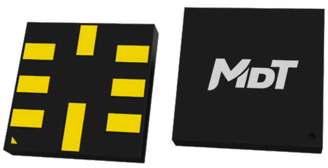
AMR3003

Dual Axis AMR Magnetic Angle Sensor

Description

The AMR3003 is a magnetic angle sensor based on anisotropic magnetoresistance (AMR) technology. It senses the magnetic field parallel to the surface of the sensor with the range of magnetic field rotation angle θ from 0° to 180°, and outputs voltage proportional to the sine or cosine of 2θ.

The AMR3003 adopts two push-pull Wheatstone bridges design, and each bridge contains four high-sensitivity AMR sensing elements to provide output signal as large as 1.6% of the supply voltage. Additionally, this unique AMR Wheatstone bridge design effectively compensates the output against changes in ambient temperature. It is available in LGA8L (5 mm x 5 mm x 0.9 mm) package.



LGA8L

Features and Benefits

- Anisotropic magnetoresistance (AMR) technology
- Wide range supply voltages
- Large air gap tolerance
- Very low hysteresis
- Excellent temperature stability
- RoHS & REACH compliant

Applications

- Rotary position sensing
- Rotary encoder
- Non-contact potentiometer
- Valve position sensor
- Dial sensor

Selection Guide

Part Number	Angle Range	Supply Voltage	Bridge Resistance	Operating Temperature	Package	Packing Form
AMR3003LG	0 to 180°	5 V	350 Ω	-40 °C to 125 °C	LGA8L	Tape & Reel

Catalogue

1. Operating principle

The AMR3003 angle sensors use dual Wheatstone bridges comprised of eight high sensitivity AMR sensing elements to increase the sensor's output signal amplitude with enhanced temperature characteristics and anti-interference performance as shown in Figure 1. The X axis outputs are defined as Vx+ and Vx-. The X axis output voltage is found by Vx = (Vx+) - (Vx-). The Y axis outputs are defined as Vy+ and Vy-. The Y axis output voltage is found by Vy = (Vy+) - (Vy-). Vx = Asin(2θ) and Vy = Bcos(2θ) when the magnetic field is at angle θ, where A and B are constants. The angle θ can thus be determined through arctangent function.

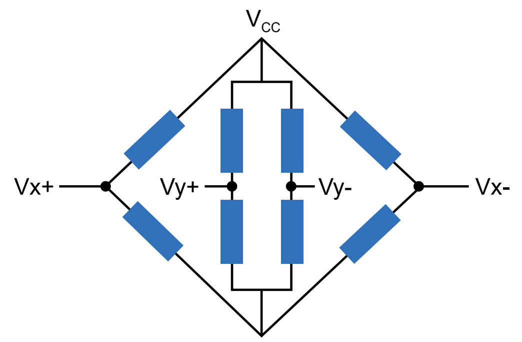


Figure 1. AMR3003 block diagram

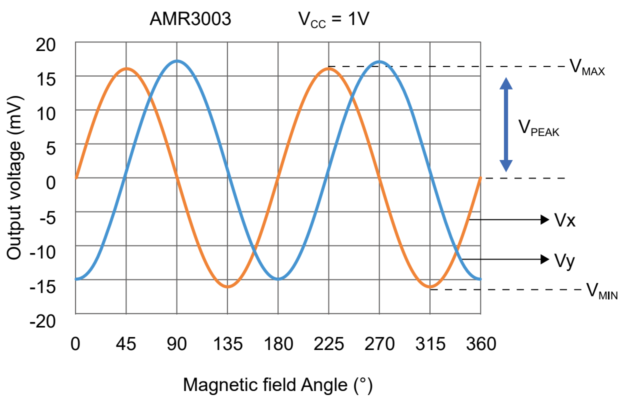


Figure 2. Typical AMR3003 output curve

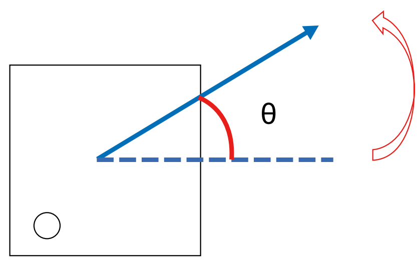


Figure 3. Definition of measured magnetic field angle (top view)

By rotating a small magnet placed on top of AMR3003, a rotating magnetic field parallel to the surface of the magnetic is generated and is at the same angle as the magnet. Figure 2 shows the typical output signals of the AMR3003 in response to a rotating field. In Figure 2, the rotating magnetic field is generated by a Helmholtz coil and the supply voltage is 1V.

As seen in Figure 2, the period of the AMR3003 is 180° and Vx and Vy have a phase shift of 45°. Figure 2 also illustrates the definition of peak voltage V_{PEAK}. The output voltage may not be zero at 0° due the process tolerance, and this V_{OFFSET} can be calculated by equations 1 and 2. Figure 3 illustrates the definition of the magnetic field angle.

Equation (1) $$V_{PEAK} = \frac{V_{MAX} - V_{MIN}}{2}$$

Equation (2) $$V_{OFFSET} = \frac{V_{MAX} + V_{MIN}}{2}$$

2. Pin Configuration

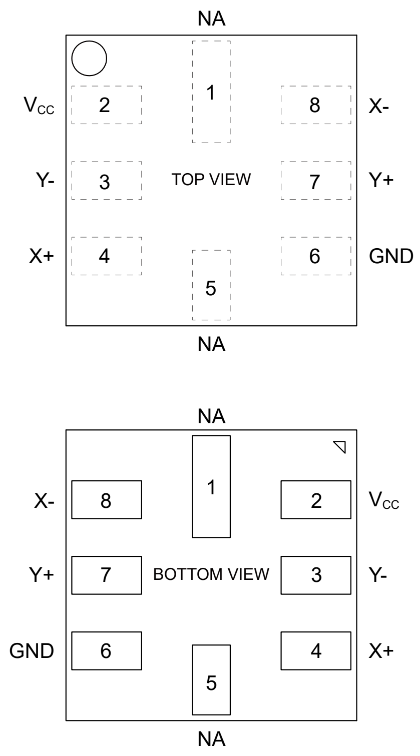


Figure 4. AMR3003LG pin configuration (LGA8L)

Number	Name	Function
1	NA	N/A
2	V_{CC}	Supply voltage
3	Y-	Analog differential output 2 (Y axis)
4	X+	Analog differential output 1 (X axis)
5	NA	N/A
6	GND	Ground
7	Y+	Analog differential output 1 (Y axis)
8	X-	Analog differential output 2 (X axis)

3. Absolute Maximum Ratings

Parameters	Symbol	Condition	Min.	Max.	Unit
Supply voltage	V_{CC}	T_A = 25 °C	-	19	V
Magnetic flux density	B	T_A = 25 °C	-	4000	Gs
Operating ambient temperature	T_A	-	-40	125	°C
Storage ambient temperature	T_{STG}	-	-40	150	°C

4. Electrical Specifications

V_{CC} = 5 V, T_A = 25 °C, unless specified otherwise

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	Operating	-	5	18	V
Bridge resistance	R_B	Resistance between V_{CC} and GND; B = 700 Gs, Room temperature	330	350	420	Ω
Magnetic field angle range	θ_{range}	-	0	-	180	°
Peak voltage	V_{PEAK}	V_{CC} = 5 V, B = 700 Gs, Room temperature	13.5	16	17	mV/V
Offset voltage	V_{OFFSET}	V_{CC} = 5 V, B = 700 Gs, Room temperature	-5	-	5	mV/V
Angular error	Δθ	Operating	-	0.1	-	°
Operation coefficient of bridge resistance	TCR_B	T_A = -40 °C to 125 °C	-	2500	-	PPM/°C
Operation coefficient of peak voltage	TCV_{PEAK}	T_A = -40 °C to 125 °C	-	-4250	-	PPM/°C
Operation coefficient of offset voltage	TCV_{OFF}	T_A = -40 °C to 125 °C	-	40	-	μV/V/°C

5. Dimensions

LGA8L Package

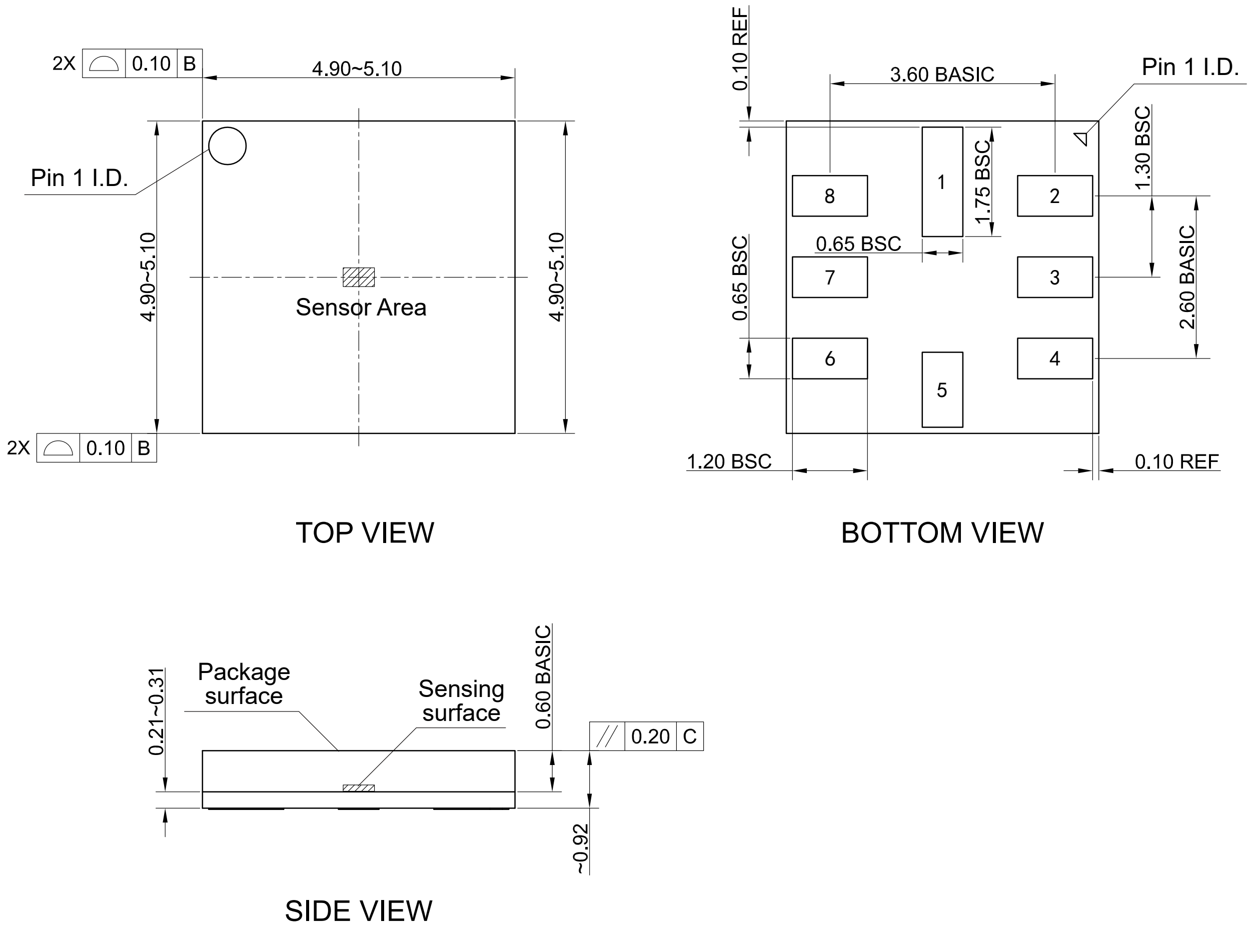


Figure 5. Package outline of LGA8L (unit: mm)

Absolute maximum ratings are the extreme limits the device will withstand without damage to the MDT product. However, the electrical and mechanical characteristics are not guaranteed as the maximum limits (above recommended operating conditions) are approached. MDT disclaims any and all warranties and liabilities of the MDT product will operate at absolute maximum ratings.

Specifications may change without notice.

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Recycling

The product(s) in this document need to be handed over to a qualified solid waste management services company for recycling in accordance with relevant regulations on waste classification after the end of the product(s) life.

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