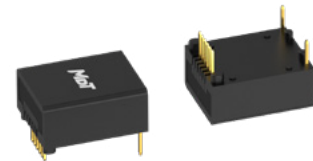


TMR8603 / TMR8605

High-precision, Low-noise Linear Magnetic Sensor

Description

TMR8603/TMR8605 is a compact and high-precision linear magnetic sensor, featuring low noise and fast response. This sensor is encased in a module-level package measuring 18mm × 14.4mm × 7.8mm. It boasts a measurement range of $\pm 500\mu\text{T}$ and supports either single or dual power supply options, with voltage ranges from $\pm 3.3\text{V}$ to $\pm 15\text{V}$. Operating temperatures range from -40°C to 85°C . Utilizing advanced tunneling magnetoresistance (TMR) technology, the TMR8603/TMR8605 integrates a magnetic field feedback coil and a weak signal conditioning circuit, achieving different low-noise grades of $30\sim 100\text{ pT}/\sqrt{\text{Hz}}@1\text{Hz}$, linearity of 0.05%, sensitivity temperature drift of 60 PPM, and sensitivity variation of 0.5% across a temperature range of -40°C to 75°C . With a bandwidth of 500kHz and ideal frequency characteristics, it enables high-resolution, real-time measurement of weak magnetic fields. For ease of application, triaxial magnetic sensor modules TMR8633/TMR8635 are also available. They are ideal suited for applications such as environmental magnetic field monitoring, food safety testing, geophysical magnetic detection, traffic monitoring, and magnetic metal detection.



TMR8603 / TMR8605



TMR8633 / TMR8635

Features and Benefits

- Low-noise tunnel magnetoresistance technology
- Precision magnetic field feedback technology
- $30 \sim 100\text{ pT}/\sqrt{\text{Hz}}@1\text{Hz}$ low noise
- 60 PPM sensitivity temperature drift
- 0.05% linear response characteristics
- DC $\sim$ 500 kHz wide frequency response

Applications

- Environmental magnetic field monitoring
- Food safety testing
- Geophysical magnetic exploration
- Urban non-inductive security inspection
- Magnetic metal detection
- Traffic vehicle detection

Selection Guide

Part Number	Sensing Direction	Frequency Response (-3dB)	Magnetic Field Spectral Noise Density	Supply Voltage	Dimension (mm)
TMR8603	Single axis	DC to 500 kHz	30 to 50 $\text{pT}/\sqrt{\text{Hz}}@1\text{Hz}$	5 V to 30 V $\pm 3.3\text{ V}$ to $\pm 15\text{ V}$	18 × 14.4 × 7.8
TMR8605	Single axis	DC to 500 kHz	50 to 100 $\text{pT}/\sqrt{\text{Hz}}@1\text{Hz}$	5 V to 30 V $\pm 3.3\text{ V}$ to $\pm 15\text{ V}$	18 × 14.4 × 7.8
TMR8633	Triaxial	DC to 500 kHz	30 to 50 $\text{pT}/\sqrt{\text{Hz}}@1\text{Hz}$	$\pm 3.3\text{ V}$ to $\pm 15\text{ V}$	50 × 22 × 22
TMR8635	Triaxial	DC to 500 kHz	50 to 100 $\text{pT}/\sqrt{\text{Hz}}@1\text{Hz}$	$\pm 3.3\text{ V}$ to $\pm 15\text{ V}$	50 × 22 × 22

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1. Functional Block Diagram

The TMR8603/TMR8605 magnetoresistive sensor is primarily designed for detecting weak magnetic fields. The block diagram below explores its operating principle. The sensor IC measures the external magnetic field (H_{ext}) and outputs a voltage signal. This signal is amplified and passed through a feedback coil, which generates a feedback magnetic field (H_{fed}) to counteract H_{ext} . The feedback loop current (I_{fed}) is then measured via the sampling resistor (R_s), enabling the detection of the external magnetic field signal. When the feedback stabilizes, the loop operates in a state of deep negative feedback where the feedback magnetic field entirely cancels out H_{ext} . Consequently, the sensor's output voltage (V_{OUT}) varies linearly with changes in H_{ext} :

$$V_{OUT} = Sen \times H_{ext} + V_{offset}$$

Here, Sen represents the sensor's sensitivity, and V_{offset} is the zero offset voltage, which can be adjusted through the sensor's voltage-to-magnetic field relationship (V_H). The transfer characteristic curve is derived from empirical testing.

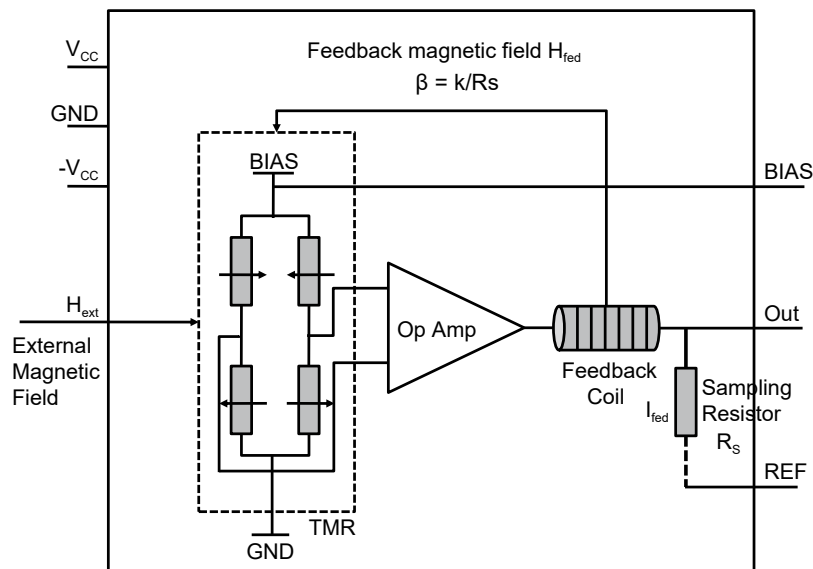


Figure 1. TMR8603/TMR8605 functional block diagram

2. TMR8603 / TMR8605 Pin Definition

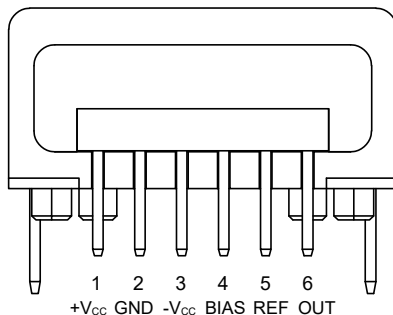


Figure 2. Pin definition

Pin	Name	Function	Reference Connection	
			Single Supply Connection	Dual Supply Connection
1	+V _{CC}	Positive supply	Positive supply	Positive supply
2	GND	Ground	Ground	Ground
3	-V _{CC}	Negative supply	Ground	Negative supply
4	BIAS	Internal bias voltage	REF	NC
5	REF	Output reference	Bias or external	Ground or external
6	OUT	Output	Output	Output

3. TMR8603 Specifications

$V_{CC} = \pm 5\text{ V}$, $T_A = 25\text{ }^{\circ}\text{C}$

Specification	Symbol	Condition	Min.	Typ.	Max.	Unit
Measuring range	FS	$V_{CC} = \pm 15\text{ V}$	-	± 200	± 500	μT
Sensitivity	Sen	$-200\text{ }\mu\text{T}$ to $200\text{ }\mu\text{T}$	19.50	20.00	20.50	$\text{mV}/\mu\text{T}$
Sensitivity temperature coefficient	TCS	-40°C to 75°C	-	40	-	$\text{PPM}/^{\circ}\text{C}$
Zero magnetic field offset ¹	H_{offset}	$H = 0$	-	-	10	μT
Nonlinearity	δ_L	$\pm 200\text{ }\mu\text{T}$	-	0.05	0.1	%
Hysteresis	Hys	$\pm 200\text{ }\mu\text{T}$	-	0.5	1	μT
Voltage noise density	V_N	$H = 0$, at 1Hz	-	800	1500	$\text{nV}/\sqrt{\text{Hz}}@1\text{Hz}$
Magnetic field noise density	B_N	$H = 0$, at 1Hz	-	30	50	$\text{pT}/\sqrt{\text{Hz}}@1\text{Hz}$
Thermal magnetic field noise density	B_{NW}	$H = 0$, $f = 1\text{ kHz}$	-	2.5	-	$\text{pT}/\sqrt{\text{Hz}}$
Magnetic field noise peak-to-peak	B_{NPP}	0.1 Hz to 10 Hz	-	0.6	1.0	nT_{pp}
Output voltage range	V_{OUT}	-	$-V_{CC} + 0.5$	-	$V_{CC} - 0.5$	V
Maximum output current	I_{OUT}	-	-	-	30	mA
Frequency characteristics	FR	-3 dB	-	500	-	kHz
Single supply voltage	V_{CC}	-	5	12	30	V
Dual power supply voltage		-	± 3.3	± 5	± 15	V
Static power	P_W	$H = 0$, $\pm 5\text{ V}$	-	50	-	mW
$+V_{CC}$ static operating current	I_{Q+}	$H = 0$	-	5	-	mA
$-V_{CC}$ static operating current	I_{Q-}	$H = 0$	-	4	-	mA
Operating temperature	T_A	-	-40	-	85	$^{\circ}\text{C}$
storage temperature	T_S	-	-40	-	85	$^{\circ}\text{C}$

Note:

1. Users can compensate for zero offset and zero temperature drift as needed.
2. During operation and storage, avoid strong magnetic field shocks.

4. TMR8603 Characteristic Curves

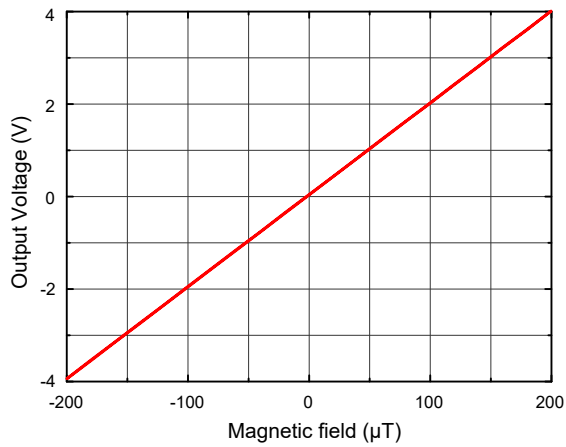


Figure 3. Typical VH transfer curve

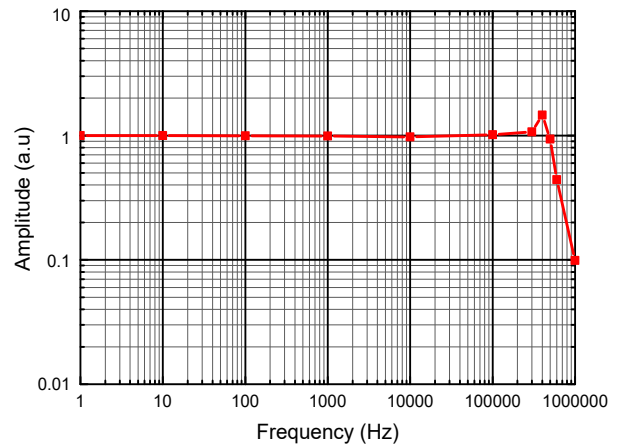


Figure 4. Typical frequency response characteristics

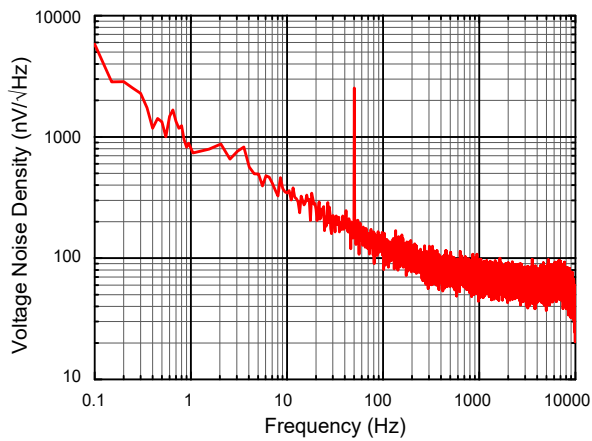


Figure 5. Typical voltage noise spectral density

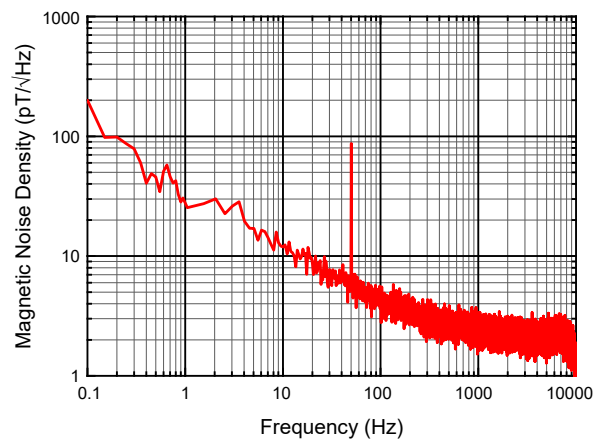


Figure 6. Typical magnetic field noise spectral density curve

5. TMR8605 Specifications

$V_{CC} = \pm 5\text{ V}$, $T_A = 25\text{ }^{\circ}\text{C}$

Specification	Symbol	Condition	Min.	Typ.	Max.	Unit
Measuring range	FS	$V_{CC} = \pm 15\text{ V}$	-	± 200	± 500	μT
Sensitivity	Sen	$-200\text{ }\mu\text{T}$ to $200\text{ }\mu\text{T}$	19.50	20.00	20.50	$\text{mV}/\mu\text{T}$
Sensitivity temperature coefficient	TCS	-40°C to 75°C	-	60	-	$\text{PPM}/^{\circ}\text{C}$
Zero magnetic field offset ¹	H_{offset}	$H = 0$	-	-	10	μT
Nonlinearity	δ_L	$\pm 200\text{ }\mu\text{T}$	-	0.05	0.1	%
Hysteresis	Hys	$\pm 200\text{ }\mu\text{T}$	-	0.2	1	μT
Voltage noise density	V_N	$H = 0$, at 1Hz	-	1500	2500	$\text{nV}/\sqrt{\text{Hz}}@1\text{Hz}$
Magnetic field noise density	B_N	$H = 0$, at 1Hz	-	60	100	$\text{pT}/\sqrt{\text{Hz}}@1\text{Hz}$
Thermal magnetic field noise density	B_{NW}	$H = 0$, $f = 1\text{ kHz}$	-	2.5	-	$\text{pT}/\sqrt{\text{Hz}}$
Magnetic field noise peak-to-peak	B_{NPP}	0.1 Hz to 10 Hz	-	1.2	2.0	nT_{pp}
Output voltage range	V_{OUT}	-	$-V_{CC} + 0.5$	-	$V_{CC} - 0.5$	V
Maximum output current	I_{OUT}	-	-	-	30	mA
Frequency characteristics	FR	-3 dB	-	500	-	kHz
Single supply voltage	V_{CC}	-	5	12	30	V
Dual power supply voltage		-	± 3.3	± 5	± 15	V
Static power	P_W	$H = 0$, $\pm 5\text{ V}$	-	10	-	mW
$+V_{CC}$ static operating current	I_{Q+}	$H = 0$	-	1	-	mA
$-V_{CC}$ static operating current	I_{Q-}	$H = 0$	-	0.5	-	mA
Operating temperature	T_A	-	-40	-	85	$^{\circ}\text{C}$
storage temperature	T_S	-	-40	-	85	$^{\circ}\text{C}$

Note:

1. Users can compensate for zero offset and zero temperature drift as needed.
2. During operation and storage, avoid strong magnetic field shocks.

6. TMR8605 Characteristic Curves

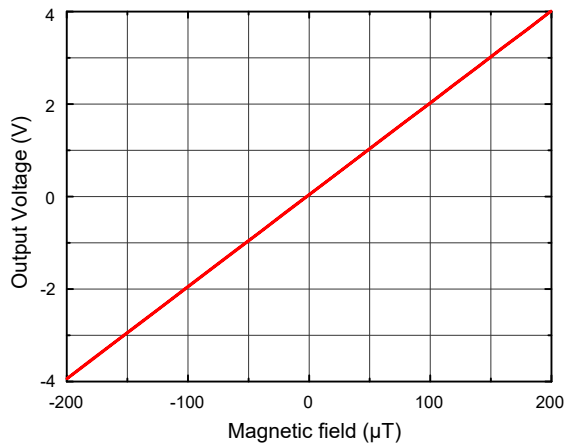


Figure 7. Typical VH transfer curve

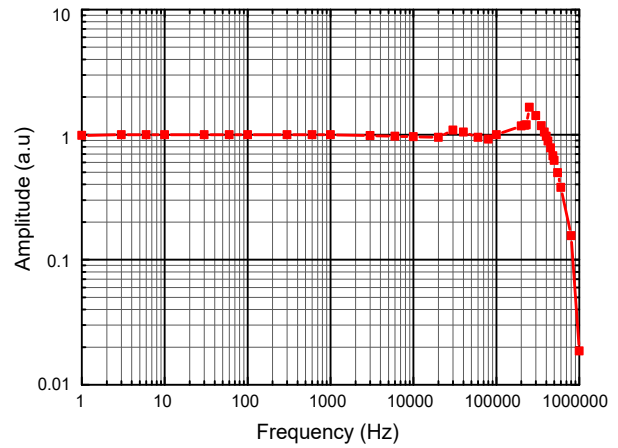


Figure 8. Typical frequency response characteristics

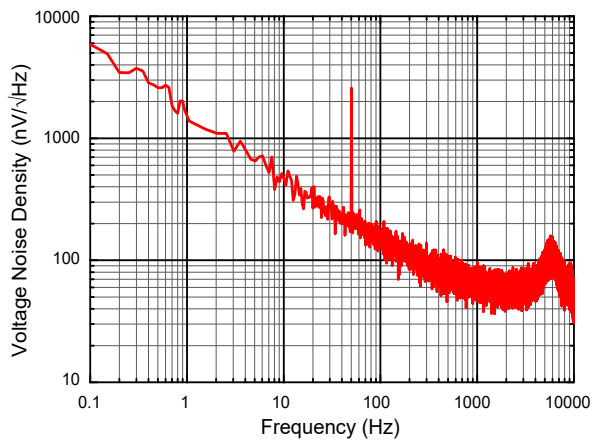


Figure 9. Typical voltage noise spectral density

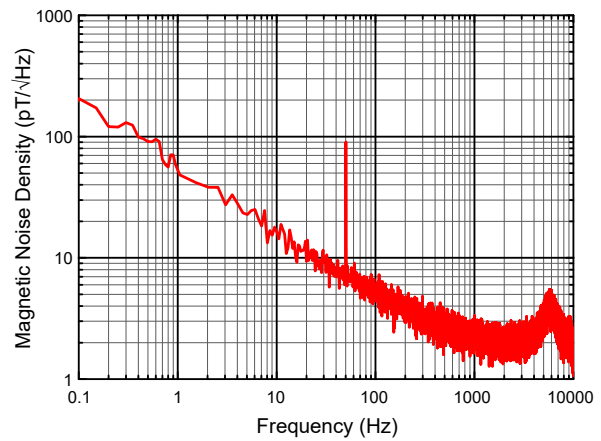
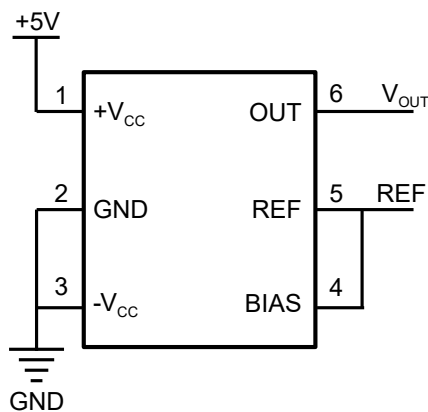


Figure 10. Typical magnetic field noise spectral density curve

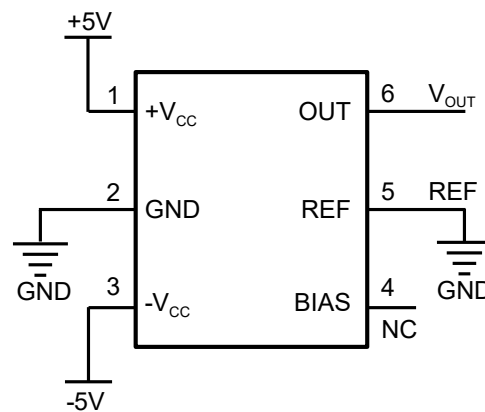
7. Application Guide

TMR8603/TMR8605 can be operated with either a single or dual power supply setup, featuring an integrated power bypass capacitor that eliminates the need for additional power supply processing. This design effectively suppresses power ripple interference, ensuring stable and reliable operation. To mitigate installation errors, the package includes a specially designed mounting positioning hole. In practice, the sensor simply requires external positive and negative power supplies to function. It incorporates an internal precision magnetic field feedback coil and a signal conditioning circuit for stable performance and ease of use.

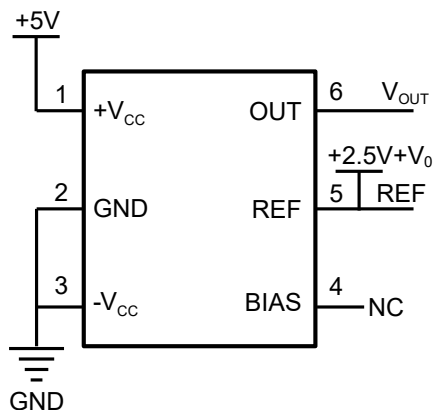
To enhance zero-point accuracy, users can utilize the reference point REF (Pin 5). By connecting an externally constructed reference voltage, this setup compensates for zero offset and temperature drift. Depending on the application, the compensation reference point can be adjusted using resistor voltage division, external network voltage division, or microcontroller-controlled DAC to modify the analog output voltage of the reference point. In specific scenarios, the output of the first sensor (V_{OUT}) can be linked to the output reference point of the second sensor REF (Pin 5), facilitating differential output between the two sensors. This connection helps better counteract the common-mode magnetic interference from external environments. For more details, please refer to the typical application reference circuit provided.



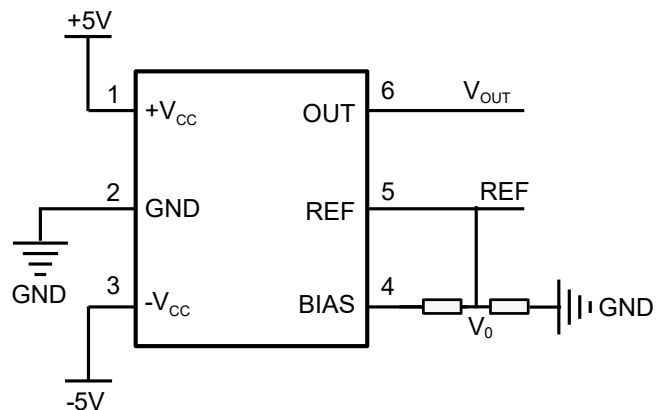
Single power supply



Dual power supply



Single power supply with
zero compensation



Dual power supply with
zero compensation

Figure 11. Typical application reference circuit

8. TMR8603 / TMR8605 Mechanical and Interface Parameters

Name	Parameter	Unit
Dimensions (length × width × height)	18 × 14.4 × 7.8	mm
Weight	4.0	g
Electrical Interface	6 × Φ0.8, hole center distance 1.27	mm
Install the positioning interface	2 × Φ2.2, hole center distance 11.4 2 × Φ1.4, hole center distance 7.0	mm
Sensitive axis direction	Sensor long axis direction	-

9. TMR8603 / TMR8605 Dimensions

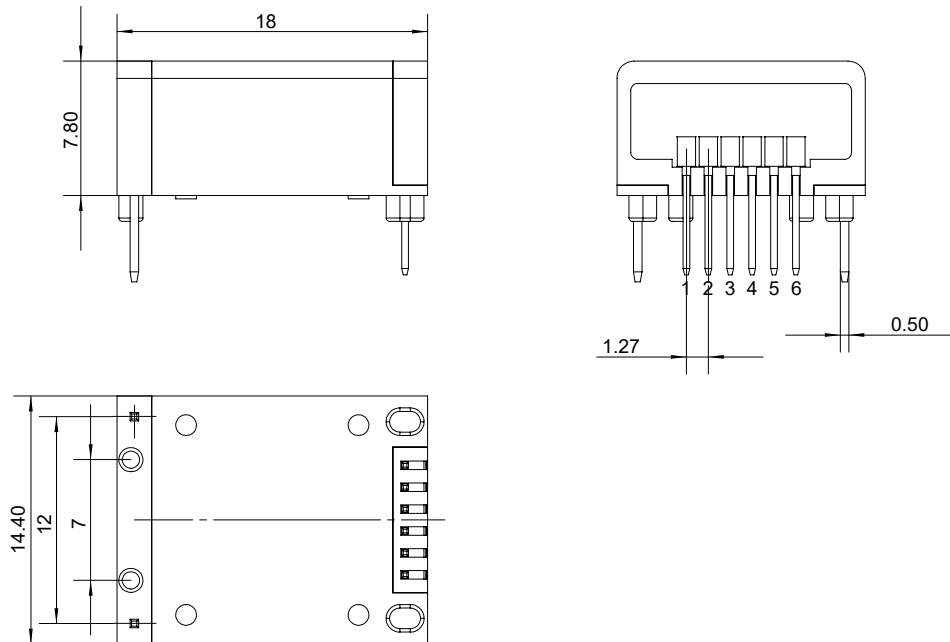


Figure 12. Dimensions (unit: mm)

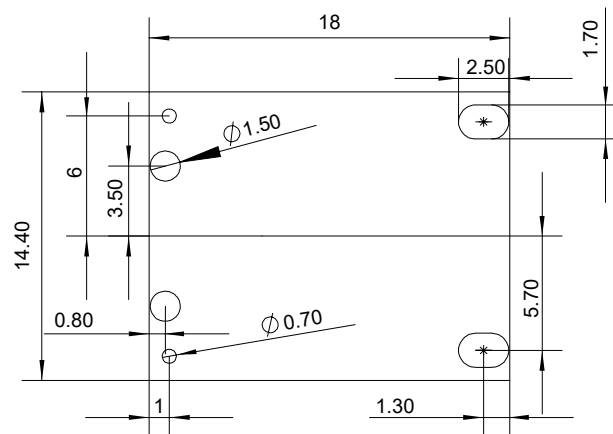


Figure 13. PCB board opening dimensions (unit: mm)

TMR8633 / TMR8635

High-precision, Low-noise, Three Triaxial Linear Magnetic Sensor

10. TMR8633 / TMR8635 Pin Configuration

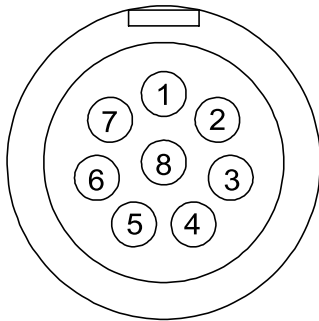


Figure 14. Pin definition

Pin	Name	Colour	Function
1	+V _{CC}	Red (R)	Positive Supply Voltage
2	PWR GND	Black (K)	Power Ground
3	-V _{CC}	Blue (B)	Negative Supply Voltage
4	SIG GND	Orange (O)	Signal Ground
5	X	Chartreuse (C)	X Axis Output
6	Y	Yellow (Y)	Y Axis Output
7	Z	Green (G)	Z Axis Output
8	NC	White (W)	Not Connected

11. TMR8633 / TMR8635 Mechanical and Interface Parameters

Name	Parameter	Unit
Dimensions (length × width × height)	50 × 22 × 22.4	mm
Weight	33 (Cable not included)	g
Electrical Interface	FGG 1B 8 Pin Connector	-
Cable Length	1	m
Sensing Direction	X/Y/Z Axes	-
X/Y/Z Axis Deviation	< 1	deg

12. TMR8633 / TMR8635 Dimensions

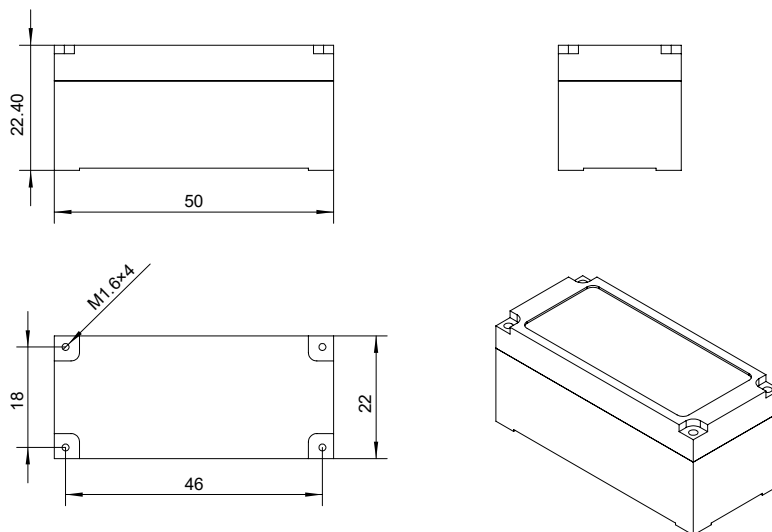


Figure 15. Dimensions (unit: mm)

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