AMR4100

High accuracy analog output dual axis position sensor

Description

AMR4100 is based on the principle of anisotropic magnetoresistance (AMR), and its output voltage changes with the direction of the magnetic field (target magnetic field) received. The AMR4100 outputs two sets of analog voltage signals (sine and cosine) with a phase difference of 45° when the magnetic field direction rotates one circle. The period of these two sets of analog voltage signals is twice the rotation period of the magnetic field direction. The angular position information of the target magnetic field can be determined in real time by calculating the two sets of analog voltage signals.

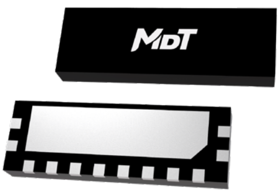
Through the optimized design, the temperature drift of the AMR4100 is effectively compensated, the measurement accuracy of the sensor in various application environments is improved, and the limitation for the installation distance between the measured object and the sensor is reduced. It is available in the compact DFN12L(6 mm × 2 mm × 0.75 mm) packages and easy to assemble in tight spaces.

Features and benefits

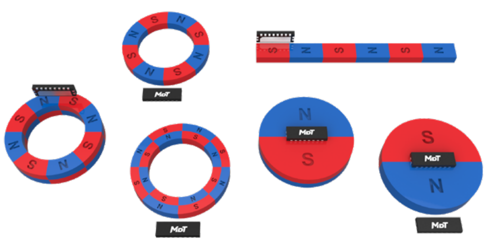
- Anisotropic magnetoresistance (AMR) technology
- Wide operating voltage range (up to ±9 V)
- Sine/cosine signal output (differential analog signal)
- Excellent thermal stability
- High accuracy (absolute accuracy 0.1º)
- RoHS & REACH compliant

Applications

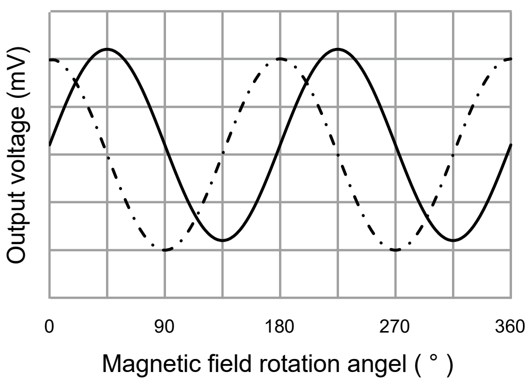
- Linear displacement sensing
- Length measurement
- Linear encoder
- High speed rotation encoder
- Angular displacement sensing
- Knob sensor



DFN12L



Application schematics of AMR4100



Selection Guide

Part Number	Bridge resistance	Output amplitude	Output period	Package	Packing Form
AMR4100	2.7 KΩ	13 mV/V	180°	DFN12L	Tape & Reel

Catalogue

1. Functional Block Diagram

Eight AMR resistors inside the sensor, power supply and electrical connection of two sets of analog voltage outputs as shown in Figure 1.

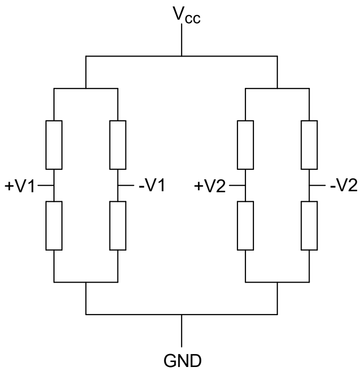


Figure 1. Block diagram

2. Application schematics

AMR4100 sensor responds to horizontal magnetic field (X-Y plane), and magnetic field rotation angle θ was defined as 0º, while V1 = V_{PEAK} and V2 = V_{OFF}, when magnetic field direction is in the same direction as X-axis as shown in Figure 3, the red dash line.

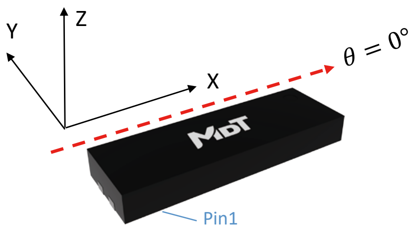


Figure 2. Sensing direction

The positions and magnetization directions of eight AMR sensing elements integrated in the sensor are precisely designed, so that the sensor output V1 = Acos(2θ) represents the angle between the direction of the external magnetic field and X axis, and V2 = Bsin(2θ) represents the angle between the direction of the external magnetic field and Y axis, where A and B are constant and A ≅ B. The angular position information of the applied magnetic field at any time can be obtained by combining the V1 and V2 signals at the corresponding time.

Each output signal is a differential analog voltage signal, and each signal consists of two pin outputs as shown in the table of pin configuration section.

3. Pin Configuration

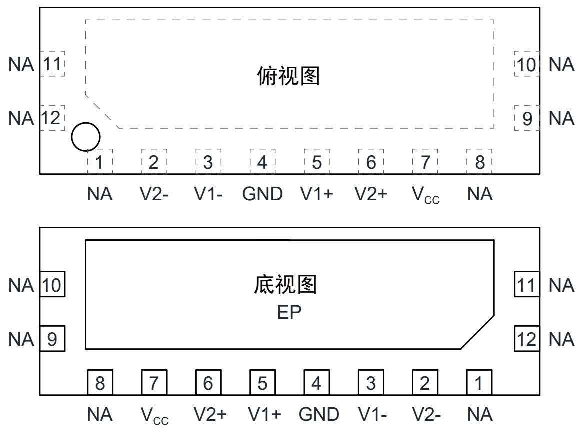


Figure 3. Pin configuration (DFN12L)

Number	Symbol	Function
1	NA	-
2	V2-	Sin signal negative output
3	V1-	Cos signal negative output
4	GND	Ground
5	V1+	Cos signal positive output
6	V2+	Sin signal positive output
7	V_{CC}	Power supply
8	NA	-
9	NA	-
10	NA	-
11	NA	-
12	NA	-
-	EP	Heat dissipation pad

Note: Pin 9, pin 12 and heat dissipation pad EP are internally connected

4. Absolute Maximum Ratings

Parameters	Symbol	Min.	Max.	Unit
Supply voltage	V_{CC}	-9	9	V
Operating ambient temperature	T_A	-40	125	°C
Storage ambient temperature	T_{STG}	-40	150	°C

5. Electrical Specifications

V_{CC} = 5 V, T_A = 25 °C, a 0.1 μF capacitor is connected between V_{CC} and GND

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	-	-	5	-	V
Angle error	Δθ	-	-	0.1	-	°
Response time [1]	$t_{response}$	-	0.1	-	1	μs
Offset [2]	V_{OFFSET}	-	-2.0	-	+2.0	mV/V
Offset temperature coefficient [3]	TCO	T1 = -40 °C, T2 = +150 °C	-2.0	-	+2.0	μV/V/°C
Output amplitude [4]	V_{PEAK}	-	11.0	13.0	15.0	mV/V
V_{PEAK} temperature coefficient [5]	TCV_{PEAK}	T1 = -40 °C, T2 = +150 °C	-0.32	-0.36	-0.40	%/°C
Bridge resistance [6]	R_B	-	2.2	2.7	3.2	kΩ
Resistance temperature coefficient [7]	TCR_B	T1 = -40 °C, T2 = +150 °C	0.34	0.38	0.42	%/°C

6. Magnetic Specifications

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Applied magnetic field	B	-	-	300	-	Gs
Applied magnetic field	B	Anti-interference enhanced	-	750	-	Gs

Note:

1) Response time is defined as the delay of the output signal relative to the change in the magnetic field

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

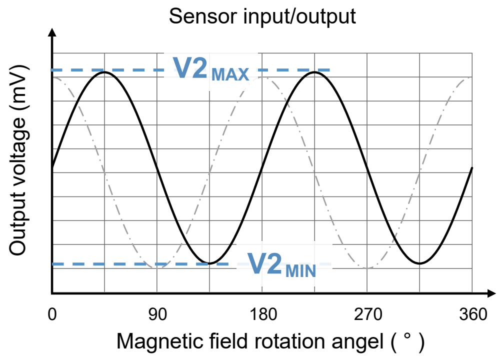
3) $TCO = \frac{V_{OFF}(T2) - V_{OFF}(T1)}{T2 - T1}$

4) $V_{PEAK} = \frac{V_{MAX} - V_{MIN}}{2}$

5) $TCV_{PEAK} = \frac{V_{PEAK}(T2) - V_{PEAK}(T1)}{V_{PEAK}(T1) \times (T2 - T1)} \times 100\%$

6) Resistance between V1+ and V1- and/or between V2+ and V2-

7) $TCR_B = \frac{R_B(T2) - R_B(T1)}{R_B(T1) \times (T2-T1)} \times 100\%$



7. Application Information

The AMR elements in chip work in the saturation status, when the applied magnetic field strength B is 300 Gs (25000 A/m) or above, and the output signal will not change with the applied magnetic field strength in this case. This allows the AMR4100 to better adapt to a variety of applications environment, such as air-gap vibration or high temperature demagnetization during the operation of the measurement system.

The output signal amplitude of AMR4100 is proportional to the power supply voltage. Figure 4 and 5 are the schematic diagrams of the waveforms of the two output signals of the sensor in 2 cycles when power supply is 5 V.

The signal processing algorithm for sampling, correcting, and decoding the output SIN/COS analog signals will directly affect the final measurement accuracy.

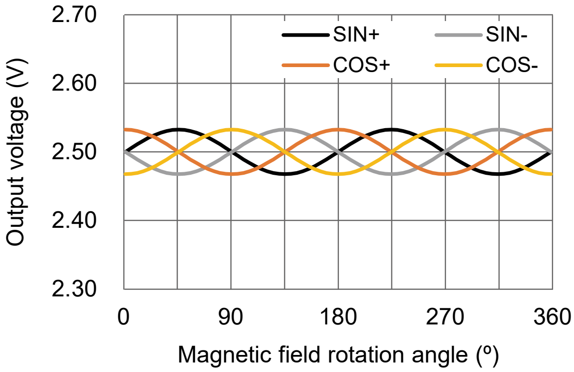


Figure 4. Schematic diagram of the single-ended output voltage waveform of AMR4100 within 2 cycles

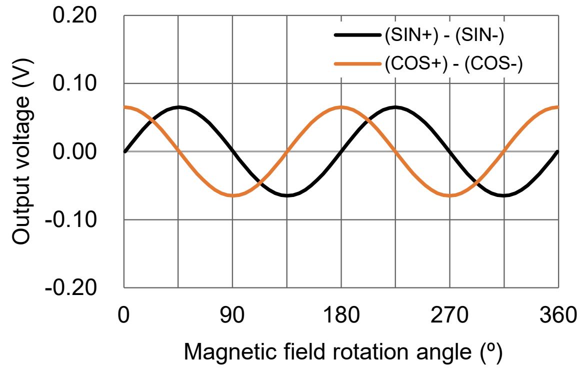


Figure 5. Schematic diagram of the differential output voltage waveform of AMR4100 within 2 cycles

8. Dimensions

DFN12L Package

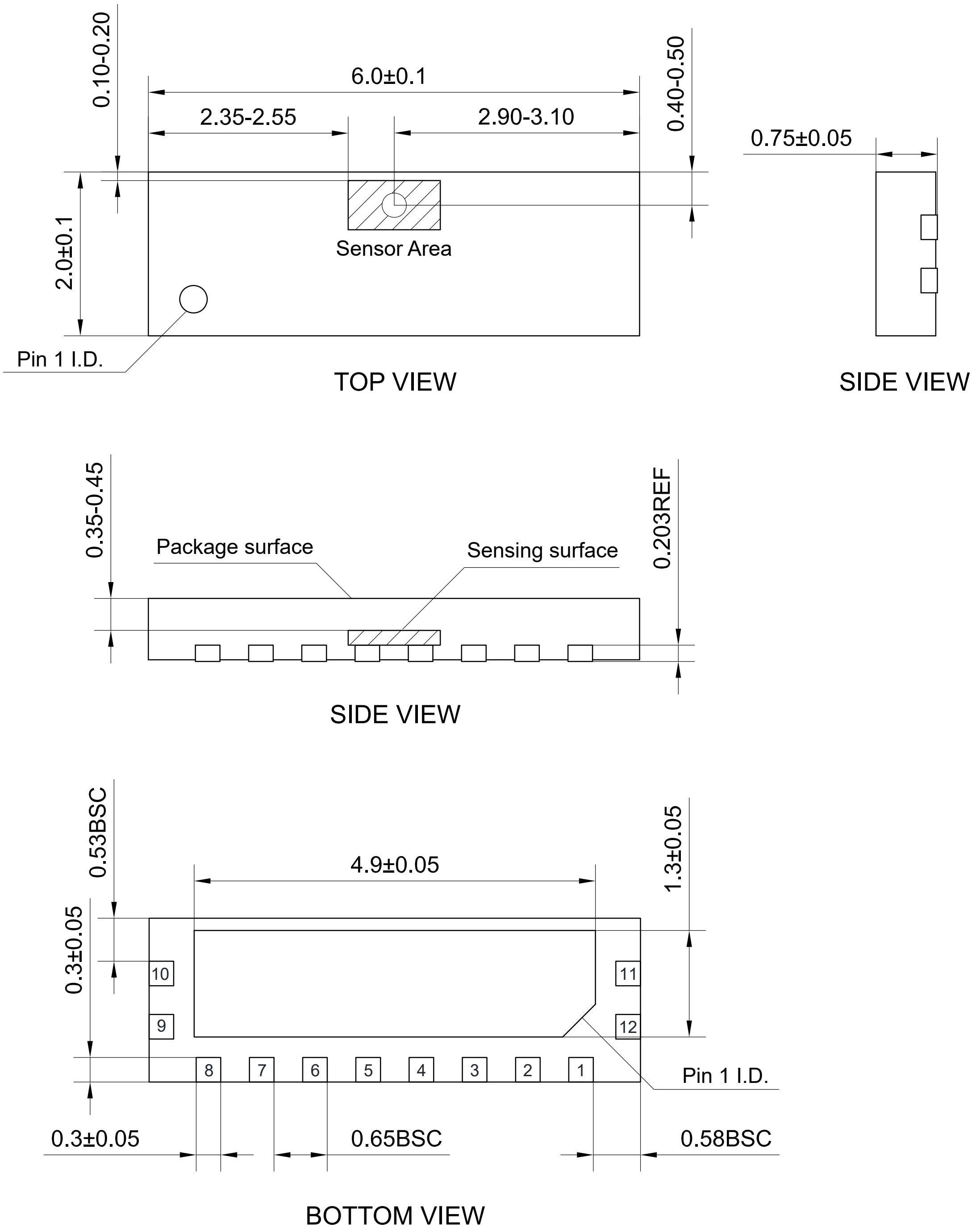


Figure 6. Package outline of DFN12L (unit: mm)

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.

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