

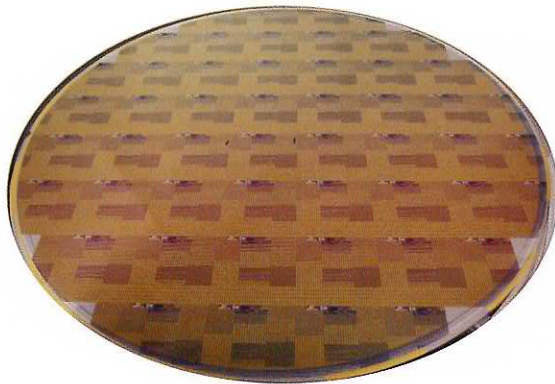
## MDT: Leading Supplier of TMR Magnetic Sensors

### Quick Facts of MDT

- First Volume Supplier of Tunneling Magnetoresistance (TMR) Sensors
- Owns 70+ Patents on TMR Sensor Design and Applications
- Developed Advanced TMR Sensor Fab for Volume Production
- Founded 2010 in Zhangjiagang, China
- Launched Volume Production of Several TMR Sensor Products in 2012



MDT's TMR Sensor Fab in Zhangjiagang, China



[www.multidimensiontech.com](http://www.multidimensiontech.com)

TMR Sensor Wafer Manufactured by MDT

Product	Applications	Features
<b>TMR Switch Sensor</b>	<ul style="list-style-type: none"> <li>• Flow meters</li> <li>• Motor control</li> <li>• Proximity switches</li> </ul>	<ul style="list-style-type: none"> <li>• Low power</li> <li>• High frequency response</li> </ul>
<b>TMR Linear Sensor</b>	<ul style="list-style-type: none"> <li>• Current Sensors</li> <li>• Magnetic Field Sensors</li> <li>• Position Sensors</li> </ul>	<ul style="list-style-type: none"> <li>• High sensitivity</li> <li>• Low power</li> <li>• Large dynamic range</li> </ul>
<b>TMR Angle Sensor</b>	<ul style="list-style-type: none"> <li>• Flow meters</li> <li>• Rotary encoders</li> <li>• Potentiometers</li> </ul>	<ul style="list-style-type: none"> <li>• Robust output with high amplitude</li> <li>• Allowing large air-gap or small magnets</li> </ul>
<b>TMR Gear Tooth Sensor</b>	<ul style="list-style-type: none"> <li>• Gear tooth detection</li> <li>• Linear and rotary encoders</li> <li>• Speed sensors</li> </ul>	<ul style="list-style-type: none"> <li>• Small pitch detection</li> <li>• High sensitivity</li> <li>• Allowing large air-gap or small magnets</li> </ul>

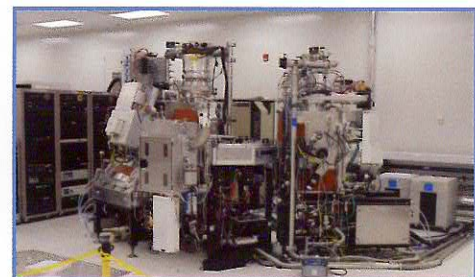
Summary of MDT's TMR Sensor Products



TMR Deposition Tool



Magnetic Annealing Oven

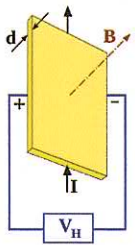


Ion Beam Etching/Deposition Tool

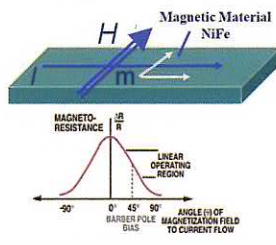
## TMR: New Generation Magnetic Sensor Technology

### Technology Advancement

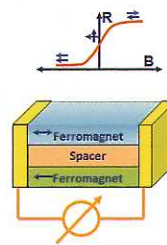
#### Hall Effect



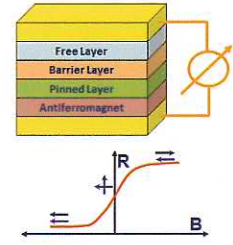
#### AMR – Anisotropic Magnetoresistance



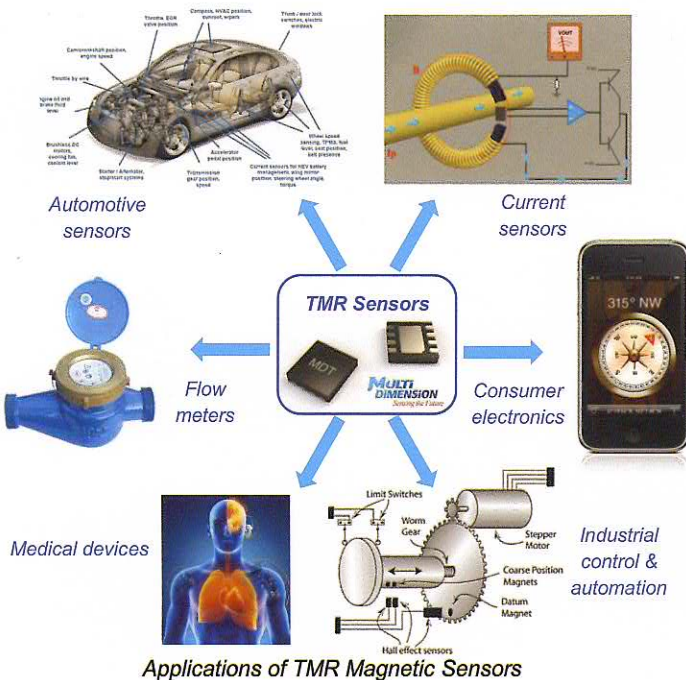
#### GMR – Giant Magnetoresistance



#### TMR – Tunneling Magnetoresistance



Technology	Power Consumption (mA)	Die Size (mm <sup>2</sup> )	Field Sensitivity (mV/V/Oe)	Dynamic Range (Oe)	Resolution (mOe)	Temperature Performance (°C)
Hall Effect	5 – 20	1 × 1	~ 0.05	±1000	~ 500	< 150
AMR	1 – 10	1 × 1	~ 1	±10	~ 0.1	< 150
GMR	1 – 10	1 × 1	~ 3	±20	~ 2	< 150
TMR	0.001 – 0.01	1 × 1	6 – 20	±150	~ 0.1	< 200



## MDT TMR Sensors

- Very High Sensitivity
- Very Low Power Consumption
- Large Dynamic Range
- Low Hysteresis
- Small Die Size
- Allowing Small Magnets or Larger Air-Gap



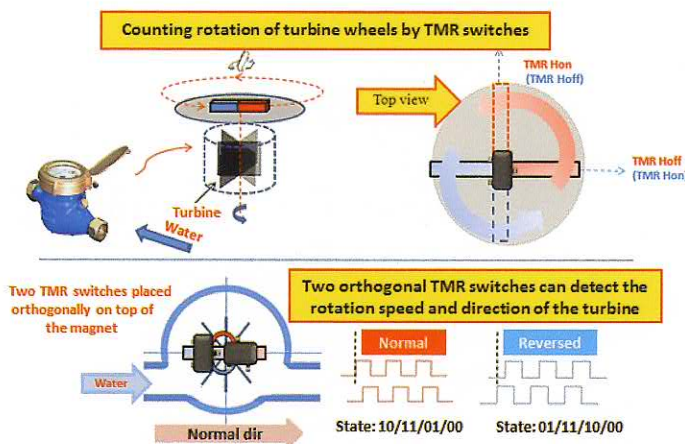
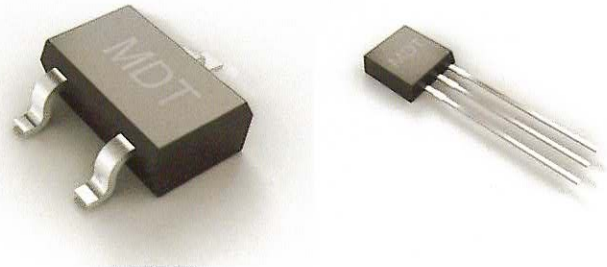
MultiDimension (MDT) Offers Best in Class Magnetoresistive Sensors and Solutions.

Sensing the Future

## TMR Magnetic Switch Sensor

### Features

- Tunneling Magnetoresistance (TMR) Technology
- Ultra Low Power at 1.5-4.5 $\mu$ A
- High Frequency Response
- Excellent Thermal Stability
- Small Form Factor



### Applications

- Smart Flow Meters: Water / Gas / Heat Meters
- Proximity Switches
- Motor Controllers

### Products

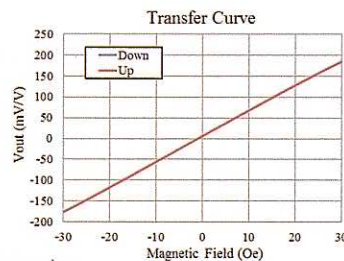
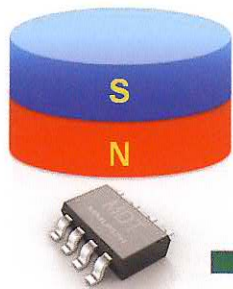
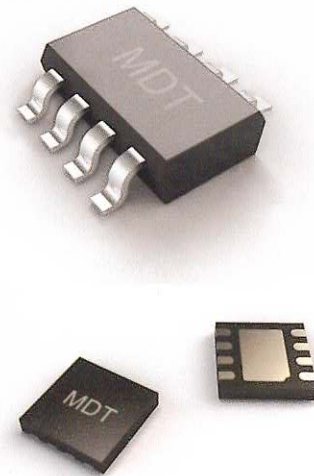
Part No.	Type	Supply Current ( $\mu$ A) @3V	BOP (G)	BRP (G)
MMS2X1H	Omnipolar	1.5	$\pm 17$	$\pm 10$
MMS201H	Omnipolar	4.5	$\pm 15$	$\pm 10$
MMS1X1H	Bipolar	1.4	+17	-17
MMS101H	Bipolar	3.4	+15	-15



## TMR Linear Magnetic Field Sensor

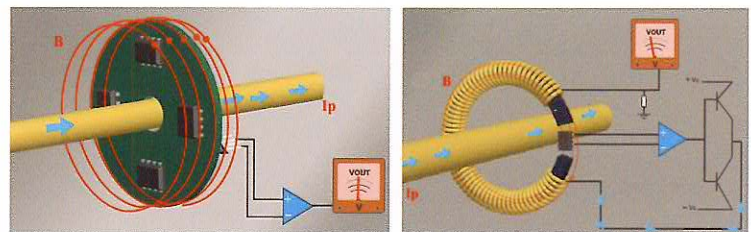
### Features

- Tunneling Magnetoresistance (TMR) Technology
- High Sensitivity up to 12mV/V/Oe
- Very Low Power Consumption
- Large Dynamic Range
- Low Hysteresis



### Applications

- Magnet Field Sensing
- Current Sensors
- Position Sensors



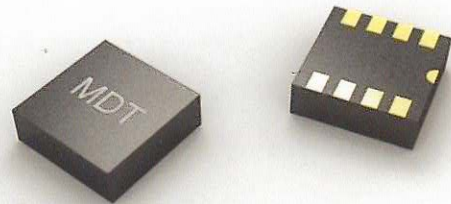
### Products

Part No.	Sensitivity (mV/V/Oe)	Dynamic Range (Oe)	Linear Range (Oe)	Supply Current (µA)@1V	Hysteresis (%FS)
MMLP57H	3.0	±70	±30	5	0.1
MMLP57F	4.9	±90	±30	11 – 22	0.1
MMLH45F	12.0	±50	±15	12.5	1.0

## TMR Magnetic Angle Sensor

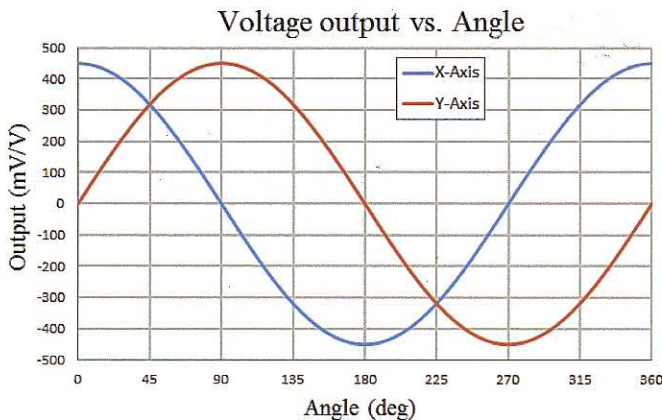
### Features

- Tunneling Magnetoresistance (TMR) Technology
- Contactless 360° Measurement
- Very Low Power Consumption
- Large Signal Output at 900-1030mV/V Allowing Smaller Magnets or Larger Air-Gap



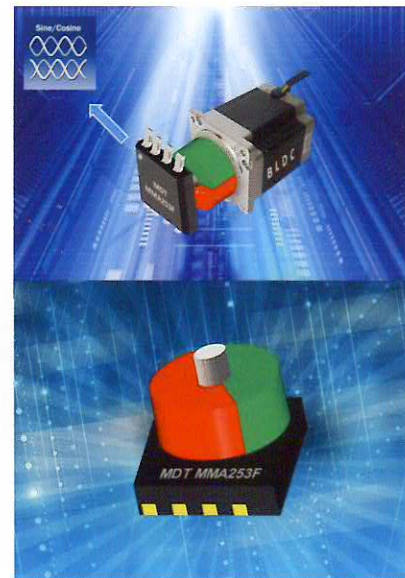
### Applications

- Angular Position Sensors
- Rotary Encoders
- BLDC Controllers
- Contactless Potentiometers



### Products

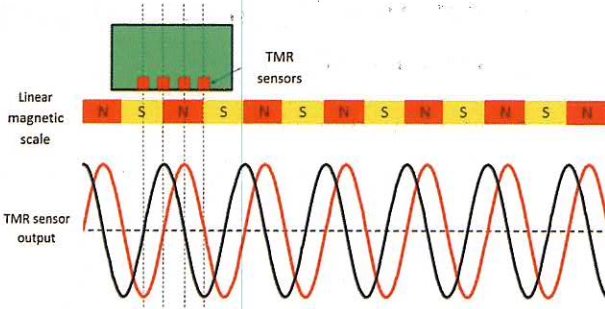
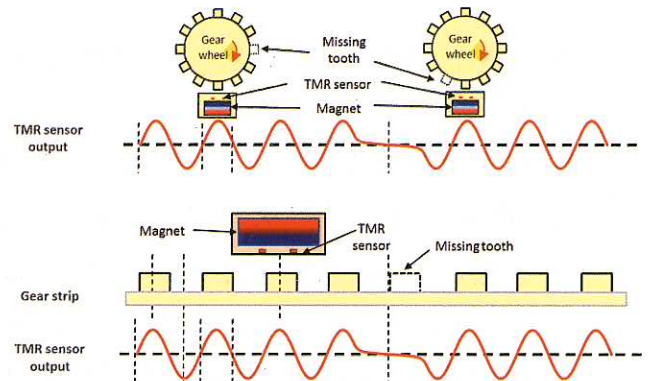
Part No.	Angular Range (°)	Signal Amplitude (mV/V)	Size (mm <sup>2</sup> )	Bridge Resistance (kOhm)
MMA253F	360	1030	3×3	280
MMA233F	360	900	3×3	4



# TMR Magnetic Gear Tooth Sensor

## Features

- Tunneling Magnetoresistance (TMR) Technology
- Small-Pitch Gear Tooth Detection
- High Tolerance to Magnetic Field Interference
- High Sensitivity Allowing Smaller Magnets or Larger Air-Gap
- High Speed Operation

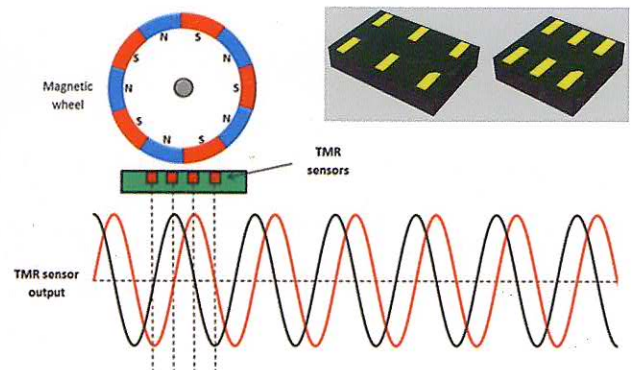


## Applications

- Gear Tooth Detection
- Linear Displacement or Rotary Position Sensors
- Linear Scale or Wheel Speed Sensors

## Products

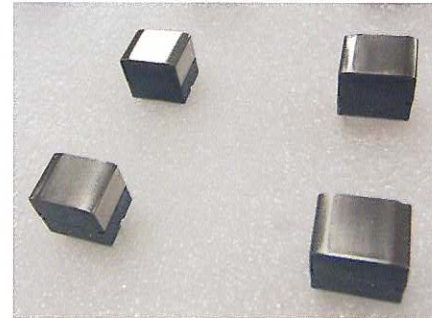
Part No.	Sensor Spacing (mm)	Tooth Pitch (mm)	Size (mm <sup>2</sup> )	Single / Dual Output
MMG145F	0.25	0.3~1.0	3×3	S
MMG245F	0.50	0.7~2.0	3×3	S
MMG345F	0.75	1.0~3.0	3×3	S
MMG245D	0.50	0.7~2.0	3×3	D
MMG445D	1.0	1.3~4.0	3×3	D
MMG845D	2.0	2.7~8.0	3×6	D
MMGC45D	3.0	4.0~12.0	3×6	D



## TMR Magnetic Pattern Recognition Sensor

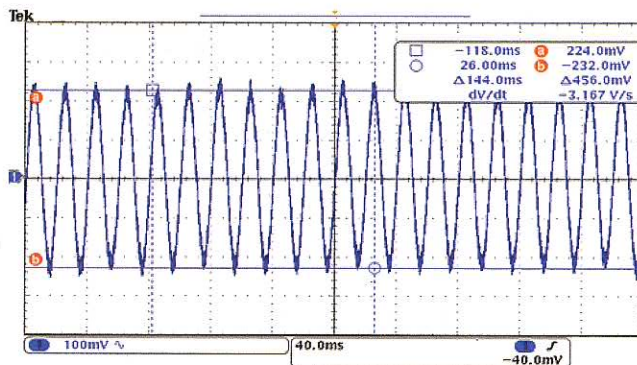
### Features

- Tunneling Magnetoresistance (TMR) Technology
- High Sensitivity
- Excellent Noise Immunity
- High Tolerance to Magnetic Field Interference
- Fast Response Time
- Durable Metal Housing for Heavy-Duty Operations in ATM and Bank Note Counters



### Applications

- Bank Note Validator
- Magnetic Ink Reader



### Product

Part No.	Supply Voltage (V)	Output Voltage (mV rms)	SNR (dB)	Detection Width (mm)	Resolution (mm)	Resistance (kOhm)
MMG332TG	5.0	280 – 400	+30	5.0	0.75	2.0

## TMR Sensor Modules and Demo Kits

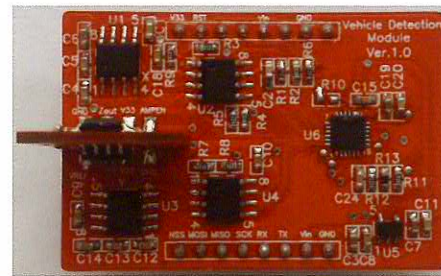
### TMR Potentiometer

- Applications: knob controllers
- Voltage supply: 4 – 6V
- Angular position range:  $324^{\circ} \pm 5^{\circ}$
- Output format: PWM
- Duty cycle: 5 – 95%
- Integrated TMR angle sensor MMA253F with MCU



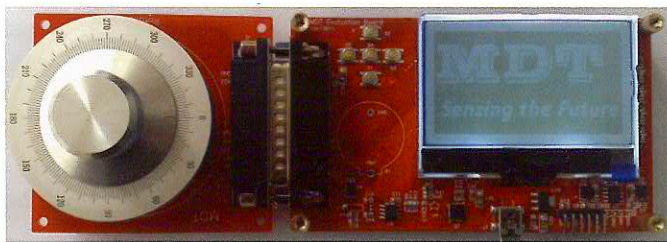
### TMR Parking Sensor

- Applications: vehicle detection, magnetic field measurement
- Voltage supply: 3.7 – 5.5V
- Sampling rate: 100 Hz
- Output format: SPI, with vehicle status and 3-axis field reading
- Integrated TMR linear sensor MMLP57F with MCU



### TMR Angle Sensor Demo

- Demo kit for TMR angle sensor MMA253F, with programming interface (top) or LCD (bottom)
- Real-time feedback of angular position of the knob
- Voltage supply: USB 5V or 9V
- Output format: SPI/UART/ABZ/PWM



### TMR Switch Sensor Demo

- Single demo kit for TMR omnipolar switch MMS201H and TMR bipolar switch MMS101H
- Real-time display of sensor states by LEDs
- Voltage supply: 1.8 – 5.5V

