Digital Tachometers / Sensors and Peripherals

ONO SOKKI
Select the rotation detector/rotation display unit that is optimal for your needs from the wide range of products that Ono Sokki is proud to offer.

**Rotation Detectors Selection Guide**

Electromagnetic Rotation Detectors (Internal Gear Type)
MP-610 (P. 14)
MP-800 Series (P. 13)

- **Electromagnetic Rotation Detectors (Internal Gear Type) – Features**
  a) Direct connection to the rotating shaft is all that is required. A flexible coupling is recommended for the direct connection method.
  b) Non-contact detection provided inside the detector.
  c) Superb rigidity and environmental resistance; high durability
  d) No power supply required
  e) Provides stable measurement, particularly at the lower limit of the measurement range, when compared to the external gear type

- **When using a rotary encoder with a 12 VDC drive**
  TM-2100 Series (P. 4)
  TM-5100 (P. 17)

- **Reversible Counter**
  RV-3150 (P. 19)

- **Length Detector**
  RP-732 (P. 18)

Electromagnetic Rotation Detectors (External Gear Type)
MP-900/MP-9000 Series (P. 7)
(excluding MP-981 and AP-981)

- **Electromagnetic Rotation Detectors (External Gear Type) – Features**
  a) Non-contact detection enables measurement even of high-speed rotations
  b) Superb rigidity and environmental resistance; high durability
  c) No power supply required (excluding MP-981, AP-981)
  d) P/R selectable (the number of detector gear teeth becomes the P/R value)
  e) The mounting position is enabled simply by attaching the gear to the target measurement object.
**Rotary Encoders – Features**

- Small rotation torque
- Capable of measuring large P/R values; wide selection range
- Can perform detection of low-speed rotations (close to zero)
- Choice of two types of power supply depending on the model, AC or DC.
- Wide selection of models for different applications

**Rotary Encoders**

- RP-432Z (P. 16)
- SP-405ZA (P. 16)

**Line Speed Detector**

- RP-721 (P. 18)

**Line Speed Detector**

This is a roller-type detector that can measure speed simply by being applied to the running line.

**Magnetoelectric Rotation Detectors (External Gear Type)**

- MP-981 (P. 12)
- AP-981 (P. 12)

**Magnetoelectric Rotation Detectors (External Gear Type)**

These detectors utilize magnetic flux response (the resistance value changes according to the magnetic flux). The internal mechanism comprises magnetic resistance elements, permanent magnets, a direct current amplifier, and a voltage regulator. Detection can be performed as square wave output of the same amplitude over a wide range from ultra-low speeds to high speeds (1 to 20,000 r/min [60 P/R]).

**Photoelectric rotation detector**

This device measures the rotation speed either by utilizing the light reflected from reflective tape, or from the contrast in the light received that is caused by the color of the shaft or by a difference in level.

**Photoelectric rotation detectors – Features**

- Sensing is performed with minimal load on the rotating shaft.
- Since output is generally performed through an amplifier, the waveform is constant and stable.

**Photoelectric Rotation Detectors**

- LG-916, LG930 (P. 14, 15)
- FS-540/FG-1200 (P. 15)

**Power supply unit for a detector (Ono Sokki’s PS-012 model) is required when connecting an HM or TM Series display unit other than those listed below.**

**TM-5100 (P. 17)**

**TM-2100 Series (P. 4)**

**Cable (P. 26)**

**Coupling (P. 25)**

**Cable (P. 26)**
## Rotation Display Units Selection Guide

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<th>Compatible Detectors</th>
<th>Page No.</th>
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<td>Display only</td>
<td>100 to 240 VAC (12 VDC/100 mA)</td>
<td>MP Series SP-4052A</td>
<td>—</td>
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<tr>
<td>TM-2120</td>
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<td></td>
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<td>—</td>
</tr>
<tr>
<td><strong>Multifunction Model</strong></td>
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<td>TM-5100</td>
<td>BCD output Analog output Comparator output RS-232C 2-channel calculation</td>
<td>100 to 240 VAC (5 VDC/150 mA) (Total of A and B channels) (12 VDC /150 mA) (For each A and B channel)</td>
<td>MP Series LG Series RP Series</td>
<td>—</td>
</tr>
</tbody>
</table>

**Note 1:** Please see “Table of Signal Cable” on Pages 26 and 27 to select the suitable model of signal cable.  
**Note 2:** Please contact nearest Ono Sokki representative for the separated catalogue of TM-2100 series and CT-6520.
## Rotation Detectors

### Notes on Detection Gears

#### Electromagnetic Type (External Gear Type) [Modules 1 to 3]

<table>
<thead>
<tr>
<th>Type</th>
<th>Model</th>
<th>Range (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General-purpose type</td>
<td>MP-9100</td>
<td>7 to 10</td>
</tr>
<tr>
<td>With a directly attached cable</td>
<td>MP-911</td>
<td>7 to 10</td>
</tr>
<tr>
<td>Measurable for high speed rotation</td>
<td>MP-9120</td>
<td>7 to 10</td>
</tr>
<tr>
<td>Oil-proof type</td>
<td>MP-930</td>
<td>7 to 10</td>
</tr>
<tr>
<td>Oil-proof/Heat-resistant type (up to 150°C)</td>
<td>MP-935</td>
<td>7 to 10</td>
</tr>
<tr>
<td>Heat-resistant type (up to 220°C)</td>
<td>MP-936</td>
<td>7 to 10</td>
</tr>
<tr>
<td>Long body type</td>
<td>MP-940A</td>
<td>7 to 10</td>
</tr>
<tr>
<td>Compact type</td>
<td>MP-950</td>
<td>7 to 10</td>
</tr>
<tr>
<td>Long body type</td>
<td>MP-954</td>
<td>7 to 9, 11</td>
</tr>
<tr>
<td>Compact type</td>
<td>MP-962</td>
<td>7 to 9, 11</td>
</tr>
<tr>
<td>Ultra-compact type</td>
<td>MP-992</td>
<td>7 to 9, 11</td>
</tr>
<tr>
<td>For modules 0.5 to 1</td>
<td>MP-9200</td>
<td>7 to 9, 11</td>
</tr>
<tr>
<td>Modules 3 to 10</td>
<td>MP-963</td>
<td>7 to 9, 11</td>
</tr>
</tbody>
</table>

#### Magnetoelectric Type (External Gear Type)

<table>
<thead>
<tr>
<th>For low-to-medium speeds</th>
<th>Model</th>
<th>Range (µm)</th>
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<tbody>
<tr>
<td>Acid-proof/waterproof</td>
<td>AP-981</td>
<td>12</td>
</tr>
</tbody>
</table>

#### Electromagnetic Type (Internal Gear Type)

<table>
<thead>
<tr>
<th>For low-to-medium speeds</th>
<th>Model</th>
<th>Range (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wide range</td>
<td>MP-610</td>
<td>14</td>
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</table>

#### Photoelectric Type

<table>
<thead>
<tr>
<th>Type</th>
<th>Model</th>
<th>Range (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact type</td>
<td>LG-916</td>
<td>14</td>
</tr>
<tr>
<td>Long distance detection</td>
<td>LG-930</td>
<td>15</td>
</tr>
<tr>
<td>Glass Fiber</td>
<td>FS-540/FG-1200</td>
<td>15</td>
</tr>
</tbody>
</table>

#### Rotary Encoders

<table>
<thead>
<tr>
<th>Type</th>
<th>Model</th>
<th>Range (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General-purpose compact type</td>
<td>RP-432Z</td>
<td>16</td>
</tr>
<tr>
<td>Ultra-compact type</td>
<td>SP-405ZA</td>
<td>16</td>
</tr>
</tbody>
</table>

## Rotation Display Units

### Multifunction type

| With 2-channel calculation function | TM-5100 | 17 |

## Related Products

### Line Speed Detector (Roller Encoder)

| For medium-to-low speeds | RP-721 | 18 |

### Length Meter

| Length detector          | RP-732 | 18 |
| Reversible Counter       | RV-3150 | 19 |

### Peripheral Devices

| Ratio Multiplier       | TA-103 | 20 |
| Signal Amplifier       | PA-150 | 20 |

### Frequency-Voltage converters

| General-purpose type | FV-1100 | 21 |
| High-speed response type | FV-1300 | 22, 24 |
| Multi-channel type    | FV-5300 | 23, 24 |

## Coupling Selection Guide

Table of Signal Cable

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26, 27
Notes on Detection Gears

- **Detection Gear**
  In theory, a detector is a magnetic body. Since it has a large magnetic permeability, soft metals (such as S20C, SS41) are generally used.
  When performing normal rotating speed measurements, if the gate time is specified at 1 second, using a 60 P/R gear enables direct readout of the rotating speed by the counter.

- **Shape of a Detection Gear**
  Fig. 1 shows detector output waveforms from various types of external rotors (detection gears and so forth).
  If the gear is a spur gear, an involute gear is the most suitable type, as it produces waveforms with high frequency spikes from squared-off, triangular or rounded teeth. Care is required because spikes appear in waveforms even when the gear teeth are chipped in places.
  Furthermore, if the gear teeth are magnetized, please be aware that reciprocal interference between the teeth and the permanent magnets inside the detector will result in a reduction of the output voltage, and abnormal waveform signals.

  Fig. 2 shows the relational dimensions of the gear and detector that are required in order to obtain the optimal output voltage and output waveform.
  
  "a" shall be the same dimension as or larger than "d"
  "b" shall be the same dimension as or larger than "c"
  "c" shall be three times the dimension of "d"
  "e" shall be less than half the dimension of "b", and as small as possible

  The tooth width shall be at least 4 mm
  
  a: Gear tip thickness b: Tooth height c: The spacing between teeth
d: Yoke diameter e: Gap between the gear and the detector

  Abbreviations used
  M = Module Z = Number of teeth D = Outer diameter of gear
  \[ M = \frac{D}{Z+2} \]
  \[ N (\text{r/min}) \times Z \times \text{number of teeth} = C \times \text{Hz} \]
  \[ \frac{60 \times \text{s}}{} \]

  If \( Z = 60 \), then \( N = C \)

- **Shape of the gear for the MP-981 and the mounting method**

  1. **Output signals according to the shape of the gear**

     - (A) Involute gear
     - (B) Spur gear
     - (C) Custom gear

  Since two pulses may be output for one tooth in the case of (B) and (C) in the above figure, (B) and (C) are not suitable for use as a detection gear.

  2. **Mounting method**

     Please avoid the mounting configurations shown in the above figure, as they will cause reciprocal magnetic interference.

     In the case of (A), a gear with a different module is mounted in the vicinity of the MP-981.

     In the case of (B), two or more MP-981 units are mounted within the vicinity of one gear.

  3. **How to use a custom gear**

     Reduce the tooth width
     Reduce this dimension to 2 mm or less

  4. **How to calculate Module M**

     This calculation is for involute gears only
     
     \[ \text{Module M} = \frac{\text{Reference pitch circle diameter}}{\text{Number of teeth}} \]

  5. **How to use a gear when M = 3 or larger**

     Reduce the tooth width until this dimension is 2 mm or less
The MP-900/9000 Series detectors have been designed primarily to detect frequency signals in proportion to the rotating speed by bringing the detector in close proximity to the addendum of a detection gear fitted to a rotating shaft (sine wave output). Various types are available, from general-purpose, oil-proof and heat-resistant types through to user-customized types, enabling you to select the one that best suits your application. Extension cables, signal cables and connectors can also be purchased separately.

**Features**

- **General-purpose type**
  - MP-9100
  - General-use type

- **General-purpose type with a directly attached cable**
  - MP-911
  - MP-910 with a 5-m directly attached (cable: 3D-2V type)

- **Low impedance type (for measuring high-speed rotations)**
  - MP-9120
  - Low impedance enables better noise resistance
  - Ideal for detecting high-speed rotations
  - Same outer dimensions as those of the MP-9100 model

- **Oil-proof type**
  - MP-930
  - Complies with the JEM (Japan Electrical Manufacturers Association) 1030-1983 standard for oil-proof models

- **Oil-proof/Heat-resistant type**
  - MP-935
  - Complies with the JEM (Japan Electrical Manufacturers Association) 1030-1983 standard for oil-proof models
  - Heat-resistant up to 150°C
  - Comes with a 1-m heat-resistant cable

- **Heat-resistant type**
  - MP-936
  - Heat-resistant up to 220°C
  - Comes with a 1-m heat-resistant cable

- **Long body type**
  - MP-940A
  - The 105-mm mounting section on this long body type makes it ideal for detecting rotations deep in the rotating object.

- **Compact type**
  - MP-950
  - Compact; comes with a 0.5-m cable

**Long body type**
- **MP-954**
  - The 81-mm mounting section on this long body type makes it ideal for detecting rotations deep in the rotating object.
  - The mounting screw dimensions are the same as those of the MP-950 model.

**Compact type**
- **MP-962**
  - Compact; comes with a 0.5-m cable

**Ultra-compact type**
- **MP-992**
  - Ultra-compact; comes with a 0.5-m cable

**Small module type**
- **MP-9200**
  - For modules 0.5 to 1

**Medium module type**
- **MP-963**
  - For modules 3 to 10

**Standard Detection Gear**
- **MP-001** *(φ = 62)*
  - Module 1, 60 teeth

**Non-contact method**

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**Note:** When using the MP Series electromagnetic rotation detectors in locations where there are requirements for high reliability, please contact nearest Ono Sokki representative for separate technical solutions that meet your needs.
### MP-900/9000 Series Specifications

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<thead>
<tr>
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<th>Detector</th>
<th>General-purposes</th>
<th>With cable attached</th>
<th>Low impedance (Measurable high speed rotation)</th>
<th>Oil-proof</th>
<th>Oil-proof/Heat-resistant (150°C)</th>
<th>Heat-resistant (220°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MP-9100</td>
<td>MP-911</td>
<td>MP-9120</td>
<td>MP-930</td>
<td>MP-935</td>
<td>MP-936</td>
</tr>
<tr>
<td>DC resistance value (Ω)*)</td>
<td></td>
<td>850 to 950</td>
<td>85 to 105</td>
<td>850 to 950</td>
<td>600 to 700</td>
<td>800 to 900</td>
<td></td>
</tr>
<tr>
<td>Inductance (mH) [1 kHz, typ.]</td>
<td></td>
<td>300</td>
<td>30</td>
<td>300</td>
<td>270</td>
<td>370</td>
<td></td>
</tr>
<tr>
<td>Impedance (Ω) [1 kHz, typ.]</td>
<td></td>
<td>2 k</td>
<td>240</td>
<td>2 k</td>
<td>1.8 k</td>
<td>2.5 k</td>
<td></td>
</tr>
<tr>
<td>Output voltage (Vp-p) [1 kHz, typ.]*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detectable frequency range (Hz)*</td>
<td></td>
<td>200 to 35,000</td>
<td>200 to 80,000</td>
<td>200 to 35,000</td>
<td>300 to 35,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detection gear module</td>
<td></td>
<td>1 to 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating temperature range</td>
<td></td>
<td>-10 to +90°C</td>
<td>-10 to +150°C</td>
<td>-10 to +220°C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vibration resistance (m/s²)*</td>
<td></td>
<td>196</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shock resistance (m/s²)*</td>
<td></td>
<td>1,960</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (g)</td>
<td></td>
<td>90</td>
<td>300 (including cable)</td>
<td>90 (including cable)</td>
<td>100 (including cable)</td>
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<tr>
<td>Surrounding magnetic field (T)</td>
<td></td>
<td>Up to 0.03</td>
<td></td>
<td>Up to 0.02</td>
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</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Detector</th>
<th>Long body</th>
<th>Compact type (With cable attached)</th>
<th>Long body</th>
<th>Compact type (With cable attached)</th>
<th>Ultra-compact type</th>
<th>For small modules</th>
<th>For medium modules</th>
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<tr>
<td>DC resistance value (Ω)*)</td>
<td></td>
<td>500 to 600</td>
<td>2.1 k to 2.3 k</td>
<td>2.1 k to 2.3 k</td>
<td>1.25 k to 1.45 k</td>
<td>160 to 190</td>
<td>850 to 950</td>
<td>3.7 k to 4 k</td>
</tr>
<tr>
<td>Inductance (mH) [1 kHz, typ.]</td>
<td></td>
<td>270</td>
<td>400</td>
<td>210</td>
<td>25</td>
<td>300</td>
<td>1800</td>
<td></td>
</tr>
<tr>
<td>Impedance (Ω) [1 kHz, typ.]</td>
<td></td>
<td>1.8 k</td>
<td>3.5 k</td>
<td>2.1 k</td>
<td>250</td>
<td>2 k</td>
<td>16 k</td>
<td></td>
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<tr>
<td>Output voltage (Vp-p) [1 kHz, typ.]*</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detectable frequency range (Hz)*</td>
<td></td>
<td>300 to 35,000</td>
<td>400 to 35,000</td>
<td>400 to 100,000</td>
<td>300 to 35,000</td>
<td>45 to 15,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detection gear module</td>
<td></td>
<td>1 to 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating temperature range</td>
<td></td>
<td>-10 to +90°C</td>
<td>-10 to +120°C</td>
<td>-10 to +90°C</td>
<td></td>
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<tr>
<td>Vibration resistance (m/s²)*</td>
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<td>196</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Shock resistance (m/s²)*</td>
<td></td>
<td>1,960</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Weight (g)</td>
<td></td>
<td>150</td>
<td>70</td>
<td>90</td>
<td>50</td>
<td>3</td>
<td>90</td>
<td>200</td>
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<tr>
<td>Surrounding magnetic field (T)</td>
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<td>Up to 0.01</td>
<td></td>
<td>Up to 0.005</td>
<td>Up to 0.001</td>
<td>Up to 0.005</td>
<td>Up to 0.03</td>
<td></td>
</tr>
</tbody>
</table>

*1 The temperature coefficient for the DC resistance value is 0.4%/°C.
*2 Load resistance is 10 kΩ, M =1, Gap =0.5 mm
*3 The frequency value (Hz) indicated corresponds to the rotating speed (r/min) indicated when a 60 P/R detection gear is used.
*4 When using the Ono Sokki standard MP-001 detection gear
*5 JIS E 4031, five types, 40 Hz, two hours in each of the X and Y directions; four hours in the Z direction
*6 Three times each in the X, Y and Z directions

### Notes on the Detection Gear

- **a) Gap between the detector and the detection gear**
  The smaller the gap, the lower the rotational speed that can be detected. The gap should normally be set between 0.5 to 1 mm.

- **b) Detection gear tooth shape**
  An involute gear is recommended.

- **c) Gear size**
  The module unit (M) is used. This value is used to determine the size of the teeth. Modules with the same number of teeth can be meshed.

  **Module = Pitch circle diameter / Number of teeth**
  For a module that is greater than 1, we recommend a tooth width of 4 mm.

- **d) Detection gear material**
  Material with a property of being strongly attracted to a magnet, or in other words, a ferromagnet, is ideal. If you have a choice, we recommend materials such as 45C, SS400, SUS430, or FC400.

- **Ono Sokki’s standard detection gear MP-001**
  The detection gear available from Ono Sokki is a module 1 involute gear with 60 teeth.
  Number of teeth: 60
  Module: 1
  Material: SS400 (Chrome plated)
The Relationship between the Gap and Detection Rotation Range

1. The relationship between the gap between the detector and the detection gear and the detection range (Lowest measurable value) is given in the tables below.

2. The rotating speed range is that for which an output voltage of 0.5 Vp-p or greater can be maintained (load resistance = 10 kΩ).

3. The rotating speed that can be measured varies according to the type of display unit used.

• MP-900/9000 Series: Rotating speed (r/min) that can be measured

<table>
<thead>
<tr>
<th>Model name</th>
<th>Module</th>
<th>Lowest measurable value</th>
<th>Highest measurable value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M=1</td>
<td>M=1.5</td>
</tr>
<tr>
<td>Gap</td>
<td></td>
<td>0.5</td>
<td>1</td>
</tr>
<tr>
<td>MP-9100</td>
<td>200</td>
<td>500</td>
<td>50</td>
</tr>
<tr>
<td>911</td>
<td>200</td>
<td>500</td>
<td>50</td>
</tr>
<tr>
<td>9120</td>
<td>200</td>
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<td>930</td>
<td>200</td>
<td>500</td>
<td>50</td>
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<tr>
<td>935</td>
<td>300</td>
<td>1200</td>
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<tr>
<td>936</td>
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<td>1000</td>
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<td>940A</td>
<td>300</td>
<td>1200</td>
<td>80</td>
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<td>950</td>
<td>300</td>
<td>1000</td>
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<tr>
<td>954</td>
<td>300</td>
<td>1200</td>
<td>100</td>
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<tr>
<td>962</td>
<td>400</td>
<td>1500</td>
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<table>
<thead>
<tr>
<th>Model name</th>
<th>Module</th>
<th>M=1</th>
<th>M=1.5</th>
<th>M=2</th>
<th>Highest measurable value</th>
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<tbody>
<tr>
<td>Gap</td>
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<td>0.2</td>
<td>0.5</td>
<td>0.2</td>
<td>0.5</td>
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<tr>
<td>MP-992</td>
<td>400</td>
<td>1000</td>
<td>230</td>
<td>600</td>
<td>140</td>
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<table>
<thead>
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<th>Highest measurable value</th>
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<tr>
<td>Gap</td>
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<td>0.5</td>
<td>1000</td>
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<tr>
<td>MP-9200</td>
<td></td>
<td></td>
<td>35,000</td>
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<table>
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<th>Module</th>
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<th>M=5</th>
<th>M=7.5</th>
<th>Highest measurable value</th>
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<tbody>
<tr>
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<td>2</td>
</tr>
<tr>
<td>MP-963</td>
<td>45</td>
<td>90</td>
<td>25</td>
<td>50</td>
<td>20</td>
</tr>
</tbody>
</table>

Note: The data in the above tables are standard values, and operation at these values is not guaranteed. An Ono Sokki display unit was used to be available at the above figures.
Magnetoelectric Rotation Detector **MP-981**

For detection of low-to-medium speeds

These detectors utilize magnetic flux response (the resistance value changes according to the magnetic flux). The internal mechanism comprises magnetic resistance elements, permanent magnets, a direct current amplifier, and a voltage regulator. Detection can be performed as square wave output over a wide range from ultra-low speeds to high speeds (1 to 20,000 r/min [60 P/R]).

There are two models: the general-purpose MP-981 model and the waterproof AP-981 model.

---

**Features**

- Detection from nearly 0 r/min
- Output from ultra-low to high speeds (1 to 20,000 r/min [in the case of a 60-tooth gear])
- Compact, lightweight, easy-to-mount

**Specifications**

- Detection method: Detection using magnetic resistance elements
- Detection range: 1 Hz to 20 kHz
- Detection gear: Ferromagnet (Tooth width: At least 3 mm, Module: 0.5 to 3)
- Detection accuracy: See the figure at the right
- Power requirement: 12 VDC ±2 V
- Power consumption: Approx. 4.0 mA (at 12 V)
- Output waveform: Square wave
  - Lo: Up to +0.5 V
  - Hi: +5 ±0.5 V
- Output impedance: Approx. 330 Ω
- Protective circuit: Power source polarity, output short-circuit protection
- Operating temperature range: -10 to +70°C
- Withstand voltage: 250 VDC
- Vibration resistance: Normal power supply: 1.2 mm compound amplitude, 30Hz (for one hour in each of the X, Y, and Z directions)
- Shock resistance (when not connected to a power supply):
  - 490 m/s² (three times each in the X and Y directions)
- Connection method: Connector (compatible plug, RH-9PB6) or MX-700, MX-800 Series signal cable
- Weight: Approx. 80 g (including the two nuts used for fastening)

---

Magnetoelectric Rotation Detector **AP-981**

Acid-resistant, waterproof type

The AP-981 is a waterproof model that complies with the JIS C 0920 Protective Class 7 (marking symbol: IPX7) requirements for the waterproof testing of electrical equipment and wiring materials.

---

**Features**

- Can be used for measurement in locations where nitric acid mist in the atmosphere, or in environments where the detector needs to be submerged.
- Performs detection by non-contact rotation
- Output from ultra-low to high speeds (1 to 20,000 r/min [in the case of a 60-tooth gear]) as square waves of the same amplitude
- Comes with a 2-m length acid-resistant cable attached

**Specifications**

- Detection method: Detection using magnetic resistance elements
- Detection range: 1 Hz to 20 kHz
- Detection gear: Ferromagnet (Tooth width: At least 3 mm, Module: 1 to 3)
- Detection accuracy: See the figure at the right
- Power requirement: 12 VDC ±2 V
- Power consumption: Approx. 4.0 mA
- Output waveform: Square wave
  - Lo: Up to +0.5 V
  - Hi: +5 ±0.5 V
- Output impedance: Approx. 330 Ω
- Protective circuit: Power source polarity, output short-circuit protection
- Operating temperature range: -10 to +70°C (on the condition that it is within the atmosphere or IP-X7(JIS C0920))
- Withstand voltage: 250 VDC
- Vibration resistance (when connected to a power supply):
  - 1.2 mm compound amplitude, 30Hz (for one hour in each of the X, Y, and Z directions)
- Shock resistance (when not connected to a power supply):
  - 490 m/s² (three times each in the X and Y directions)
- Outer surface material: Polycarbonate
- Connection method: 2-m length directly attached cable (other end: open)
- Weight: Approx. 130 g

---

**CAUTION**

The MP-981 and AP-981 have been designed for the purpose of detecting rotational speed.

Please observe the following points when using these detectors.

1. Output is performed from ultra-low to high speeds (1 to 20,000 r/min [in the case of a 60-tooth gear]) as rectangular waves with the same amplitude, but this does not necessarily mean that the High level will be at the peaks of the gear and the Low level at the valleys. Accordingly, when using several detectors to perform synchronized measurement, the starting positions may not be the same.

2. The pulse width that is output when the gear is rotated in the clockwise direction may differ from the width that is output when the gear is rotated in the counter-clockwise direction.
Electromagnetic Rotation Detectors  **MP-800 Series**

For the detection of low-to-medium speeds

There are three models in the series, each with a different outer appearance: MP-810B, MP-820B and MP-830B.

- **Features**
  - Since the output is 600 P/R (MP-810B), the detector can be connected to a digital tachometer with a gate time being specified at 1 second, to enable direct reading in 0.1 r/min units.
  - If required, these detectors can perform high-precision measurement of low speeds.
  - There are three models in the series, differentiated by their outer appearance.
    - MP-810B: Base mount type
    - MP-820B: Dual-shaft type
    - MP-830B: Flange type

- **Number of output pulses**

<table>
<thead>
<tr>
<th>Model</th>
<th>Number of Signals (P/R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP-810B/820B*</td>
<td>600</td>
</tr>
<tr>
<td>MP-810F/820F*/</td>
<td>300</td>
</tr>
<tr>
<td>MP-810G*/820G*/</td>
<td>60, 120, 180, 200, 240, 360, 400, 420</td>
</tr>
</tbody>
</table>

*Manufactured after receipt of order

- **Specifications**
  - Rotating speed range: 5 to 5,000 r/min
  - Output waveform: Sine wave approximation
  - Output voltage: At least 0.5 Vp-p
  - DC resistance value: 770 ±30 Ω
  - Inductance: 2 H (typ)
  - Starting torque: 245 mN·m or less
  - Moment of inertia: Approx. 1.5 kg·cm² (1588 g·cm²)
  - Permissible shaft load: Radial 147 N, thrust 98N
  - Vibration resistance: 98 m/s² (for two hours in each of the X, Y, and Z directions)
  - Shock resistance: 980 m/s² (three times in each of the X, Y, and Z directions)
  - Operating temperature range: -10 to +80°C
  - Weight: Approx. 2 kg
  - Connection method: M3 crimp terminal (JIS C 2805 1.25-3) (when using the MP-081)
    - MP-081 + MX-005 Series (BNC) / Sold separately
    - MP-081 + MX-505 Series (Crimp terminals) / Sold separately
  - Cable outlet: Cable plug (complies with IP-68)
  - Surrounding magnetic field: Up to 0.01 T

Option: MP-081
Connector plugs 1P2B
For attachment to the terminal box (with covers)
Electromagnetic Rotation Detector MP-610

For measurement over a wide range

- MP-610 (Base mount type)

• Features
  - Handles a wide rotation range from 50 to 15,000 r/min
  - Since the output is 60 P/R, the detector can be connected to a digital tachometer with a gate time being specified at 1 second, to enable direct reading in 1 r/min units.

• Specifications
  - Rotating speed range: 50 to 15,000 r/min
  - Number of output pulses: 60 P/R
  - Output waveform: Sine wave approximation
  - Output voltage: 0.5 Vp-p or greater
  - DC resistance value: 760 to 920 Ω
  - Inductance: 860 mH (typ)
  - Starting torque: 9.8 mN·m or less
  - Moment of inertia: Approx 70 g·cm²
  - Permissible shaft load: Radial 8.6 N, thrust 39.2 N
  - Vibration resistance: 98 m/s² (for two hours in each of the X, Y, and Z directions)
  - Shock resistance: 980 m/s² (three times in each of the X, Y, and Z directions)
  - Operating temperature range: -10 to +90°C
  - Weight: Approx. 650 g
  - Connection method: Connector (compatible plug: 12P2B), or MX-005 Series signal cable (Sold separately)
  - Surrounding magnetic field: Up to 0.007 T

Note: Please refer to p.25 for the coupling used.

Photoelectric Rotation Detector LG-916

Compact, Optical Fiber Sensor

The LG-916 model is a reflective-type photoelectric rotation detector that employs an optical fiber at its tip. A pulse modulation method has been used for the light projection source, and the detector has been designed to be virtually unaffected by ambient light.

• Features
  - Detection from nearly 0 r/min
  - This compact, easy-to-use photoelectric detector that features the light source, light receiver and amplification section in a unified structure is a lightweight model weighing only 150 g.
  - A light-emitting diode is used for the light element.
  - A waterproof connector is provided as standard.

• Specifications
  - Detection method: Light reflection using an optical fiber sensor
  - Detection distance: Up to a maximum of 20 mm when using the 12-mm-square reflective mark (Ono Sokki Model HT-011).
  - Maximum response speed: 20 m/s (conversion of the rotating shaft's circumferential speed)
  - Time response delay: 0.6 m/s (light receiver conversion time) or less
  - Light source: Light-emitting diode (infrared light)
  - Light receiver element: Phototransistor
  - Power requirement: 12 VDC ±2 V
  - Current consumption: 60 mA or less (when using 12 V)
  - Output waveform: Rectangular wave Hi: +5 ±0.5 V, Lo: Up to +0.5 V
  - Output impedance: 1 kΩ or less
  - Connection method: Connector (compatible plug: R04-PB6F or MX-700/800 Series signal cable/sold separately)
  - Operating temperature range: -10 to +60°C
  - Storage temperature range: -20 to +80°C
  - Weight: 150 g

- LG-916 measurement range

Dimensions from the center of the output shaft ( )
- 12 mm/12 mm 1 piece
- 12 mm X 12 mm 1 piece

Rotating speed (r/min)
Photoelectric Rotation Detector  
LG-930

Compact model designed for the long-distance detection of visible light

The LG-930 model is a compact reflective-type photoelectric rotation detector that can be positioned up to 200 mm away from the target object.

**Features**
- Can be positioned at a distance of up to 200 mm away from the target measurement object
- The compact design enables it to be mounted in small spaces. Moreover, the L-shaped mounting fixture enables easy mounting.
- Visible light is used for easy positioning, and the built-in operating indicator light enables easy setup.
- The pulse lighting method ensures that the LG-930 is virtually unaffected by ambient light.

**Specifications**
- Detection method: Photoelectric reflection of visible light
- Detection distance: 70 to 200 mm (when using the 12-mm-square reflective mark)
- Object detected: Reflective mark
- Maximum response speed: 25 ms (when using the 12-mm-square reflective mark, and when the distance from the point to which the mark was fixed is 48 mm)

*Ono Sokki Model HT-011 is recommended as reflective mark.*
- Time response delay: 0.5 ms (light receiver conversion time) or less
- Light source: Light-emitting diode (red visible rays)
- Light receiving element: Phototransistor
- Power requirement: 12 VDC ±2 V
- Current consumption: 85 mA or less (when using 12 V)
- Output waveform: Rectangular wave: Ht: +5 V ±0.5 V, L: Up to +0.5 V (on condition that a load resistance is at 100 kΩ at least.)
- Output impedance: 1 kΩ or less
- Operating temperature range: -10 to +60°C
- Storage temperature range: -20 to +80°C
- Input/output connectors: Directly attached cable with the other end open
- Cable length: 4.9 m
- Weight: Approx. 200 g
- Accessory provided: Mounting fixture

**Application Example**
Attach the reflective mark to the shaft of the rotating object and then perform detection.

---

Photoelectric Rotation Detector  
FS-540/FG-1200

Optical Fiber Sensor/Optical Multimeter

Combine the FS-540 Optical Fiber Sensor with the FG-1200 Optical Multimeter to enable a detection distance of up to 70 mm

**Features**
- Detects the rotational speed, number of objects, position, level, and judges whether or not an object is present
- If reflective mark (Ono Sokki Model HT-011) that generates a large amount of reflected light is affixed to the target object, detection can be performed at a distance of up to 70 mm.
- Since light is used for detection, the products are virtually unaffected by noise.
- Detection of even ultra-small amounts of light can be performed.

**Specifications**

**FG-1200 Optical Multimeter**
- Response frequency: 0 to 5 kHz
- Lighting method: Light-emitting diode (near infra-red rays)
- Light receiving method: Photodiode
- Output signals: Analog output (proportional to the amount of reflected light): 0 to 10 V
- Load resistance: At least 10 kΩ
- Pulse output: Ht: +5 V, L: Up to +0.5 V
- Load resistance: At least 10 kΩ
- Contact output: 0.1 A (100 VAC resistance load)
- Slice level: User-specifiable setting
- Connection method: Connector (compatible plug: BNC) or MX-100 Series signal cable (option)
- Power requirement: 100 VAC ±10% (100/120/220/240 VAC on request)
- Operating temperature range: 0 to +40°C

**Gap between the optical fiber sensor and the target measurement object (when the output signal is 1 V)**

<table>
<thead>
<tr>
<th>Target measurement object</th>
<th>Minimum Gain</th>
<th>Maximum Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black matte painted surface</td>
<td>±5% 7 mm</td>
<td>±5% 14 mm</td>
</tr>
<tr>
<td>White paper 12 mm x 12 mm</td>
<td>±5% 8 mm</td>
<td>±5% 15 mm</td>
</tr>
<tr>
<td>White paper 12 mm x 12 mm</td>
<td>±5% 8 mm</td>
<td>±5% 15 mm</td>
</tr>
<tr>
<td>Reflective mark 12 mm x 12 mm</td>
<td>±5% 44 mm</td>
<td>±5% 99 mm</td>
</tr>
<tr>
<td>(Ono Sokki Model HT-011)</td>
<td>±5% 44 mm</td>
<td>±5% 99 mm</td>
</tr>
</tbody>
</table>

**FS-540 Optical Fiber Sensor Specifications**

<table>
<thead>
<tr>
<th></th>
<th>FS-540</th>
<th>FS-340 (Manufactured after receipt of order)</th>
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</thead>
<tbody>
<tr>
<td>Detection method</td>
<td>Reflective</td>
<td>Reflective</td>
</tr>
<tr>
<td>Diameter of fiber (tip)</td>
<td>4 mm</td>
<td>4 mm</td>
</tr>
<tr>
<td>Length of fiber (%)</td>
<td>1 mm</td>
<td>1 mm</td>
</tr>
<tr>
<td>Temperature</td>
<td>-10 to +70°C</td>
<td>-10 to +250°C</td>
</tr>
</tbody>
</table>

* TMF-80 swivel-neck model with magnetic base
* The optical fiber can be extended up to a length of 10 m. (option)
* Reflective mark Model HT-011 can be supplied as an option. 1 set of HT-011 includes 250 pcs. of reflective mark.
**Rotary Encoder RP-432Z**

*Compact type for general-purpose use*

- **Features**
  - Small, standardized, economical design
  - Compact, general-purpose type with a shaft diameter of φ6, an outer diameter of φ70, and weighing only 300 g
  - 5 VDC or 12 VDC power supply can be selected
  - 2-phase square wave + zero mark output
  - Easy-to-use connector
  - Choice of eight pulse output types

- **Specifications**
  - Detection method: Photoelectric
  - Number of output pulses: 60, 120, 300, 360, 500, 600, 1000, 1024 P/R
  - Response frequency: 50 kHz
  - Output signal: 90° phase difference; 2-phase square wave + zero mark output
  - Output voltage: Square wave Hi: At least 4 V,
    - Lo: Up to 0.2 V (5-V power supply)
    - Hi: At least 10 V
  - Output method: Totem pole output, load resistance at least 1 kΩ
  - Power requirement: 5 VDC ±5%, 100 mA or 12 VDC ±5%, 100 mA
  - Maximum rotating speed: 5000 r/min
  - Starting torque: 1.5 mN·m
  - Moment of inertia: 24 g·cm²
  - Operating (storage) temperature range: 0 to +50°C (-20 to +80°C)
  - Connection method: Connector (cable end: TRC116-12A10-7F provided as standard)
  - Permissible shaft load: Radial 20 N, thrust 10 N

**Rotary Encoder SP-405ZA**

*Ultra-compact type*

- **Features**
  - Economical type designed for OEM needs
  - φ40 outer diameter, ultra-compact, lightweight model weighing only 100 g
  - 2-phase square wave + zero mark signal output
  - High resolution up to a maximum of 600 P/R
  - Choice of seven pulse output types

- **Specifications**
  - Detection method: Photoelectric
  - Number of output pulses: 60, 100, 200, 300, 360, 500, 600 P/R
  - Response frequency: 100 kHz
  - Output signal: 90° phase difference; 2-phase square wave + zero mark output
  - Output voltage: "1": At least the power voltage -20%, "0": Up to 0.5 V
  - Power requirement: 5 to 12 VDC ±10%, 50 mA
  - Maximum rotating speed: 6000 r/min
  - Starting torque: 2 mN·m
  - Moment of inertia: 6 g·cm²
  - Operating (storage) temperature range: -10 to +70°C (-20 to +80°C)
  - Connection method: Directly attached 1-m length cable (other end: open)
  - Permissible shaft load: Radial 25 N, thrust 15 N
  - Protection class: IP40

Note: Ono Sokki handles a wide range of rotary encoders, and we have printed a separate catalog for these products. Please ask nearest Ono Sokki representative for a copy of the "RP Series" catalog or download it from the company’s web site.
Digital Tachometer  TM-5100

Multifunctional tachometer with a 2-channel calculation function

- Features
  - Capable of measuring a wide range of rotations from low to high speeds (input frequency: 0.6 mHz to 100 kHz)
  - Calculation and display of signals from two rotating objects
  - The independent coefficient compensation function for each channel enables conversion to the desired physical quantity proportional to the rotating speed.
  - Built-in upper and lower level comparator functions
  - The 2-channel calculation function displays the rotational difference, rotational ratio, draft, draw, rotational rate of change and rotational direction.
  - BCD, analog, comparator and RS-232C output functions are provided as standard.
  - DIN standard size (144 x 72) for easy panel mounting.
  - Two display sections have been incorporated: the main display section for displaying the numerical values and a sub display section (two rows) for displaying the setup parameters (comparator setup values, coefficient values, measurement values for two channels, and so forth).

- Specifications
  - Compatible detectors: MP Series electromagnetic and magnetoelectric detectors, LG Series photoelectric detectors, RP Series rotary encoders, etc.
  - Number of input channels: 2
  - Input amplification mode: AC/DC (switch-selectable)
  - Measurement method: Synchronized calculation, gate calculation (switch-selectable)
  - Measurement time: 0.2s + time required for one period (for period calculation)
  - Coefficient measurement range: 0.001 to 99.9999
  - 2-ch calculation function: Difference ≪B-A≫, Ratio ≪B/A≫ x 100, rate of change ≪B-A/A≫ x 100
  - Rotational direction measurement function:
    - When a 2-phase rotary encoder is used, the rotational direction is displayed as a polarity display
    - Main display section: Green 7-segment LED (character height: 14 mm)
    - Display range: 0 to ±999999 (0.00 to 9999.99%)
  - Sub display section: (parameter setup display section):
    - LCD module
  - Number of characters displayed: 16 characters x 2 rows
  - Signal input section: Input impedance: At least 10 kΩ (At 100 kHz)
  - AC amplification section: Signal waveform: Sine wave or square wave
    - Signal voltage range: Sine wave 0.2 to +45 Vrms
    - Square wave 0.6 to 63 Vp-p
    - Signal frequency range: 1 Hz to 100 kHz
  - DC amplification section: Signal waveform: Rectangular wave with a pulse width of at least 4 μs
    - Signal voltage range: Hi: +44 to +30 V
    - Lo: -4 to +1 V
    - Signal frequency range: 0.0006 Hz to 100 kHz
  - Comparator function: Number of setting levels: 2
    - Setting range: 0 to ±999999
    - Parameters output: UPPER/GOOD/LOWER
    - Output format: Semiconductor relay make contact (30 VDC, 0.1A)
  - Analog output: Converter: 12-bit, D/A method
    - Voltage range: 0 to ±10 V/F/S (full scale is user-specifiable)
  - BCD output: Positive/negative logic (switch-selectable), 6 digits in parallel
  - Output format: Open collector
  - RS-232 transmission: Baud rate: 2400, 4800, 9600 bps
  - Sensor power supply: 5 VDC ± 0.25 V (max. 150 mA) for the total value of channels A and B
    - 12 VDC ± 0.6 V (max. 150 mA) for each of the channels A and B
  - Power requirement: 100 to 240 VAC (50/60 Hz)
  - Power consumption: 45 VA or less
  - Operating temperature range: 0 to 40°C
  - Humidity range: Max 95% (non-condensing)
  - Outer dimensions: 144 (W) x 72 (H) x 191.5 (D) mm
  - Weight: Approx. 1.5 kg

- Applications
  - Measurement of the draw on paper manufacturing or glass manufacturing line
  - Rotation detectors are mounted on the rotating parts of the line, and signals from the detectors are input to the TM-5100. At this time, the speed of the reference roller and the rate of change are displayed on the TM-5100, enabling the speed at different parts of the line to be adjusted and thereby ensure stable quality products.

- Inspection of Motor Products
  - A signal is input from the encoder to the TM-5100, and the speed and rotational direction are determined. The main display section displays the numerical values, and the sub display section displays the setup parameters.
  - The comparator function is used for quality control. If the speed is out of specification, an alarm is generated.

- Diagrams
  - Diagram of the TM-5100 display and connections
  - Diagram of the detector and reference roller
  - Diagram of the inspection of motor products

- Additional Information
  - Calculation function
    - Difference ≪B-A≫, Ratio ≪B/A≫ x 100, rate of change ≪B-A/A≫ x 100
  - Rotational direction
    - When a 2-phase rotary encoder is used, the rotational direction is displayed as a polarity display
  - Display sections
    - Main display section: Green 7-segment LED (character height: 14 mm)
    - Sub display section: (parameter setup display section): LCD module
  - Signal input and output
    - Input impedance: At least 10 kΩ (At 100 kHz)
    - Output format: Semiconductor relay make contact (30 VDC, 0.1A)
  - Power supply
    - 5 VDC ± 0.25 V (max. 150 mA) for the total value of channels A and B
    - 12 VDC ± 0.6 V (max. 150 mA) for each of the channels A and B

- Technical specifications
  - Resolution: 0.01 degrees
  - Accuracy: ±0.1% + 1 digit
  - Linearity: ±0.1% + 1 digit
  - Inrush current: 10 times nominal current
  - Power consumption: 45 VA or less
  - Operating temperature range: 0 to 40°C
  - Humidity range: Max 95% (non-condensing)
  - Dimensions: 144 (W) x 72 (H) x 191.5 (D) mm
  - Weight: Approx. 1.5 kg
Line Speed Detector (Roller Encoder)  
RP-721

For low-to-medium speed applications

**Features**
- Capable of directly reading and outputting signals in increments of 0.1 (120 P/R) m/min or 0.01 m/min (1200 P/R) (When the gate time is specified at 1 second, we recommend that you use the TM-2100 series counter.)
- Detects from close to 0 m/min
- Can also be used as a length detector (200 P/R)

**Specifications**
- Speed detection range: Medium speeds: 0 to 400 m/min (0.1 m/min measurement unit)
  - Low speeds: 0 to 200 m/min (0.01 m/min measurement unit)
- Detection method: Photoelectric
- Number of output pulses: Medium speed measurement: 120 P/R
  - Low speed measurement: 1200 P/R
  - Length measurement: 200 P/R
- Output signal: Single-phase square wave Hi: +10 ±1 V, Lo: Up to +0.5 V
- Roller outer circumference: 200 mm (hardened urethane rubber baked onto aluminum; hardness value: 90)
- Starting torque: 1 mN·m or less
- Connection method: Connector (cable end: RM12BPG-SS)
- Operating temperature range: 0 to +50°C
- Power requirement: 12 VDC ±5%, 100 mA
- Weight: Approx. 500 g
- Compatible display unit: TM-2100 Series

*Note: There is no plug attached to the cable end of the RP-721 device.*

---

Length Detector (Roller Encoder)  
RP-732

Reversible type

**Features**
- Hardened baked-on urethane rubber roller used to reduce slipping
- Discrimination of the rotational direction is enabled.

**Specifications**
- Roller outer circumference: 300 mm (ø95.49)
- Number of output pulses: 300 P/R, 750 P/R
- Measurement unit: 1 mm (300 P/R)
  - 0.4 mm (750 P/R)
- Output waveform: Two-phase square wave
- Output voltage: Hi: +10 V ±1 V,
  - Lo: Up to +0.5 V
- Operating temperature range: 0 to +50°C
- Power requirement: 12 VDC ±5%, 100 mA
- Weight: Approx. 2.2 kg
- Compatible display unit: RV-3150
Reversible Counter

• Reversible counter designed to measure linear position, displacement, dimensions, and so forth
• Easy-to-read large-size LED (14 mm)
• Wide range of external output functions (comparator, analog, BCD and RS-232C transmission); four types of comparator setting values can be saved as conditions.

Specifications
Compatible sensors: RP Series (rotary encoders),
        RP-700 Series (roller encoders),
        GS Series (linear gauge sensors),
Display sections: Main display section: Red LEDs (24 mm), 6 digits and
        polarity(0 to ±999999)
        Sub display section: LCD, 16 characters x 2 rows,
        with backlight (yellow-green)
Decimal point: 0, 0, 0.0, 0.00, 0.000 (select one)
Status display section: Comparator output display:
        UPPER (red)/GOOD (green)
        LOWER (red)
Sensor input signal: Single-phase or 90° phase difference square
        wave voltage signal
        (Hi: +4 to +30 V, Lo: 0 to +1 V)
Line receiver (conforms to RS-422A)
Input frequency DC to 100 kHz
Sensor power supply: 5 VDC ±0.25 V (max. 150 mA) or
        12 VDC ±0.6 V (max. 120 mA), selectable
External control signal: Input signal type: Voltage signal (Hi: +4 to
        +5.25 V, Lo: 0 to +1 V),
        non-voltage contact input
        Input signal function: Reset, Gate, Offset,
        Key Protection
Modes/Functions: Multipliers: 1/2/4
        Ratio compensation range: 0.000001 to 0.999999
        Exponent values: 1/1, 1/10, 1/100, 1/1000
        Offset setting range: 0 to ±999999
Comparator function: Setting range: 0 to ±999999
        Setting levels: 2
        Output parameters:
        LOWER (LOWER setting value ≥ calculated value)/
        GOOD (LOWER setting value < Calculated value <
        UPPER setting value)/
        UPPER (UPPER setting value ≤ calculated value)
        Output format: semiconductor relay (single make contact)
        Maximum contact capacity: 30 VDC, 0.1A,
        Refresh time within 15 ms
BCD Input/Output: Output signals (BCD, Polarity, Judgment, Error, Print
        command): Open collector (withstand voltage: Max. 30 V)
        Control signal (reset, hold), Input format (voltage input)
        Hi: +4 to 5.25 V, Lo: 0 to +1 V
Analog output: Output voltage range 0 to ±10 V/F (FS is user-specifiable)
        Load resistance: At least 10 kΩ
        Linearity measurement error ≤±0.3 % of FS
        Calibration function: ZERO/FULL 12 bit D/A method
        Refresh time: Within 15 ms
RS-232C transmission: Functions: Readout of measured data,
        parameter setup and readout
        Baud rate: 2400/4800/9600 bps
Power requirement: 100 to 240 VAC (50 to 60 Hz)
Power consumption: 30 VA or less
Operating temperature range: 0 to +40°C
Outer dimensions: 144 (W) x 72 (H) x 191 (D) mm
Weight: Approx. 1.3 kg
Ratio Multiplier  TA-103

Features
- The number of pulses generated by the detector can be multiplied as desired from 99.99% to 0.01% (pulse stream spot sampling method).
- Use to change the number of output pulses of the detection signals in accordance with the changes to wear compensation, temperature compensation, and gear ratio.
- Ideal for a wide range of applications such as fraction compensation for length compensation, flow, and wind speed.
- The low output impedance enables long-distance signal transmission.
- Both the input and output circuits are isolated to make them less susceptible to noise.

Specifications
- Input/output connectors: BNC connector and terminal block
- Input impedance: At least 30 kΩ (at 100 kHz)
- Amplification mode: AC/DC, switch-selectable
- AC amplification input signal range: Sine wave, 0.2 to 50 Vrms (10 Hz to 100 kHz)
- DC amplification input signal range: Rectangular wave with a pulse width of at least 5μs
  - Hi: +4 to +30 V
  - Lo: -1 to +1 V (DC to 100 kHz)

Setting method: 4-digit digital switch
Setting range: 0.0001 to 0.9999 or 1/1
Output signal: Hi: +10 ± 2V, Lo: 0 to +0.5 V rectangular wave
Output impedance: 5 Ω or less
Detection power supply: 12 VDC ±0.6 V, 100 mA
Power requirement: 100 VAC ±10% (100/120/220/240 VAC on request)
Power consumption: Approx. 18 VA
Operating temperature range: 0 to +40°C
Weight: Approx. 2 kg

Isolated Signal Amplifier  PA-150

Features
- Electromagnetic type designed for use as a detector amplifier in adverse electrical environments.
- Converts detector signals to a high voltage for low-impedance output.
- 12 VDC output to those detectors for which a power supply is required.
- Sealed structure, terminal block for easy wiring, outlet designed for easy handling of piping and cabling.
- Both the input and output circuits are isolated to make them less susceptible to noise.

Specifications
- Input frequency range: 1 Hz to 50 kHz
- Input waveform: Sine wave or square wave
- Operating voltage range: Sine wave input: 0.1 to 30 Vrms
  - Square wave input: 0.3 to 30 Vp-p
- Voltage output: Hi: +10 ±2 V
  - Lo: Up to +0.5 (when the load resistance is 4.7 kΩ.)
    - Can be switched to open collector output
  - Output impedance 330 Ω
- Detector power supply: 12 VDC ±0.6 V, 100 mA
- Operating temperature range: -10 to +40°C
- Power requirement: 100 VAC ±10%, 50/60 Hz (110/200/220 VAC on request)
- Power consumption: Approx. 8 VA
- Weight: Approx. 4 kg
- Accessories: 11 crimp terminals
**Features**
- Withstand voltage: 2000 VAC for one minute (between the chassis and primary power supply)
- Comes with a power supply for the detector (12 V, 100 mA)
- Switch-selectable AC/DC input signals
- The frequency range can be specified as any desired frequency in the range from 100 Hz to 100 kHz (option; standard is 10 kHz). (The specified frequency is fixed and the setting cannot be changed).
- Data output as current or voltage signals can be recorded using a pen recorder or displayed on a display unit such as an indicator.
- Convenient, compact, single-function type that smoothes out the input frequency to enable viewing of the average behavior of the fluctuations

**Specifications**
Conversion method: Fixed width pulse integration
Frequency range: 10 kHz (specification of a different frequency is available as an option.)
Response: 30 ms (varies according to the specified optional frequency)
Input frequency: 10 kHz (a frequency in the range from 100 Hz to 100 kHz can be specified as an option)
Input terminal: BNC (C02), terminal block (3.5 M)
Input voltage: AC input Sine wave: 0.2 to 50 Vrms
Square wave: 0.6 to 70 Vp-p
DC input Rectangular wave: Hi: +4 to +30 V,
Lo: -1 to +1 V
Pulse width: At least 3 μs
Input impedance: At least 80 kΩ (20 kHz),
at least 30 kΩ (100 kHz)

Output terminal: Terminal block (3.5 M)
Output voltage: 0 to 10 V Load resistance at least 1 kΩ (0 to 5 V/0 to 1 V/0 to 0.1 V available as options)
Output current: 4 to 20 mA Load resistance 500 Ω or less (can also be set in the 0 to 16 mA range)
Linearity: Within ±0.2% of the maximum rated value
Ripple: 0.1% of the maximum rated value or 10 mV or less (when the frequency input is 5% of the frequency range.)
Detector power supply: +12 VDC ±10% 100 mA
Power requirement: 100 VAC + within 10 to 15%, 46 to 63 Hz (110 V/120 V/200 V/220 V/240 VAC on request)
Operating temperature range: 0 to +40°C
Outer dimensions: 245 (W) x 99 (H) x 202 (D) mm
Weight: Approx. 2 kg
**Features**
- Output delay: High-speed response within 1 period +7.6 µs
- Measurement scale settable in 1-Hz units
- 1 Hz to 20 kHz input frequency range
- Built-in deviation output function
- Built-in moving average function
- Built-in detector power supply (+12 VDC)
- Capable of measuring variations in rotational speed and transient phenomena

**Specifications**
Conversion method: Period calculation
Response: Time of input frequency period + 7.6 µs (DSP calculation time)
Input configuration: Isolated single-ended input

(Difference in electric potential between common and ground on the chassis:
42 VDC max.)
Input frequency range: 1 to 20,000 Hz (50 kHz and 100 kHz also available as options)
Input voltage range: 0.3 to 30 Vp-p (AC, DC)
Input terminal: C02 type (BNC), and terminal block (M3)
Frequency range: Full scale output mode:
The maximum frequency can be set in 1-Hz increments in the range from 1 to 20,000 Hz.
Deviation output mode:
The center frequency can be set in the range from 2 to 19,801 Hz, in 1-Hz increments.
Deviation setting range: ±1, ±5, ±10, ±20%
(Cannot be set if the maximum measuring frequency exceeds 20,000 Hz due to the deviation setting)
Frequency display: 5-digit, 7-segment, green/1-s display interval

Output signal (voltage): When full scale: 0 to 10 V, deviation output setting; 0±5V/load resistance at 10 kΩ or less
Output signal (current): When full scale: 0 to 16 mA (factory default setting)/4 to 20 mA/load resistance at 100 Ω or more
When deviation output: 8 ±8mA/12 ±8 mA
Output terminal: BNC (voltage output), terminal block (current output)
D/A conversion: 16-bit
Linearity (excluding offset):
- Full-scale output mode: ±0.1%/FS (voltage),
  ±0.7%/FS (current)
- Deviation output mode: ±0.5 to ±5%/FS (voltage),
  ±3 to ±10%/FS (current)
(difference according to the central frequency and the deviation setting range)
Sensor power supply: +12 V (±10%)/100 mA max.
(ripple 20 mVp-p max.)
Operating temperature range: 0 to +40°C/0 to 80% RH
(non-condensing)
Power requirement: 100 to 240 VAC/50 to 400 Hz
(continuous), approx. 13 VA
Outer dimensions: 100 to 240 VAC/50 to 400 Hz
Panel Mounting Fixture [sold separately]

Panel Cutout Dimensions
**F-V Converter FV-5300**

**Frequency-to-Voltage/Frequency-to-Current Converter**

Stackable for multi-channel capability

**Features**
- Wide input frequency range: 0.1 mHz to 100 kHz (DC)
- Wide input voltage range: 0.14 to 30 Vp-p (AC)
- User-specifiable measurement ranges and output voltages (in 1% increments)
- Built-in estimate calculation and emergency stop judgment functions (PERIOMATIC™)*1
- Equipped with a simple 3-digit monitor
- Factor setup function enables display and setting of the rotating speed, etc.
- The stacking feature enables up to four units to be linked together.
- DC drive: 10 to 42 VDC (an AC adapter is also available)

**Specifications**
Conversion method: 1 ms averaged period calculation (PERIOMATIC™)*1
Response: 1 ms + 1 input signal period
Input signal mode: AC/DC, switch-selectable
Input frequency range: DC: 0.1 mHz to 100 kHz
AC: 1 Hz to 100 kHz
Input voltage range: AC: 0.14 to 30 Vp-p
DC: Lo: Up to +1V, Hi: +4 to +30 V
Input terminal: C02 type (BNC), R03-R6F
Measurement ranges*2: 0.10 to 999 k
  3 digits (0.10 to 999) x1 or x1000 times
  Frequency or factor setup conversion value
Functions: Factor, estimate calculation, emergency stop judgment, stepless
Factor setup: Mantissa (3-digit, 0.01 to 999),
multiplier (0.01, 0.1, 1, 10, 100)
Simple monitor: 3-digit LED, decimal point matches the measurement range setting
Trigger level: AC: 0.07 to +2 V (variable using the VR on the front panel)

Output range: 0 to 10 V (full scale settable in 1% increments)
  /load resistance at 10 kΩ or more
  (Option: 0 to 16 mA, 4 to 20 mA/Load resistance at 500 Ω or less)
Resolution: ±0.03%/10 V
Accuracy: ±0.2%/FS (when FS = 10 V)
Output adjustment: Zero and Full
Sensor power supply: 12 VDC ±10%, 100 mA max.
Power requirement: Terminal block: 10 to 42 VDC
  AC adapter terminal: 14 to 18 VDC
Consumption current: Approx. 0.6 A (when 12 VDC)
Operating temperature range: 0 to 40°C
Weight: Approx. 500 g
Outer dimensions: 28 (W) x 121 (H) x 205 (D) mm
Option: PB-707 AC adapter (100 to 240 VAC, 50/60 Hz)

*1 PERIOMATIC™ is a registered trademark of Cocoresearch, Inc.
*2 The measurement ranges that can be set are limited by the factor setup values.
**F-V Converter Applications**

- **FV-1300 High-speed F-V converter**  High-speed period conversion output for each period

  - Gear
  - Drive section such as a belt
  - Measurement of motor rotation fluctuations

**Measurement at the start of rotation**

Whether the start is smooth or not

<table>
<thead>
<tr>
<th>Speed</th>
<th>Time</th>
</tr>
</thead>
</table>

**Measurement of Rotation Fluctuations**

- **Order ratio analysis**
  - Speed fluctuations
  - Speed fluctuations

  Measurement is performed of the number of times an uneven speed is generated. In the above example, speed fluctuations occurred 60 times, 120 times, 180 times and 240 times during one rotation.

- **Tracking analysis**
  - Speed fluctuations
  - Time

  We can ascertain the rotating speed where the maximum number of speed fluctuations occurred when the rotational speed was changed.

- **FV-5300 F-V converter**  1-ms response period conversion, smooth signal output even at a low pulse

  - Rotary motion
    - Photoelectric sensor
    - Electromagnetic/Magnetoelectric sensor
  
  - Linear motion
    - Linear gauge
    - Laser switch
    - Power converter

- **Automobile braking tests, fuel flow measurement**

  Four FV-5300 units
  - Number of tire rotations
  - Flow

  For monitoring rotations, the start of linear motion, and when at rest.
While a rigid coupling can ensure accurate rotation and angle measurements when an electromagnetic detector is connected to a device, mounting errors such as shaft misalignment and play in the thrust direction can result in deformation of the elasticity of the bearings and can cause loss of detector accuracy and even damage to the detector. To ensure stable operation when using a rigid coupling over a long period of time, the shaft misalignment should be kept within ±1000 mm. If precise center alignment such as that stipulated above is a practical impossibility, a flexible coupling that can take up such center misalignment and play in the thrust direction must be used. A wide range of flexible couplings with high torsional rigidity as well as couplings that are suitable for general-purpose rotational measurements is available for an optimal selection to suit the application. Even with the use of a flexible coupling, however, there is always the possibility that the method used for mounting will subject the shaft to more than the allowable static or dynamic load. For this reason, centering of the shaft should be performed with extreme care.

### Example of couplings (Shape and weight)

**Fig. 1** Baumann Flex Coupling
![Image of Baumann Flex Coupling]

**Fig. 2** Rubber Flex Coupling
![Image of Rubber Flex Coupling]

**Fig. 3** Link Coupling
![Image of Link Coupling]

**Fig. 4** Center Flex Coupling
![Image of Center Flex Coupling]

<table>
<thead>
<tr>
<th>Coupling Name</th>
<th>Compatible Models</th>
<th>Features</th>
<th>Permissible eccentricity, angle of deviation [Note 1]</th>
<th>Mounting/removal methods</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baumann Flex Coupling</td>
<td>MP-610</td>
<td>- Utilizes a coil spring for elasticity</td>
<td>Number of rotations: 2000 r/min</td>
<td>Mount the coupling on the detector or on the device, and then insert it as one piece into the mating piece.</td>
<td>Since a coil spring is used, sudden forward/reverse rotations are not possible because of backlash, and play in the thrust direction is not absorbed. Drive shaft diameter ø10 to ø16 [See Note 2]</td>
</tr>
<tr>
<td>Rubber Flex Coupling</td>
<td>MP-810B</td>
<td>- Utilizes rubber for elasticity; reduces shock</td>
<td>Number of rotations: 2000 r/min</td>
<td>Mount the flange on the detector or device, and then after establishing the various centering dimensions required, attach the rubber ring. Mounting and removal can be performed without moving the device.</td>
<td>At high speeds, a thrust force caused by expansion of the rubber due to centrifugal force will damage the detector. Drive shaft diameter ø10 to ø22 [See Note 2]</td>
</tr>
<tr>
<td>Link Coupling</td>
<td></td>
<td>- Utilizes a stainless steel spring for elasticity</td>
<td>Number of rotations: 5000 r/min</td>
<td>This is the same as the rubber flex coupling as above and similar models except that a stainless steel link is used instead of rubber ring.</td>
<td>Drive shaft diameter ø10 to ø20</td>
</tr>
<tr>
<td>Center Flex Coupling</td>
<td></td>
<td>- Absorbs vibration and shock</td>
<td>Number of rotations: 5000 r/min</td>
<td>Mount the flange and the flange hub on the detector or device, perform centering, and then attach the rubber body.</td>
<td>Drive shaft diameter ø10 to ø25</td>
</tr>
</tbody>
</table>

**Note 1** The permissible eccentricity and angle of deviation are within the range that enables guaranteed performance of the coupling. Even though these values are within the permissible range, avoid mounting the coupling in a location where the load on the detector shaft will exceed the stipulated limits.

**Note 2** Hole machining is the responsibility of the user.
### Table of Signal Cable

<table>
<thead>
<tr>
<th>Item</th>
<th>Compatible Detectors</th>
<th>Cable</th>
<th>Model Name/Specifications</th>
</tr>
</thead>
</table>
| 1    | MP- 610-610B-9100-9120-9200-940A-963  
     | MP- 810B-820B-830B (MP-081+MX-005 Series) | 3C-2V (high-frequency coaxial cable) | MX-005 5 m  
   |     |                       |                               | 010 10 m  
   |     |                       |                               | 015 15 m  
   |     |                       |                               | 020 20 m  
   |     |                       |                               | 12P2B BNC plug |
| 2    | MP- 930-935-950-962  
     | FG-1200 | 3C-2V (high-frequency coaxial cable) | MX-101 1.5 m  
   |     |                       |                               | 105 5 m  
   |     |                       |                               | 110 10 m  
   |     |                       |                               | 115 15 m  
   |     |                       |                               | 120 20 m  
   |     |                       |                               | BNC plug |
| 3    | MX- 000 Series cable  
     | 100 Series cable | P-2 (2-core outer shielded cable) | MX-603 0.3 m  
   |     |                       |                               | BNC jack  
   |     |                       |                               | TM1:25-3.5S |
| 4    | MP- 610-610B-9100-9120-9200-940A-963  
     | MP- 810B-820B-830B (MP-081+MX-500 Series) | P-2 (2-core outer shielded cable) | MX-505 5 m  
   |     |                       |                               | 510 10 m  
   |     |                       |                               | 520 20 m  
   |     |                       |                               | 12P2B TM1:25-3.5S |
| 5    | MP- 981  
     | LG- 916 | D-5 (Composite 5-core vinyl sheath cable) | MX-705 5 m  
   |     |                       |                               | 710 10 m  
   |     |                       |                               | 715 15 m  
   |     |                       |                               | 720 20 m  
   |     |                       | MX-705 One end is open. MX-715 is fitted with crimp terminals.  
   |     |                       |                               | MX-720 is fitted with crimp terminals.  
   |     |                       |                               | R04-PB6F* TM1:25-3.5S |
| 6    | MP- 981  
     | LG- 916 | D-5 (Composite 5-core vinyl sheath cable) | MX-805A 5 m  
   |     |                       |                               | 810 10 m  
   |     |                       |                               | 815 15 m  
   |     |                       |                               | 820 20 m  
   |     |                       |                               | R04-PB6F* R03-PB6M |
| 7    | RP- 721 | R-6 (twisted-pair cable) | RP-004 5 m  
   |     |                       |                               | *10 m  
   |     |                       |                               | RM12SPG-5S TM1:25-3.5S |
| 8    | RP- 721-732 | R-6 (twisted-pair cable) | RP-006 5 m  
   |     |                       |                               | *10 m  
   |     |                       |                               | RM12SPG-5S |
| 9    | RP- 432Z | R-8 (twisted-pair cable) | RP-008 5 m  
   |     |                       |                               | *10 m  
   |     |                       |                               | TRC116-12A10-7F |

* Manufactured after receipt of order

- When several counters are connected to one detector, you will find it convenient to use BNC-JPJ connector.

### BNC-JPJ Usage Example

![BNC-JPJ Usage Example](image)
# Table of Signal Cable

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<td>1</td>
<td>MP-610B-9100-9100-9120-9200-940A-963&lt;br&gt;MP-810B-820B-830B (MP-081+MX-005 Series)</td>
<td>3C-2V (high-frequency coaxial cable)</td>
<td>MX-005 5 m&lt;br&gt;010 10 m&lt;br&gt;015 15 m&lt;br&gt;020 20 m&lt;br&gt;12P2B BNC plug</td>
</tr>
<tr>
<td>2</td>
<td>MP-930-935-950-962&lt;br&gt;FG-1200</td>
<td>3C-2V (high-frequency coaxial cable)</td>
<td>MX-101 1.5 m&lt;br&gt;05 5 m&lt;br&gt;110 10 m&lt;br&gt;115 15 m&lt;br&gt;120 20 m&lt;br&gt;BNC plug BNC plug</td>
</tr>
<tr>
<td>3</td>
<td>MX-000 Series cable&lt;br&gt;100 Series cable</td>
<td>P-2 (2-core outer shielded cable)</td>
<td>MX-603 0.3 m&lt;br&gt;BNC jack TM1.25-3.5S</td>
</tr>
<tr>
<td>4</td>
<td>MP-610B-9100-9100-9120-9200-940A-963&lt;br&gt;MP-810B-820B-830B (MP-081+MX-500 Series)</td>
<td>P-2 (2-core outer shielded cable)</td>
<td>MX-505 5 m&lt;br&gt;510 10 m&lt;br&gt;520 20 m&lt;br&gt;12P2B TM1:25-3.5S</td>
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<tr>
<td>5</td>
<td>MP-981 LG-916</td>
<td>D-5 (Composite 5-core vinyl sheath cable)</td>
<td>MX-705 5 m&lt;br&gt;710 10 m&lt;br&gt;715 15 m&lt;br&gt;720 20 m&lt;br&gt;MX-705: One end is open.&lt;br&gt;MX-735: One end is fitted with crimp terminals.</td>
</tr>
<tr>
<td>6</td>
<td>MP-981 LG-916</td>
<td>D-5 (Composite 5-core vinyl sheath cable)</td>
<td>MX-805A 5 m&lt;br&gt;810 10 m&lt;br&gt;815 15 m&lt;br&gt;820 20 m&lt;br&gt;Ro4-P86F* Ro3-P86M</td>
</tr>
<tr>
<td>7</td>
<td>RP-721</td>
<td>R-6 (twisted pair cable)</td>
<td>RP-004 5 m&lt;br&gt;10 m&lt;br&gt;RM128PG-5G TM1:25-3.5S</td>
</tr>
<tr>
<td>8</td>
<td>RP-721-732</td>
<td>R-6 (twisted pair cable)</td>
<td>RP-006 5 m&lt;br&gt;10 m&lt;br&gt;RM128PG-5G</td>
</tr>
<tr>
<td>9</td>
<td>RP-432Z</td>
<td>R-8 (twisted pair cable)</td>
<td>RP-008 5 m&lt;br&gt;10 m&lt;br&gt;TRC116-12A10-7F</td>
</tr>
</tbody>
</table>

*Manufactured after receipt of order

- When several counters are connected to one detector, you will find it convenient to use BNC-JPJ connector.

## BNC-JPJ Usage Example

[Diagram showing BNC-JPJ usage example]