# TMR1148

## MicroAmpere High Frequency Response Unipolar Magnetic Switch Sensor

## Description

TMR1148 is a unipolar magnetic switch 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 TMR1148 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, TMR1148 can provide true continuous detection of magnetic field signals, avoiding sampling errors from the traditional time-sharing power supply mode.

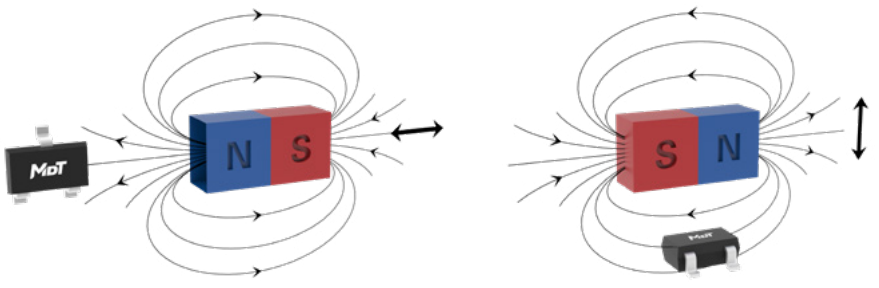
SOT23-3

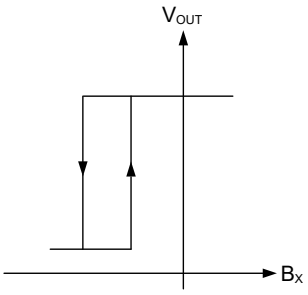
## Features and Benefits

- Tunneling magnetoresistance (TMR) technology
- Low power consumption: supply current 1.5 μA
- High frequency response: typ. 1 kHz
- Unipolar operation
- Wide range supply voltages: 1.8 V to 5.5 V
- Open-drain output
- High sensitivity
- Excellent temperature stability
- High tolerance to external magnetic field interference
- RoHS & REACH compliant
- Validation according to AEC-Q100 Grade1
- Fulfill MSL 1

## Applications

- Utility meters: water, gas, and heat meters
- Proximity switches
- Speed sensing
- Linear and rotation position sensing
- Wake-up switch
- Level switch



## Selection Guide

| Part Number | Supply Current | Response Frequency | Operating Ambient Temperature | Operating Point | Release Point | Package | Packing Form |
|---|---|---|---|---|---|---|---|
| TMR1148S | 1.5 μA | 0 to 1 kHz | -40 °C to 125 °C | -15 Gs | -10 Gs | SOT23-3 | Tape & Reel |
| Note: Please contact MultiDimension Technology local sales representative for customizing $B_{OP}$ and $B_{RP}$ information. | | | | | | | |

## Catalogue

## 1. Functional Block Diagram

TMR1148 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.

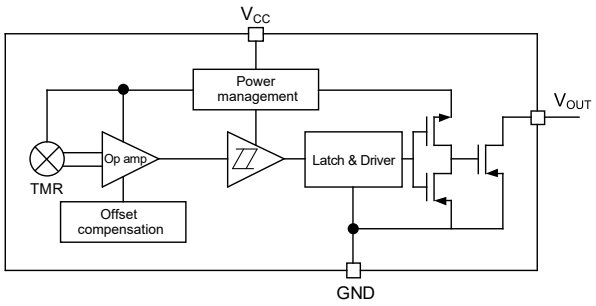



Figure 1. Block diagram

## 2. Switching Characteristics

The TMR1102 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.

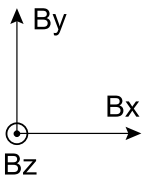



Figure 2-1. Definition of axis

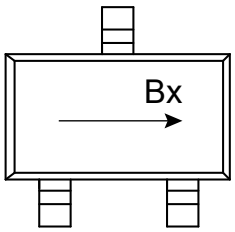



Figure 2-2. Axial diagram (SOT23-3 top view)

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 define as the difference between $B_{OP}$ and $B_{RP}$.

The sensor outputs a low level, when the magnetic field along the sensing axis exceeds the operate 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.

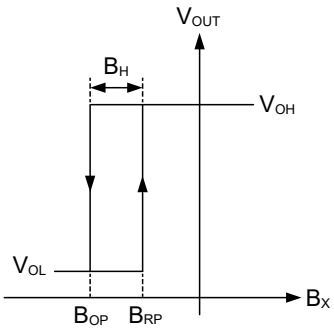



Figure 3. Switching characteristics

## 3. Pin Configuration

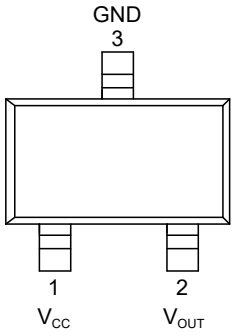



Figure 4. Pin configuration

| Pin Number | Name | Function |
|---|---|---|
| 1 | $V_{CC}$ | Power supply |
| 2 | $V_{OUT}$ | Output |
| 3 | GND | Ground |

## 4. Absolute Maximum Ratings

| Parameters | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Supply voltage | $V_{CC}$ | -0.3 | 7 | V |
| Output current | $I_{SINK}$ | - | 20 | 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 |

Note: $I_{SINK}$ is the current flowing through the pin of sensor, when the output is turned on.

## 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 stress voltage | $V_{stress}$ | - | - | - | 5.5 | V |
| Output leak current | $I_{leak}$ | OUT = H | - | - | 1 | μA |
| On resistance of output | $R_{ON}$ | OUT = L | - | 0.75 | 1 | Ω |
| Off resistance of output | $R_{OFF}$ | OUT = H | - | 30 | - | MΩ |
| Output high voltage | $V_{OH}$ | RP status | [2] | - | $V_{CC}$ | V |
| Output low voltage | $V_{OL}$ | OP status | 0 | - | 0.2 | V |
| Supply current | $I_{CC}$ | OP and RP status | 0.5 | 1.5 | 2 | μA |
| Power-on time | $t_{PO}$ | $V_{CC}$ = 3.0 V | - | - | 400 | μs |
| Power-on current | $I_{PO}$ | $V_{CC}$ = 3.0 V | - | - | 10 | μA |
| Response frequency | F | - | 0 to 1000 | | | Hz |

[2] $V_{OH}$ is affected by the resistance of the switch output pull-up resistor and the leakage current flowing through the pull-up resistor.

## 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

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Operate point | $B_{OP}$ | -25 | -15 | -10 | Gs |
| Release point | $B_{RP}$ | -20 | -10 | -5 | Gs |
| Hysteresis | $B_H$ | 2 | 5 | 9 | Gs |

## 7. Typical Supply Voltage Characteristics

Supply Voltage Characteristics

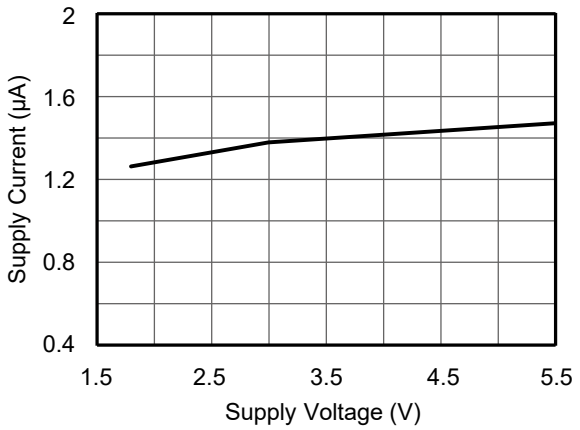



Figure 5. Supply current versus supply voltage ($T_A$=25°C)

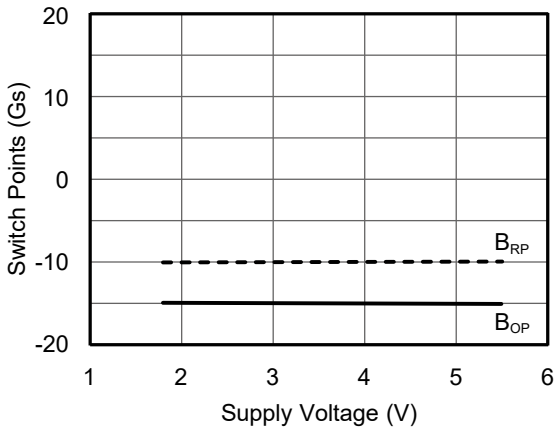



Figure 6. Switch points versus supply voltage ($T_A$=25°C)

## 8. Typical Temperature Characteristics

Temperature Characteristics

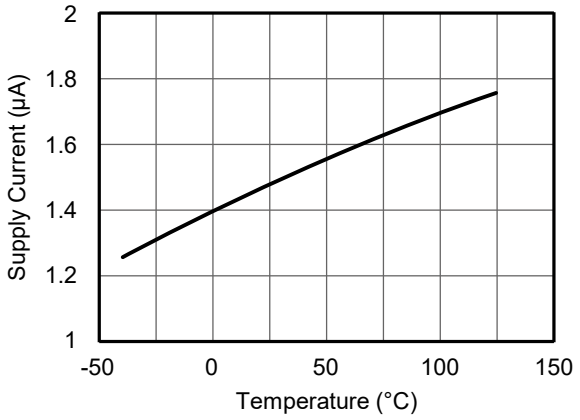



Figure 7. Supply current versus temperature ($V_{CC}$ = 3 V)

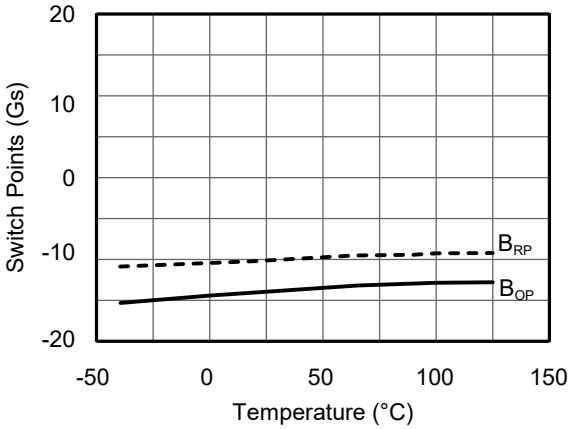



Figure 8. Switch points versus temperature ($V_{CC}$ = 3 V)

## 9. Application Information

It 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 9.

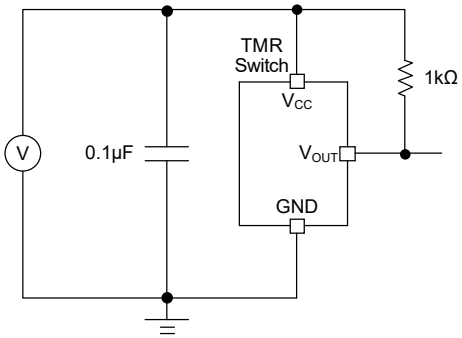



Figure 9. Application circuit diagram

The TMR1148 series sensor chips are not suitable for driving power loads. Figure 10 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.

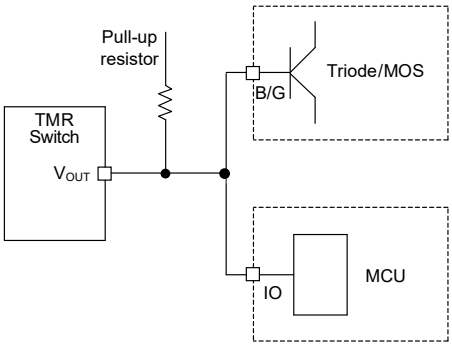



Figure 10. Application diagram for driving power load

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

### SOT23-3 Package

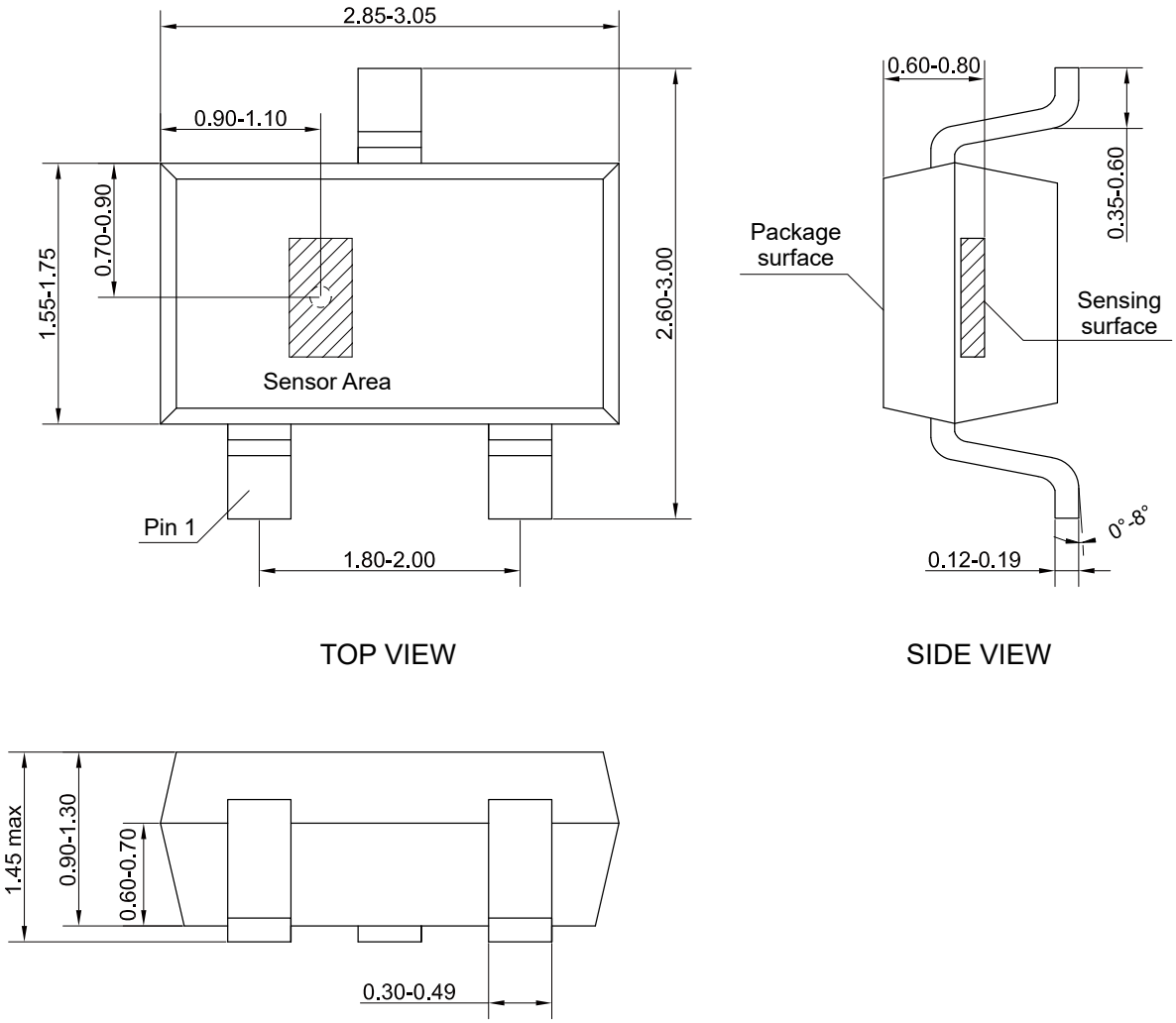



Figure 11. Package outline of SOT23-3 (unit: mm)

## 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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