TMR13Dx

MicroAmpere High Frequency Response Omnipolar Magnetic Switch Sensor

Description

TMR13Dx is an omnipolar magnetic switch integrated the tunnel 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. Compared with traditional TMR switches, TMR13Dx can provide better product performance consistency by pre-programing the switch points (operating point B_{OP}, release point B_{RP}, and hysteresis B_H) based on customers' needs before delivery.

Unlike Hall/AMR sensors, TMR sensors with extremely high resistance values allows TMR13Dx 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 greater than 1 kHz. Therefore, TMR13Dx can provide true continuous detection of magnetic field signals, avoiding sampling errors from the traditional time-sharing power supply mode.

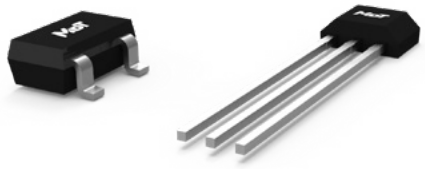
TMR13Dx allows a wide range of operating supply voltages from 1.8 V to 5.5 V with excellent temperature characteristics, and can meet the requirements of most applications.

Features and Benefits

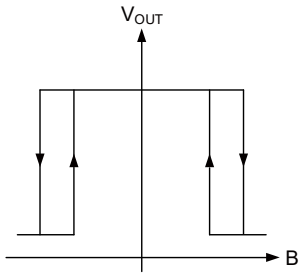
- Tunneling magnetoresistance (TMR) technology
- Low power consumption: supply current 1.5 μA
- High frequency response: typ. 1 kHz
- Omnipolar operation
- Wide range supply voltages: 1.8 V to 5.5 V
- CMOS push-pull output
- High sensitivity
- Excellent temperature stability
- High tolerance to external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

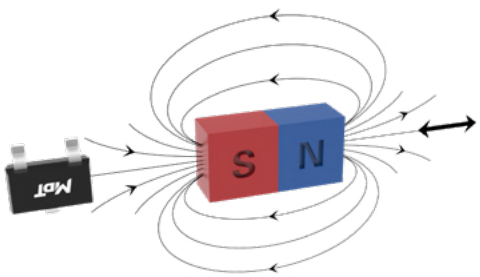
Applications

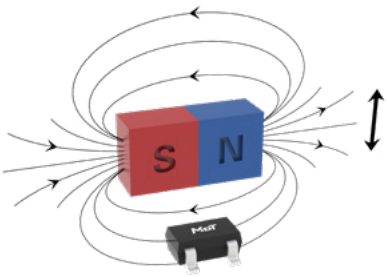
- Utility meters: water, gas, and heat meters
- Proximity switches
- Speed sensing
- Linear and rotation position sensing
- Wake-up switch



SOT23-3 TO92S







Selection Guide

Part Number	Supply Current	Response Frequency	Operating Ambient Temperature	Operating Point	Release Point	Package	Packing Form
TMR13D1S	1.5 μA	1 kHz	-40 °C to 125 °C	±60 Gs	±40 Gs	SOT23-3	Tape & Reel
TMR13D1T	1.5 μA	1 kHz	-40 °C to 125 °C	±60 Gs	±40 Gs	TO92S	ESD Bag
TMR13D3S	1.5 μA	1 kHz	-40 °C to 125 °C	±40 Gs	±30 Gs	SOT23-3	Tape & Reel
TMR13D3T	1.5 μA	1 kHz	-40 °C to 125 °C	±40 Gs	±30 Gs	TO92S	ESD Bag
TMR13D5S	1.5 μA	1 kHz	-40 °C to 125 °C	±30 Gs	±20 Gs	SOT23-3	Tape & Reel
TMR13D5T	1.5 μA	1 kHz	-40 °C to 125 °C	±30 Gs	±20 Gs	TO92S	ESD Bag
TMR13D7S	1.5 μA	1 kHz	-40 °C to 125 °C	±20 Gs	±14 Gs	SOT23-3	Tape & Reel
TMR13D7T	1.5 μA	1 kHz	-40 °C to 125 °C	±20 Gs	±14 Gs	TO92S	ESD Bag
TMR13D8S	1.5 μA	1 kHz	-40 °C to 125 °C	±10 Gs	±5 Gs	SOT23-3	Tape & Reel
TMR13D8T	1.5 μA	1 kHz	-40 °C to 125 °C	±10 Gs	±5 Gs	TO92S	ESD Bag
Note: Please contact MultiDimension Technology local sales for customizing operating and release points.							

Catalogue

1. Functional Block Diagram

TMR13Dx 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 circuits as shown in Figure 1.

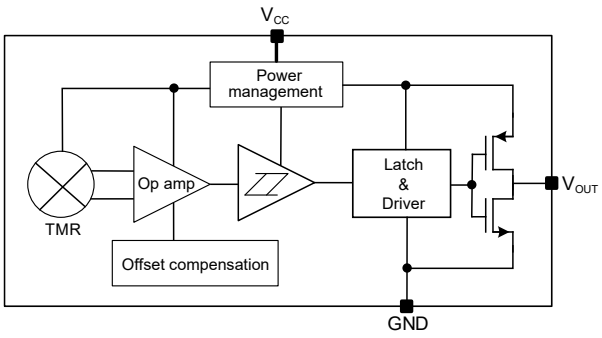


Figure 1. Block diagram

2. Switching Characteristics

The TMR13Dx 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.

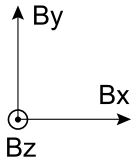


Figure 2-1. Definition of axis

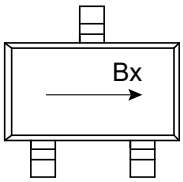


Figure 2-2. Axial diagram (SOT23-3 top view)

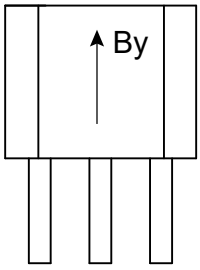


Figure 2-3. Axial diagram (TO92S side view)

The output is “High”, when power is on at zero magnetic field. B is the external magnetic field along the sensing direction, B_{OPS} (B_{OPN}) is the operating point, B_{RPS} (B_{RPN}) is the release point, and hysteresis B_H is define as the difference between B_{OPS} and B_{RPS} (B_{OPN} and B_{RPN}).

The sensor outputs a low level, when the magnetic field along the sensing axis exceeds the operate point B_{OPS} (B_{OPN}), and the device outputs a high level, when the magnetic field is reduced below the release point B_{RPS} (B_{RPN}) as shown in Figure 3.

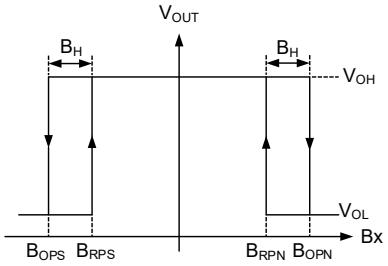


Figure 3-1. Switching characteristics (SOT23-3)

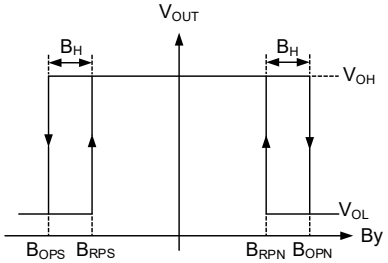


Figure 3-2. Switching characteristics (TO92S)

3. Pin Configuration

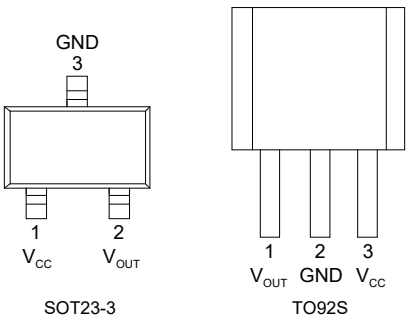


Figure 4. Pin configuration

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}	-0.3	7	V
Output current	I_{SINK} and I_{SOURCE}	-	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

Note: I_{SINK} is the current flowing through the high side MOSFET, when the high side MOSFET is turned on, and I_{SOURCE} is the current flowing through the low side MOSFET when the low side MOSFET is turned on.

5. Electrical Specifications

V_{CC} = 3 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	2.8	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}	output open	0.5	1.5	2	μA
Response frequency	F	-	0 to 1000			Hz

6. Magnetic Specifications

V_{CC} = 3 V, T_A = 25 °C, a 0.1 μF capacitor is connected between V_{CC} and GND

TMR13D1

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operate point	B_{OPS}	-70	-60	-50	Gs
	B_{OPN}	50	60	70	Gs
Release point	B_{RPS}	-50	-40	-30	Gs
	B_{RPN}	30	40	50	Gs
Hysteresis	B_H	10	20	30	Gs

TMR13D3

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operate point	B_{OPS}	-48	-40	-32	Gs
	B_{OPN}	32	40	48	Gs
Release point	B_{RPS}	-36	-30	-24	Gs
	B_{RPN}	24	30	36	Gs
Hysteresis	B_H	8	10	12	Gs

TMR13D5

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operate point	B_{OPS}	-36	-30	-24	Gs
	B_{OPN}	24	30	36	Gs
Release point	B_{RPS}	-24	-20	-16	Gs
	B_{RPN}	16	20	24	Gs
Hysteresis	B_H	8	10	12	Gs

TMR13D7

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operate point	B_{OPS}	-26	-20	-14	Gs
	B_{OPN}	14	20	26	Gs
Release point	B_{RPS}	-18	-14	-10	Gs
	B_{RPN}	10	14	18	Gs
Hysteresis	B_H	4	6	8	Gs

TMR13D8

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operate point	B_{OPS}	-15	-10	-5	Gs
	B_{OPN}	5	10	15	Gs
Release point	B_{RPS}	-8	-5	-3	Gs
	B_{RPN}	3	5	8	Gs
Hysteresis	B_H	2	5	7	Gs

7. Typical Supply Voltage Characteristics

TMR13Dx Supply Voltage Characteristics

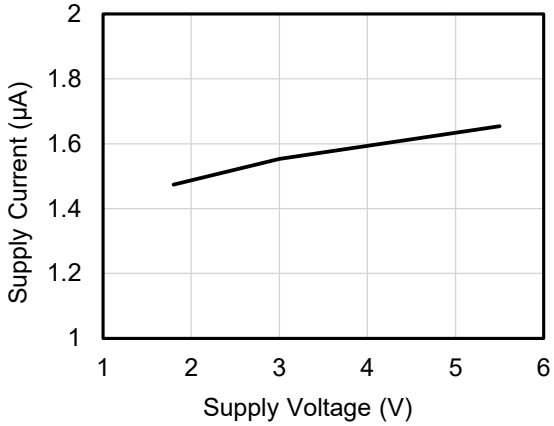


Figure 5. Supply current versus supply voltage (T_A=25°C)

TMR13D1 Supply Voltage Characteristics

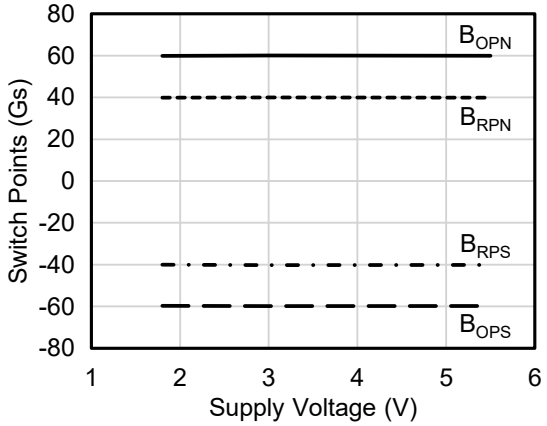


Figure 6. Switch points versus supply voltage (T_A=25°C)

TMR13D3 Supply Voltage Characteristics

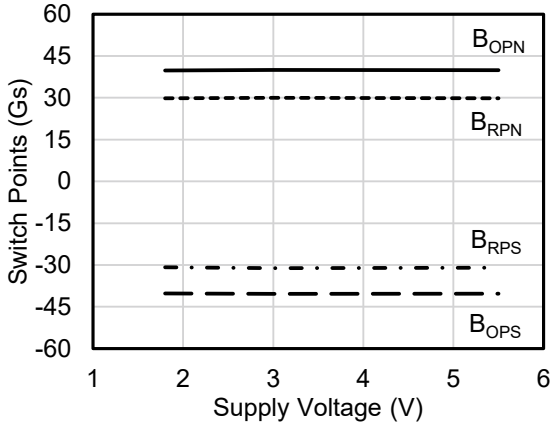


Figure 7. Switch points versus supply voltage (T_A=25°C)

TMR13D5 Supply Voltage Characteristics

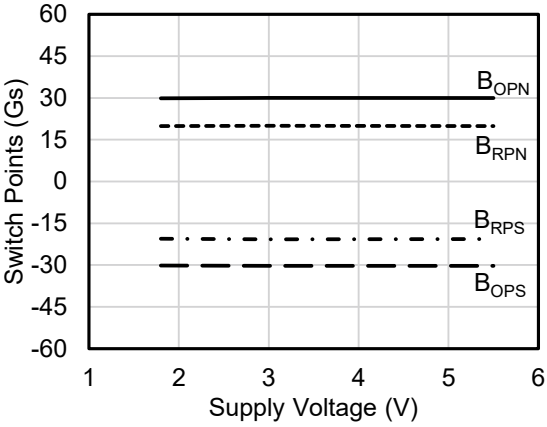


Figure 8. Switch points versus supply voltage (T_A=25°C)

TMR13D7 Supply Voltage Characteristics

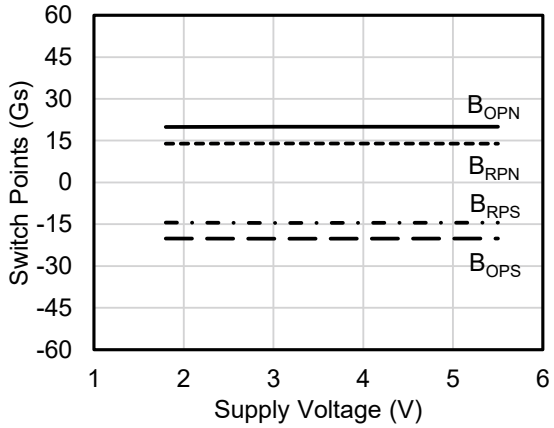


Figure 9. Switch points versus supply voltage (T_A=25°C)

TMR13D8 Supply Voltage Characteristics

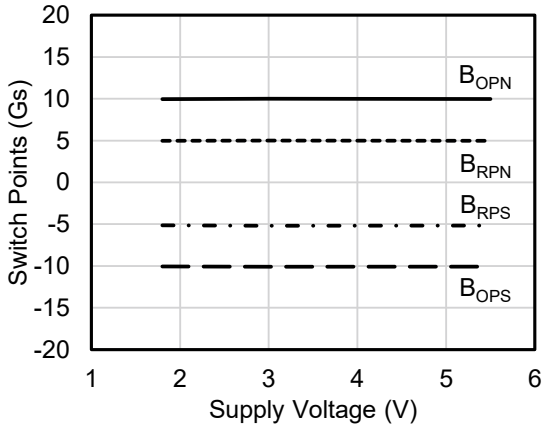


Figure 10. Switch points versus supply voltage (T_A=25°C)

8. Typical Temperature Characteristics

TMR13Dx Supply Temperature Characteristics

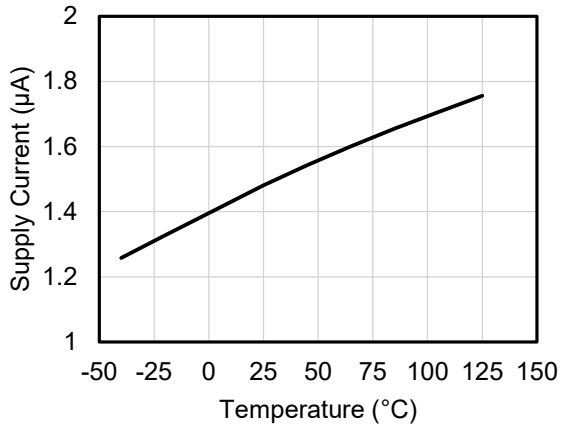


Figure 11. Supply current versus temperature (V_{CC} = 3 V)

TMR13D1 Temperature Characteristics

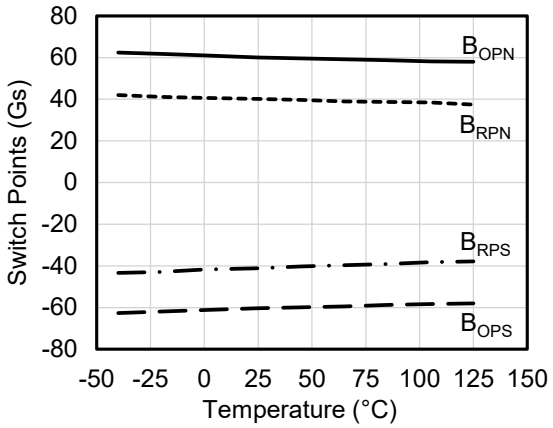


Figure 12. Switch points versus temperature (V_{CC} = 3 V)

TMR13D3 Temperature Characteristics

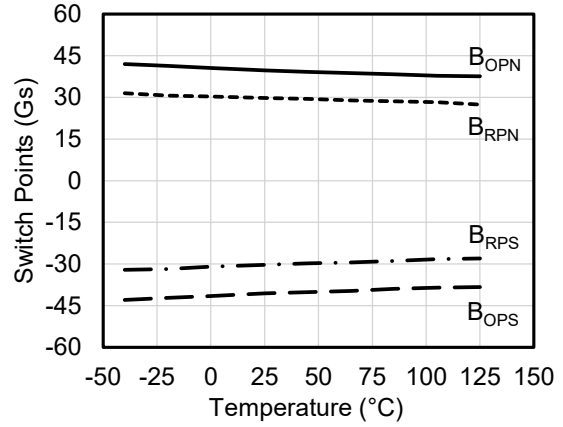


Figure 13. Switch points versus temperature (V_{CC} = 3 V)

TMR13D5 Temperature Characteristics

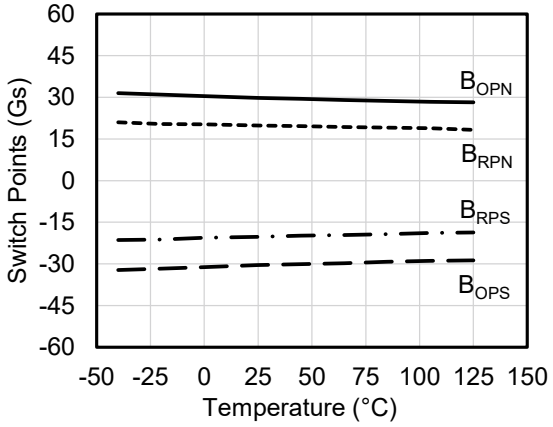


Figure 14. Switch points versus temperature (V_{CC} = 3 V)

TMR13D7 Temperature Characteristics

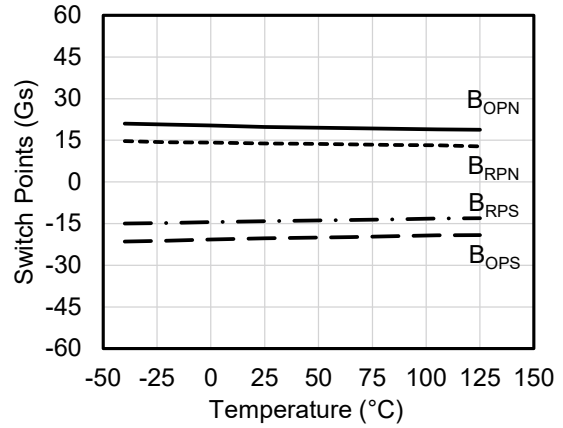


Figure 15. Switch points versus temperature (V_{CC} = 3 V)

TMR13D8 Temperature Characteristics

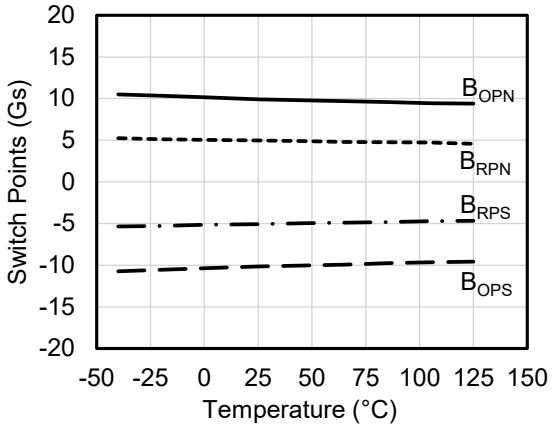


Figure 16. Switch points versus temperature (V_{CC} = 3 V)

9. Application Information

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 17, the typical value is 0.1 μF.

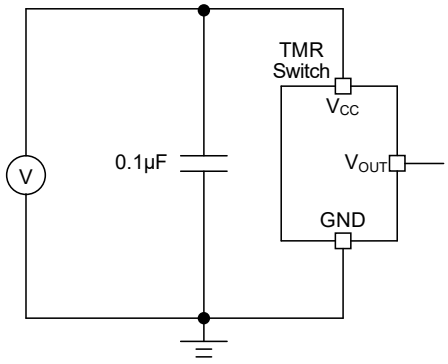


Figure 17. Application circuit diagram

The TMR13Dx series sensor chips are not suitable for driving power loads. Figure 18 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.

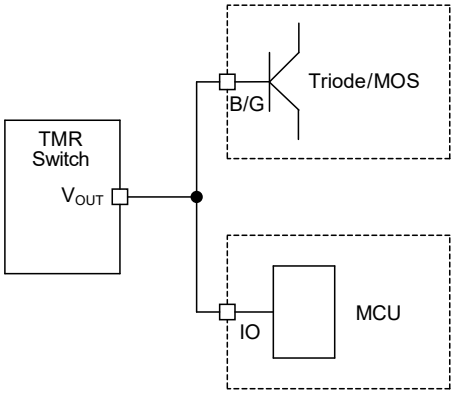


Figure 18. Application diagram for driving power load

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.

The TMR13Dx power-up phase reads the switch point values in the register within the voltage range of 1.2 V < V_{CC} < 1.4 V. Excessive filtering capacitance (10 μF or higher) will cause the chip to stay between 1.2 V and 1.4 V for a long time during power-up and power-down, causing the register to error and the TMR13Dx to operate abnormally. Please avoid longer power-up and power-down times when using, and the recommended power-up and power-down timing are shown in Figure 19 and 20.

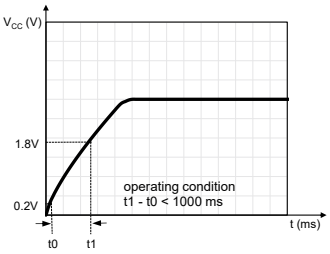


Figure 19. Power up timing

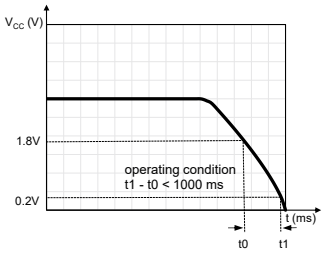


Figure 20. Power down timing

10. Dimensions

SOT23-3 Package

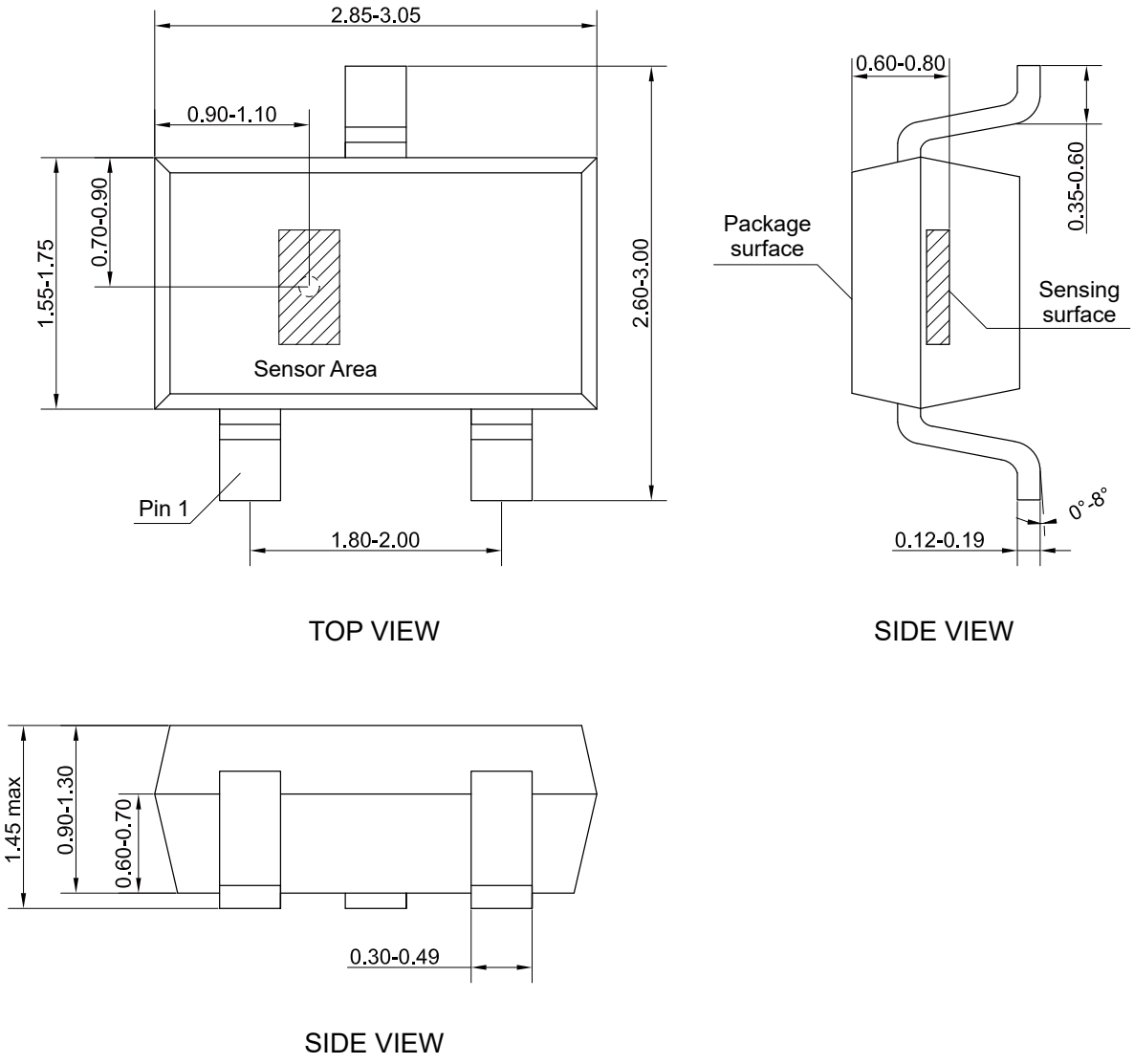


Figure 21. Package outline of SOT23-3 (unit: mm)

TO92S Package

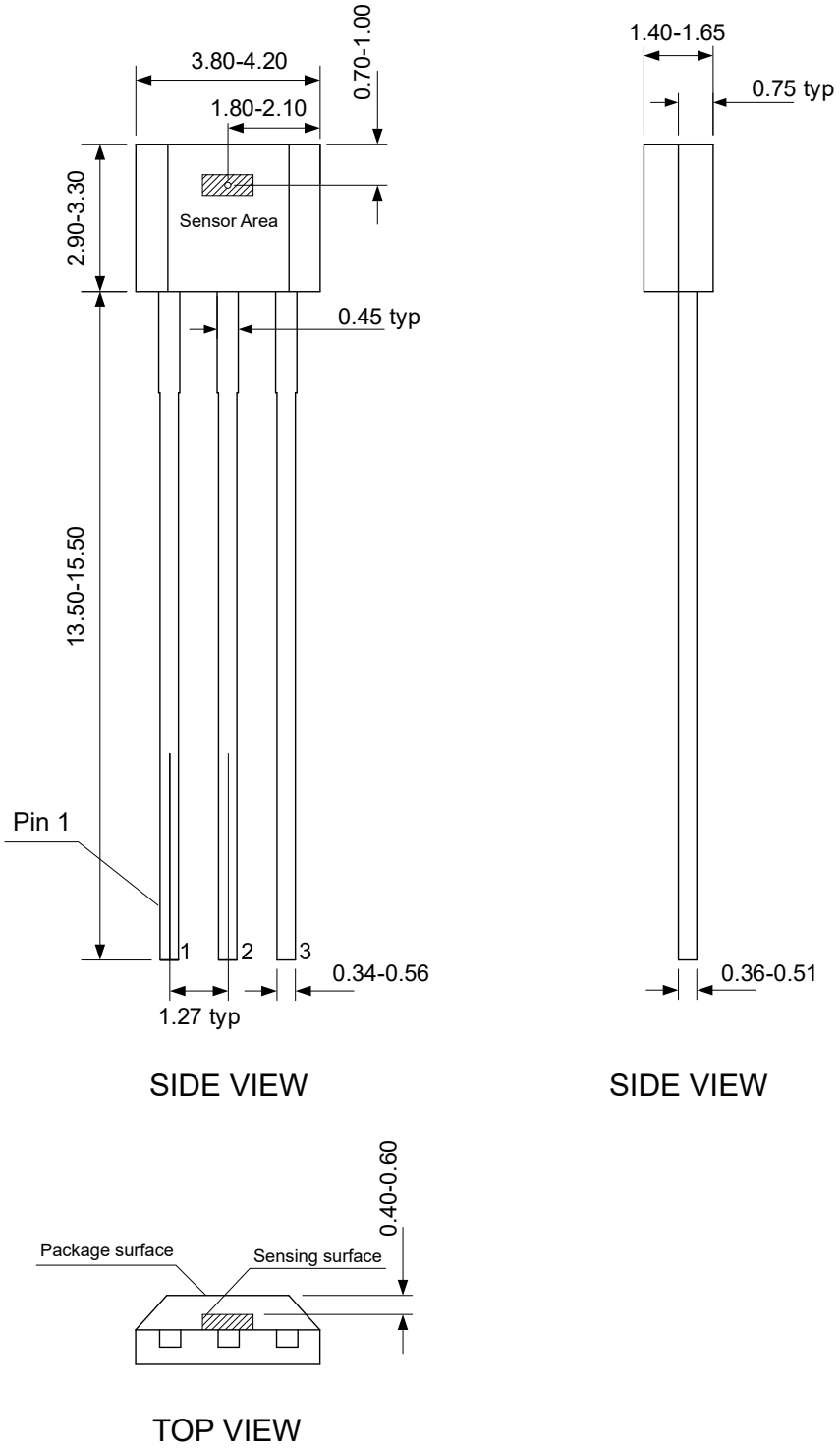


Figure 22. Package outline of TO92S (unit: mm)

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.

MULTIDIMENSION
MultiDimension Technology Co., Ltd.
No.2 Guangdong Road, Zhangjiagang Free Trade Zone, Jiangsu, China
Web：www.dowaytech.com/en E-mail：info@dowaytech.com