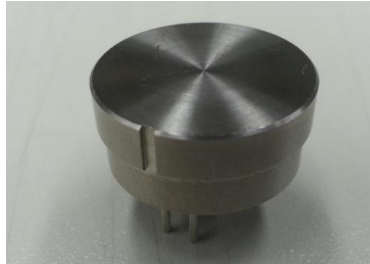


FR05CM13AE

Rotary Sensor



Features

- The rotary sensor to detect gear or rack for motor
- The output wave pattern of this para-sine wave is close to an ideal sine wave.
- Therefore a wave pattern can be divided by an electric circuit..
- A strength of the FR sensor is to be strong on the outside of magnetic field, cutting oil, dust, vibration.
- And it can give Z signal for the origin detection.

Applications

- Spindle motor of the machine tool
- Motor (speed control and ABS use) of the train
- Needle position detection of the knitting machine
- Linear stroke detection of the cylinder

Overview

FR sensor uses semiconductor MR element (SMR) and permanent magnet.

It faces a gear or a rack which is made of ferromagnetic material.

Then it outputs a para-sine wave depending on a turn and movement of a gear or a rack

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2. Specifications

2.1 Sensor Operation

2.1.1 Equivalent circuit

The sensor circuit is configured with a combination of elements and a permanent magnet.

A bias-type sensor circuit can be used to detect magnetic media movement.

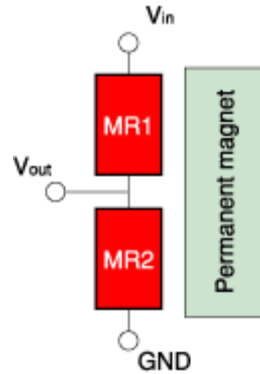


Fig.1 Combination of Element with Magnet

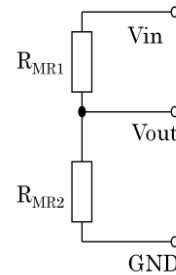
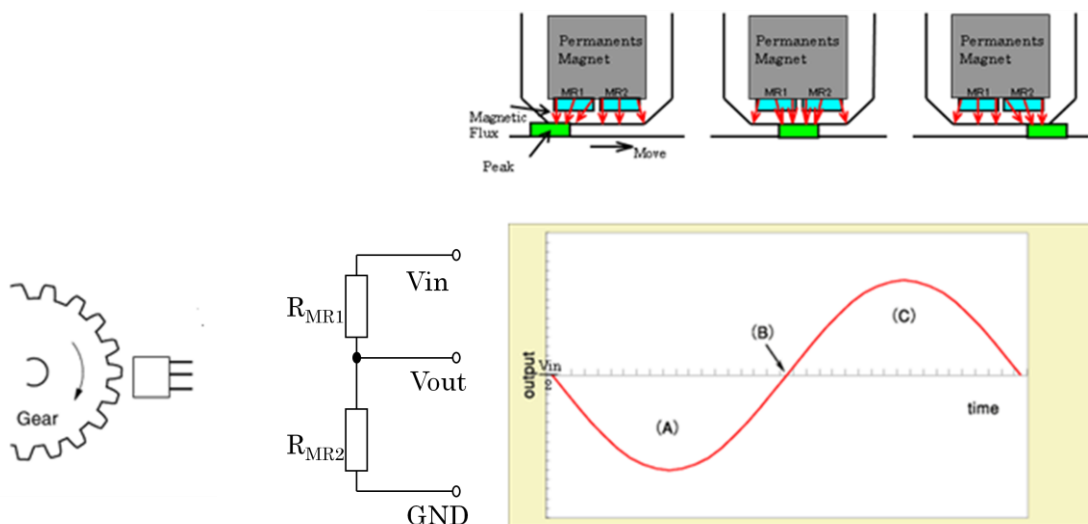


Fig.2 Equivalent circuit

2.1.2 Sensor Medium Operation Principle

Rotary sensors are configured with a combination of a permanent magnet and elements. While a magnetic medium is passing over the sensor's detecting surface, the elements detect a change in the magnetic flux density, which is then converted into an electrical signal. The elements detect the magnetic flux perpendicular to the element surface.



$$V_{out} = \frac{R_{MR2}}{R_{MR1} + R_{MR2}} \times V_{in}$$

Fig.3 Output signal

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2.2 Performance of Electrical Specification

Table.1 Performance of Electrical Specification

Ta=25±3 °C, HMD=less than 60%RH, unless otherwise specified.

Item	Mark	Spec	Condition
Total Resistance (Rin)	RinAB	400~3000Ω	1
	RinZ	700~5500Ω	
Mid voltage	VoA, VoB, VoZ	2.5±0.3V	1
Rotary direction differences of mid voltage	VoA(CW)- VoA(CCW)	Max15mV	1
	VoB(CW)- VoB(CCW)		
	VoZ(CW)- VoZ(CCW)	Max25mV	
Output voltage	Vp-pA, Vp-pB	min600mVp-p	1
	Vp-pZ	min600mVp-p	
Output voltage ratio	Vp-pA / Vp-pB	1.00±0.10	1
Phase delay of output voltage	Vp-pA~Vp-pB	90±3deg	1
	CW turned	B advances for A	
	CCW turned	A advances for B	
Wave pattern of the Z signal	CW turned	Rise to fall to rise	1
	CCW turned	Fall to rise to fall	
Temperature drift of mid voltage	VdA(-10), VdB(-10), VdZ(-10)	examine	2
	VdA(+85), VdB(+85), VdZ(+85)	examine	
Insulation resistance	IR	min100MΩ	3
Dielectric Strength		Current leak max 1mA	4

Please refer to Clause 6 for the measurement condition.

Explanation of spec mark

RinAB, RinZ Resistance terminal from Pin2 to Pin7 and Pin5 to Pin3

VoA, VoB, VoZ Mid voltage of the output

Vp-pA, Vp-pB, Vp-pZ Peak to peak voltage of the output

VdA(t), Vd B(t), VdZ(t) $VdA(t) = | VoA(t) - VoA(+25) |$

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2.3 Measurement Method

Table.2 Measurement Method

No	Measurement method
1	Temperature 25±3°C Vin 5.000±0.002V Gear AB M0.4gear, tooth 256 Z Dent1pcs Gap(from sensor to gear) 0.130±0.013mm Number of revolutions 1500±150rpm
2	Temperature -10, +25, +85°C Vin 5.000±0.002V Gap from sensor to gear ∞ (There are no magnetic material around sensor)
3	Between all pin④ to case surface Circuited which places the sensor at 250VDC HMD 60%RH Temperature 25±3°C Gap from sensor to gear ∞ (There are no magnetic material around sensor)
4	Between all pin④ to case surface Circuited which places the sensor at 500VAC, 1min HMD 60%RH Temperature 25±3°C Gap from sensor to gear ∞ (There are not magnetic material around sensor)

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3. Measurement Direction

3.1 Technical performance Characteristic

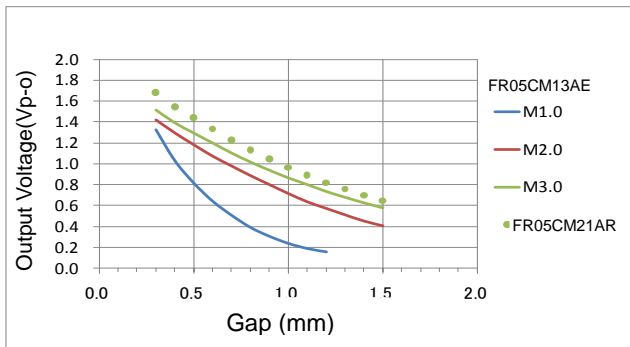


Fig.4 Output voltage

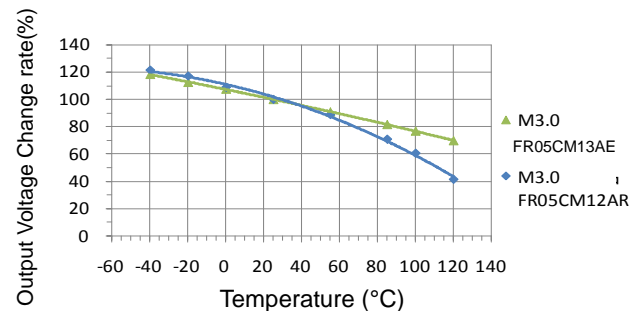


Fig.5 Output voltage vs Temperature (Gap=1.0mm)

4. Dimension and Terminal Assign

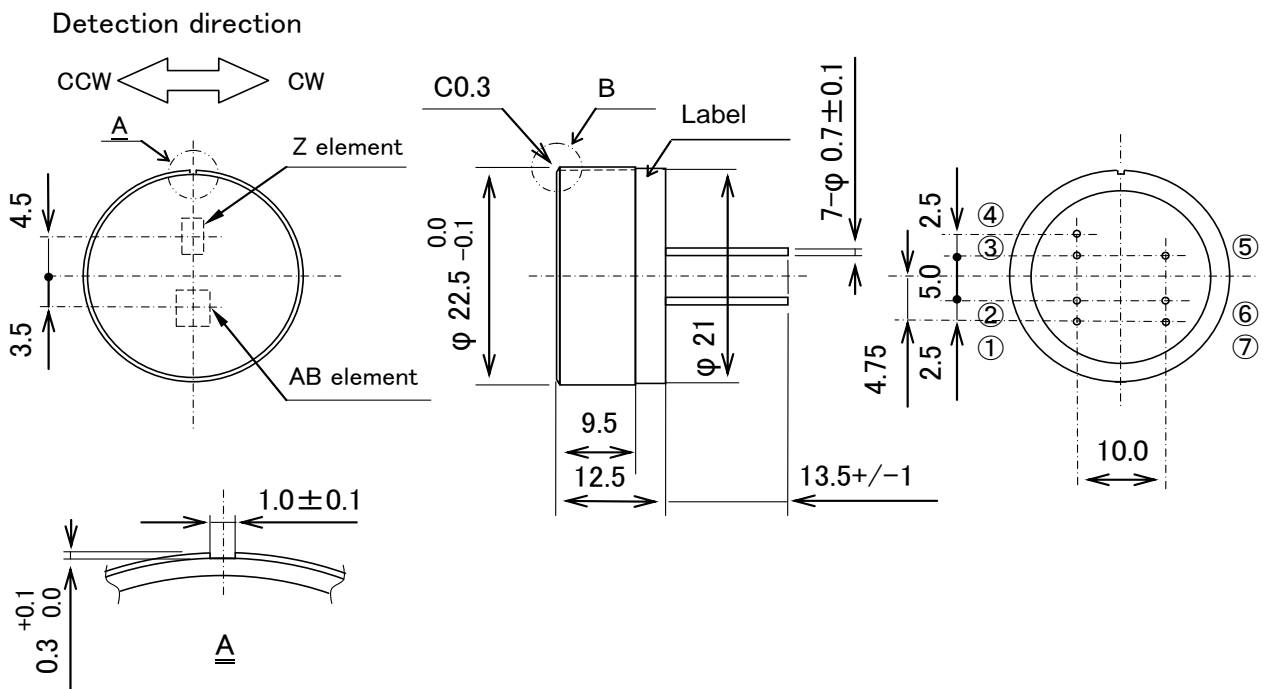


Fig.6 Dimension

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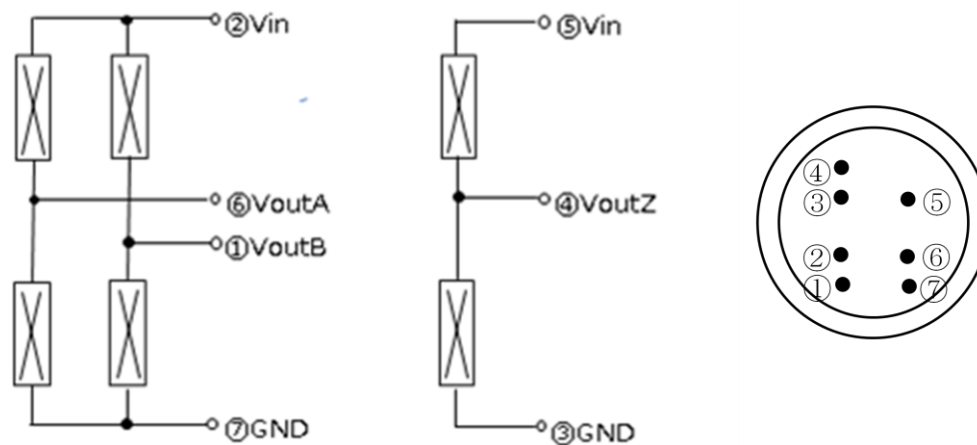


Fig.7 Equivalent circuit and terminal layout

5. Application Circuit

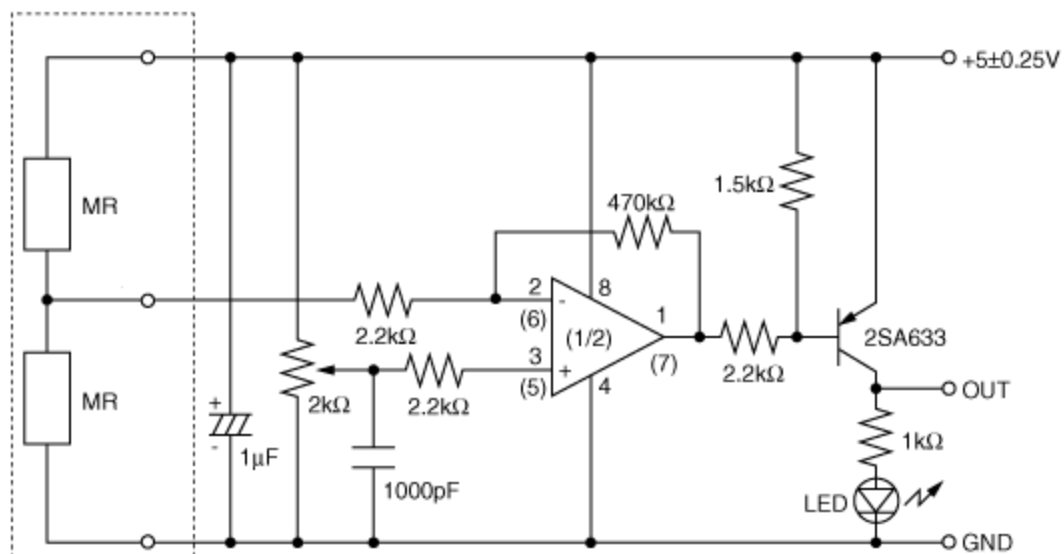


Fig.8 Application circuit

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6. ⚠Caution

6.1 Limitation of Applications

Please do not use in the applications listed below which require a high reliability to prevent the defects which might cause a damage to the Peoples' life and/or property.

- 1) Aircraft equipment
- 2) Aerospace equipment
- 3) Undersea equipment
- 4) Power plant control equipment
- 5) Medical equipment
- 6) Transportation equipment (automobiles, trains, ships, etc.)
- 7) Traffic signal equipment
- 8) Disaster prevention / crime prevention equipment
- 9) Data-processing equipment
- 10) Military equipment (regardless of directly/indirectly)
- 11) Security device/system

Application of similar complexity and/or reliability requirement to the applications listed in the above

6.2 Fail-Safe

Please make sure to provide an appropriate fail-safe function on your product to prevent a second damage that may be caused by the abnormal function or the failure of our product.

6.3 Notice in design

- 1) This product is designed to detect gear of motor. Please contact us when using this product to detect any magnetic properties.
- 2) Because this product contains a permanent magnet, magnetic signals in writable magnetic cards, such as train tickets or pre-paid cards could be damaged. Please consult with us before applying it in such circumstances.
- 3) Please mount this product with holder stuck firmly on the PCB in addition to solder pins..

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6.4 Notice in handling and storage

- 1) This products generates very strong suction because this product contains a permanent magnet. Be careful when handling the sensor not to apply mechanical shock.
- 2) Do not place this product near magnetic recording media such as magnetic tapes or floppy disks. Magnetic recording could be damaged.
- 3) Do not place this product near a person who has an electronic medical device. It is very dangerous and may cause malfunction of an electronic medical device.
- 4) Please avoid water, chemical solvent or oil. Please avoid corrosive gas (Chlorine gas, Hydrogen sulfide gas, Nitric oxide gas, Ammonia gas, Nitric oxide gas, etc.).
- 5) Please avoid airborne particles.
- 6) Please avoid strong vibration or shock.
- 7) Ambient temperature change should be within 1°C/min.
- 8) Please storage that the temperature is -25°C to +70°C and the relative humidity is 5% to 85% RH (No dew), and use within six months after delivery. If you are going to use a product that has been stored for more than six months, please check no residual adhesive of Polyester sheet on the sensing surface beforehand after removing Polyester sheet.

6.5 Notice in mounting

- 1) Excessive force or shock to the product should be avoided, especially to the MR-elements.
- 2) Do not place the product near magnets, moving ferromagnetic materials, parts which generate magnetic fields, high voltage lines or high current lines.
- 3) Do not place the product near high voltage lines or high current lines.
- 4) Do not apply excessive force, rotate or bend the pin.
- 5) Wiring should be avoided while voltage supply is active.

5.5.1 Soldering and cleaning.

- 1) Hand soldering should be applied. Soldering should be done in following conditions:
Soldering Temperature: 350±10°C less than 3 seconds
or 260±5°C less than 10 seconds with soldering iron.
- 2) Flux should be rosin with a contain content of no more than 0.2wt %
- 3) Flux cleaning should be done by hand brushing.
- 4) Prevent the flux cleaning solvent from splashing on the product, especially to the MR-elements and the outskirts.

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6.6 Other

- 1) Please make sure that your product has been evaluated in view of your specifications with our product being mounted to your product.
- 2) You are requested not to use our product deviating from the agreed specifications.
- 3) We consider inappropriate to include any terms or conditions with regard to the business transaction in the product specifications, drawings or other technical documents. Therefore, if your technical documents as above include such terms and conditions such as warranty clause, product liability clause, or intellectual property infringement liability clause, they will be deemed to be invalid

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