Alps Magnetic Encoder Sensor device Application Note
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Magnet for encoder
Detect rotation speed and direction
Design guide
  Magnet size and magnetic field
  Sensor to Magnet distance
  Sampling rate/Max speed
  Temp dependency
Application circuit
1. Basic Information about ALPS GMR Magnetic encoder

There is magnetic field distribution beside the magnet. If the magnet rotates, field distribution also changes. Magnetic sensor device can detect this field distribution change.

Magnetic field is from magnet N-pole to S-pole. ALPS GMR sensor can detect this magnetic field direction change.

Magnetic field has two elements, 
One is Br element : radius direction.
Another is B\( \Phi \) : \( \Phi \) direction.
Br and B\( \Phi \) element strength is changing alternatively with 90 degree phase offset.

GMR sensor can detect this Br and B\( \Phi \) element individually.
There are two GMR sensor elements inside ALPS sensor device package,
One element detects Br field,
And another element detects B\( \Phi \) field.
Combined ASIC process these GMR signal and output 2-phase Hi/Lo signal.

Then sensor can detect magnet rotation speed and direction.

2. Design guide

Device structure

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Sensor device is consisted from two GMR element and electrical circuit. Br GMR element output is related to OUT1, and BΦ GMR element is related to OUT2.

Br and BΦ two direction sensors are combined in one package device. Two sensor sensitivity direction is 90degree different, so OUT1 and OUT2 has 90degree phase difference with any pole pitch magnet. Br and BΦ sensing area center is located as below picture. Br and BΦ sensitivity center is at same position.

2.1. Definition of Br, and BΦ-Sensor

Br and BΦ sensor output is processed in IC circuit with amplifier and comparator, then final OUTPUT signal becomes Hi/Lo signal.

3. Magnet and Sensor layout

There are some recommendations for Magnet and
sensor layout.

1. Radial magnet / 
   Sensor is located beside the magnet.

   ![In plane diagram]

2. Radial Magnet / 
   Sensor is located vertical to magnet.

   ![Vertical diagram]

3. Axial Magnet / 
   Sensor is located under the magnet.

![Axial diagram]

- Sensor can detect magnet rotation at any layout.
- Setting the sensor on the line of Magnet Edge is recommended for accurate 2-phase sensing.

### 3.1 Magnet recommendation

Any type magnet can be used. Magnetic field strength should be more than 1.5mT, (more than 3mT is recommended for accurate sensing.)

In the case of Ferrite-Magnet, Magnet surface to sensor top Gap capability is similar value to magnet pole pitch.

### 4. Evaluation equipment.

- Sensor sample can be delivered as package device
alone or Test PCB mounted style like below.

Sensor can be evaluated with magnet and power supply. Environmental chamber or Hermhorz coil equipment is useful.

Oscilloscope can measure OUT1 and OUT2 signal.

4.1. Recommendation circuit
Sensor device is using CMOS IC, Bi-pass capacitance is strongly recommended.

5. Legal Disclaimer
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