency Response Dual-Axis Bipolar Magnetic Switch Sensor

## Description

The TMR1222/TMR1228 series magnetic switches integrated the tunneling magnetoresistance (TMR) magnetic sensor and CMOS circuitry, which is able to detect the change of magnetic field and output high and low voltage signals for high accuracy position detection.

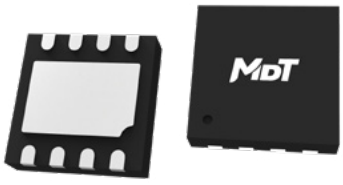
Unlike Hall/AMR sensors, TMR sensors with extremely high resistance values allows TMR1222/1228 to achieve the supply current as low as 1.5 μA while operating in the full-time power supply mode, and maintaining the response frequency of the magnetic signal is 1 kHz. Therefore, the TMR1222/TMR1228 can provide true continuous detection of magnetic field signals, avoiding sampling errors from the traditional time-sharing power supply mode.

## Features and Benefits

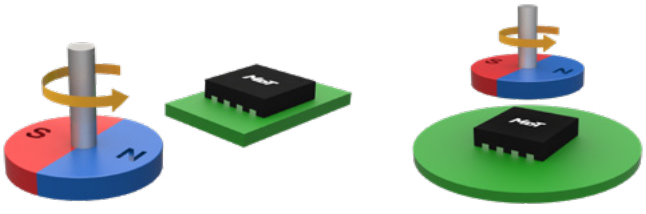
- Tunneling magnetoresistance (TMR) technology
- Low power consumption: supply current 1.5 μA
- High frequency response: typ. 1 kHz
- Bipolar latching operation
- Wide range supply voltages: 1.8 V to 5.5 V
- CMOS push-pull output
- High sensitivity
- Excellent temperature stability
- High tolerance to external magnetic field interference
- RoHS & REACH compliant

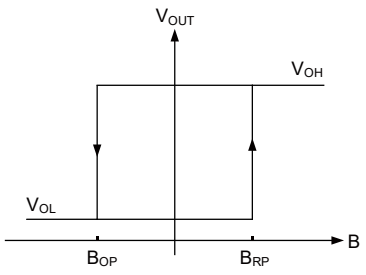
## Applications

- Utility meters: water, gas, and heat meters
- Proximity switches
- Speed sensing
- Linear and rotation position sensing
- Linear and rotation direction sensing



DFN8L





## Selection Guide

| Part Number | Supply Current | Response Frequency | Operating Ambient Temperature | Operating Point | Release Point | Package | Packing Form |
|---|---|---|---|---|---|---|---|
| TMR1222D | 1.5 μA | 0 to 1 kHz | -40 °C to 125 °C | 17 Gs | -17 Gs | DFN8L | Tape & Reel |
| TMR1228D | 1.5 μA | 0 to 1 kHz | -40 °C to 125 °C | 5 Gs | -5 Gs | DFN8L | Tape & Reel |
| Note: Please contact MultiDimension Technology local sales for customizing operating and release points. | | | | | | | |

## Catalogue

## 1. Functional Block Diagram

The TMR1222/TMR1228 series switches are composed of TMR sensors and signal processing circuits. The TMR sensor detects external magnetic field, generates an analog voltage signal, and outputs a logical switch level after processing by the circuit as shown in Figure 1.

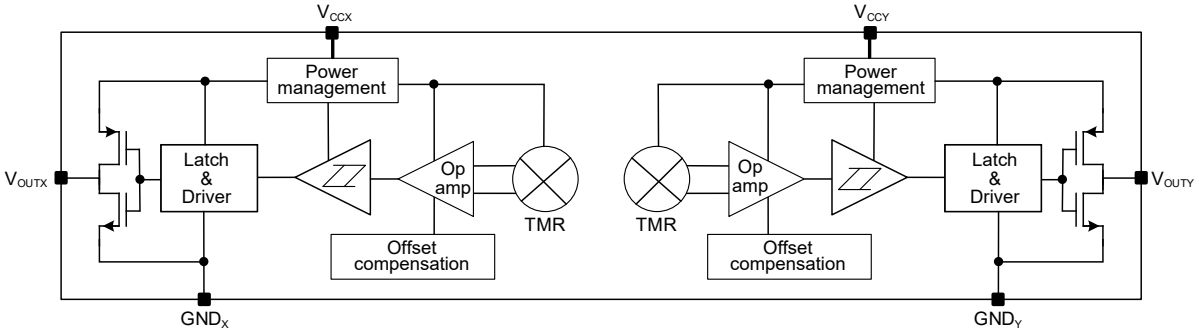



Figure 1. Block diagram

## 2. Switching Characteristics

TMR1222/TMR1228 sensing axis is parallel 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.

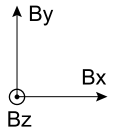



Figure 2-1. Definition of axis

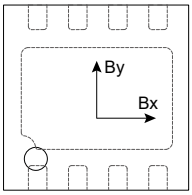



Figure 2-2. Axial diagram (DFN8L top view)

The output is “High”, when power is on at zero magnetic field. B is the external magnetic field along the sensing direction, $B_{OP}$ is the operating point, $B_{RP}$ is the release point, and hysteresis $B_H$ is defined as the difference between $B_{OP}$ and $B_{RP}$.

The sensor outputs a low level, when the magnetic field along the sensing axis exceed the operating point $B_{OP}$, and the device outputs a high level, when the magnetic field is reduced below the release point $B_{RP}$ as shown in Figure 3.

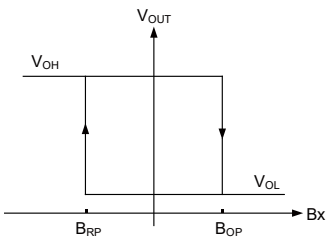



Figure 3-1. Switching characteristics

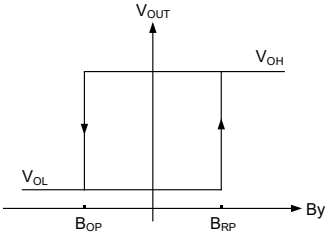



Figure 3-2. Switching characteristics

## 3. Pin Configuration

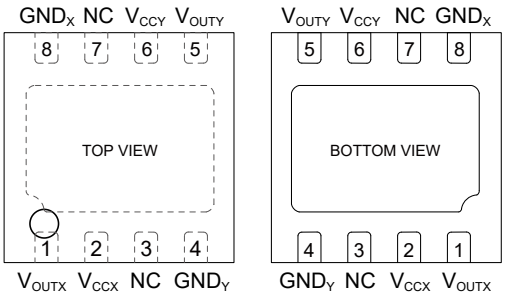



Figure 4. Pin configuration

| Pin Number | Name | Function |
|---|---|---|
| 1 | $V_{OUTX}$ | X axis output |
| 2 | $V_{CCX}$ | X axis power supply |
| 3 | NC | NC |
| 4 | $GND_Y$ | Y axis ground |
| 5 | $V_{OUTY}$ | Y axis output |
| 6 | $V_{CCY}$ | Y axis power supply |
| 7 | NC | NC |
| 8 | $GND_X$ | X axis ground |

## 4. Absolute Maximum Ratings

| Parameters | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Supply voltage | $V_{CC}$ | -0.3 | 7 | V |
| Output current | $I_{SINK}$ and $I_{SOURCE}$ [1)] | - | 9 | mA |
| Magnetic flux density | B | - | 4000 | Gs |
| ESD performance (HBM) | $V_{ESD}$ | - | 4 | kV |
| Operating ambient temperature | $T_A$ | -40 | 125 | °C |
| Storage ambient temperature | $T_{STG}$ | -50 | 150 | °C |

1) $I_{SINK}$ is the current flowing through the pin of switch, when the output is turned on, and $I_{SOURCE}$ is the current flowing through the pin of the switch, when the output is turned off.

## 5. Electrical Specifications

$V_{CC}$ = 3.0 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 |
|---|---|---|---|---|---|---|
| Supply voltage | $V_{CC}$ | Operating | 1.8 | 3.0 | 5.5 | V |
| Output high voltage | $V_{OH}$ | RP status | $V_{CC}$-0.3 | - | $V_{CC}$ | V |
| Output low voltage | $V_{OL}$ | OP status | 0 | - | 0.2 | V |
| Supply current | $I_{CC}$ [2)] | OP and RP status | 0.5 | 1.5 | 2 | μA |
| Response frequency | F | - | 0 to 1000 | | | Hz |

2) $I_{CC}$ defines the single axis mode current consumption. Dual axis mode current consumption is 2X single axis mode consumption.

## 6. Magnetic Specifications

$V_{CC}$ = 3.0 V, $T_A$ = 25 °C, a 0.1 μF capacitor is connected between $V_{CC}$ and GND unless specified otherwise

TMR1222

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Operate point | $B_{OPX}$, $B_{OPY}$ | 10 | 17 | 25 | Gs |
| Release point | $B_{RPX}$, $B_{RPY}$ | -25 | -17 | -10 | Gs |
| Hysteresis | $B_{HX}$, $B_{HY}$ | 20 | - | 50 | Gs |

TMR1228

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Operate point | $B_{OPX}$, $B_{OPY}$ | 2 | 5 | 9 | Gs |
| Release point | $B_{RPX}$, $B_{RPY}$ | -9 | -5 | -2 | Gs |
| Hysteresis | $B_{HX}$, $B_{HY}$ | 4 | - | 18 | Gs |

## 7. Typical Supply Voltage Characteristics

TMR1222D Supply Voltage Characteristics

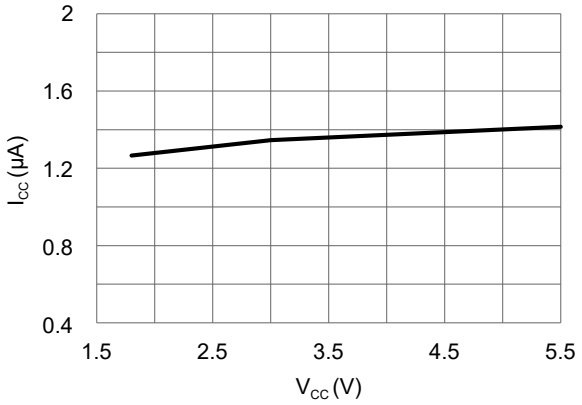



Figure 5. Supply current versus supply voltage ($T_A$=25°C)

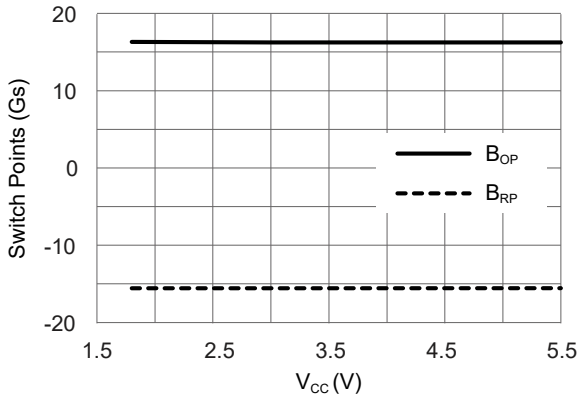



Figure 6. Switch points versus supply voltage ($T_A$=25°C)

TMR1228D Supply Voltage Characteristics

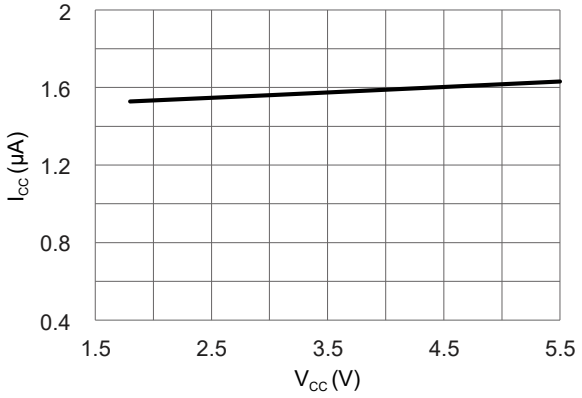



Figure 7. Supply current versus supply voltage ($T_A$=25°C)

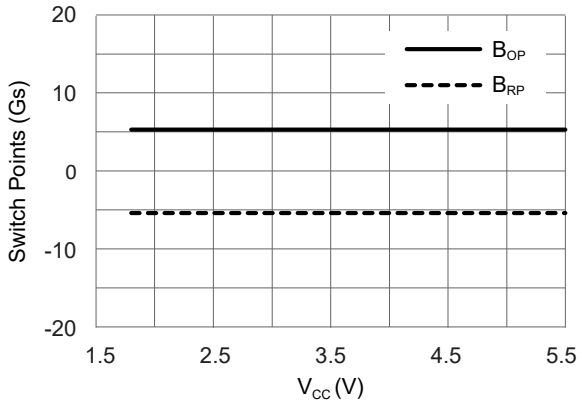



Figure 8. Switch points versus supply voltage ($T_A$=25°C)

## 8. Typical Temperature Characteristics

TMR1222D Temperature Characteristics

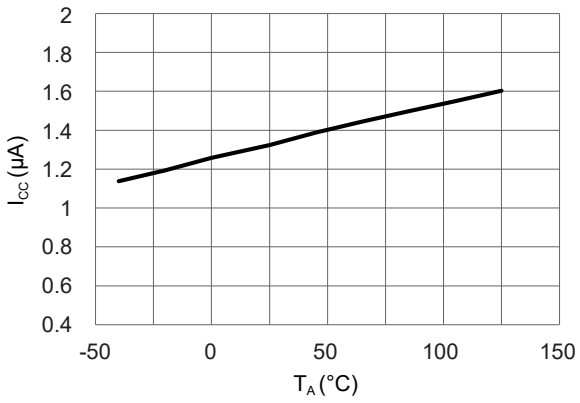



Figure 9. Supply current versus temperature ($V_{CC}$ = 3 V)

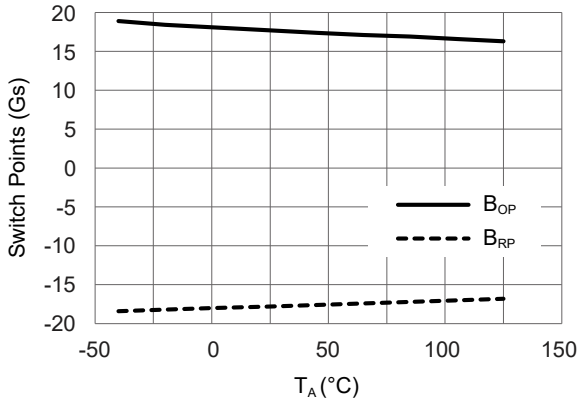



Figure 10. Switch points versus temperature ($V_{CC}$ = 3 V)

TMR1228D Temperature Characteristics

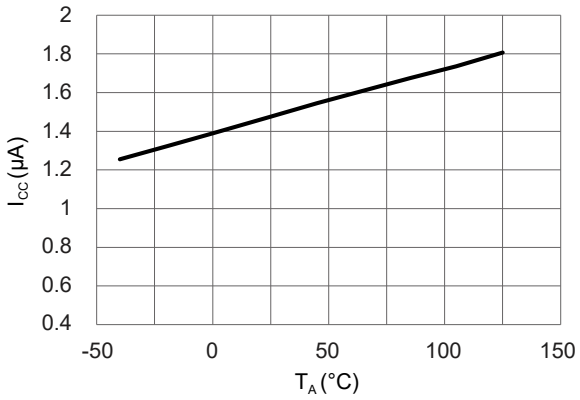



Figure 11. Supply current versus temperature ($V_{CC}$ = 3 V)

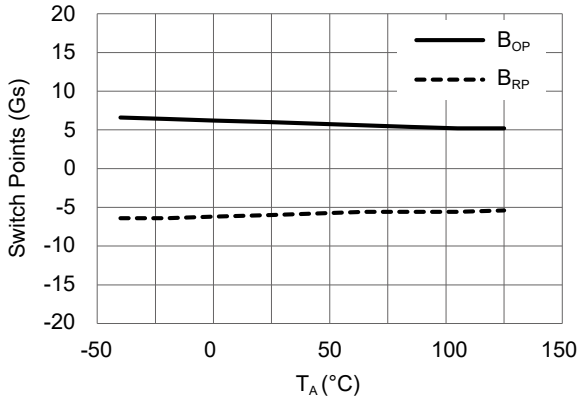



Figure 12. Switch points versus temperature ($V_{CC}$ = 3 V)

## 9. Application Information

IIt is recommended to add a filter capacitor with the typical value of 0.1 μF between the switch power supply and ground (close to the sensor) to reduce external noise as shown in Figure 13.

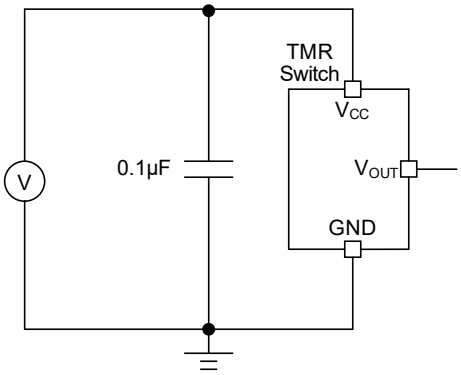



Figure 13. Application circuit diagram

The TMR1222/1228 series switches are not suitable for driving power loads. Figure 14 illustrates the general method of improving the drive capability is utilizing the output voltage of $V_{OUT}$ pin as a signal to input the MCU or drive a triode or MOS.

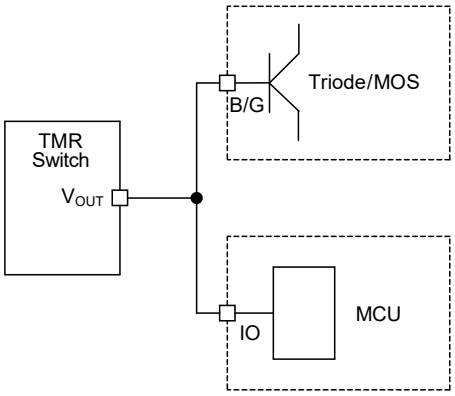



Figure 14. Application diagram for driving power load

Common failure conditions:

- The device is exposed to conditions exceeding any absolute maximum rating.
- The external circuit does not include properly matched supply-pin decoupling/filter capacitors.
- The device's $V_{OUT}$ pin is used to directly drive power devices (e.g., relays), causing the output current to exceed the "Absolute Maximum Ratings".
- The device operates in a humid environment for an extended period.
- The maximum soldering temperature exceeds 260°C, or exposure above 250°C lasts longer than 10s.
- The device is exposed to temperatures above the maximum operating temperature while the external magnetic field exceeds 20 Gs.
- The device is exposed to an ultrasonic environment.
- Excessive deformation of the device leads/pins.
- Applying a voltage to the $V_{OUT}$ pin, or powering the device through the $V_{OUT}$ pin.

## 10. Dimensions

### DFN8L Package

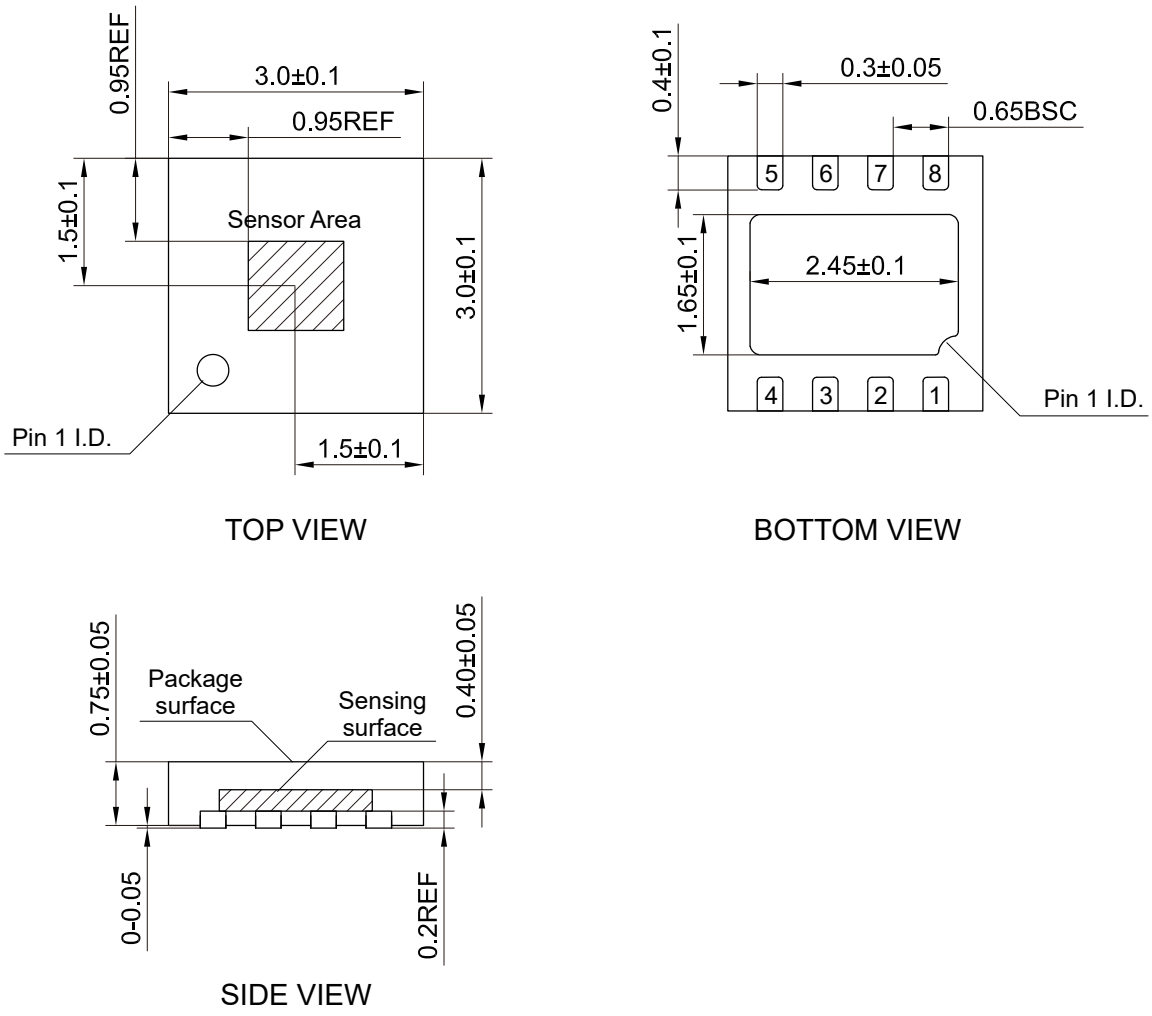



Figure 15. Package outline of DFN8L (unit: mm)

## 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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