MULTI DIMENSION
Sensing the Future

TMR400X

TMR Gear tooth sensor with high sensitivity to magnetic field

General Description

The TMR400X magnetic gear tooth sensors utilize a unique push-pull Wheatstone bridge design, including one or two Wheatstone full bridges, with four or eight unshielded high sensitivity TMR sensing elements. The Wheatstone bridge creates a differential voltage output with respect to the magnetic field gradient along the sensor's sensitive direction. In the dual-bridge configuration, the two orthogonal Wheatstone full bridges provide sine and cosine voltage signals that can be used to measure both the gear tooth position and the direction of motion. The TMR400X magnetic gear tooth sensors offer superior performance with high sensitivity to the magnetic field gradient. They can detect very small changes in magnetic field, along with good temperature stability of the output signal.

The TMR400X magnetic gear tooth sensors are available in 6 different standard spacings of 0.25mm, 0.5mm, 0.75mm, 1.0mm, 2.0mm, and 3.0mm. Two types of small form factor LGA packages are available. The package dimensions are 3mm × 3mm × 0.9mm, and 3mm × 6mm × 0.9mm.

Features and Benefits

- Tunneling Magnetoresistance (TMR) Technology
- High Saturation Point Allowing Operation under Large DC Magnetic Field
- Wide Air-Gap Tolerance
- High Sensitivity to Magnetic Field Gradient
- Capable of Small-Pitch Gear Tooth Detection
- DC(Zero-Speed) Operation
- Sine/Cosine Signal Outputs with Precise Phase Shift
- Excellent Thermal Stability
- Good Immunity to Environmental Magnetic Field
- Compact Ultra-Thin Package

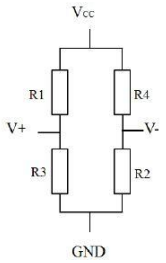


TMR400X

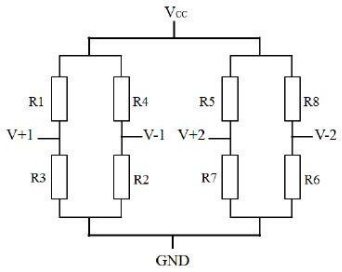
Applications

- Gear Tooth Motion, Speed, and Direction Sensing
- Linear and Rotary Speed Sensing
- Linear and Rotary position Sensing
- Linear Magnetic Scales
- Magnetic Encoders

Wheatstone Bridge Connection

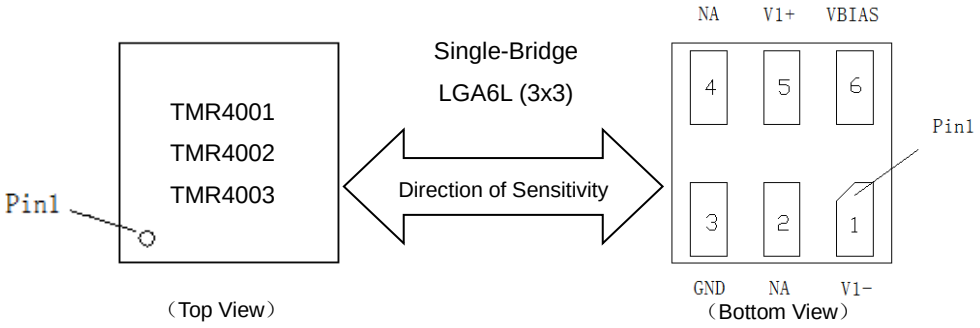


Single-Bridge Configuration

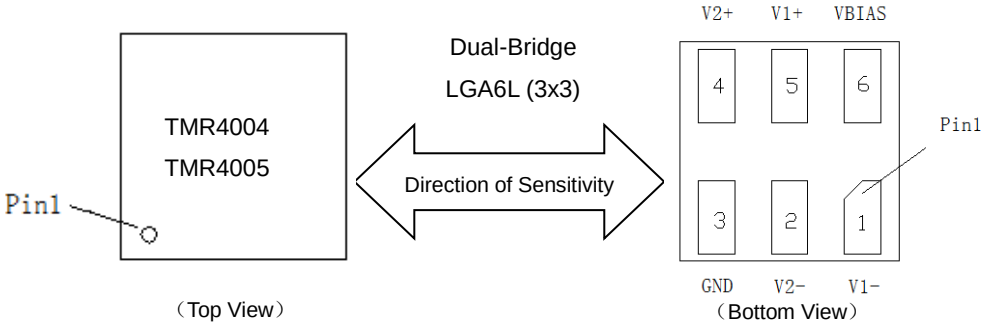


Dual-Bridge Configuration

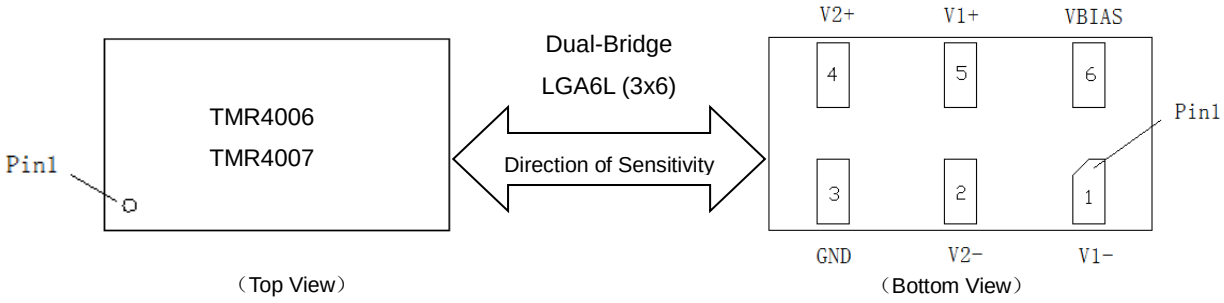
Pin Configuration



（Top View） （Bottom View）



（Top View） （Bottom View）



（Top View） （Bottom View）

Pin No.	Pin Name	Pin Function
1	V1-	Differential Output (-) of Bridge 1
2	V2- *	Differential Output (-) of Bridge 2 *
3	GND	Ground
4	V2+ *	Differential Output (+) of Bridge 2 *
5	V1+	Differential Output (-) of Bridge 1
6	V_{CC}	Supply Voltage

Absolute Maximum Ratings

Parameter	Symbol	Limit	Unit
Supply Voltage	V_{CC}	7	V
Reverse Supply Voltage	V_{Rcc}	7	V
Magnetic Field	H	1500	Oe (1)
ESD Voltage	V_{ESD}	4000	V
Operating Temperature	T_A	-40 ~ 125	°C
Storage Temperature	T_{stg}	-50 ~150	°C

Specification (V_{CC}=1.0V, T_A=25°C, Differential Output)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Supply Voltage	V_{CC}	Operating		1	7	V
Supply Current	I_{CC}	Output Open		67(2)		μA
Bridge Resistance	R			15(3)		kOhm
Single Resistor Sensitivity	SEN		-	0.46		%ΔR/Oe
Saturation Field	H_{sat}			±70 (4)		Oe
Linear Range 1	LIN1	Linearity ⩾ 98%		±20		Oe
Linear Range 2	LIN2	Linearity ⩾ 95%		±40		Oe
Offset Voltage	V_{offset}		-20		20	mV/V
Hysteresis	Hys	Fit @±20 Oe		1		%FS
Maximum Differential Voltage Output	$Vout_{Max}$			650		mV/V
Temperature Coefficient of Resistance	TCR	H = 0 Oe		-985		PPM/°C
Temperature Coefficient of Sensitivity	TCS			-1800		PPM/°C

Note:

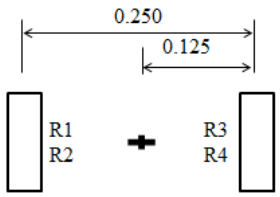
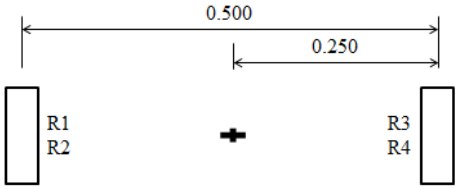
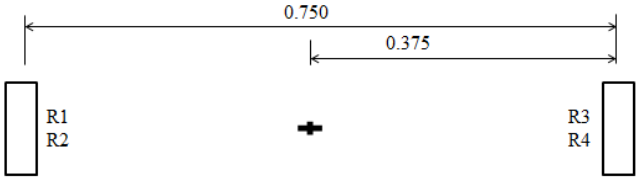
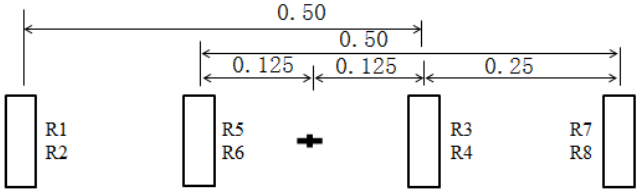
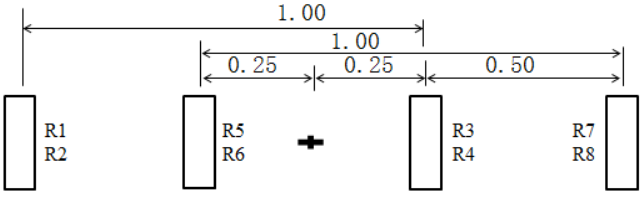
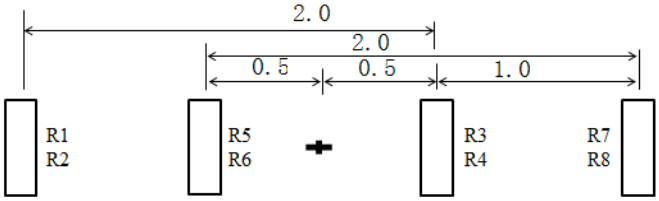
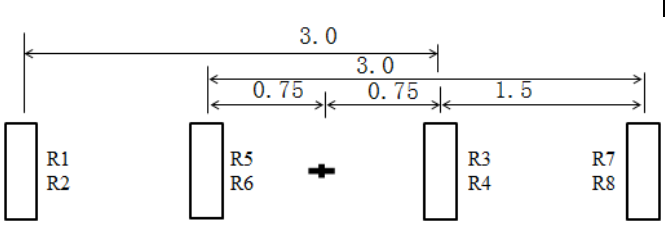
(1) 1 Oe (Oersted) = 1 Gauss in air = 0.1 millitesla = 79.8 A/m.

(2) Supply current is determined by the resistance of the sensor.

(3) Custom sensor resistance may be available upon request.

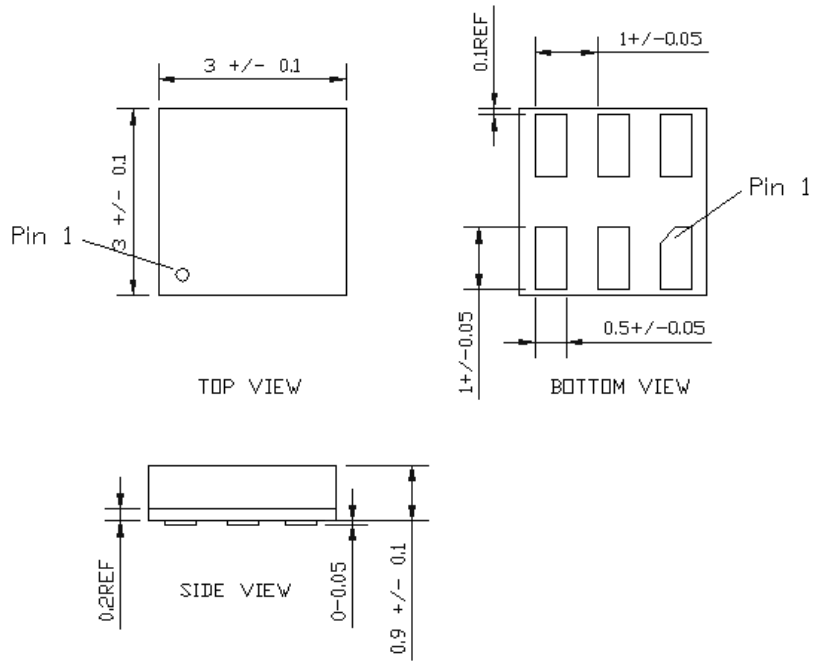
(4) The sensors may saturate if the magnetic field exceeds this range. Saturation field can be custom designed to meet special requirements.

TMR Element Layout

Part Number	Single/ Dual Bridge	TMR Element Spacing (mm) (TMR elements are placed symmetrially with respect to the center of the package, which is marked by the “+”symbol.)	Approx. Gear Tooth Pitch Range	Package Format
TMR4001	Single	0.25 	0.3~1.0mm；optimal pitch at 0.5mm	LGA6L (3x3)
TMR4002	Single	0.50 	0.7~2.0mm；optimal pitch at 1.0mm	LGA6L (3x3)
TMR4003	Single	0.75 	1.0~3.0mm；optimal pitch at 1.5mm	LGA6L (3x3)
TMR4004	Dual	0.50 	0.7~2.0mm；optimal pitch at 1.0mm	LGA6L (3x3)
TMR4005	Dual	1.0 	1.3~4.0mm；optimal pitch at 2.0mm	LGA6L (3x3)
TMR4006	Dual	2.0 	2.7~8.0mm；optimal pitch at 4.0mm	LGA6L (3x6)
TMR4007	Dual	3.0 	4.0~ 12.0mm；optimal pitch at 6.0mm	LGA6L (3x6)

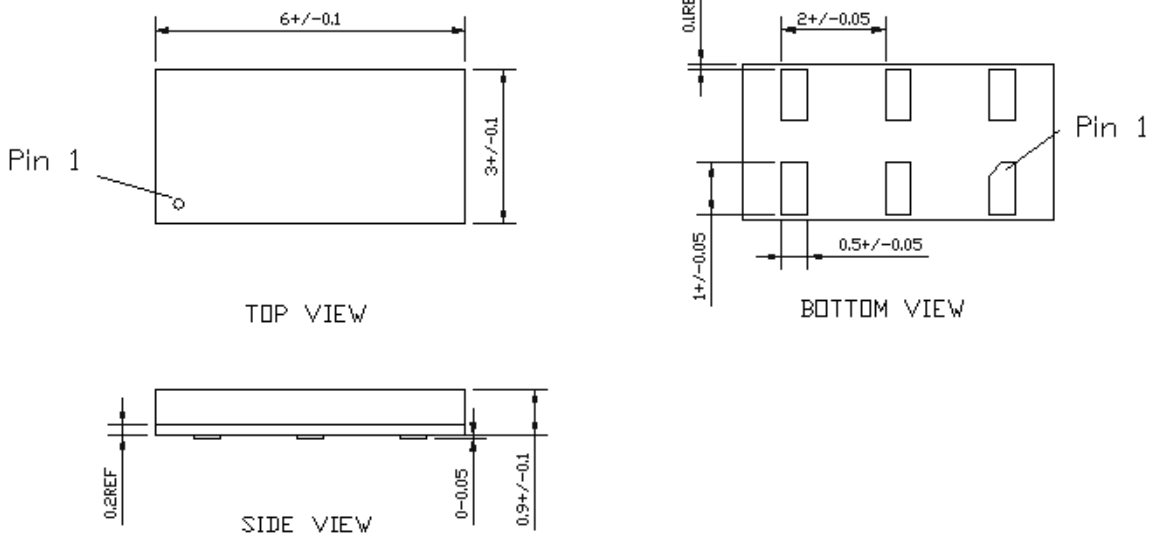
Package Information

LGA6L (3x3) package drawing:



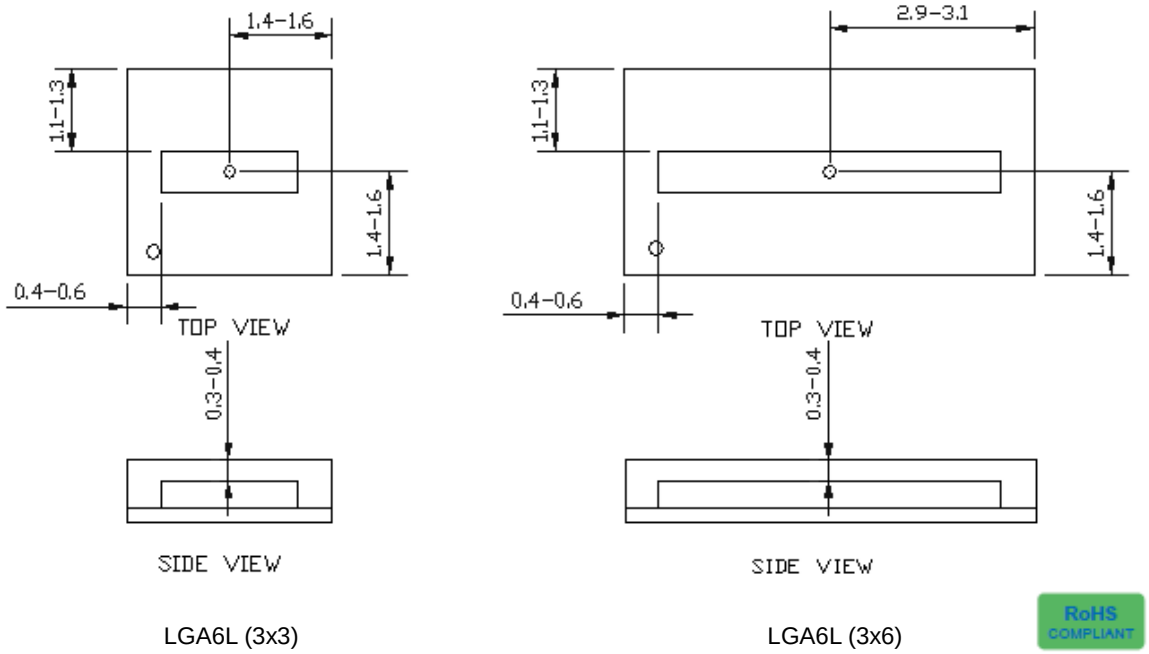
Unit: mm

LGA6L (3x6) package drawing:



Unit: mm

TMR Sensor Position



LGA6L (3x3) LGA6L (3x6)

RoHS COMPLIANT

Top view and side view(unit: mm)

MultiDimension Technology Co., Ltd.

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

Web: www.dowaytech.com/en

Email: info@dowaytech.com

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