TMR121x

Bi-stable TMR Bipolar Magnetic Switch with Passive Memory Effect

Description

The TMR121x is a bi-stable digital bipolar magnetic switch that integrates TMR and CMOS technology in order to provide a magnetically triggered digital switch with high sensitivity, high speed, and ultra-low power consumption. It integrates a push-pull half-bridge TMR magnetic sensor and CMOS signal processing circuitry within the same package. Compared with conventional magnetic switch sensors, TMR121x can detect and store the ON/OFF state triggered by magnetic polarity without power supply, and the latest state can be retrieved immediately after power supply is resumed. Designed for use in applications that are power-critical, performance-demanding, and failsafe, this device includes an on-chip TMR voltage generator for precise magnetic sensing, TMR voltage amplifier and comparator, a Schmitt trigger to provide switching hysteresis for noise rejection, and CMOS push-pull output. An internal band gap regulator is used to provide temperature compensated supply voltage for internal circuits, and it allows a wide range of operating supply voltages. The TMR121x draws only 1.5μA resulting in ultra-low power operation, additionally it has fast response, accurate switching points, excellent thermal stability, and immunity to stray field interference. It is available in two compact SOT23-3 and TO92S packages.

Features and Benefits

- Tunneling magnetoresistance (TMR) technology
- Ultra low power consumption at 1.5 μA
- Passive operation with magnetic memory effect
- High frequency response at 1 kHz
- Bipolar latching operation
- Compatible with a wide range of supply voltages
- Excellent temperature stability
- High tolerance to external magnetic field interference
- RoHS & REACH compliant

Applications

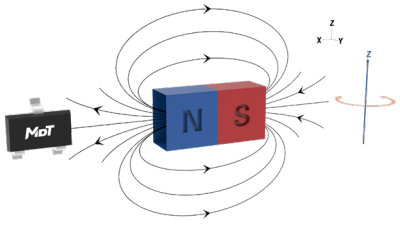
- Utility meters: water, gas, and heat meters
- Bi-stable level switches in elevator doors
- Magnetic flip level gauges
- Solid state switches
- Speed sensing
- Linear and rotation position sensing

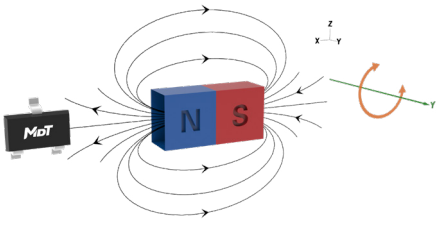


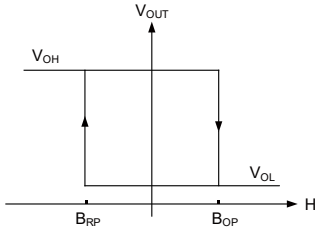
SOT23-3



TO92S







Selection Guide

Part Number	Supply Current	Response Frequency	Operating Ambient Temperature	Operating Point	Release Point	Package	Packing Form
TMR1212S	1.5 μA	1 kHz	-40 °C to 125 °C	45 Gs	-45 Gs	SOT23-3	Tape & Reel
TMR1212T	1.5 μA	1 kHz	-40 °C to 125 °C	45 Gs	-45 Gs	TO92S	ESD Bag
TMR1215S	1.5 μA	1 kHz	-40 °C to 125 °C	35 Gs	-35 Gs	SOT23-3	Tape & Reel
TMR1215T	1.5 μA	1 kHz	-40 °C to 125 °C	35 Gs	-35 Gs	TO92S	ESD Bag
Note: Please contact MultiDimension Technology local sales for customizing operating and release points.							

Catalogue

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1. Functional Block Diagram

TMR121x series switch chips 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.

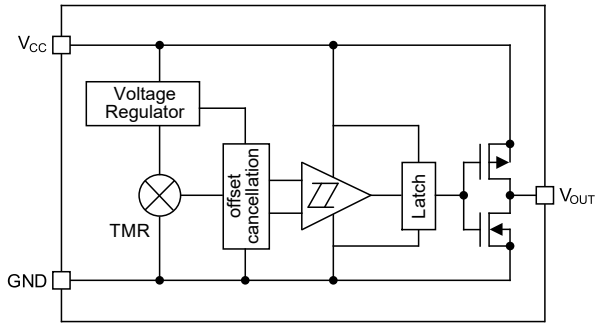


Figure 1. Block diagram

2. Switching Characteristics

The Figure 2 shows the sensing direction is parallel to the silkscreen surface of the package as shown by the arrow.

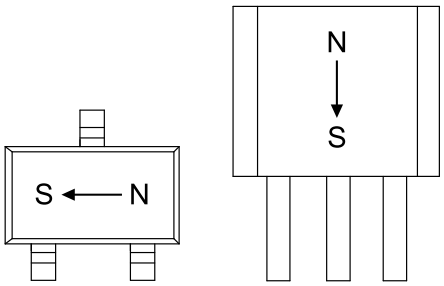


Figure 2. Sensing direction

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.

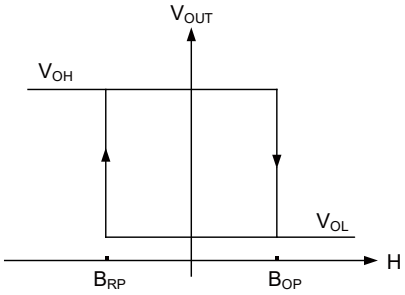


Figure 3. Switching characteristics

3. Pin Configuration

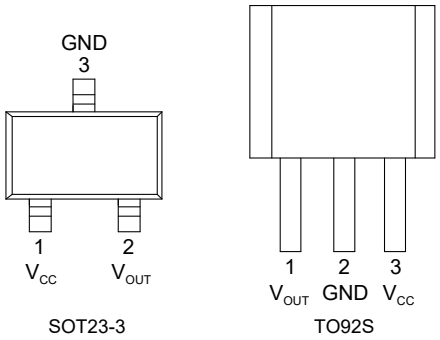


Figure 4. Pin configuration

Pin Number		Name	Function
SOT23-3	TO92S		
1	3	V_{CC}	Power supply
2	1	V_{OUT}	Output
3	2	GND	Ground

4. Absolute Maximum Ratings

Parameters	Symbol	Min.	Max.	Unit
Supply voltage	V_{CC}	-	7	V
Reverse supply voltage	V_{RCC}	-	0.3	V
Output current	$I_{OUTSINK}$	-	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	125	°C

5. Electrical Specifications

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

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	Operating	1.8	3.0	5.5	V
Output high voltage	V_{OH}	-	V_{CC}-0.3	-	V_{CC}	V
Output low voltage	V_{OL}	-	-	-	0.2	V
Supply current	I_{CC}	Output open	-	1.5	-	μA
Response frequency	F	-	-	1000	-	Hz

6. Magnetic Specifications

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

TMR1212

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operate point	B_{OP}	35	45	60	Gs
Release point	B_{RP}	-60	-45	-35	Gs
Hysteresis	B_H	-	90	-	Gs
Operate point for passive memory effect	B_{OPS}	60	-	-	Gs
Release point for passive memory effect	B_{RPS}	-	-	-60	Gs

TMR1215

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operate point	B_{OP}	20	35	40	Gs
Release point	B_{RP}	-40	-35	-20	Gs
Hysteresis	B_H	-	70	-	Gs
Operate point for passive memory effect	B_{OPS}	40	-	-	Gs
Release point for passive memory effect	B_{RPS}	-	-	-40	Gs

7. Typical Supply Voltage Characteristics

TMR1212

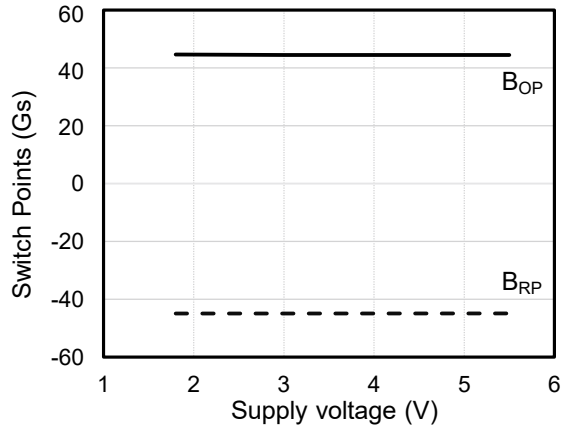


Figure 5. Switch points versus supply voltage (T_A=25°C)

TMR1215

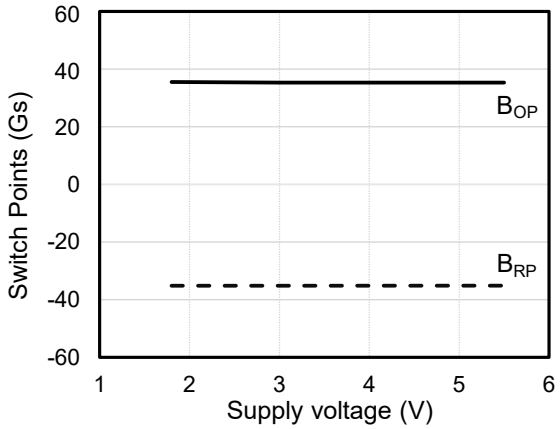


Figure 6. Switch points versus supply voltage (T_A=25°C)

8. Typical Temperature Characteristics

TMR1212

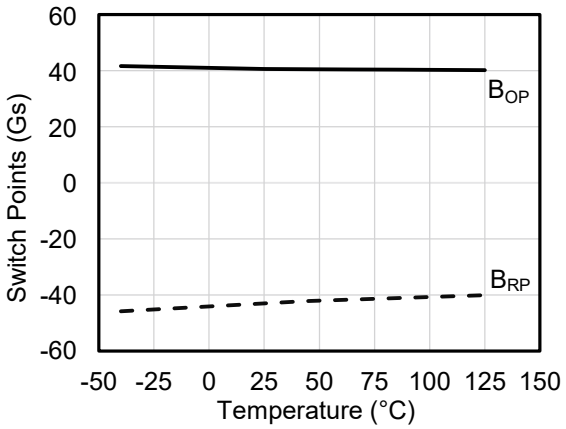


Figure 7. Switch points versus temperature (V_{CC} = 3 V)

TMR1215

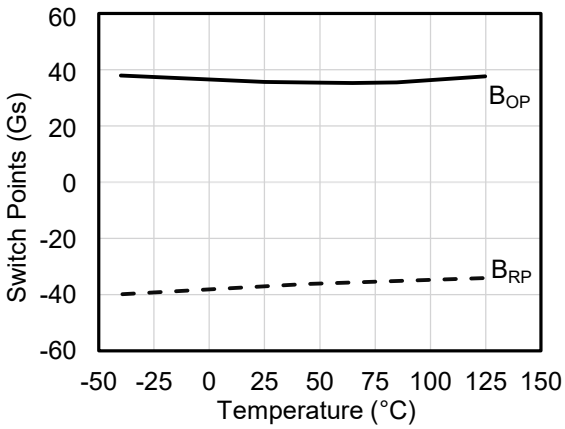


Figure 8. Switch points versus temperature (V_{CC} = 3 V)

9. Application Information

To ensure stable operation of the sensor and effective retention of its output state after power-off, the maximum magnetic field strength experienced in the sensitivity direction must reach at least twice the OP field.

It is recommended to add a filter capacitor between the sensor power supply and ground (close to the sensor) to reduce external noise. As shown in Figure 9, the typical value is 0.1 μF.

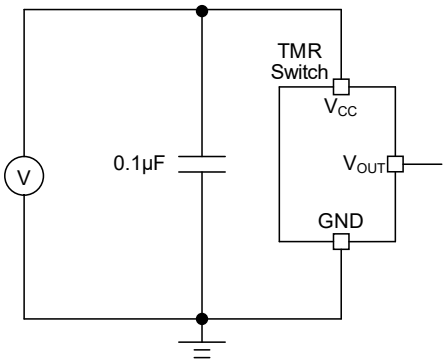


Figure 9. Application circuit diagram

The TMR121x series sensor chips are not suitable for driving power loads. The general method of use is utilizing the output voltage of V_{OUT} pin as a signal to input the MCU or drive a triode or MOS as shown in Figure 10.

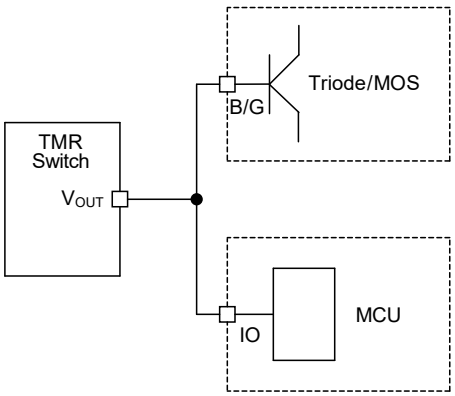


Figure 10. Application diagram for driving power load

Common failure conditions:

- The supply voltage exceeds the limit of absolute maximum ratings
- Absence of matching filter capacitor to power supply when the power supply is unstable, which can cause the product to restart repeatedly
- Using switch output V_{OUT} to control high-power relays, etc., and cause I_{SINK} and I_{SOURCE} exceeding the limit of absolute maximum ratings
- The external magnetic field exceeds the limit of absolute maximum ratings
- Operating in a humid environment for a long time, causing vapor penetration and increased power consumption
- Overheating when soldering
- Over bending of pins

10. Dimensions

SOT23-3 Package

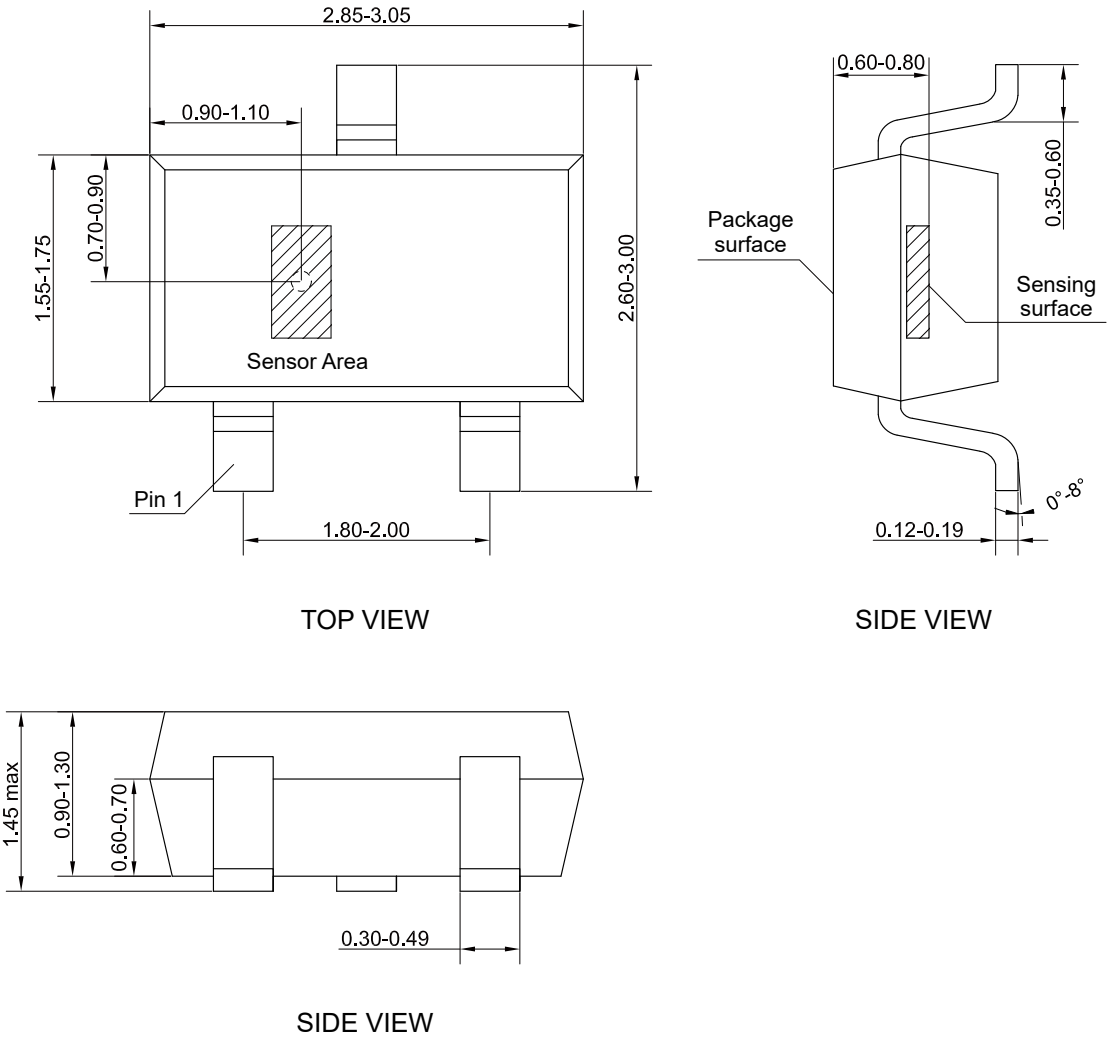


Figure 11. Package outline of SOT23-3 (unit: mm)

TO92S Package

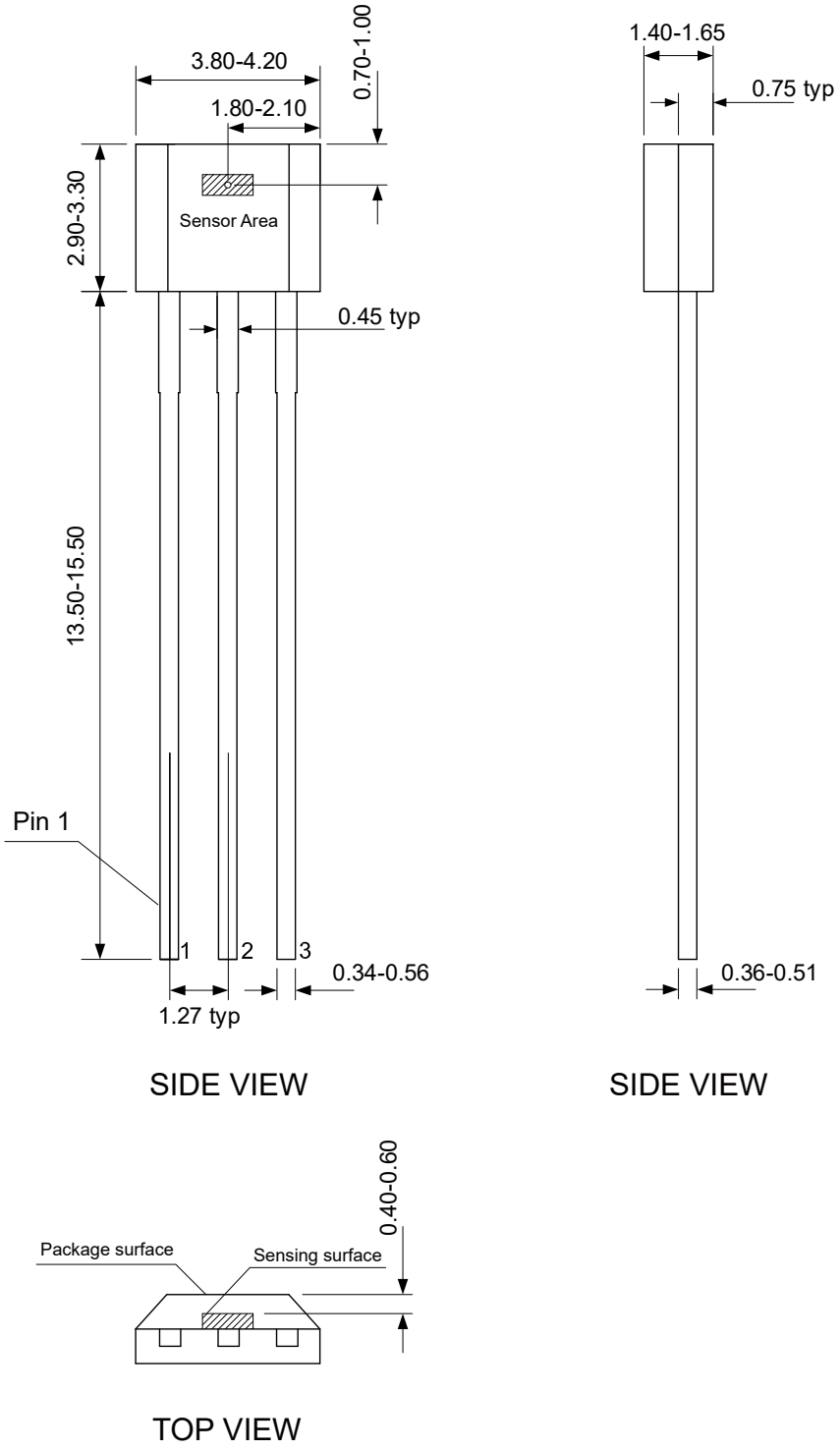


Figure 12. Package outline of TO92S (unit: mm)

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