Magnetic Sensor
Analog linear output type
HGARPS011A
Evaluation Kit Manual

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Analog Linear Output Type Magnetic Sensor HGARPS011A

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 Analog Linear Output Type Magnetic Sensor (herein after magnetic angle sensor) with M5Stack quickly.

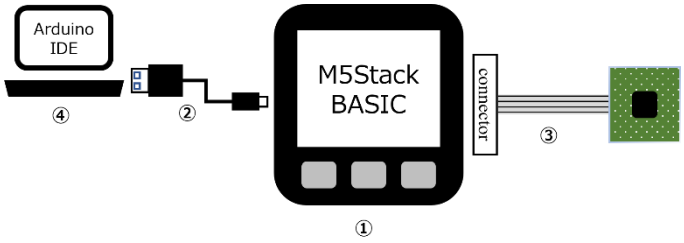
1. Requirements

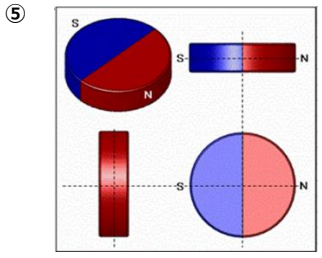
Please prepare followings for evaluation:

① M5Stack BASIC
② USB cable (come with M5Stack)
③ Evaluation board for HGARPS011A
④ PC w/Arduino IDE & other files (see below)
⑤ Ferrite magnet (Cylindrical-Column 2-pole

The layout of the magnetic angle sensor and magnet is shown in Fig.1. Adjust the layout of the magnet and the sensor to obtain appropriate the magnetic field strength within the range of 10mT to 120mT. For details, refer to the Design Manual.

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.





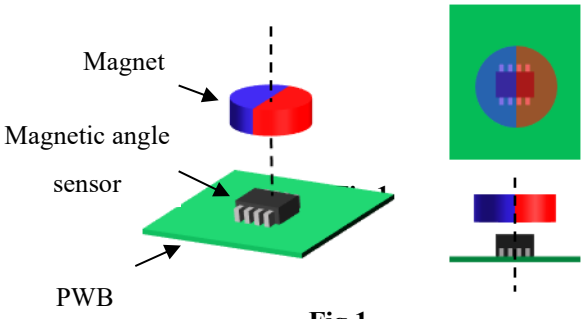


Fig.1

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.

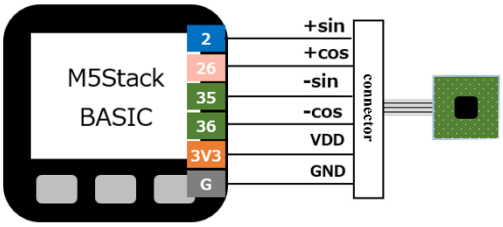


Fig 2

3. Compile a program

Download sample program for the magnetic angle sensor (HGARPS011A) from Alps Alpine website and extract zip file anywhere on your PC. Then follow the instruction below 1 - 4.

(For download, user registration is required)

Archive file: HGARPS011A_SSW0***.zip

After extraction ..¥(Any)¥HGARPS011A_SSW0***¥HGARPS011A_SSW0***.ino

1. Strat Arduino IDE
2. In menu [file]→[Open] and select (“file name”.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 for “Done compiling” (Fig.5).

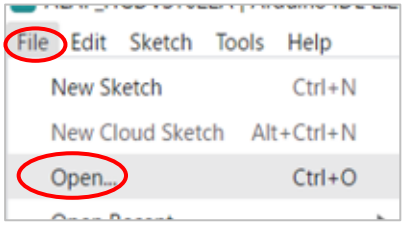


Fig.3

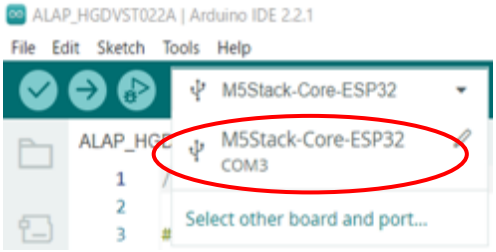


Fig.4

Note 1) Number of COM port is different depend on user condition.

Note 2) This sample program is confirmed with Arduino IDE 2.2.1.

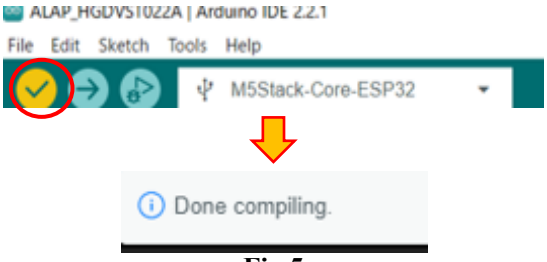


Fig.5

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 and status of magnetic sensor can be monitored on M5stack LCD.

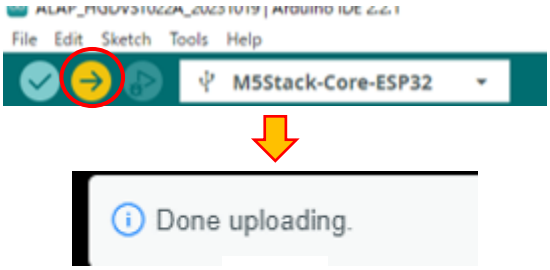


Fig.6

5. About sample program

The magnetic angle sensor detects the change in magnetic flux density of the rotating magnet and converts it as digital signal. The program performs the compensation process for this converted value, calculates the angle and displays it on the LCD screen.

1. When the power button is turned on, the program starts and displays the initial screen (Fig.7(1)).
2. To set 0 deg position, rotate the magnet at least one time and press the “A” button at desired position to set as 0 deg.
3. The sensor detects the change in magnetic flux density and displays three types of values on the screen (Fig.7(2)).

Fig.7(1)

Fig.7(2)

Displayed information on LCD

Angle: Detected angle

Zero: Compensated angle at 0 deg position

Pdiff: Compensated value of phase difference between sin and cos

Angle calculation and compensation process

The angle calculation and compensation processing flow are shown in Fig8. This sample program covers **compensation level 1**. For more information on the angle calculation and compensation process, refer to the Design guide.

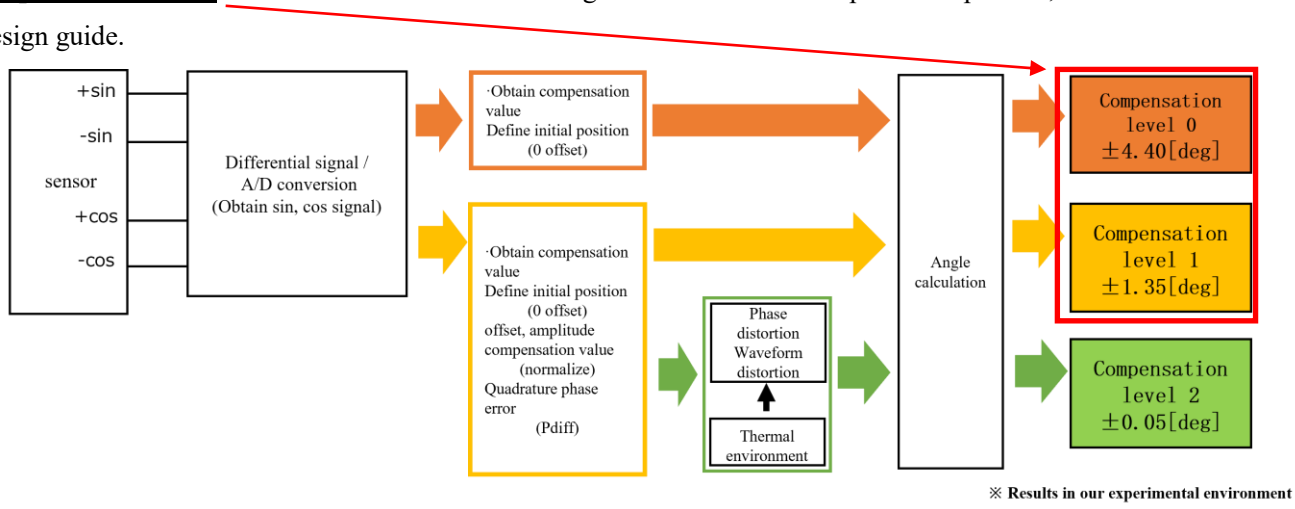


Fig.8 Angle compensation processing flow

Overview of the operating principle of magnetic angle sensors

The magnetic angle sensor (HGARPS011A) has four MR sensor bridges in the package and the four sensor bridges output two phase signals with a phase difference of 90 degrees. Following is the flow from the four signals output from the magnetic angle sensor to the angle acquisition. The item numbers (① to ③) in the description correspond to the numbers shown in Fig.9. For details, refer to the Design guide.

Description of the process

① The magnetic angle sensor output four analog signal such as +sin, -sin, +cos and -cos.

② Obtain the value for sin and cos by calculating the difference between +sin and -sin also +cos and -cos. Depend on necessity amplify (or attenuate) the signal level.

③ Angle can be obtained by calculation using the value sin and cos. Absolute angle range: 0～360deg

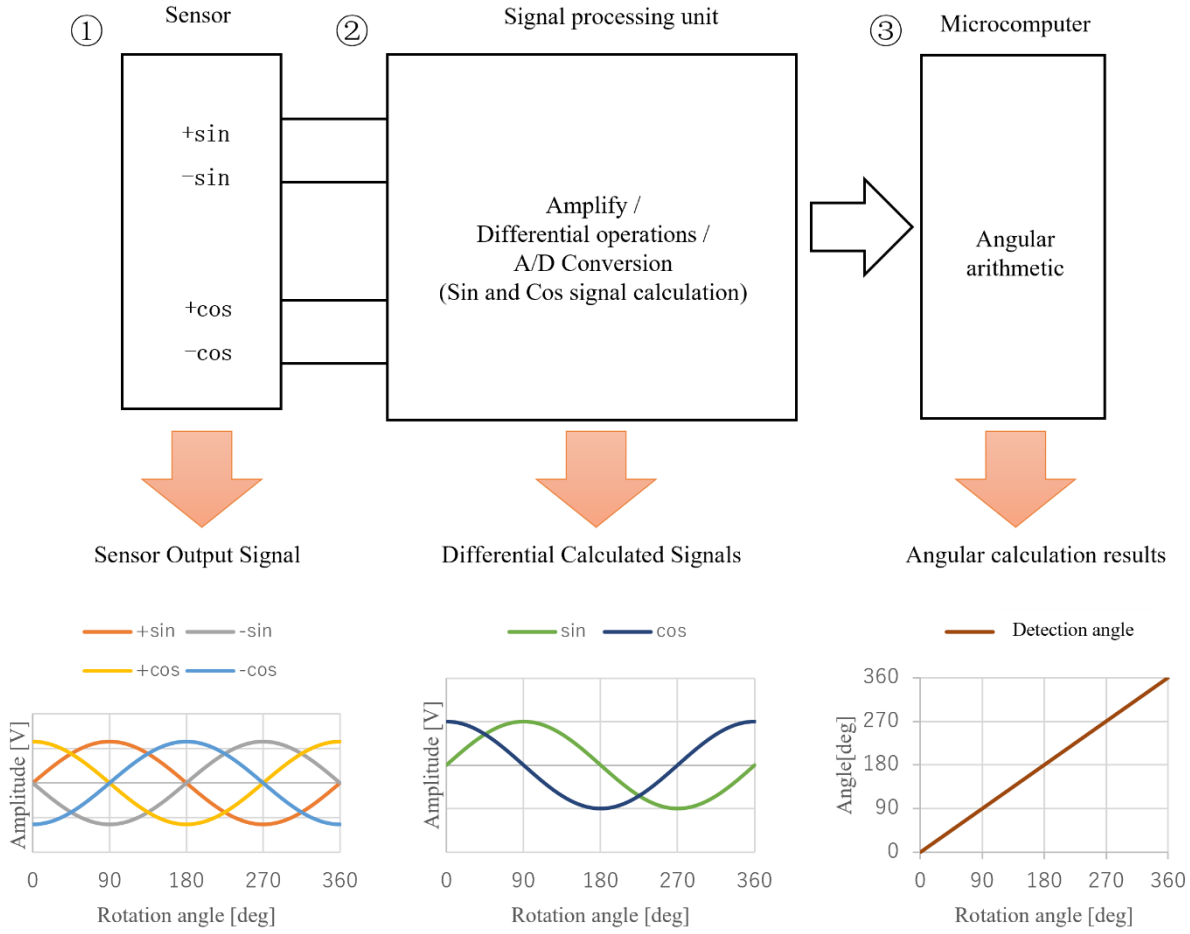


Fig.9 Angle calculation flow

About serial monitor

This sample code outputs the calculated values to the serial port. When the PC and M5Stack are connected via USB and the serial monitor of the Arduino IDE is started, the values are displayed on the monitor screen. To use this function, please set baud rate as below:

Baud rate: 115,200bps

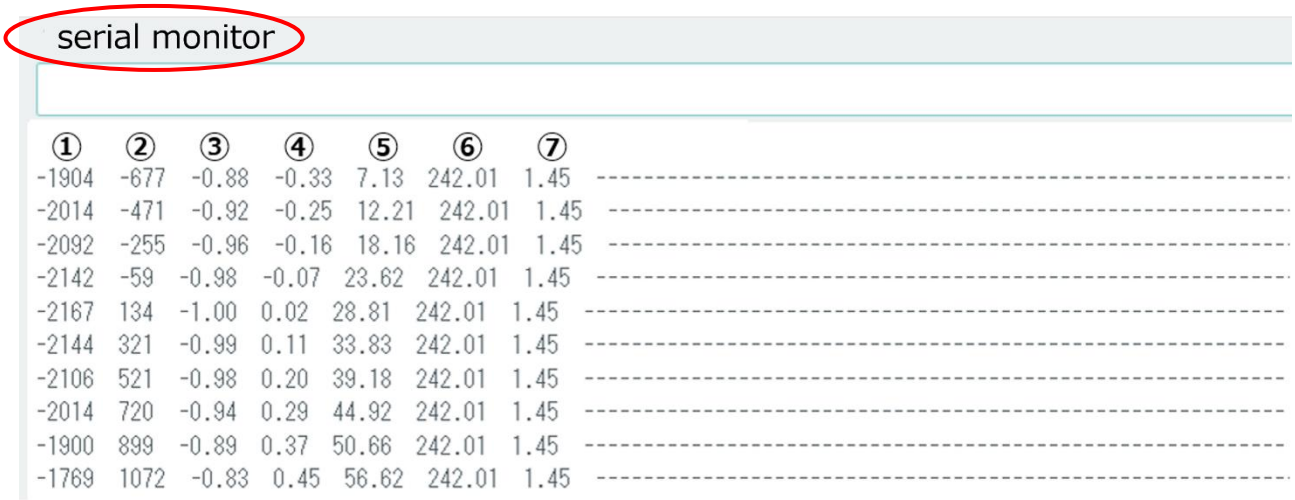
The status of sensor input port can be monitored at Arduino IDE "serial monitor" when M5stack is connected. "Switch: 0" means "LOW" and "Switch: 1" means "HIGH".

s

Meaning of each value

1	2	3	4	5	6	7
Difference between +Sin and -Sin	Difference between +Cos and -Cos	Normalized Sin	Normalized Cos	Detected Angle	Compensated Angle at 0 deg position	Compensated phase difference between Sin and Cos

Example of serial monitor



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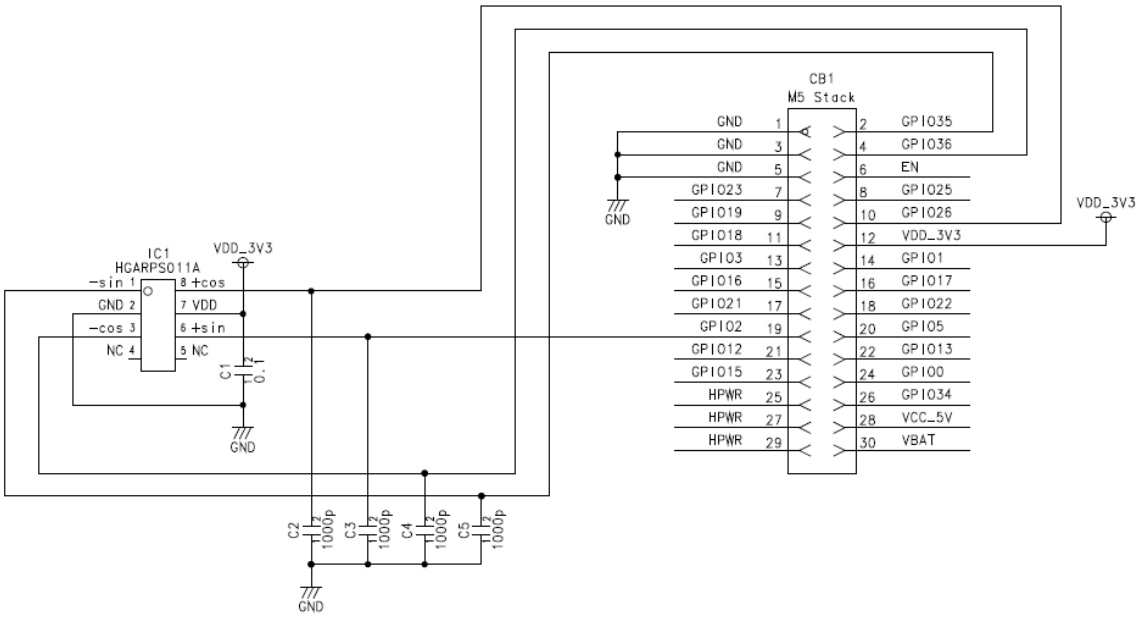
Appendix

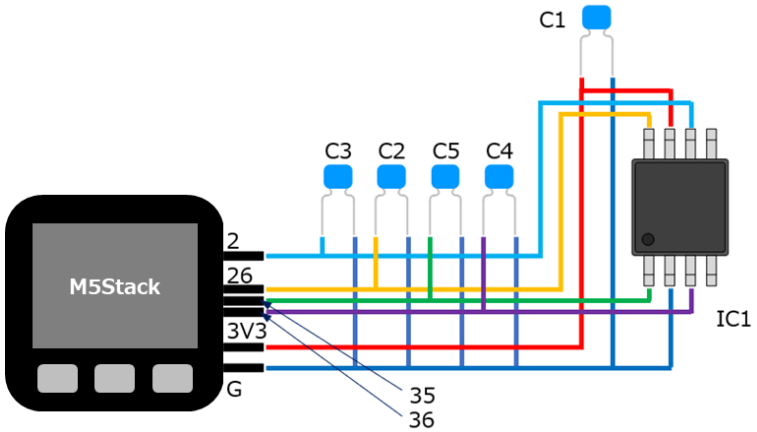
1. Circuit diagram



2. Components

Part No.	Description	Parts/Value
IC1	Magnetic angle sensor	HGARPS011A
C1	Bypass capacitor	0.1uF
C2	Load capacitor	1000pF
C3	Load capacitor	1000pF
C4	Load capacitor	1000pF
C5	Load capacitor	1000pF

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)