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

<table>
<thead>
<tr>
<th>Product</th>
<th>Applications</th>
<th>Features</th>
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<tbody>
<tr>
<td>TMR Switch Sensor</td>
<td>Flow meters</td>
<td>Low power, High frequency</td>
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<tr>
<td></td>
<td>Motor control</td>
<td>response</td>
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<td></td>
<td>Proximity switches</td>
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<tr>
<td>TMR Linear Sensor</td>
<td>Current Sensors</td>
<td>High sensitivity, Low power,</td>
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<td>Magnetic Field Sensors</td>
<td>Large dynamic range</td>
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<td>Position Sensors</td>
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<tr>
<td>TMR Angle Sensor</td>
<td>Flow meters</td>
<td>Robust output with high</td>
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<tr>
<td></td>
<td>Rotary encoders</td>
<td>amplitude</td>
</tr>
<tr>
<td></td>
<td>Potentiometers</td>
<td>Allowing large air-gap or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>small magnets</td>
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<tr>
<td>TMR Gear Tooth Sensor</td>
<td>Gear tooth detection</td>
<td>Small pitch detection, High</td>
</tr>
<tr>
<td></td>
<td>Linear and rotary encoders</td>
<td>sensitivity, Allowing large</td>
</tr>
<tr>
<td></td>
<td>Speed sensors</td>
<td>air-gap or small magnets</td>
</tr>
</tbody>
</table>

MDT Sensor Wafer Manufactured by MDT

Summary of MDT’s TMR Sensor Products

TMR Deposition Tool
Magnetic Annealing Oven
Ion Beam Etching/Deposition Tool

www.multidimensiontech.com

MultiDimension Technology Co., Ltd. (MDT)
info@multidimensiontech.com
TMR: New Generation Magnetic Sensor Technology

<table>
<thead>
<tr>
<th>Technology</th>
<th>Power Consumption (mA)</th>
<th>Die Size (mm²)</th>
<th>Field Sensitivity (mV/V/Oe)</th>
<th>Dynamic Range (Oe)</th>
<th>Resolution (mOe)</th>
<th>Temperature Performance (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hall Effect</td>
<td>5 – 20</td>
<td>1 x 1</td>
<td>~ 0.05</td>
<td>±1000</td>
<td>~ 500</td>
<td>&lt; 150</td>
</tr>
<tr>
<td>AMR</td>
<td>1 – 10</td>
<td>1 x 1</td>
<td>~ 1</td>
<td>±10</td>
<td>~ 0.1</td>
<td>&lt; 150</td>
</tr>
<tr>
<td>GMR</td>
<td>1 – 10</td>
<td>1 x 1</td>
<td>~ 3</td>
<td>±20</td>
<td>~ 2</td>
<td>&lt; 150</td>
</tr>
<tr>
<td>TMR</td>
<td>0.001 – 0.01</td>
<td>1 x 1</td>
<td>6 – 20</td>
<td>±150</td>
<td>~ 0.1</td>
<td>&lt; 200</td>
</tr>
</tbody>
</table>

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

Applications of TMR Magnetic Sensors
TMR Magnetic Switch Sensor

Features

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

Applications

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

Products

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Type</th>
<th>Supply Current (μA) @3V</th>
<th>BOP (G)</th>
<th>BRP (G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMS2X1H</td>
<td>Omnipolar</td>
<td>1.5</td>
<td>±17</td>
<td>±10</td>
</tr>
<tr>
<td>MMS201H</td>
<td>Omnipolar</td>
<td>4.5</td>
<td>±15</td>
<td>±10</td>
</tr>
<tr>
<td>MMS1X1H</td>
<td>Bipolar</td>
<td>1.4</td>
<td>+17</td>
<td>-17</td>
</tr>
<tr>
<td>MMS101H</td>
<td>Bipolar</td>
<td>3.4</td>
<td>+15</td>
<td>-15</td>
</tr>
</tbody>
</table>
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

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

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Angular Range (°)</th>
<th>Signal Amplitude (mV/V)</th>
<th>Size (mm²)</th>
<th>Bridge Resistance (kOhm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMA253F</td>
<td>360</td>
<td>1030</td>
<td>3×3</td>
<td>280</td>
</tr>
<tr>
<td>MMA233F</td>
<td>360</td>
<td>900</td>
<td>3×3</td>
<td>4</td>
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</tbody>
</table>

No. 7 Guangdong Road
Zhangjiagang Free Trade Zone
Jiangsu 215634, China

MultiDimension Technology Co., Ltd. (MDT)
www.multidimensiontech.com
info@multidimensiontech.com

6000 Hellyer Ave. Suite 100
San Jose, CA 95138, USA
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

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Sensor Spacing (mm)</th>
<th>Tooth Pitch (mm)</th>
<th>Size (mm²)</th>
<th>Single / Dual Output</th>
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</thead>
<tbody>
<tr>
<td>MMG145F</td>
<td>0.25</td>
<td>0.3~1.0</td>
<td>3×3</td>
<td>S</td>
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<td>MMG245F</td>
<td>0.50</td>
<td>0.7~2.0</td>
<td>3×3</td>
<td>S</td>
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<tr>
<td>MMG345F</td>
<td>0.75</td>
<td>1.0~3.0</td>
<td>3×3</td>
<td>S</td>
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<tr>
<td>MMG245D</td>
<td>0.50</td>
<td>0.7~2.0</td>
<td>3×3</td>
<td>D</td>
</tr>
<tr>
<td>MMG445D</td>
<td>1.0</td>
<td>1.3~4.0</td>
<td>3×3</td>
<td>D</td>
</tr>
<tr>
<td>MMG845D</td>
<td>2.0</td>
<td>2.7~8.0</td>
<td>3×6</td>
<td>D</td>
</tr>
<tr>
<td>MMGC45D</td>
<td>3.0</td>
<td>4.0~12.0</td>
<td>3×6</td>
<td>D</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Supply Voltage (V)</th>
<th>Output Voltage (mV rms)</th>
<th>SNR (dB)</th>
<th>Detection Width (mm)</th>
<th>Resolution (mm)</th>
<th>Resistance (kOhm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMG332TG</td>
<td>5.0</td>
<td>280 – 400</td>
<td>+30</td>
<td>5.0</td>
<td>0.75</td>
<td>2.0</td>
</tr>
</tbody>
</table>
# TMR Sensor Modules and Demo Kits

## TMR Potentiometer
- **Applications:** knob controllers
- **Voltage supply:** 4 – 6V
- **Angular position range:** 324° ± 5°
- **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