## TMR2309 3-Axis TMR Linear Sensor

## Features and Benefits

- Tunneling Magnetoresistance (TMR) Technology
- Ultra High Sensitivity ( $\sim 100 \mathrm{mV} / \mathrm{V} / \mathrm{Oe}$ )
- Ultra Low Noise Spectral Density ( $150 \mathrm{pT} / \sqrt{ } \mathrm{Hz}$ @ 1 Hz )
- Very Low Power Consumption
- Excellent Thermal Stability
- Low Hysteresis
- Compatible with Wide Range of Supply Voltages
- No need for set/reset calibration


## Applications

- Weak Magnetic Field Sensing
- Current Sensors
- Position and Displacement Sensing
- Bio-medical Sensing
- Magnetic Communication


## General Description

The 3-Axis TMR2309 linear sensor utilizes three unique push-pull Wheatstone bridges. The 3-Axis TMR2309 is available in a $9.5 \mathrm{~mm} \times 9.5 \mathrm{~mm} \times 6.0 \mathrm{~mm}^{3}$ package.

## Transfer Curve

The following figure shows the response of the 3-axis TMR2309 to an applied magnetic field in the range of $\pm 1 \mathrm{Oe}$ and $\pm 10 \mathrm{Oe}$ when the TMR2309 is biased at 1 V .


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## Pin Configuration

VCC X+ Y+ Z+


GND X- Y- Z-

| Pin No. | Pin Name | Pin Function |
| :---: | :---: | :---: |
| 1 | VZ- | Analog Z-axis Output - |
| 2 | VY- | Analog Y-axis Output- |
| 3 | VX- | Analog X-axis Output- |
| 4 | GND | Ground |
| 5 | VCC | Supply Voltage |
| 6 | VX+ | Analog X-axis Output + |
| 7 | VY+ | Analog Y-axis Output + |
| 8 | VZ+ | Analog Z-axis Output + |

## Absolute Maximum Ratings

| Parameter | Symbol | Limit | Unit |
| :---: | :---: | :---: | :---: |
| Supply Voltage | VCC | 7 | V |
| Reverse Supply Voltage | VRCC | 7 | V |
| Max Exposed Field | He | 5000 | $\mathrm{Oe}^{(1)}$ |
| ESD Voltage | VESD | 4000 | V |
| Operating Temperature | $\mathrm{T}_{\mathrm{A}}$ | $-40 \sim 125$ | ${ }^{\circ} \mathrm{C}$ |
| Storage Temperature | $\mathrm{T}_{\text {stg }}$ | $-50 \sim 150$ | ${ }^{\circ} \mathrm{C}$ |

## Specification ( $\mathrm{V}_{\mathrm{CC}}=\mathbf{1 . 0 V}, \mathrm{T}_{\mathrm{A}}=\mathbf{2 5}{ }^{\circ} \mathrm{C}$, Differential Output)

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Supply Voltage | Vcc | Operating |  | 1 | 7 | V |
| Supply Current | ICC | Output Open |  | $0.07{ }^{(2)}$ |  | mA |
| Resistance | R |  |  | 15 |  | kOhm |
| Sensitivity | SEN | X-axis Fit @ $\pm 1 \mathrm{Oe}$ |  | 100 |  | $\mathrm{mV} / \mathrm{V} / \mathrm{Oe}$ |
|  |  | Y-axis Fit @ $\pm 1 \mathrm{Oe}$ |  | 100 |  | $\mathrm{mV} / \mathrm{V} / \mathrm{Oe}$ |
|  |  | Z-axis Fit @ $\pm 1 \mathrm{Oe}$ |  | 100 |  | $\mathrm{mV} / \mathrm{V} / \mathrm{Oe}$ |
| Saturation Field | $\mathrm{H}_{\text {sat }}$ | X-axis |  | $\pm 8$ |  | Oe |
|  |  | Y-axis |  | $\pm 8$ |  | Oe |
|  |  | Z-axis |  | $\pm 8$ |  | Oe |
| Non-Linearity | NONL | X-axis Fit @ $\pm 1$ Oe |  | 0.5 |  | \%FS |
|  |  | Y-axis Fit @ $\pm 1 \mathrm{Oe}$ |  | 0.5 |  | \%FS |
|  |  | Z-axis Fit @ $\pm 1 \mathrm{Oe}$ |  | 0.5 |  | \%FS |
| Offset Voltage | $\mathrm{V}_{\text {offset }}$ | X-axis | -15 |  | 15 | $\mathrm{mV} / \mathrm{V}$ |
|  |  | Y-axis | -15 |  | 15 | $\mathrm{mV} / \mathrm{V}$ |
|  |  | Z-axis | -15 |  | 15 | $\mathrm{mV} / \mathrm{V}$ |
| Hysteresis | Hys | X-axis Fit @ $\pm 1 \mathrm{Oe}$ |  |  | 0.02 | Oe |
|  |  | Y-axis Fit @ $\pm 1 \mathrm{Oe}$ |  |  | 0.02 | Oe |
|  |  | Z-axis Fit @ $\pm 1$ Oe |  |  | 0.02 | Oe |
| Temperature Coefficient of Resistance | TCR | $\mathrm{H}=0 \mathrm{Oe}$ |  | -600 |  | PPM/ $/{ }^{\circ} \mathrm{C}$ |
| Temperature Coefficient of Sensitivity | TCS |  |  | -300 |  | PPM/ ${ }^{\circ} \mathrm{C}$ |
| Self Noise |  | X-axis @ 1Hz |  | 150 |  | $\mathrm{pT} / \sqrt{ } \mathrm{Hz}$ |
|  |  | Y-axis @ 1Hz |  | 150 |  | $\mathrm{pT} / \sqrt{ } \mathrm{Hz}$ |
|  |  | Z-axis @ 1Hz |  | 150 |  | $\mathrm{pT} / \sqrt{ } \mathrm{Hz}$ |

Notes:
(1) $1 \mathrm{Oe}($ Oersted $)=1$ Gauss in air $=0.1$ millitesla $=79.8 \mathrm{~A} / \mathrm{m}$.
(2) Custom resistance may be available upon request.

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## Package Information

Size: Length x Width x Height $=9.5 \times 9.5 \times 6.0 \mathrm{~mm}^{3}$


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