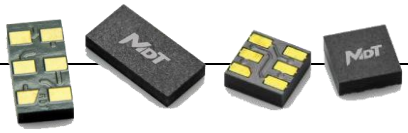
# TMR40xx Series

## TMR Geartooth Sensor

RoHS COMPLIANT



### DESCRIPTION

The TMR40xx series of geartooth sensor adopts a unique push-pull Wheatstone bridge design. This design includes a single-channel or dual-channel Wheatstone full bridge composed of four or eight unshielded high-sensitivity tunneling magnetoresistance (TMR) sensing elements. The Wheatstone bridge provides a differential voltage output along the gradient of the applied magnetic field along the sensor's sensing direction.

The dual-channel Wheatstone full bridge generates two orthogonal sine/cosine voltage output signals to measure the position of the gear rotation and detect the direction of rotation. The high-sensitivity performance of the TMR40xx series enables detection of small magnetic field changes, and its output signal has good temperature stability.

TMR40xx series provides multiple configuration of TMR sensing element spacing: 0.25mm, 0.4mm, 0.5mm, 0.6mm, 0.75mm, 0.8mm,1.0mm,1.2mm,1.4mm, 1.6mm, 2.0mm, and 3.0mm. It is available in two compact LGA packages with dimensions of 3mm×3mm×0.9mm and 3mm×6mm×0.9mm.

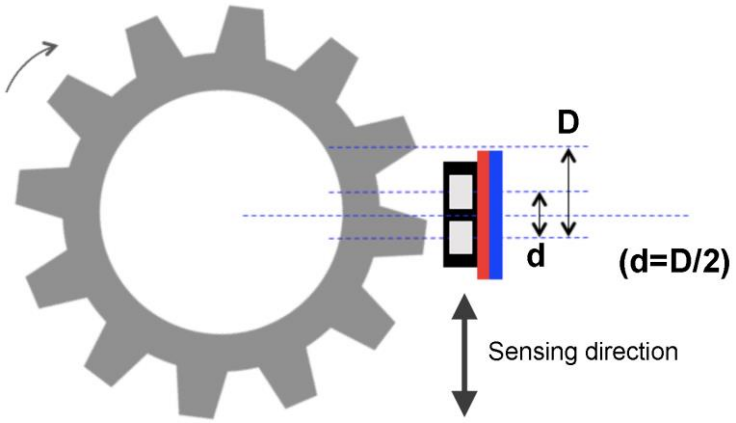
### FEATURES AND BENEFITS

- Tunneling magnetoresistance (TMR) technology
- High saturation field allows operation in large DC magnetic field
- High sensitivity to magnetic gradient
- Compatible to small pitch gear measurement
- Sine/cosine signal output with accurate phase difference
- Excellent resistance to external magnetic field interference
- Wide air gap tolerance
- DC (zero speed) operation
- Excellent thermal stability
- Compact package

## APPLICATIONS

- Gear speed and direction measurement
- Linear and angular speed sensing
- Linear displacement sensing
- Angular displacement sensing
- Magnetic scale
- Magnetic encoder

## APPLICATION SCHEMATICS




## SELECTION GUIDE

| Part Number | Bridge Channel | TMR Element Spacing d (mm) | Gear Pitch D (mm) | Package (mm) |
|---|---|---|---|---|
| TMR4001 | Single | 0.25 | 0.5 | LGA6L (3×3×0.9) |
| TMR4002 | Single | 0.5 | 1.0 | LGA6L (3×3×0.9) |
| TMR4003 | Single | 0.75 | 1.5 | LGA6L (3×3×0.9) |
| TMR4004 | Dual | 0.5 | 1.0 | LGA6L (3×3×0.9) |
| TMR4005 | Dual | 1 | 2.0 | LGA6L (3×3×0.9) |
| TMR4006 | Dual | 2 | 4.0 | LGA6L (3×6×0.9) |
| TMR4007 | Dual | 3 | 6.0 | LGA6L (3×6×0.9) |
| TMR4011 | Dual | 0.4 | 0.8 | LGA6L (3×3×0.9) |
| TMR4012 | Dual | 0.6 | 1.2 | LGA6L (3×3×0.9) |
| TMR4013 | Dual | 0.8 | 1.6 | LGA6L (3×3×0.9) |
| TMR4015 | Dual | 1.2 | 2.4 | LGA6L (3×6×0.9) |
| TMR4016 | Dual | 1.4 | 2.8 | LGA6L (3×6×0.9) |
| TMR4017 | Dual | 1.6 | 3.2 | LGA6L (3×6×0.9) |

## ABSOLUTE MAXIMUM RATINGS

| Parameters | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Supply voltage | $V_{CC}$ | - | 7 | V |
| Reverse supply voltage | $V_{RCC}$ | - | -7 | V |
| External magnetic field | H | - | 1500 | Oe (1) |
| ESD performance (HBM) | $V_{ESD}$ | - | 4000 | V |
| Operating ambient temperature | $T_A$ | -40 | 125 | °C |
| Storage ambient temperature | $T_{STG}$ | -50 | 150 | °C |

## ELECTRICAL AND MAGNETIC SPECIFICATIONS $V_{CC}$ = 3.0 V, $T_A$ = 25 °C, differential output

| Parameter | | Symbol | Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| Supply voltage | | $V_{CC}$ | operating | - | 3 | 7 | V |
| Bridge resistance (2) | Single bridge | R | H=0 Oe | | 9 | | kΩ |
| | Dual bridge | | | | 4.5 | | |
| Saturation magnetic field (3) | | $H_{SAT}$ | | | ±70 | | Oe |
| Non-linearity of resistance | | $NONL_R$ | fit in ±15 Oe | | 5 | | %FS |
| Offset | TMR4001 ~ TMR4005 | $V_{OFFSET}$ | | -20 | | 20 | mV/V |
| | TMR4006 ~ TMR4017 | | | -35 | | 35 | mV/V |
| Hysteresis | | Hys | sweep in ±200 Oe | | 1 | | %FS |
| Typical differential output | | $V_{OUT\_TYP}$ | | | 650 | | mV/V |
| Resistance temperature coefficient | | TCR | H=0 Oe | | -0.10 | | %/°C |
| Sensitivity temperature coefficient | | TCS | | | -0.18 | | %/°C |

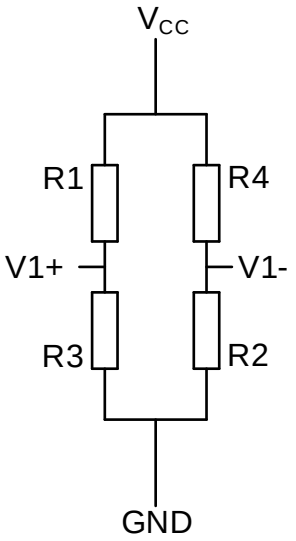
Notes:

(1) 1 Oe (Oersted) = 1 Gauss in air = 0.1 milliTesla = 79.8 A/m

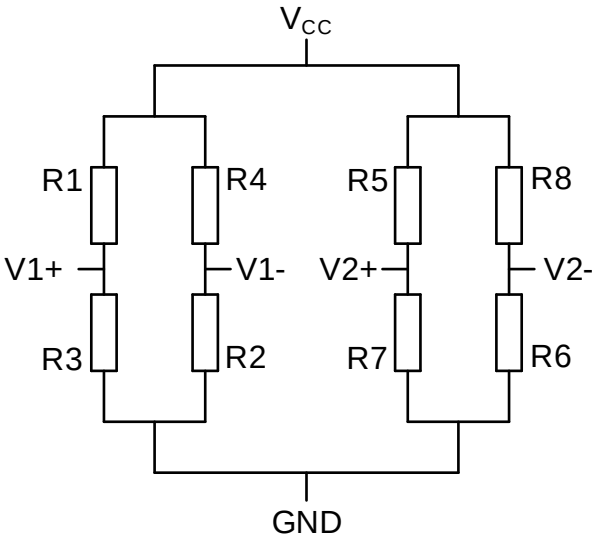
(2) Bridge resistance (resistance between $V_{CC}$ and GND) is can be custom designed. Please contact MultiDimension Technology for details.

(3) Sensor may saturate beyond the range of this magnetic field. Saturation magnetic field can be custom designed. Please contact MultiDimension Technology for details.

## FUNCTIONAL BLOCK DIAGRAM

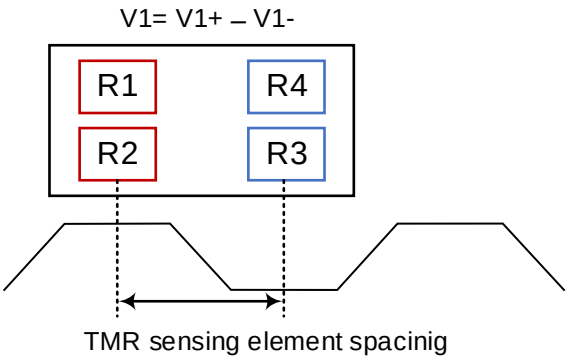



Single bridge

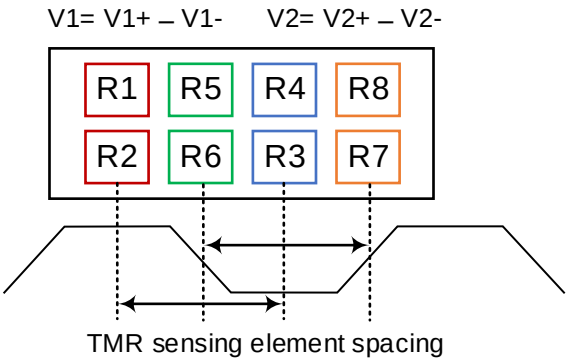



Dual bridge

## TMR SENSING ELEMENT SPACING SCHEMATICS

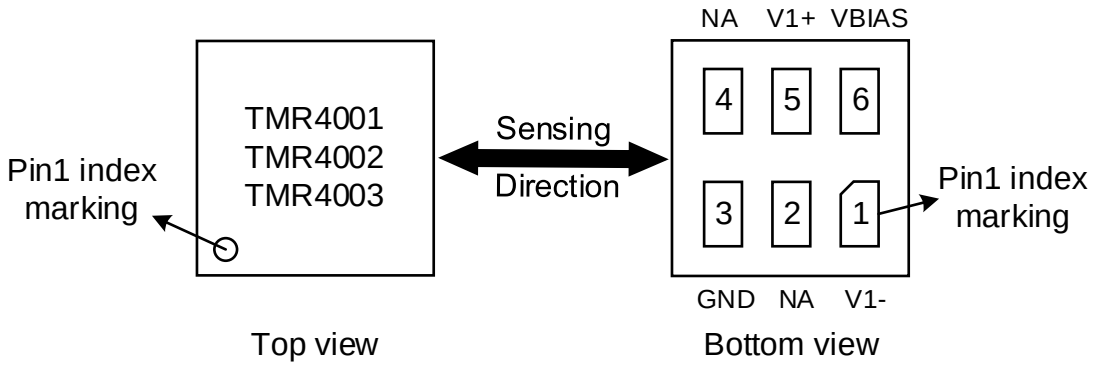



Single bridge

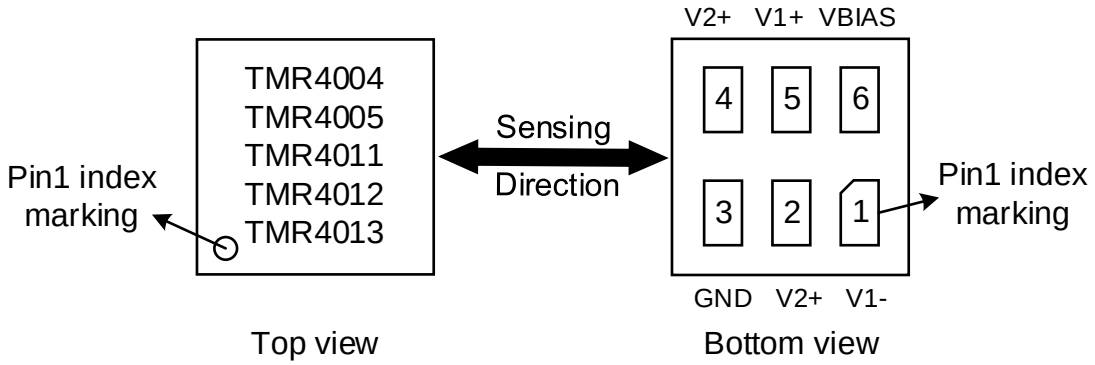



Dual bridge

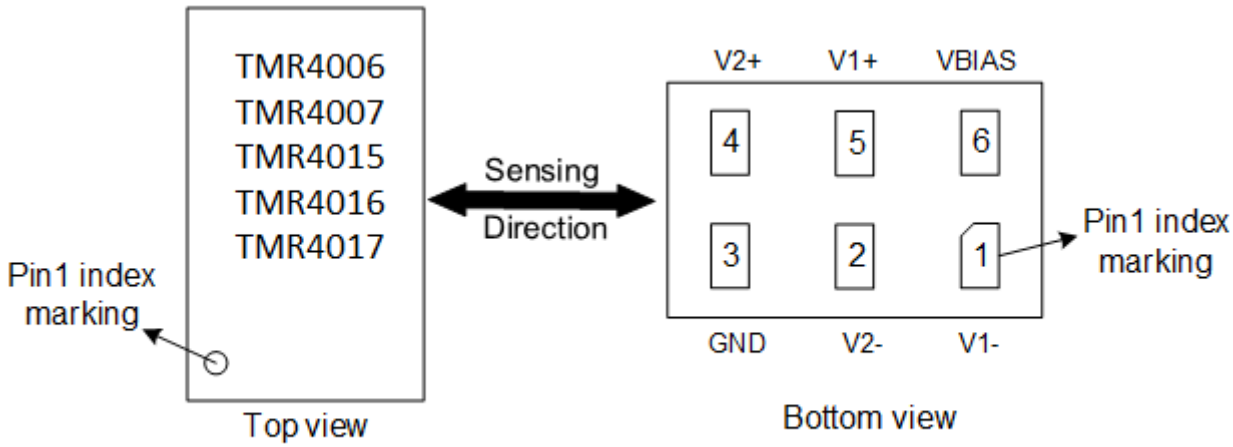
## PIN CONFIGURATION AND SENSING DIRECTION




Single bridge LGA6L (3×3)



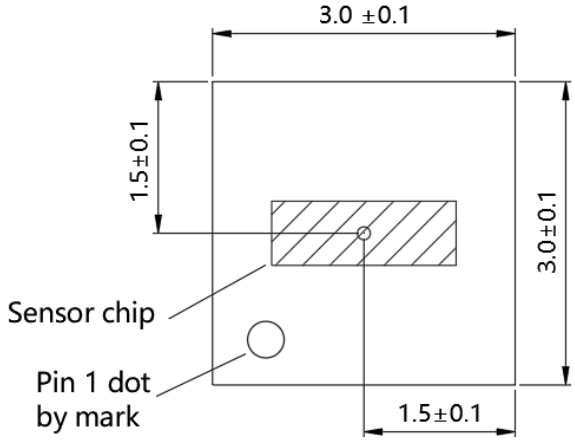

Dual bridge LGA6L (3×3)



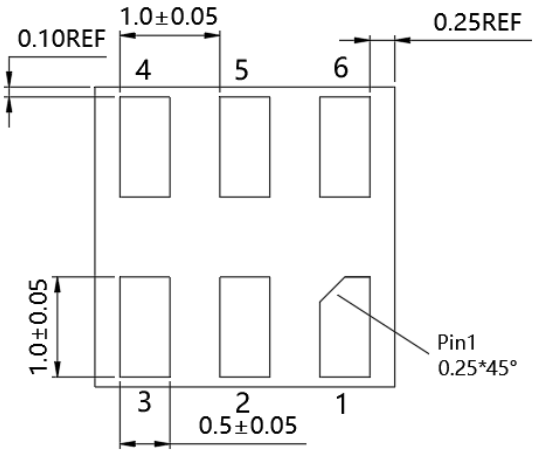

Dual bridge LGA6L (3×6)

## DIMENSIONS AND ACTIVE AREA POSITIONING

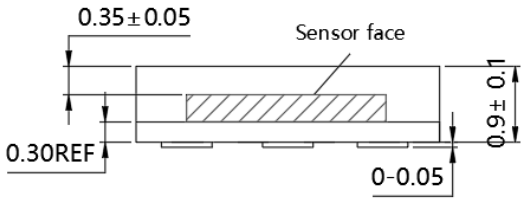
LGA6L (3mm×3mm×0.9mm) Package




Top view



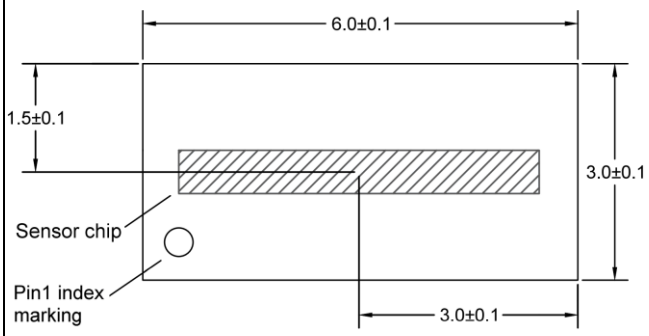

Bottom view



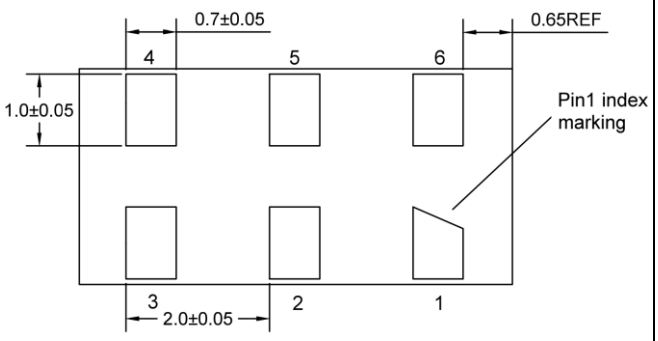

Side view

Sensing direction

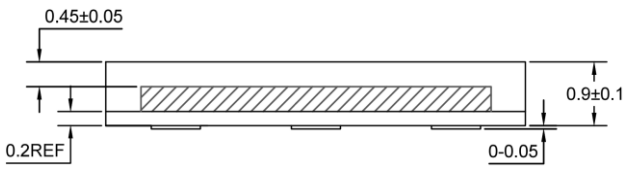
LGA6L (3mm×6mm×0.9mm) Package




Top view




Bottom view




Side view

Sensing direction

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