

MR Sensors



EU RoHS Compliant

- All the products in this catalog comply with EU RoHS.
- EU RoHS is "the European Directive 2011/65/EU on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment."
- For more details, please refer to our website 'Murata's Approach for EU RoHS' (<http://www.murata.com/info/rohs.html>).

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● Part Numbering

Magnetic Pattern Recognition Sensors

(Part Number)

BS	05W	1KFAA	
①	②	③	④

- ① Product ID
- ② Type
- ③ Characteristics
- ④ Individual Specification Code

* "(Part Number)" shows only an example which might be different from actual part number.

* Any other definitions than "① Product ID" might have different digit number from actual part number.

Rotary Sensors

(Part Number)

FR	05CM	12AL	
①	②	③	④

- ① Product ID
- ② Type
- ③ Characteristics
- ④ Individual Specification Code

* "(Part Number)" shows only an example which might be different from actual part number.

* Any other definitions than "① Product ID" might have different digit number from actual part number.

MR Sensors



1

Magnetic Pattern Recognition Sensors

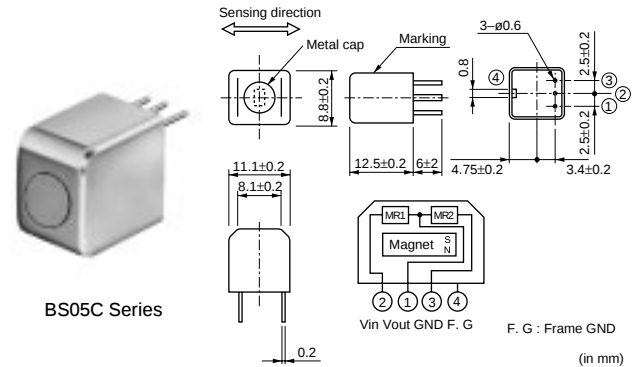
BS05C/N Series

■ Features (BS05C Series)

1. High sensitivity and excellent gap characteristics
2. Output voltage is independent of scanning speed.
3. Compact size and light weight make them ideal for downsizing.
4. Longer product life is given to BS05C series with a specially hard metal cover.
5. BS05C1HGCA has superior noise immunity against induced noise originating from motors and transformers.

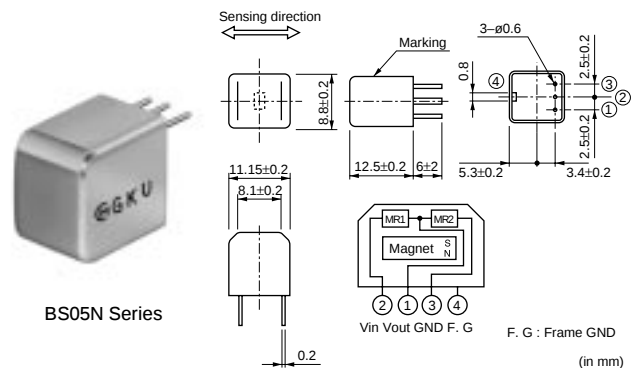
■ Applications

1. Bank note validator
2. Magnetic ink document reader



■ Features (BS05N Series)

1. High sensitivity and excellent gap characteristics
2. Output voltage is independent of scanning speed.
3. Compact size and light weight make them ideal for downsizing.
4. High reliability by sealing structure
5. BS05N1HGAA has superior noise immunity against induced noise originating from motors and transformers.
6. BS05N1NFAA has wider detection width of 6mm.



■ Applications

1. Bank note validator
2. Magnetic ink document reader

Part Number	Supply Voltage (V)	Total Resistance (k ohm)	Output Voltage (mVrms)	Test Method	Detection Width (mm)	Resolution (mm)	Operating Temperature Range (°C)
BS05C1HFAA	5	0.5 to 4	400 min.	Test Method A	3	0.75	-20 to 60
BS05C1HGCA	5	0.5 to 4	235 to 405	Test Method A	3	0.75	-20 to 60
BS05N1HFAA	5	0.5 to 4	400 min.	Test Method A	3	0.75	-20 to 60
BS05N1HGAA	5	0.5 to 4	235 to 405	Test Method A	3	0.75	-20 to 60
BS05N1NFAA	5	0.6 to 6	330 min.	Test Method B	6	0.87	-20 to 60

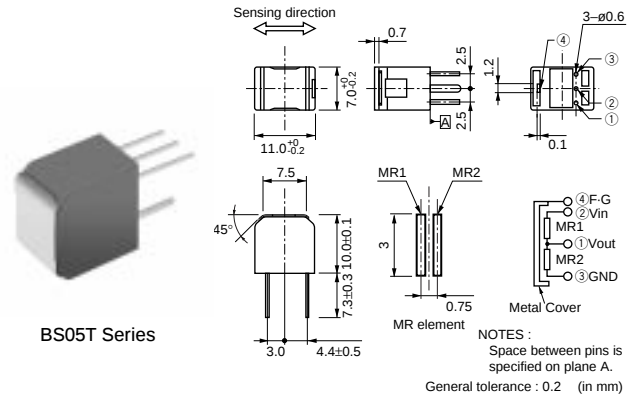
BS05T Series

■ Features

1. High sensitivity and excellent gap characteristics
2. Output voltage is independent of scanning speed.
3. Compact size and light weight make them ideal for downsizing.
4. Higher in cost performance
5. Superior noise immunity against induced noise originating from motors and transformers.

■ Applications

1. Bank note validator
2. Magnetic ink document reader



Part Number	Supply Voltage (V)	Total Resistance (k ohm)	Output Voltage (mVrms)	Test Method	Detection Width (mm)	Resolution (mm)	Operating Temperature Range (°C)
BS05T1HGNA	5	1 to 6	200 to 400	Test Method B	3	0.75	-20 to 60

■ Test Method A

1. Amplifier's gain is set to 1,100 at the frequency of 60 Hz.
Fig. 1 shows the detail of amplifier.
2. Sensor is set in the test fixture as shown in Fig. 2.
3. AC current of 100mA_{rms} is applied to the copper wire.
4. Amplifier's output voltage is read with oscilloscope while Sensor is slowly moved along the guide rail.

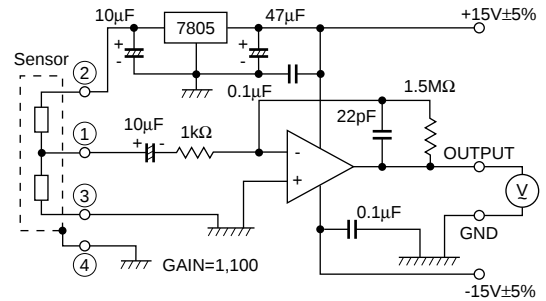


Fig. 1 Amplifier for Output Voltage Measurement

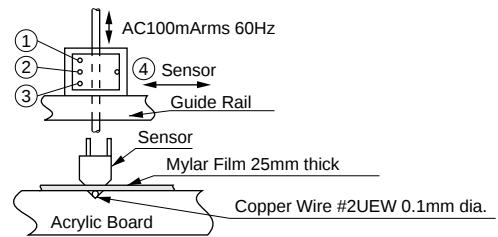


Fig. 2 Test Fixture for Output Voltage Measurement

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Test Method B

1. Amplifier's gain is set to 1,100 at the frequency of 60 Hz.
- Fig. 1 shows the detail of amplifier.
2. Sensor is set in the test fixture as shown in Fig. 2.
3. AC current of 100mArms is applied to the copper wire.
4. Amplifier's output voltage is read with oscilloscope while Sensor is slowly moved along the guide rail.

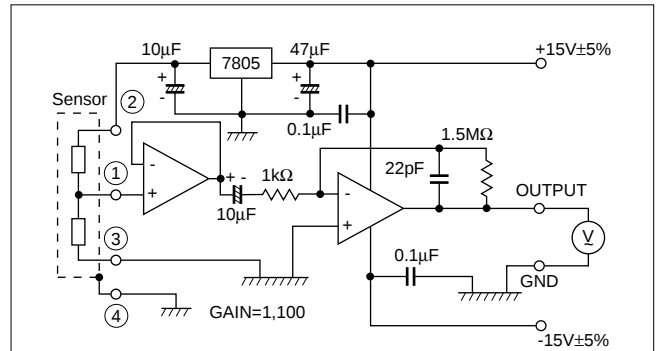


Fig. 1 Amplifier for Output Voltage Measurement

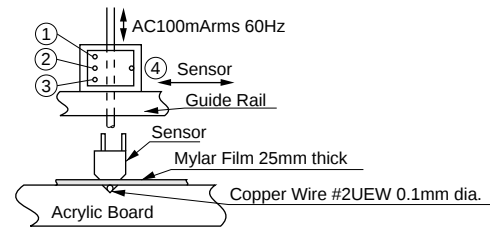


Fig. 2 Test Fixture for Output Voltage Measurement

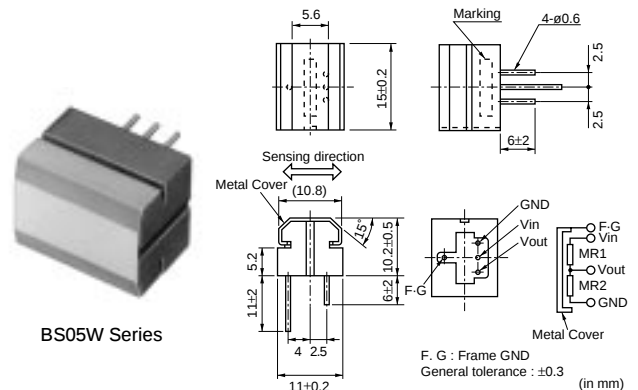
BS05W Series

Features

1. Wide MR element covering extensive area allows increased tolerance for scanning and can accept a variety of bank notes.
2. Long product life achieved by an extremely hard metal cover is ideal for use in high speed ATM and bank note counters.
3. High sensitivity and excellent gap characteristics
4. Output voltage is independent of scanning speed.

Applications

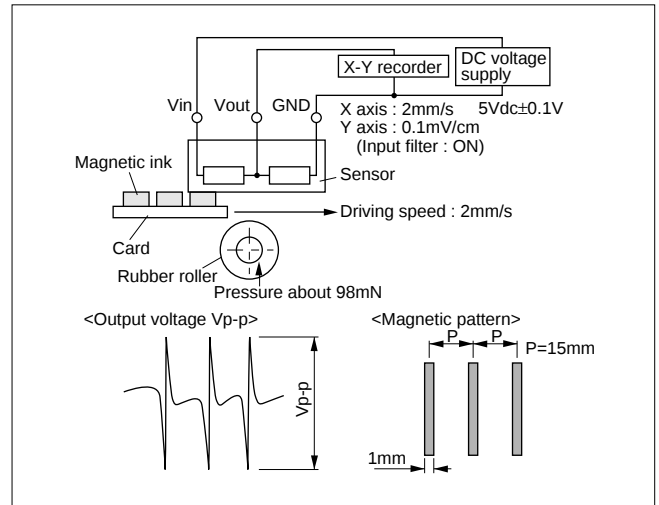
1. Bank note validator
2. Magnetic ink document reader



Part Number	Supply Voltage (V)	Total Resistance (k ohm)	Output Voltage (mVp-p)	Test Method	Detection Width (mm)	Resolution (mm)	Operating Temperature Range (°C)
BS05W1KFAA	5	1 to 15	0.3 to 0.8	Test Method C	10	0.75	-20 to 60

Test Method C

- Output voltage is measured by using the magnetic pattern card. The magnetic pattern card has the same magnetic density of 1000 letters on 1000 yen bank notes.
- Drive the magnetic pattern card and record output voltage Vp-p with X-Y recorder.



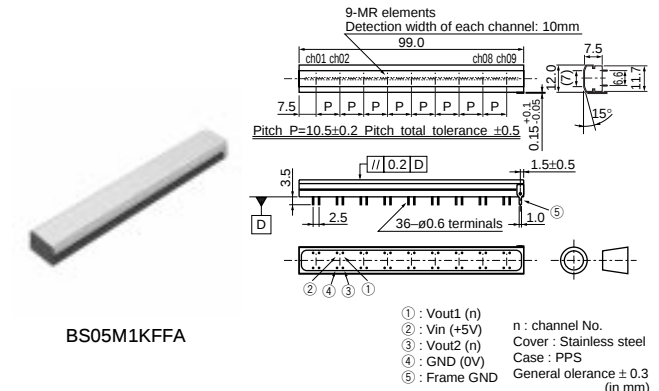
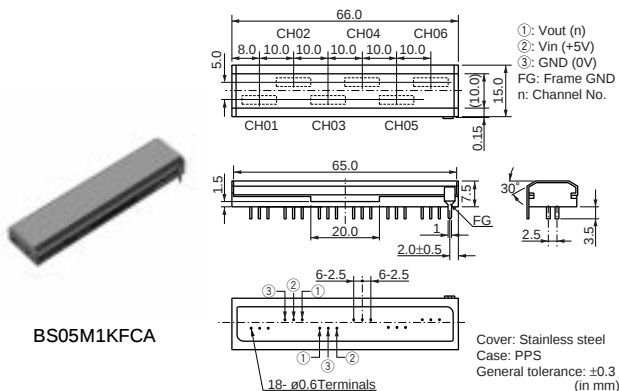
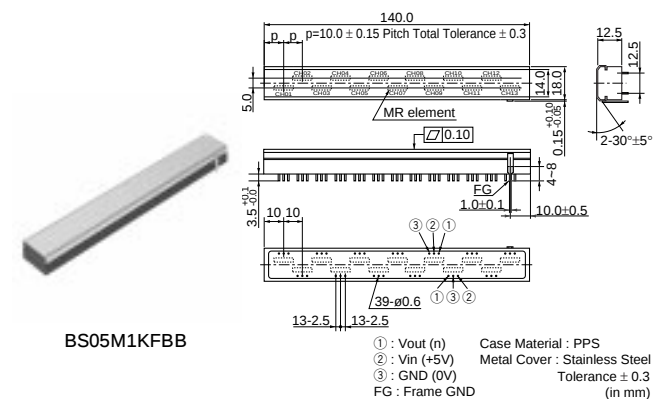
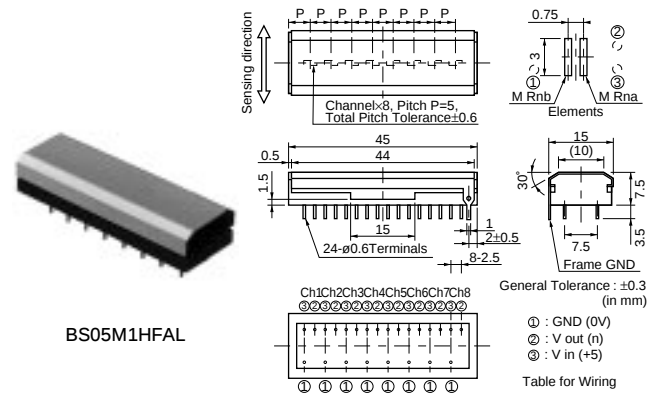
BS05M Series

Features

- High sensitivity and excellent gap characteristics
- Output voltage is independent of scanning speed.
- Simple and quick mounting is possible due to one single holder for multiple MR elements.
- BS05M1KFCA has detection width of 60mm, without non-detection area.
- BS05M1KFBB has detection width of 130mm, without non-detection area.
- BS05M1KFFA has detection width of 90mm, without non-detection area.

Applications

- Bank note validator
- Magnetic ink document reader



Part Number	Supply Voltage (V)	Total Resistance (k ohm)	Output Voltage (mVrms)	Test Method	Detection Width (mm)	Resolution (mm)	Operating Temperature Range (°C)
BS05M1HFAL	5	0.5 to 6	150 min.	Test Method D	3 x 8ch	0.75	0 to 50
BS05M1KFBB	5	1 to 5	350 min.	Test Method E	10 x 13ch	0.75	0 to 50
BS05M1KFCA	5	1 to 6	300 min.	Test Method E	10 x 6ch	0.75	0 to 50
BS05M1KFFA	5	0.6 to 3	100 min.	Test Method F	10 x 9ch	0.75	0 to 50

■ Test Method D

1. Amplifier's gain is set to 70dB at the frequency of 500Hz.
Fig. 1 shows details of amplifier.
2. Sensor is set in the test fixture as shown in Fig. 2.
3. AC current of 100mArms is applied to the copper wire.
4. Amplifier's output voltage is read with oscilloscope while Sensor is slowly moved along the guide rail.

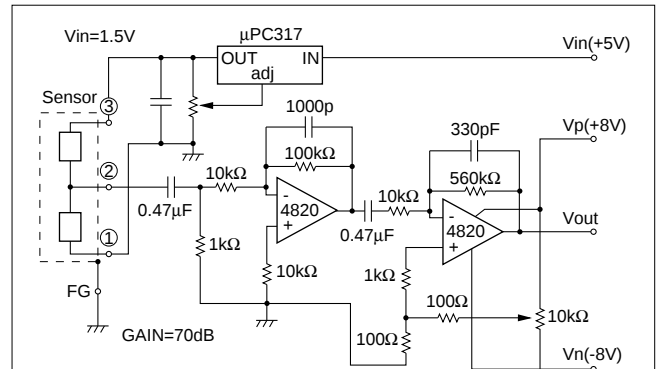


Fig. 1 Amplifier for Output Voltage Measurement

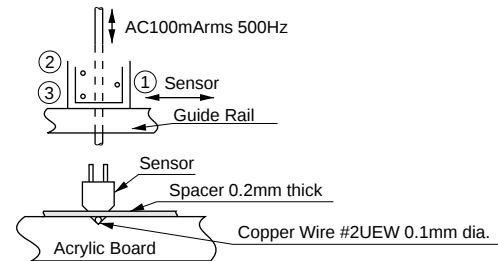


Fig. 2 Test Fixture for Output Voltage Measurement

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Test Method E

1. Amplifier's gain is set to 1,100 at the frequency of 60 Hz.
Fig. 1 shows details of amplifier.
2. Sensor is set in the test fixture as shown in Fig. 2.
3. AC current of 100mArms is applied to the copper wire.
4. Amplifier's output voltage is read with oscilloscope while Sensor is slowly moved along the guide rail.

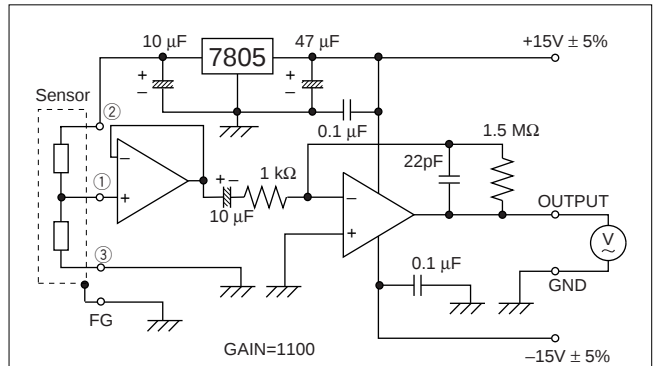


Fig. 1 Amplifier for Output Voltage Measurement

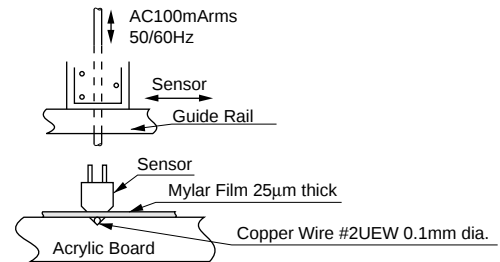


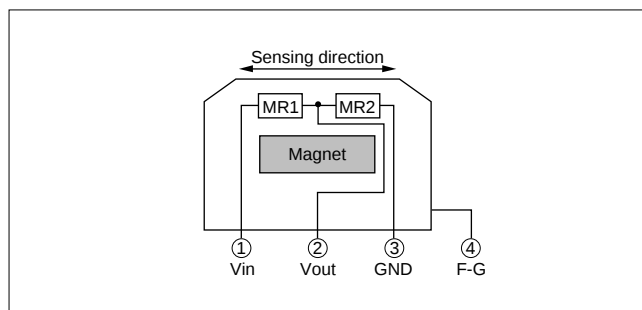
Fig. 2 Test Fixture for Output Voltage Measurement

Magnetic Pattern Recognition Sensors Reference Data

1

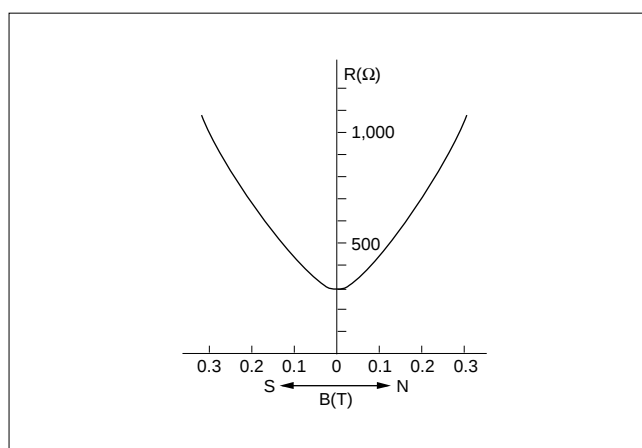
Construction

Magnetic pattern recognition sensor consists of a pair of magnetoresistive (MR) elements and a magnet.



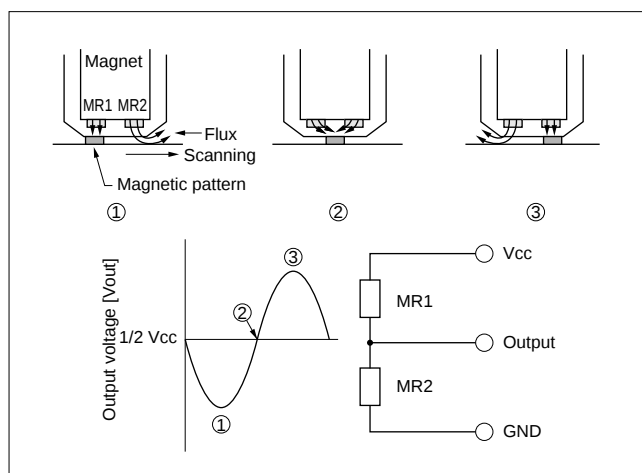
Semiconductor Magnetoresistive Effect

A change in the resistance of a ferromagnetic or semiconductive material when it is subjected to magnetic flux is illustrated in the diagram. Murata's sensor uses InSb, which exhibits a very high magnetoresistive effect.

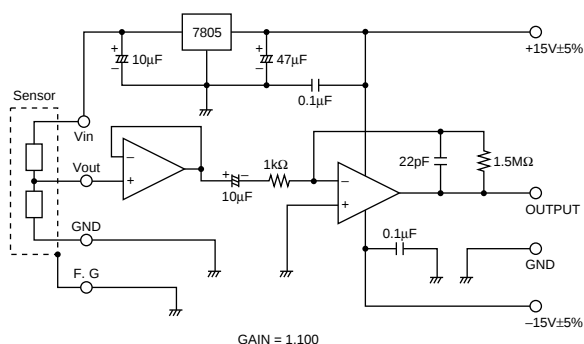


Principle of Operation

When a material printed with magnetic ink is scanned over the sensor, the magnetic flux applied to MR1 and MR2 changes. Thus, the sensor generates signals as indicated below.



Typical Application



Magnetic Pattern Recognition Sensors ⚠Caution/Notice

■ ⚠Caution (Handling)

1. This sensor generates very strong suction because this product contains a permanent magnet. Be careful not to apply mechanical shock when handling the sensor.
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.

■ Notice (Storage and Operating Condition)

1. Please avoid water, chemical solvent or oil.
2. Please avoid corrosive gas (Chlorine gas, Hydrogen sulfide gas, Ammonia gas, Nitric oxide gas, etc.).
3. Please avoid airborne particles.
4. Please avoid strong vibration or shock.
5. Ambient temperature change should be within 1 deg. C/min.

■ Notice (Design)

1. This product is designed to detect magnetic properties of banknotes. Please contact us when using this product to detect any magnetic properties other than of banknotes.
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 using in such circumstances.
3. BS05N series, BS05C series, BS05W series:
Please do not apply excessive force or shock on the sensing side. When adhering the target media on the sensing side, please give the same level of load throughout the sensor surface and the load should be less than 0.49N.

When a roller is set over the sensor, it should be cylindrical shape and its diameter greater than the width of the sensor.

If the area coming in contact with the sensor is smaller, the surface will be partially worn and lead to trouble.

4. BS05M1 series:

To avoid unusual wear of the metal cover or jamming of the banknote, around 0.1mm gap between the sensor and the opposite mechanisms such as rollers is recommended to reduce the load on the metal cover. A load of 0N is recommended.

5. Please mount this product with holder stuck firmly on the PCB in addition to solder terminals.

■ Notice (Soldering and Mounting)

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

6. Hand soldering should be applied. Soldering should be done in following conditions:

Soldering Temperature:

350+/-10 deg. C less than 3 seconds
or 260+/-5 deg. C less than 10 seconds.

7. Flux should be rosin with a chlorine content of no more than 0.2wt%.
8. Flux cleaning should be done by hand brushing.
9. Prevent the flux cleaning solvent from splashing on the product.

muRata

2

Figure 1 shows the dimensions and wiring of the sensor. The top view includes dimensions: 0.5 ± 0.2 mm for the central hole, $1.0^{+0.5}_{-0.2}$ mm for the mounting hole, 20 ± 0.3 mm for the sensor body length, 180 ± 10 mm for the total length, and 10 ± 5 mm for the cable length. The side view shows diameters: $\phi 12.7^{+0.2}_{-0.1}$ mm for the main body, $\phi 10 \pm 0.3$ mm for the mounting hole, and $\phi 10.07$ mm for the cable diameter. The cable is labeled UL1007 AWG24. The wiring diagram shows four wires: Red (Vin), Black (Vout), MR2 (MR2), and White (GND). The sensing direction is indicated by a double-headed arrow, and the element pitch is 2 mm.

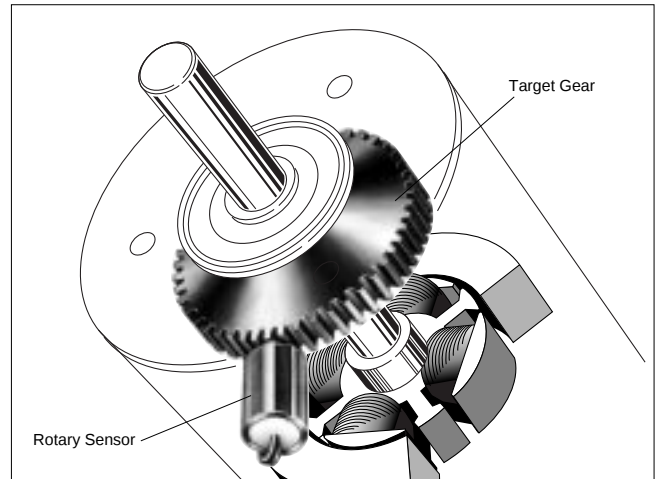
Part Number	Supply Voltage (V)	Output Voltage (Vp-p)	Total Resistance (k ohm)	Response Frequency (kHz)	Operating Temperature (°C)	Target Gear Module	Phase Difference
FR05CM21AR	5	0.5 min.(at 25°C,Gap=0.2mm)	0.7 to 1.5	0 to 100	-10 to 70	0.3~1.0	Single

The graph shows a sine wave representing the output voltage V_{out} over time t . The vertical axis is labeled "Output Voltage (V_{out})" and the horizontal axis is labeled t . The waveform starts at the origin $(0,0)$, reaches a peak of $0.5 V_{in}$, crosses the horizontal axis at π , reaches a trough of $-0.5 V_{in}$, and returns to the axis at 2π .

Rotary Sensors Reference Data

■ Features

1. FR sensor consists of semiconductive magnetoresistors and a permanent magnet.
2. FR sensor detects the position and the speed of a gear over a wide range of frequency including a complete halt.
3. Non-contact sensing mechanism guarantees a long life.
4. Rugged and reliable, suitable for motor control for Factory Automation.
5. A variety of applications is possible with multiphase type.



■ Semiconductor Magnetoresistive Effect

A change in the resistance of a ferromagnetic or semiconductive material when it is subjected to magnetic flux. Used in Murata's sensor is InSb which exhibits very high magnetoresistive effect in Fig. 1.

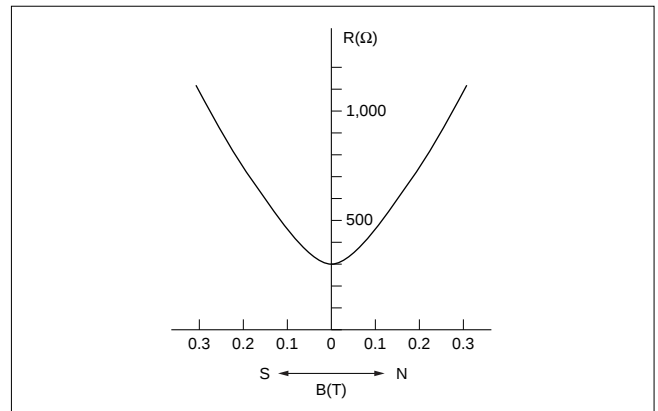


Fig. 1

■ Principle of Operation

As a magnetic material moves over the sensing surface, the magnetic flux distribution across the magnetoresistors varies.

This causes MR element resistance change and produces output signal as indicated in Fig. 2.

Therefore, when it is placed close to the magnetic gear as shown in Fig. 3, the sensor output a signal synchronized to gear rotation.

The count of signal's peaks is equal to the number of gear teeth passing over the sensor.

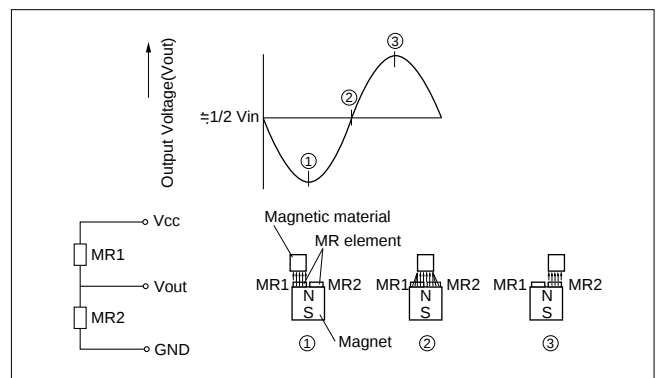


Fig. 2

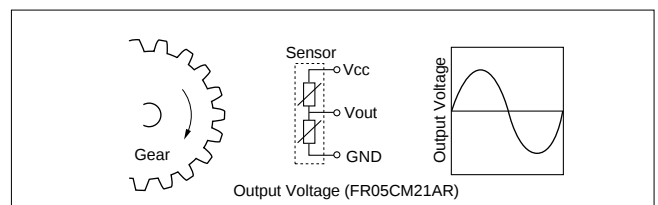


Fig. 3

2

Output signal, V_{p-p} is dependant on the ambient temperature.
Output voltage decreases as the temperature increases.

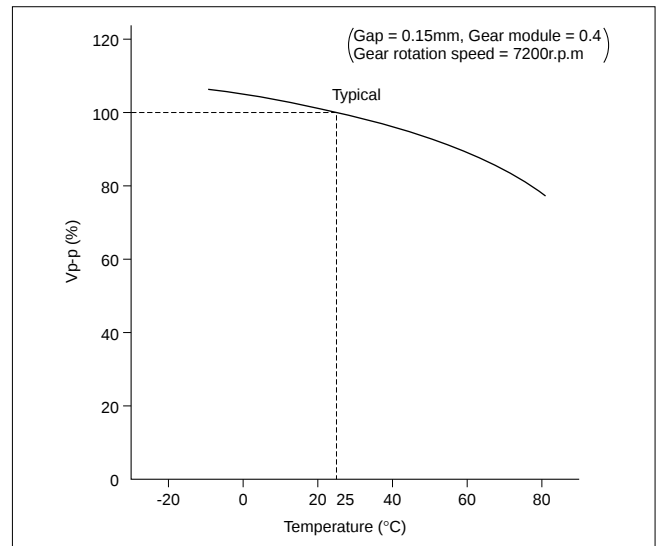


Fig. 4

■ Gap Characteristics

Larger signal are obtained when FR sensor is installed closer to the target gear.

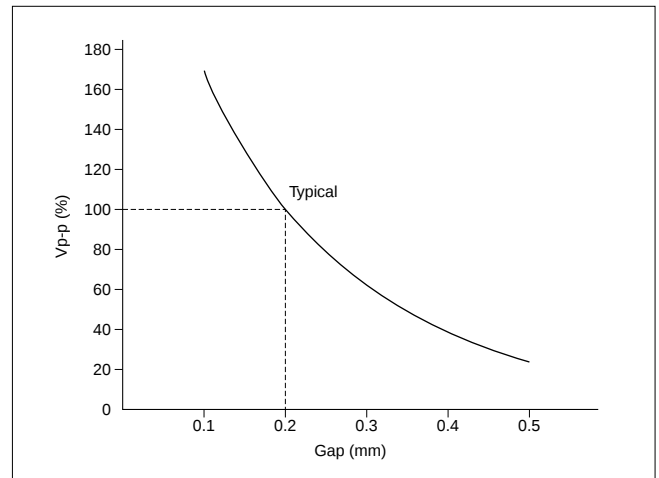


Fig. 5

■ Typical Application

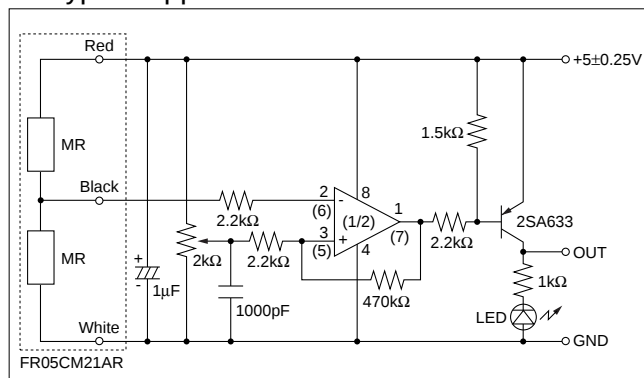


Fig. 6

■ Application Table

Part Number	Output Type	Gear Module	Gear Pitch (mm)
FR05CM21AR	Single	M=0.3 to 1.0	P=0.9 to 4.0

Rotary Sensoes ⚠Caution/Notice

2

■ ⚠Caution (Handling)

1. Because this sensor contains a permanent magnet, it could damage magnetic signal in the writable magnetic card such as train ticket and pre-paid card. Please consult with us before applying it in such circumstances.
2. Be sure to provide an appropriate fail-safe function on your product to prevent a second damage that may be caused by an abnormality or failure related to our product.

■ Notice (Storage and Operating Condition)

1. Please do not apply mechanical shock or pressure on the product because it leads to change in the output level or destruction of magnetoresistive element.
2. Please do not use or keep the sensor in the corrosive gas(Cl₂,NO_x,SO₂, and so on). Metal case might be corroded due to it. Some of our sensor is made with stainless steal case for better resistance to corrosion. If the sensor should be used in such an environment, please consult with us.
3. The terminal should be avoided excessive force, rotation or bent.
4. Avoid storing and using the product in the locations where the ambient temperature changes suddenly.

■ Notice (Soldering and Mounting)

1. Wiring should be avoided while supply voltage is applied.
2. Do not place the product near high voltage lines or high current lines.
3. Please avoid placing magnetic material or magnetic field generator other than the detected object near to the sensor. It could cause change in the output level, resulting in malfunction of the finished goods.
4. Place the sensor in the correct direction against the gear to be matched with its rotation direction. Otherwise, output level could become too small and phase may be inaccurate.
5. Hand soldering should be applied. Soldering should be done in following condition;
 Soldering Temperature: 350+/-10 deg. C less than 3 seconds or 260+/-5 deg. C less than 10 seconds with soldering iron.
 Period of time: Within 3 seconds per point
 Distance from case: Over 1.5mm
6. Flux should be water-soluble and its chlorine content should be no more than 0.2wt%.
7. Flux cleaning should be done by hand brushing.
8. Prevent the flux cleaning solvent from splashing on the product.

Sensors ISO 9000 Certifications

Manufacturer's of the products in this catalog have obtained the ISO 9000 quality system certificate.

Plant	Certified Date	Organization	Registration No.
Kanazawa Murata Mfg. Co., Ltd. Includes Nishikanazawa factory	Nov. 25,1992	Reliability Center for Electronic Components of Japan	RCJ-92M-10

⚠Note:

1. Export Control

<For customers outside Japan>

No Murata products should be used or sold, through any channels, for use in the design, development, production, utilization, maintenance or operation of, or otherwise contribution to (1) any weapons (Weapons of Mass Destruction [nuclear, chemical or biological weapons or missiles] or conventional weapons) or (2) goods or systems specially designed or intended for military end-use or utilization by military end-users.

<For customers in Japan>

For products which are controlled items subject to the "Foreign Exchange and Foreign Trade Law" of Japan, the export license specified by the law is required for export.

2. Please contact our sales representatives or product engineers before using the products in this catalog for the applications listed below, which require especially high reliability for the prevention of defects which might directly damage a third party's life, body or property, or when one of our products is intended for use in applications other than those specified in this catalog.

- | | |
|-----------------------------|--|
| ① Aircraft equipment | ② Aerospace equipment |
| ③ Undersea equipment | ④ Power plant equipment |
| ⑤ Medical equipment | ⑥ Transportation equipment (vehicles, trains, ships, etc.) |
| ⑦ Traffic signal equipment | ⑧ Disaster prevention / crime prevention equipment |
| ⑨ Data-processing equipment | ⑩ Application of similar complexity and/or reliability requirements to the applications listed above |

3. Product specifications in this catalog are as of November 2008. They are subject to change or our products in it may be discontinued without advance notice. Please check with our sales representatives or product engineers before ordering. If there are any questions, please contact our sales representatives or product engineers.

4. Please read rating and ⚠ CAUTION (for storage, operating, rating, soldering, mounting and handling) in this catalog to prevent smoking and/or burning, etc.

5. This catalog has only typical specifications because there is no space for detailed specifications. Therefore, please approve our product specifications or transact the approval sheet for product specifications before ordering.

6. Please note that unless otherwise specified, we shall assume no responsibility whatsoever for any conflict or dispute that may occur in connection with the effect of our and/or a third party's intellectual property rights and other related rights in consideration of your use of our products and/or information described or contained in our catalogs. In this connection, no representation shall be made to the effect that any third parties are authorized to use the rights mentioned above under licenses without our consent.

7. No ozone depleting substances (ODS) under the Montreal Protocol are used in our manufacturing process.



Murata Manufacturing Co., Ltd.

<http://www.murata.com/>

Head Office

1-10-1, Higashi Kotari, Nagaokakyo-shi, Kyoto 617-8555, Japan
Phone: 81-75-951-9111

International Division

3-29-12, Shibuya, Shibuya-ku, Tokyo 150-0002, Japan
Phone: 81-3-5469-6123 Fax: 81-3-5469-6155 E-mail: intl@murata.co.jp