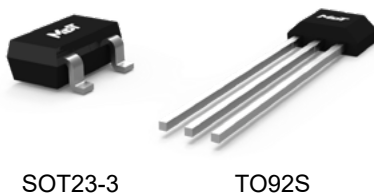


# TMR138x

## High-Voltage TMR Omnipolar Switch

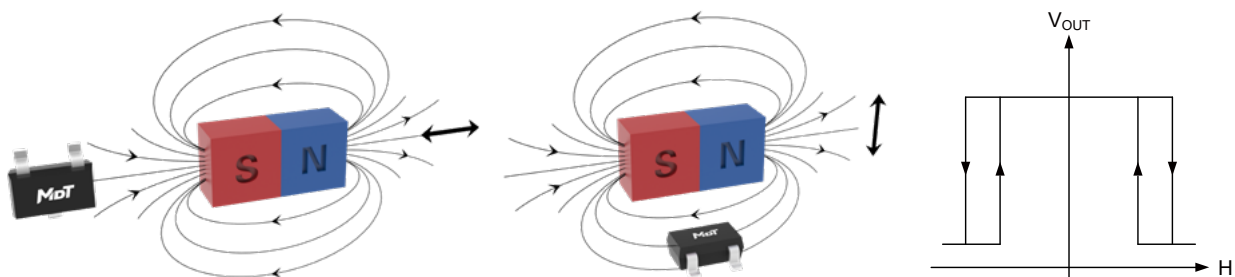
### Description

TMR138x is a digital omnipolar magnetic switch that integrates TMR and CMOS technology in order to provide a magnetically triggered digital switch with high sensitivity, high speed, and low power consumption. It is designed for use in applications that are both power-critical and performance-demanding. It contains a push-pull TMR sensor bridge and CMOS signal processing circuitry within the same package, including an on-chip TMR voltage generator for precise magnetic sensing, a TMR voltage amplifier and comparator plus a schmitt trigger to provide switching hysteresis for noise rejection, and an open-drain output. An internal band gap regulator is used to provide a temperature compensated supply voltage for internal circuits, permitting a wide range of supply voltages from 3 V up to 40 V. The TMR138x draws only 0.6 mA resulting in low-power operation. 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.



SOT23-3

TO92S



### Features and Benefits

- Tunneling magnetoresistance (TMR) technology
- Low power consumption < 0.6 mA
- High frequency response  $\geq 100$  kHz
- Omnipolar operation
- In-plane X-Axis sensing
- High supply voltages of 40 V and 30 V reverse voltage
- Open-drain 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
- Position sensing
- Motor and fan control
- Power window

## Selection Guide

Part Number	Supply Current	Response Frequency	Operating Ambient Temperature	Operating Point	Release Point	Package	Packing Form
TMR1383S	0.5 mA	100 kHz	-40 °C to 125 °C	±26 Gs	±19 Gs	SOT23-3	Tape & Reel
TMR1383T	0.5 mA	100 kHz	-40 °C to 125 °C	±26 Gs	±19 Gs	TO92S	ESD Bag
TMR1387S	0.5 mA	100 kHz	-40 °C to 125 °C	±65 Gs	±40 Gs	SOT23-3	Tape & Reel

Note: Please contact MultiDimension Technology local sales for customizing operating and release points.

## Catalogue

1. Functional Block Diagram.....	03
2. Switching Characteristics .....	03
3. Pin Configuration .....	03
4. Absolute Maximum Ratings .....	04
5. Electrical Specifications.....	04
6. Magnetic Specifications.....	05
7. Typical Supply Voltage Characteristics.....	06
8. Typical Temperature Characteristics .....	06
9. Application Information .....	07
10. Dimensions.....	08

## 1. Functional Block Diagram

TMR138x 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.

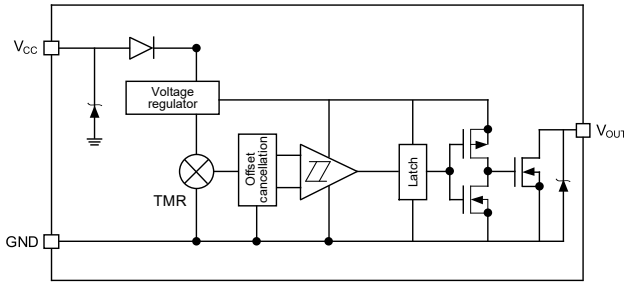


Figure 1. Block diagram

## 2. Switching Characteristics

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

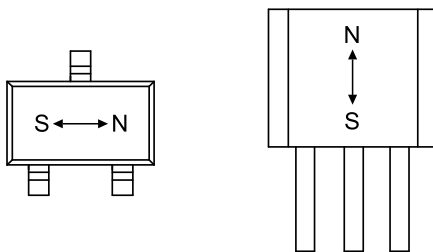


Figure 2. Sensing direction

The output is “High”, when power is on at zero magnetic field.  $B$  is the external magnetic field along the sensing direction,  $B_{OPS}$  ( $B_{OPN}$ ) 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.

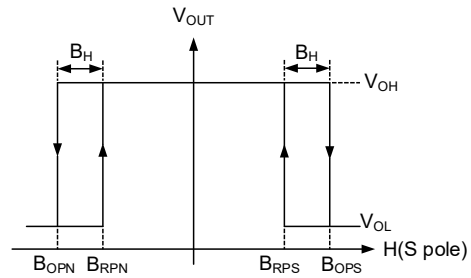


Figure 3. Switching characteristics

## 3. Pin Configuration

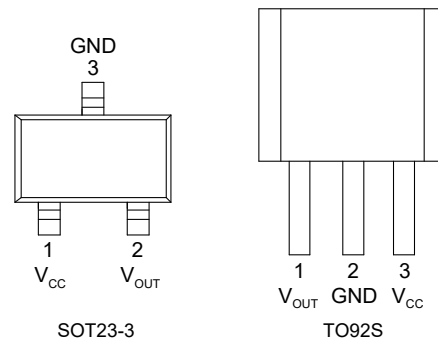


Figure 4. Pin configuration

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	$V_{CC}$	-	40	V
Reverse supply voltage	$V_{RCC}$	-	30	V
Output current	$I_{SINK}$	-	25	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

## 5. Electrical Specifications

$V_{CC} = 24\text{ V}$ ,  $T_A = 25\text{ °C}$

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	$V_{CC}$	Operating	3	24	40	V
Output stress voltage	$V_{stress}$	-	-	-	40	V
Output leak current	$I_{leak}$	OUT = H, $V_{CC} = 24\text{ V}$ , $V_{OUT} = 24\text{ V}$	-	3	-	$\mu\text{A}$
Off resistance of output	$R_{OFF}$	OUT = H	-	10	-	$\text{M}\Omega$
Output low voltage	$V_{OL}$	OUT = L, $V_{CC} = 24\text{ V}$ , $I_{SINK} = 25\text{ mA}$	-	-	0.3	V
On resistance of output	$R_{ON}$	OUT = L	-	-	10	$\Omega$
Supply current	$I_{CC}$	Output Open	0.4	0.5	0.6	mA
Response frequency	F	-	0 to 100			kHz

Note: A 1 k $\Omega$  pull-up resistor is connected between  $V_{CC}$  and  $V_{OUT}$ , and a 0.1  $\mu\text{F}$  capacitor is connected between  $V_{CC}$  and GND during all tests in the table above.

## 6. Magnetic Specifications

$V_{CC} = 24\text{ V}$ ,  $T_A = 25\text{ }^\circ\text{C}$

### TMR1383

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operate point	$B_{OPS}$	-	26	-	Gs
	$B_{OPN}$	-	-26	-	Gs
Release point	$B_{RPS}$	-	19	-	Gs
	$B_{RPN}$	-	-19	-	Gs
Hysteresis	$B_H$	-	7	-	Gs

### TMR1387

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operate point	$B_{OPS}$	-	65	-	Gs
	$B_{OPN}$	-	-65	-	Gs
Release point	$B_{RPS}$	-	40	-	Gs
	$B_{RPN}$	-	-40	-	Gs
Hysteresis	$B_H$	-	25	-	Gs

## 7. Typical Supply Voltage Characteristics

TMR1383 Supply Voltage Characteristics

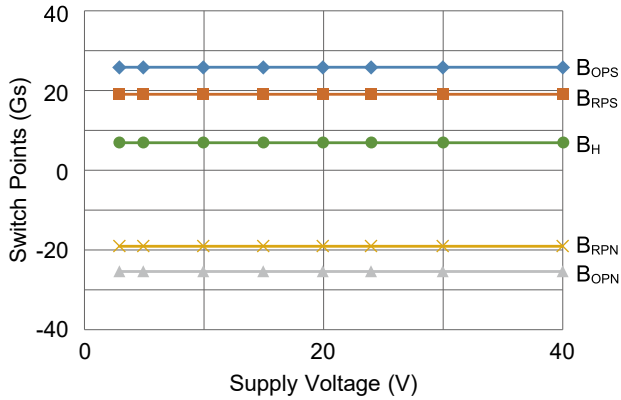


Figure 5. Switch points versus supply voltage ( $T_A = 25^\circ\text{C}$ )

TMR1387 Supply Voltage Characteristics

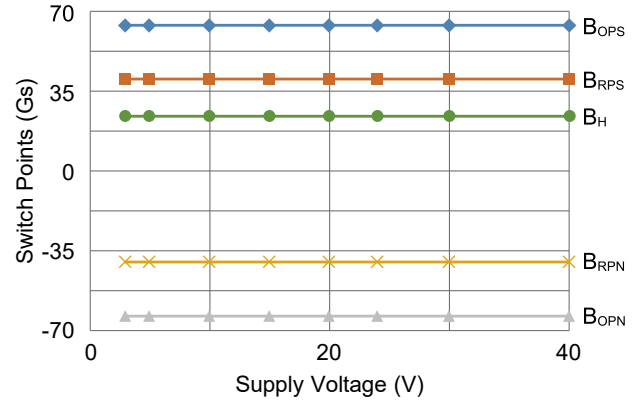


Figure 6. Switch points versus supply voltage ( $T_A = 25^\circ\text{C}$ )

## 8. Typical Temperature Characteristics

TMR1383 Temperature Characteristics

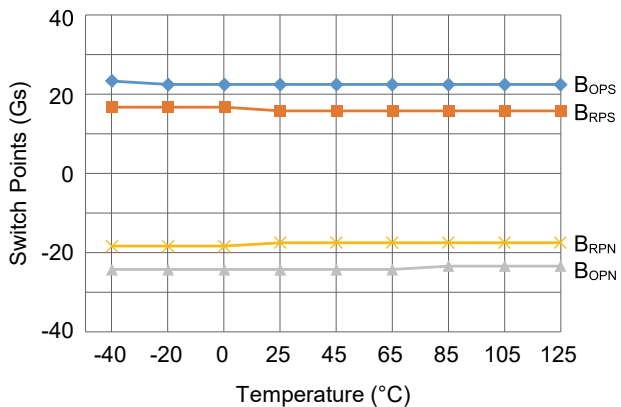


Figure 7. Switch points versus temperature ( $V_{CC} = 24\text{ V}$ )

TMR1387 Temperature Characteristics

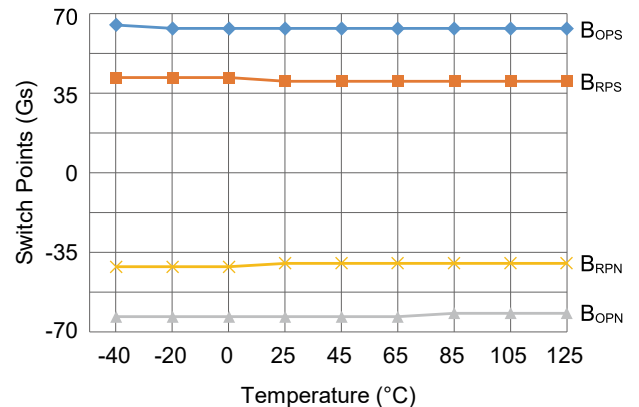


Figure 8. Switch points versus temperature ( $V_{CC} = 24\text{ V}$ )

## 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 9, the typical value is 0.1  $\mu\text{F}$ .

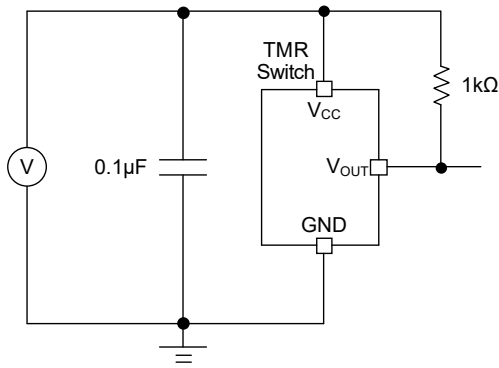


Figure 9. Application circuit diagram

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  $V_{\text{OUT}}$  to control high-power relays, etc., and cause  $I_{\text{SINK}}$  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

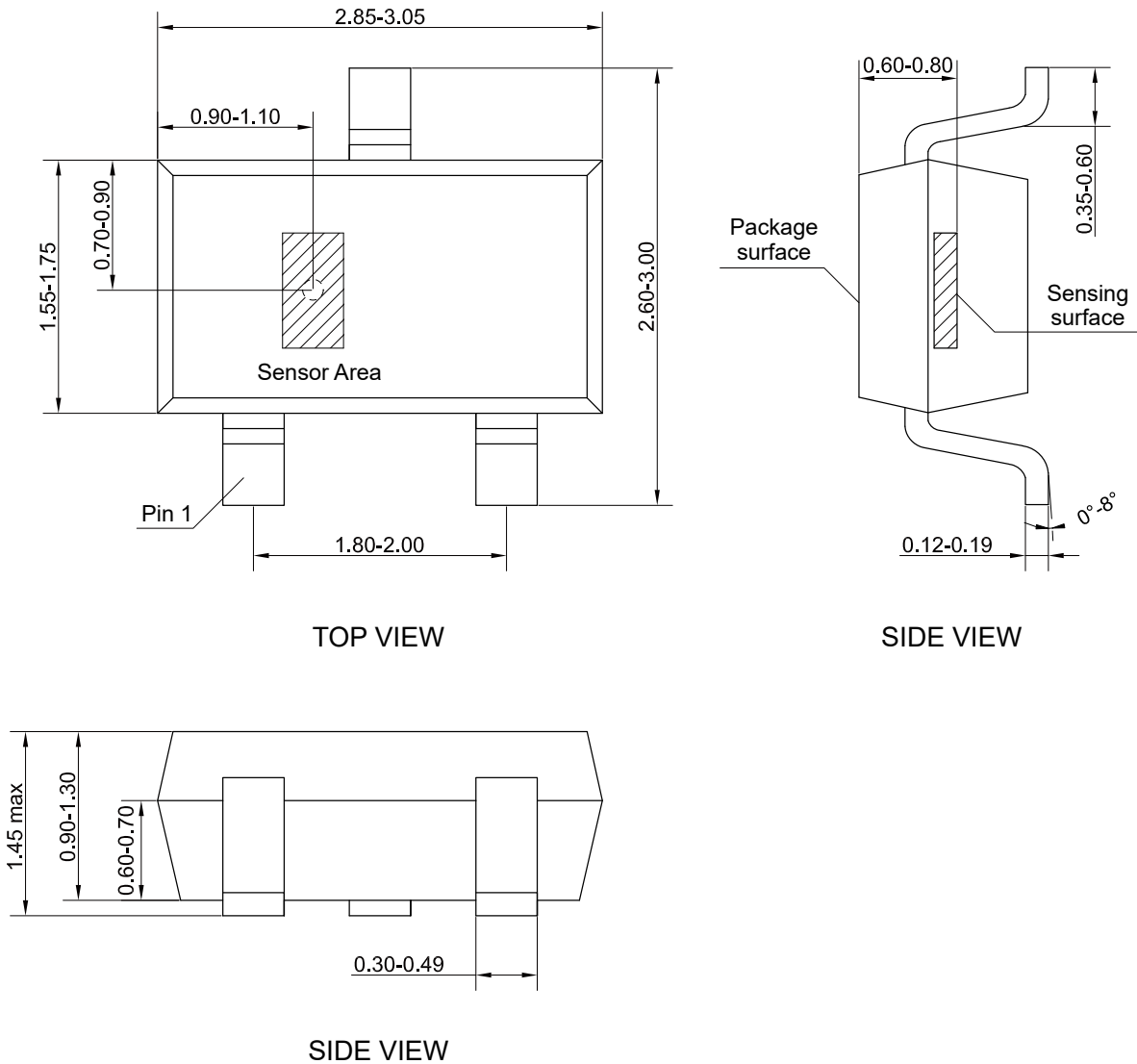


Figure 10. Package outline of SOT23-3 (unit: mm)



TO92S Package

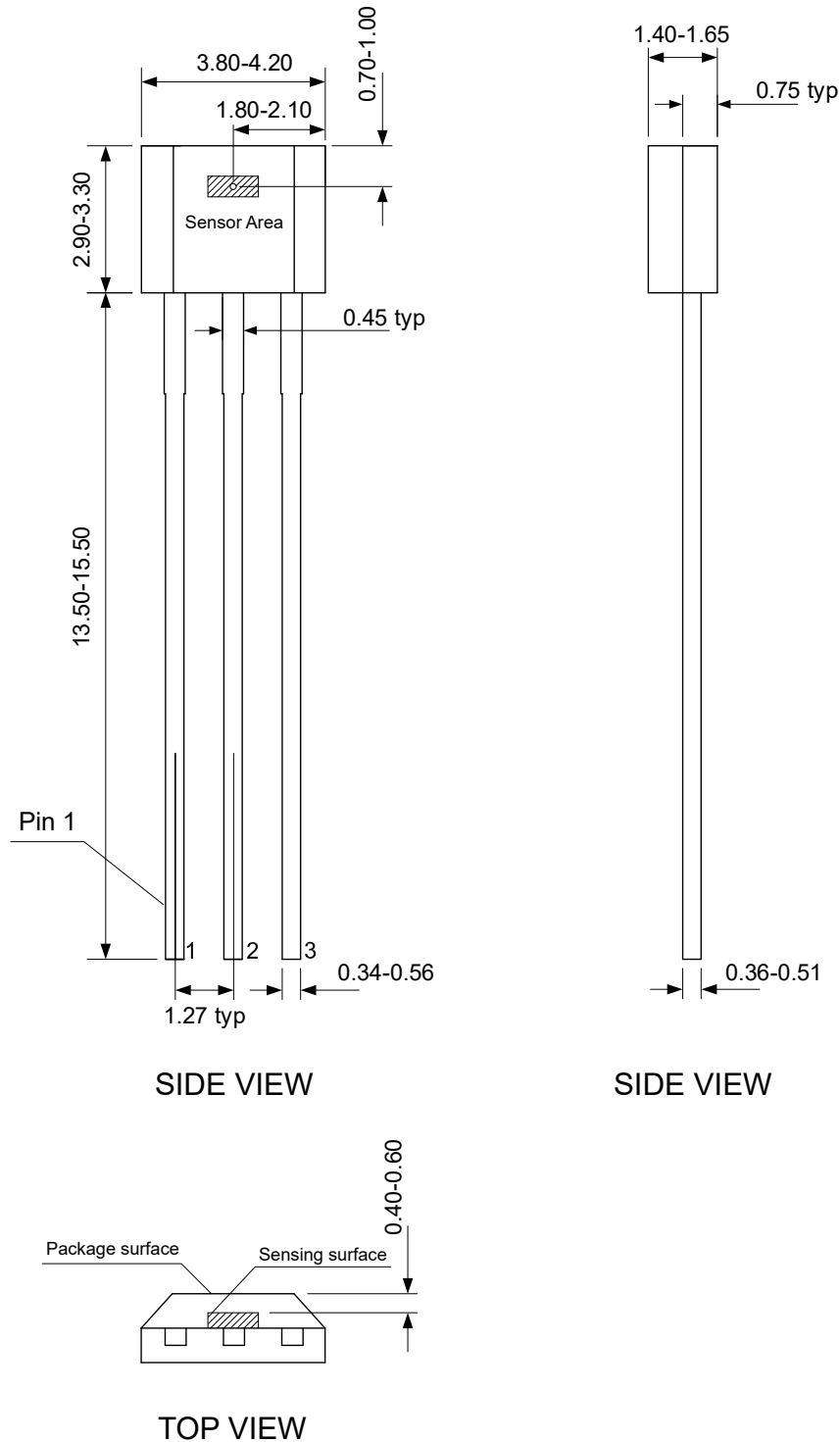


Figure 11. Package outline of TO92S (unit: mm)

Copyright © 2023 by MultiDimension Technology Co., Ltd.

Information furnished herein by MultiDimension Technology Co., Ltd. (hereinafter MDT) is believed to be accurate and reliable. However, MDT disclaims any and all warranties and liabilities of any kind, with respect to any examples, hints or any performance or use of technical data as described herein and/or any information regarding the application of the product, including without limitation warranties of non-infringement of intellectual property rights of any third party. This document neither conveys nor implies any license under patent or other industrial or intellectual property rights. Customer or any third-party must further determine the suitability of the MDT products for its applications to avoid the applications default of customer or third-party. MDT accept no liability in this respect.

MDT does not assume any liabilities of any indirect, incidental, punitive, special or consequential damages (including without limitation of lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory. Notwithstanding any damages that customer might incur for any reason whatsoever, MDT's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the terms and conditions of commercial sale of MDT.

Absolute maximum ratings are the extreme limits the device will withstand without damage to the MDT product. However, the electrical and mechanical characteristics are not guaranteed as the maximum limits (above recommended operating conditions) are approached. MDT disclaims any and all warranties and liabilities of the MDT product will operate at absolute maximum ratings.

Specifications may change without notice.

Please download latest document from our official website [www.dowaytech.com/en](http://www.dowaytech.com/en).

## 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.



No.2 Guangdong Road, Zhangjiagang Free Trade Zone, Jiangsu, China

Web: [www.dowaytech.com/en](http://www.dowaytech.com/en) E-mail: [info@dowaytech.com](mailto:info@dowaytech.com)

