Magnetic Sensor
Incremental Encode Output Type
HGPRDT007A
Evaluation Kit Manual

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Incremental Encode Output type Magnetic Sensor HGPRDT007A

Alps Alpine high-precision magnetic sensors use Giant Magneto Resistive effect (GMR) for horizontal magnetic fields detection. Utilizing the GMR element for its high output and exceptional resistance to high temperatures and magnetic fields, our sensors achieve high output level and sensitivity compared to other GMR sensors; approximately 100 times higher than Hall element and 10 times higher than AMR element based on our research. We offer various magnetic sensors for dedicated usage such as non-contact switch applications, linear position detection and angle detection as well as rotational speed and direction sensing in response to external magnetic fields.

This document provides the information how to evaluate Incremental Encode Output Type Magnetic Sensor (herein after magnetic encoder) with M5Stack quickly.

1. Requirements

Please prepare followings for evaluation:

① M5Stack BASIC
② USB cable (come with M5Stack)
③ Evaluation board for HGPRDT007A
④ PC w/Arduino IDE & other files (see below)
⑤ Neodymium magnet (4-pole ring type)
⑥ DC FAN and power supply

Note) All the necessary files should be installed into Arduino IDE such as “M5Stack Boards Manager” and “Library Manager”. For setting of M5Stack, please also refer to M5Stack website and other materials.

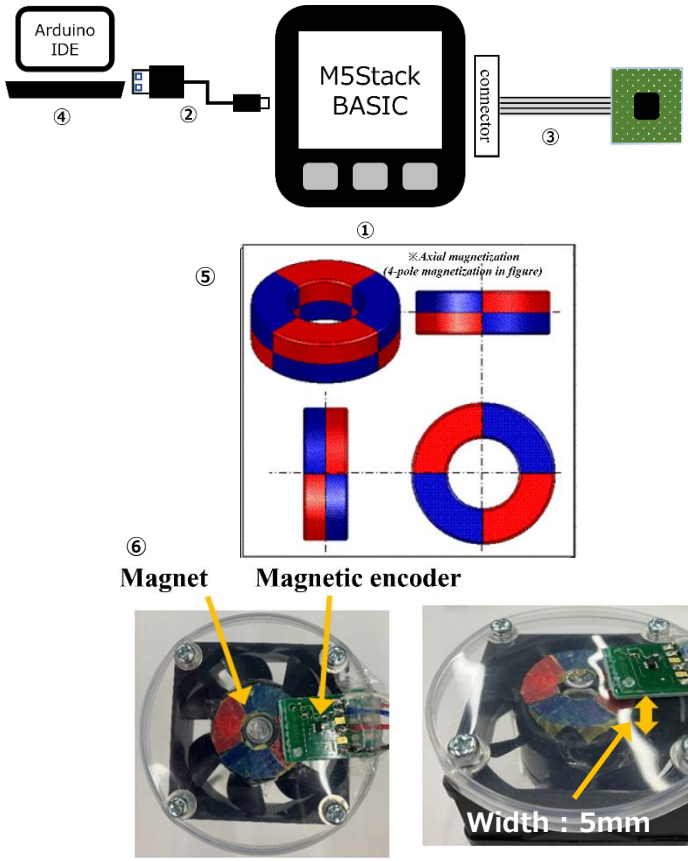

Fig. 1

2. Connection

Connect PC, M5Stack and the evaluation board by USB cable as shown in Fig.2. The circuit diagram of the evaluation board is shown in appendix in this document.

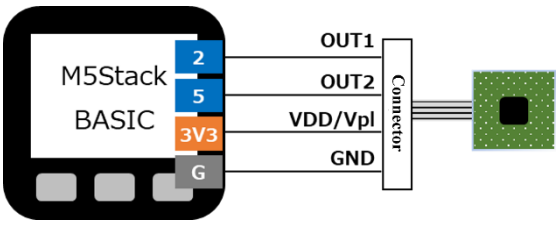

Fig. 2

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3. Compile a program

Download sample program for the magnetic encoder (HGDVST007A) from ALPSALPINE website and extract zip file anywhere on your PC. Then follow the instruction below 1 - 4.

(For download, user registration is required)

Archive file: HGPRDT007A_SSW0***.zip

After extraction:..¥(Any)¥HGPRDT007A_SSW0***¥HGPRDT007A_SSW0***.ino

1. Start Arduino IDE.
2. In menu [file]→[Open] and select (ALAP_HGPRDT007A.ino) in list (Fig.3).
3. Select “M5Stack-Core-ESP32” or "M5Core"in [Select Board] and select COMxx which is connected with M5Stack (Fig.4).
4. Click “✓” for compile and wait.

Note) Number of COM port (xx) is different depend on user condition.

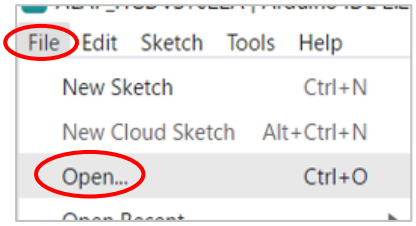

Fig.3

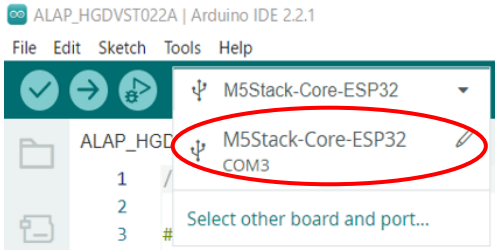

Fig.4

4. Upload compiled program to M5Stack

Upload (write) the compiled sample code to M5Stack.

1. Click “→” for upload and wait for message “Done uploading” (Fig.6).
2. After uploading, M5Stack restart automatically.
3. Status of magnetic sensor can be monitored on M5stack LCD.

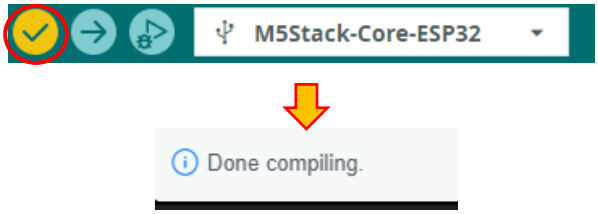

Fig.5

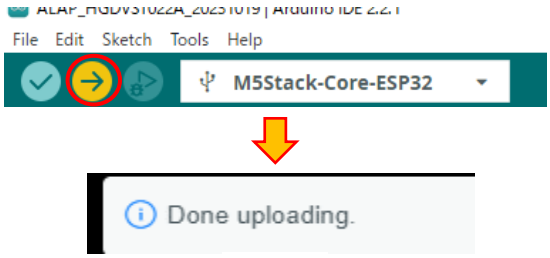

Fig.6

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5. About sample program

The magnetic encoder detects the change in flux density of the rotating magnet and output “1” or “0”. The sample program uses the output signal to calculate the rotational speed, displays the direction of rotation and the rotational speed on the LCD screen.

1. When the power button is ON, the program starts and displays the initial state (direction of rotation: STOP / speed: 0rpm).
2. When the magnet rotates, the magnetic encoder detects the change of magnetic flux density and outputs the OUT1/OUT2 signals (Fig.7).
   - Clockwise (CW): Output in the order of ①②③・・⑦⑧.
   - Counterclockwise (CCW): output in the order of ⑧⑦⑥・・②①.
3. M5Stack detects the position of the magnet through the OUT1/OUT2 signal of the magnetic encoder, calculates the rotation speed and displays the rotation direction and rotation speed on the LCD screen (Fig.8).

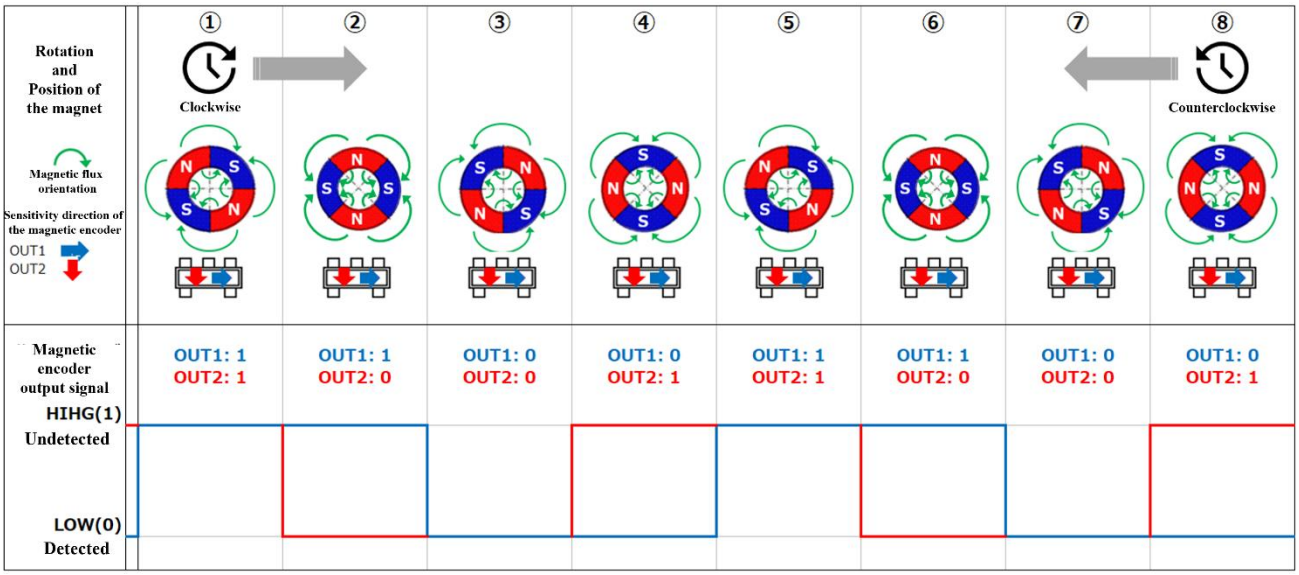

Fig.7 Rotation position of magnet and magnet encoder output

STOP: No rotation
CCW: Counterclockwise
CW: Clockwise
＊rpm: Numbers of rotation (Approximate number)

Fig. 8 Display of direction of rotation and speed

Calculation of rotational speed

In case of 4-pole magnet, 8 equal parts are exisiting per approximately 45 deg. In the sample code the change of encoder output is defined as 1 count. Rotational speed can be calculated with following steps; Accumulate the counts in 1 second, divide it by the numbers of divisions (8) and multiply by 60.

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About magnetic encoder

The magnetic encoder (HGPRDT007A) uses an open-collector circuit. As shown in Fig.9, the output signal of OUT1 is ON (output low) when the magnetic flux density from Pin3 to Pin1 is 0.8 mT (typ.) and the output signal of OUT1 is OFF (output high level) when its magnetic flux density is -0.8mT (typ.). The output signal of OUT2 is ON (output low level) when the magnetic flux density from Pin1 to Pin5 is 0.8mT (typ.) and the OUT2 output signal is OFF (output high) when the flux density is -0.8mT (typ.). Due to the pitch free design, a 2-phase signal with a 90-degree phase difference can also be output for an anisotropic magnet with multiple poles similar to the one in Fig.10. For design information and detailed procedures, refer to the product datasheet, design manual, and application notes.

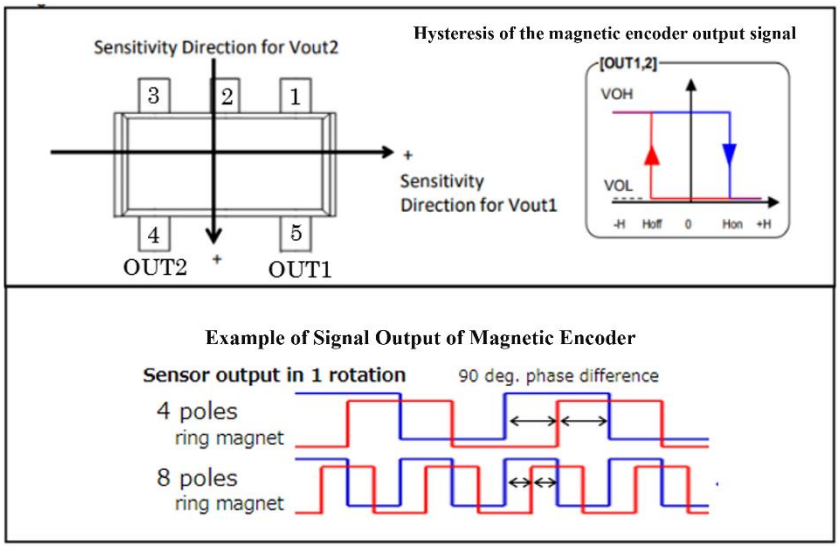


Fig. 9 Sensitivity direction of magnetic encoder

Table.1 Operating magnetic field

Parameter	Symbol	Values			Unit	Note
		Min.	Typ.	Max.		
Operating Magnetic Field	Hon	-	0.8	(1.6)	mT	25deg.C
	Hoff	(-1.6)	-0.8	-	mT	
	Hhys	-	1.6	-	mT	

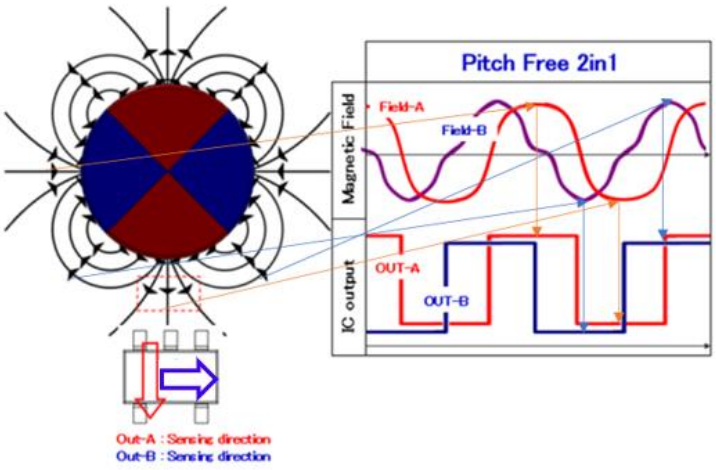


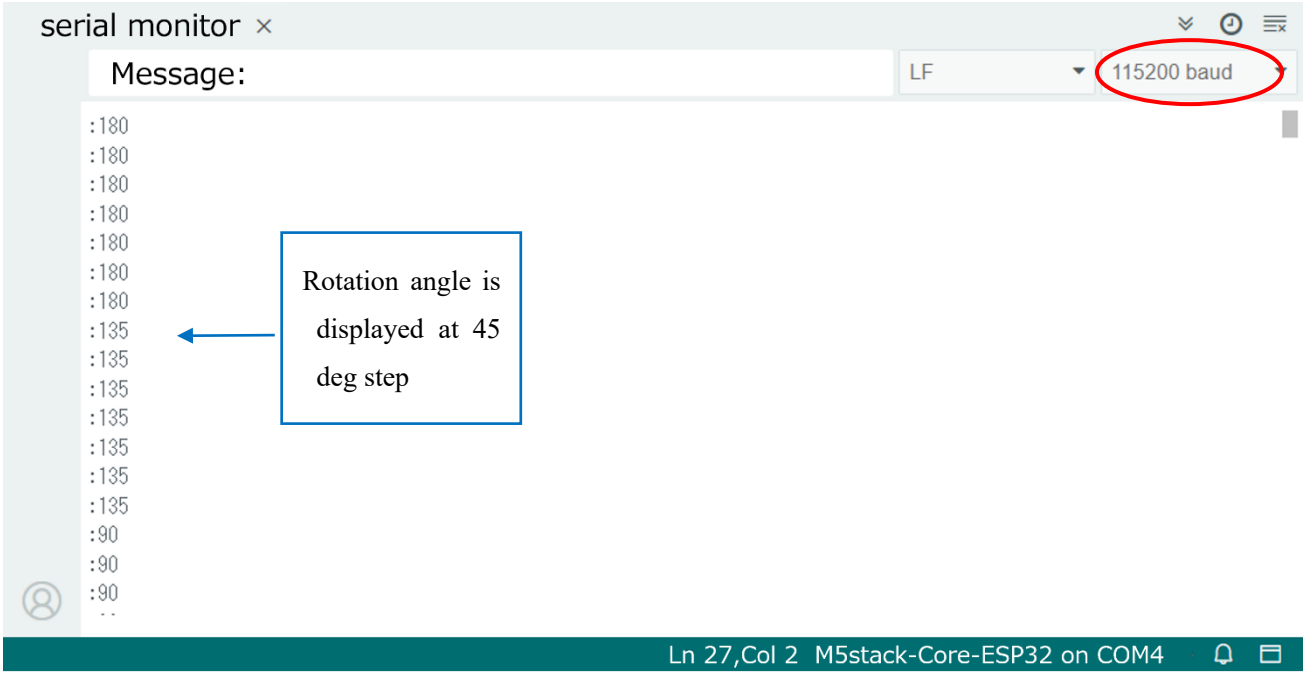
Fig.10 Pitch free

About serial monitor

The angle of magnet rotation can be monitored on Arduino IDE serial monitor when M5Stack is connected to PC.

To use this function, please set baud rate as below:

Baud rate: 115,200bps



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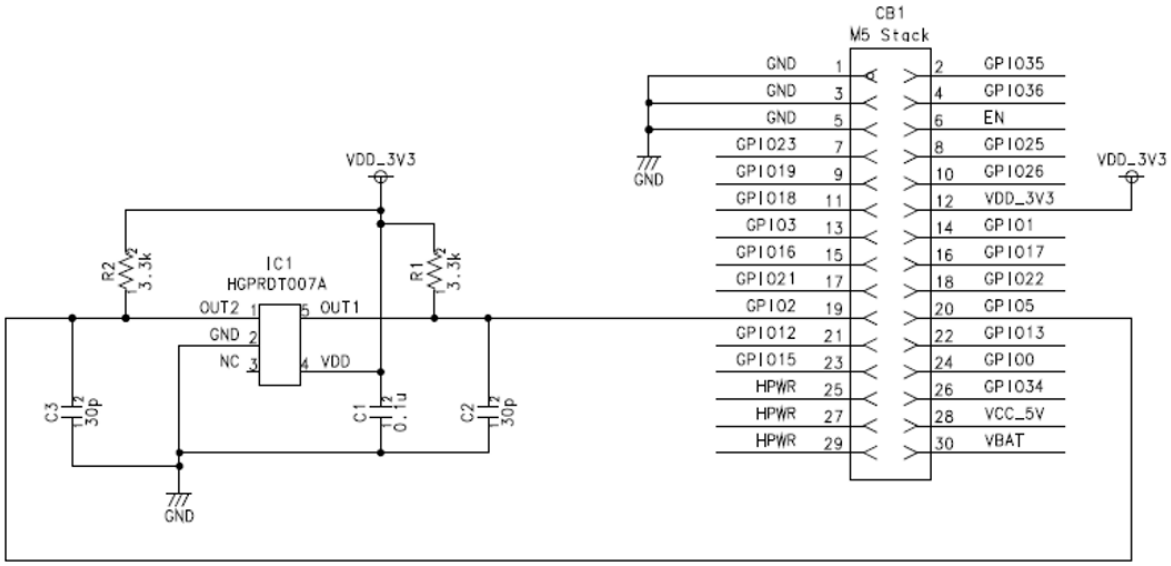
Appendix

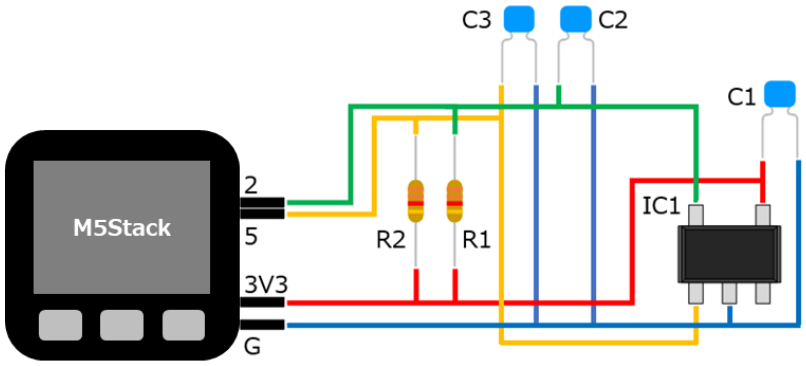
1. Circuit Diagram



2. Components

Part No.	Discription	Parts / Valur
IC1	Magnetic Encoder	HGPRDT007A
C1	Bypass Capacitor	0.1uF
C2	Load Capacitor	30pF
C3	Load Capacitor	30pF
R1	Pull-up resistor	3.3kΩ
R2	Pull-up resistor	3.3kΩ

3. Wiring diagram



Note) Follow the pin description back on M5Stack for wiring

Revision history

Date	Version	Change
Apr. 18 2024	1.0	Layout Release (English version)

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