

# 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  $\theta$  from  $0^\circ$  to  $180^\circ$ , and outputs voltage proportional to the sine or cosine of  $2\theta$ .

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) and DFN6L (2 mm x 3 mm x 0.75 mm) packages.

### 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



LGA8L

DFN6L

### Selection Guide

Part Number	Angle Range	Supply Voltage	Bridge Resistance	Operating Temperature	Package	Packing Form
AMR3003LG	0 to $180^\circ$	5 V	350 $\Omega$	-40 $^\circ\text{C}$ to 125 $^\circ\text{C}$	LGA8L	Tape & Reel
AMR3003D	0 to $180^\circ$	5 V	350 $\Omega$	-40 $^\circ\text{C}$ to 125 $^\circ\text{C}$	DFN6L	Tape & Reel

## Catalogue

1. Operating principle .....	03
2. Pin Configuration .....	04
3. Absolute Maximum Ratings .....	05
4. Electrical Specifications .....	05
5. Dimensions .....	06

## 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  $V_{x+}$  and  $V_{x-}$ . The X axis output voltage is found by  $V_x = (V_{x+}) - (V_{x-})$ . The Y axis outputs are defined as  $V_{y+}$  and  $V_{y-}$ . The Y axis output voltage is found by  $V_y = (V_{y+}) - (V_{y-})$ .  $V_x = A \sin(2\theta)$  and  $V_y = B \cos(2\theta)$  when the magnetic field is at angle  $\theta$ , where A and B are constants. The angle  $\theta$  can thus be determined through arctangent function.

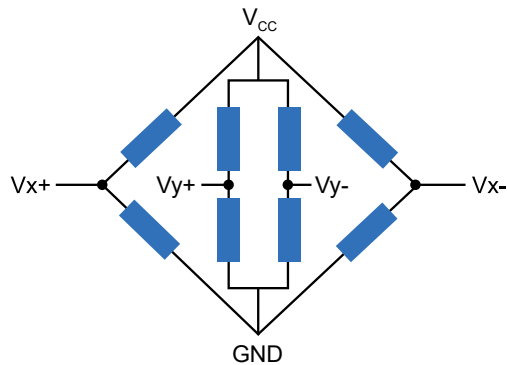


Figure 1. AMR3003 block diagram

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  $180^\circ$  and  $V_x$  and  $V_y$  have a phase shift of  $45^\circ$ . Figure 2 also illustrates the definition of peak voltage  $V_{PEAK}$ . The output voltage may not be zero at  $0^\circ$  due to 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.

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

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

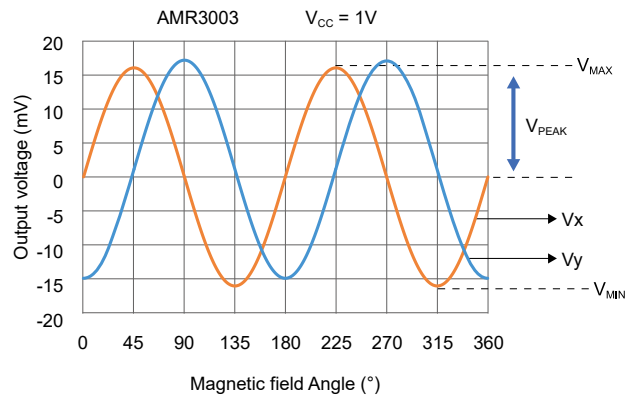


Figure 2. Typical AMR3003 output curve

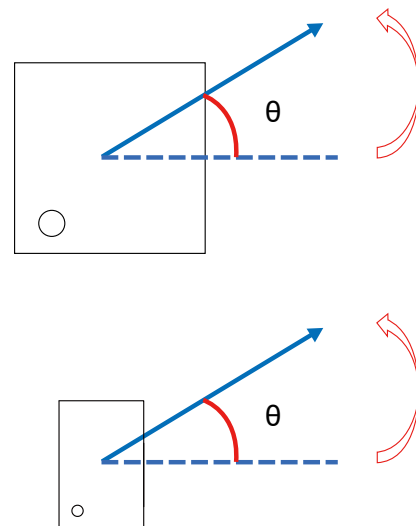
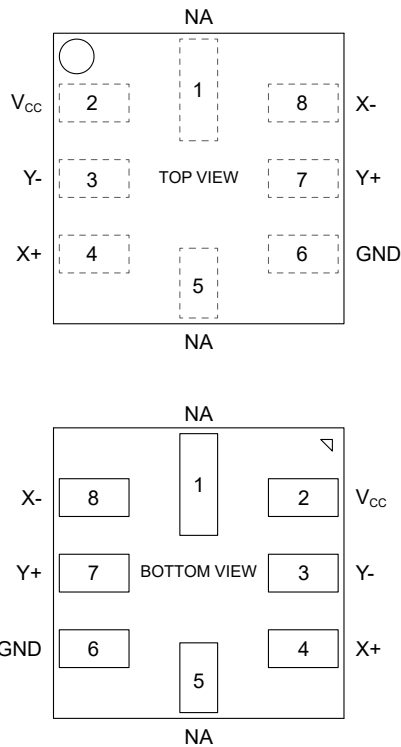


Figure 3. Definition of measured magnetic field angle (top view)

## 2. Pin Configuration



Number	Name	Function
1	NA	N/A
2	V <sub>CC</sub>	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)

Figure 4. AMR3003LG pin configuration (LGA8L)

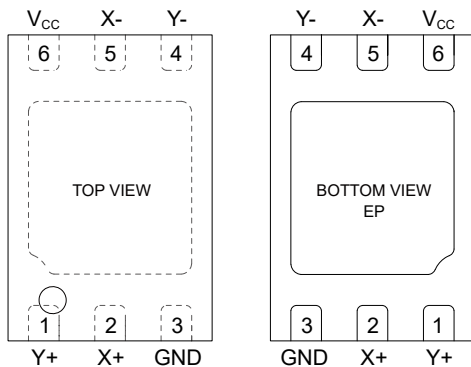


Figure 5. AMR3003D pin configuration (DFN6L)

Number	Name	Function
1	Y+	Analog differential output 1 (Y axis)
2	X+	Analog differential output 1 (X axis)
3	GND	Ground
4	Y-	Analog differential output 2 (Y axis)
5	X-	Analog differential output 2 (X axis)
6	V <sub>CC</sub>	Supply voltage
EP	NC	N/A

### 3. Absolute Maximum Ratings

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

### 4. Electrical Specifications

$V_{CC} = 5\text{ V}$ ,  $T_A = 25\text{ }^\circ\text{C}$ , 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	$\Omega$
Magnetic field angle range	$\theta_{range}$	-	0	-	180	$^\circ$
Peak voltage	$V_{PEAK}$	$V_{CC} = 5\text{ V}$ , B = 700 Gs, Room temperature	13.5	16	17	mV/V
Offset voltage	$V_{OFFSET}$	$V_{CC} = 5\text{ V}$ , B = 700 Gs, Room temperature	-5	-	5	mV/V
Angular error	$\Delta\theta$	Operating	-	0.1	-	$^\circ$
Operation coefficient of bridge resistance	$TCR_B$	$T_A = -40\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$	-	2500	-	PPM/ $^\circ\text{C}$
Operation coefficient of peak voltage	$TCV_{PEAK}$	$T_A = -40\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$	-	-4250	-	PPM/ $^\circ\text{C}$
Operation coefficient of offset voltage	$TCV_{OFF}$	$T_A = -40\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$	-	40	-	$\mu\text{V/V}/^\circ\text{C}$



DFN6L Package

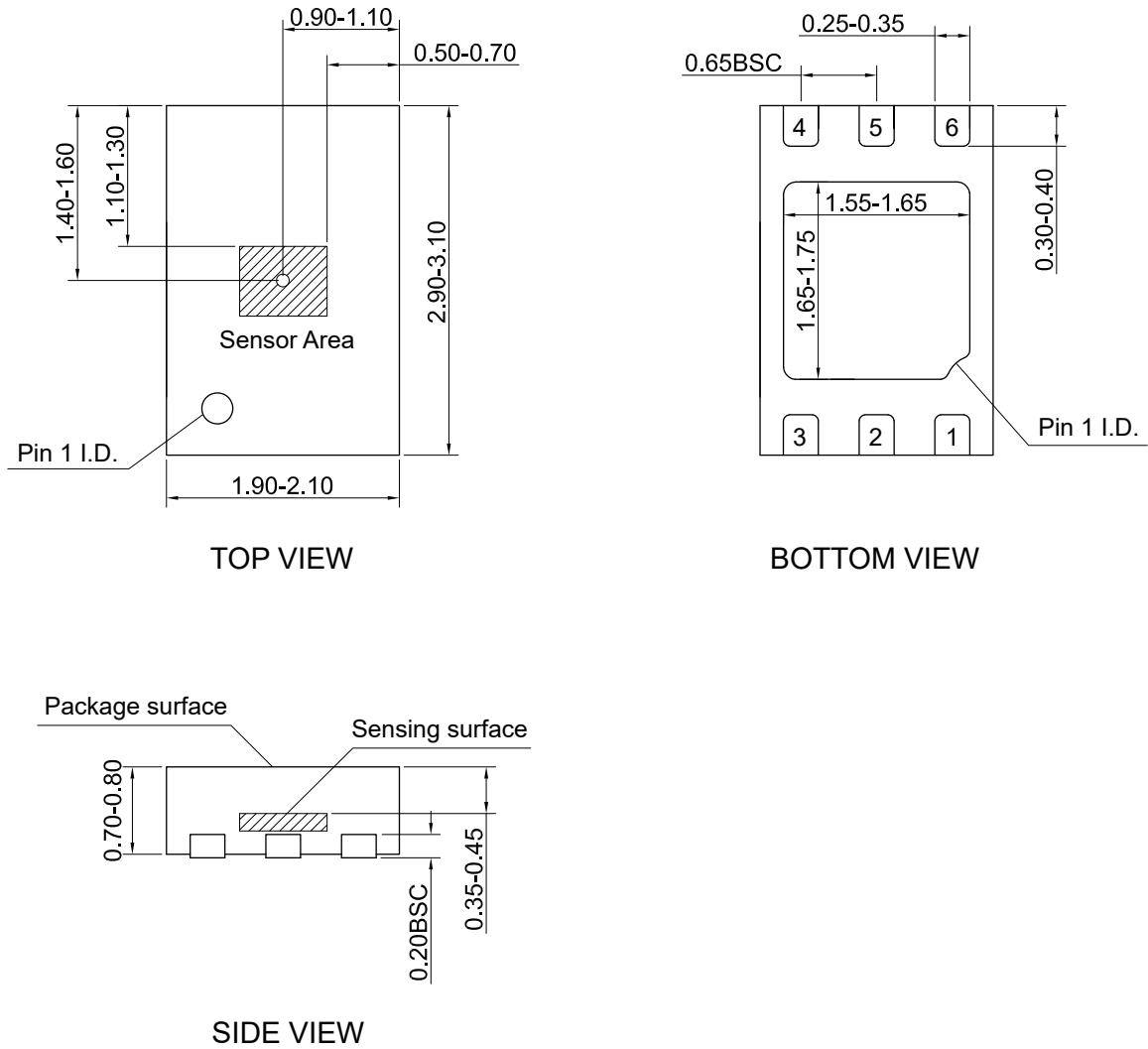


Figure 7. Package outline of DFN6L (unit: mm)

## Copyright © 2023 by MultiDimension Technology Co., Ltd.

Information furnished herein by MultiDimension Technology Co., Ltd. (hereinafter MDT) is believed to be accurate and reliable. However, MDT disclaims any and all warranties and liabilities of any kind, with respect to any examples, hints or any performance or use of technical data as described herein and/or any information regarding the application of the product, including without limitation warranties of non-infringement of intellectual property rights of any third party. This document neither conveys nor implies any license under patent or other industrial or intellectual property rights. Customer or any third-party must further determine the suitability of the MDT products for its applications to avoid the applications default of customer or third-party. MDT accept no liability in this respect.

MDT does not assume any liabilities of any indirect, incidental, punitive, special or consequential damages (including without limitation of lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory. Notwithstanding any damages that customer might incur for any reason whatsoever, MDT's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the terms and conditions of commercial sale of MDT.

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.

Please download latest document from our official website [www.dowaytech.com/en](http://www.dowaytech.com/en).

## 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.



No.2 Guangdong Road, Zhangjiagang Free Trade Zone, Jiangsu, China

Web: [www.dowaytech.com/en](http://www.dowaytech.com/en) E-mail: [info@dowaytech.com](mailto:info@dowaytech.com)

