A compass using geomagnetism will guide you across the sea even during conditions of zero visibility in dense fog or in a storm with giant waves. Similarly, Magnescan uses magnetic technology to provide precise positioning even in severely harsh environments such as oil, costant, and condensation in machine tools. Magnescan is jam-packed with state-of-the-art technologies, from precise magnetic recording and detection technology to advanced arithmetic processing technology and beyond. And, it’s these cutting-edge technologies that are supporting the next generation of global manufacturing.
Advanced technology supports the evolution of high precision and resistance to harsh environments. Magnescale continues its endless evolution to develop scales with the high precision and durability demanded by machine tool applications.

Born from advanced magnetic technology, Magnescale scales utilize a magnetic-based operating principle which makes them resistant to oil and condensation inherent to machine tools, thus enabling consistently stable and precise position detection.

**Principle**

**Detection principle**
A thin-film MR element with a high-precision, low-distortion pattern arrangement is used as the detecting element. The resistance value of the MR element changes when the magnetic field acting on the element changes due to an alteration in the relative positions between the element and the magnetic media. This change in resistance value is read electronically to detect the amount of positional change.

**Absolute position detection system**
Adopts the 2-track M-code system. Number of M-code bits: Up to 18 bits. (Left figure: Example of 4-bit coding)

**MR element**
The MR element uses a special pattern to enable stable signal detection with high precision. The patented detecting head pattern incorporates various technologies that help to achieve a high-precision signal, such as the following:
1. Harmonic distortion components are removed from the detected signal.
2. Stable signal output can be obtained over the entire effective length.
3. Stable signal output can be obtained with respect to temperature variation.

**Stability**
The raw signal is an exact sine wave.
Resistance to Harsh Environments

Protective structure
A diamond-like carbon (DLC) film is formed on the surface of the detecting head (the surface facing the magnetic scale) as a protective film. The detecting head is securely protected against both mechanical and environmental factors by multiple layers of protective film, which includes the DLC film (the world's first patent pending protective DLC film to be used on a MR element surface).

Impact resistance of 450 m/s², vibration resistance of 250 m/s²
Magnascale primarily uses ferrous materials to protect the detector, thereby realizing high vibration and impact resistance characteristics. Furthermore, the SR67A series employs multi-point connection construction and a highly rigid case to achieve top-class vibration and impact resistance.

Thermal expansion
Magnascales have the same linear expansion coefficient as that of cast iron used for the structure of general machine tools. Therefore, the scales exhibit the same thermal behavior as the equipment in which they are installed. This is evident in maintaining extremely stable positioning even in environments where the temperature is constantly changing. Due to the design structure of the SR series scales, they can be installed in close contact with the equipment while still achieving high positioning accuracy despite large temperature fluctuations.

Resistance to condensation and oil
Magnascale employs a magnetic detection principle that is resistant to the effects of condensation and oil inherent to machine tools. This principle allows for the achievement of high positioning accuracy even in severe environments.

High Precision
Advanced arithmetic processing technology
Use of an arithmetic processing circuit, based on original technology, achieves a higher resolution accuracy.

Example of multi-arithmetic processing circuit.

High resolution
High performance processing allows for resolutions down to 5mm and 1mm.*

Scale recording method
Optical scale
Master scale
Transcription
Product scale
Copy of master scale

Magnascale
Laser interferometer
Recording
The scale is recorded directly with each product using a laser interferometer, ensuring a highly precise and uniform signal over the entire length.

Each scale could be considered a "master scale".

*For resolution of transmittance, please contact our sales department.
### Lineup

<table>
<thead>
<tr>
<th>Communication system</th>
<th>Type/model name</th>
<th>Output signal</th>
<th>Compatible controllers</th>
<th>Effective length</th>
<th>Maximum resolution</th>
<th>Accuracy</th>
<th>Maximum response speed</th>
<th>Protective design grade</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ABS (Absolute)</strong></td>
<td>Slim type</td>
<td>SR27A</td>
<td>Absolute serial bidirectional signal Compliant with EIA-485 / DRIVE-CLiQ</td>
<td>70 to 2,040 mm</td>
<td>0.005μm (0.001μm is available*)</td>
<td>(3+3L/1,000) μm-p or (5+5L/1,000) μm-p</td>
<td>200m/min</td>
<td>IP64 (Air purge not included)</td>
<td>IP65 (Air purge included)</td>
</tr>
<tr>
<td></td>
<td>Robust type</td>
<td>SR67A</td>
<td>Absolute serial bidirectional signal Compliant with EIA-485 / DRIVE-CLiQ</td>
<td>140 to 3,640 mm</td>
<td>0.005μm (0.001μm is available*)</td>
<td>(3+3L/1,000) μm-p or (5+5L/1,000) μm-p</td>
<td>200m/min</td>
<td>IP64 (Air purge not included)</td>
<td>IP65 (Air purge included)</td>
</tr>
<tr>
<td><strong>INC (Incremental)</strong></td>
<td>Slim type</td>
<td>SR74</td>
<td>A/B/Reference point Line driver signal Compliant with EIA-422</td>
<td>-</td>
<td>0.05μm</td>
<td>(3+3L/1,000) μm-p or (5+5L/1,000) μm-p</td>
<td>50m/min</td>
<td>IP64 (Air purge not included)</td>
<td>IP65 (Air purge included)</td>
</tr>
<tr>
<td></td>
<td>Robust type</td>
<td>SR84</td>
<td>A/B/Reference point Line driver signal Compliant with EIA-422</td>
<td>-</td>
<td>0.05μm</td>
<td>(3+3L/1,000) μm-p or (5+5L/1,000) μm-p</td>
<td>50m/min</td>
<td>IP64 (Air purge not included)</td>
<td>IP65 (Air purge included)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Communication system</th>
<th>Type/model name</th>
<th>Output signal</th>
<th>Compatible controllers</th>
<th>Through hole diameter</th>
<th>Maximum resolution</th>
<th>Accuracy</th>
<th>Maximum response speed</th>
<th>Protective design grade</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ABS (Absolute)</strong></td>
<td>Exposed type</td>
<td>RS97-1024E</td>
<td>Absolute serial bidirectional signal Compliant with EIA-485 / DRIVE-CLiQ</td>
<td>Φ96mm</td>
<td>23 bit (8,388,608 pulse/revolution)</td>
<td>±2.5&quot;</td>
<td>5,000min⁻¹</td>
<td>IP65</td>
<td>P18-19</td>
</tr>
<tr>
<td></td>
<td>Exposed type</td>
<td>RS97-1024N</td>
<td>Absolute serial bidirectional signal Compliant with EIA-485 / DRIVE-CLiQ</td>
<td>Φ180mm</td>
<td>23 bit (8,388,608 pulse/revolution)</td>
<td>±2.5&quot;</td>
<td>5,000min⁻¹</td>
<td>IP65</td>
<td>P20-21</td>
</tr>
<tr>
<td></td>
<td>Enclosed type</td>
<td>RU97-2048</td>
<td>Compliant with DRIVE-CLiQ</td>
<td>A: Φ20mm B: Φ22mm</td>
<td>25 bit (33,554,432 pulse/revolution)</td>
<td>±2.5&quot;</td>
<td>2,000min⁻¹ (Maximum mechanical revolutions: 3,000min⁻¹)</td>
<td>IP65</td>
<td>P22-23</td>
</tr>
<tr>
<td></td>
<td>Enclosed type</td>
<td>RU77-4096</td>
<td>Absolute serial bidirectional signal Compliant with EIA-485</td>
<td>Φ20mm</td>
<td>25 bit (33,554,432 pulse/revolution)</td>
<td>±2.5&quot;</td>
<td>2,000min⁻¹ (Maximum mechanical revolutions: 3,000min⁻¹)</td>
<td>IP65</td>
<td>P24-25</td>
</tr>
</tbody>
</table>

*For resolution of 1nm (0.001μm), please contact our sales department. *Magnescale reserves the right to change product specifications without prior notices.
Absolute linear encoder

**SR27A**

- Slim type allows installation in narrow spaces
- Magnetic system enables use even in environments with condensation, oil, and other adverse conditions
- Supports the communication protocol of each supporting manufacturer
- Same thermal expansion as iron

**Specifications**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective length (L, mm)</td>
<td>70 ± 0.3</td>
<td>2,040 ± 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal expansion coefficient</td>
<td>12x ± 10°C</td>
<td>13x ± 10°C</td>
<td>13x ± 10°C</td>
<td>13x ± 10°C</td>
</tr>
<tr>
<td>Accuracry (20°C)</td>
<td>±3.0 μm (or less)</td>
<td>±4.0 μm (or less)</td>
<td>±4.0 μm (or less)</td>
<td>±4.0 μm (or less)</td>
</tr>
<tr>
<td>Reference point</td>
<td>Center, or user-selected position (Set at factory shipping)</td>
<td>Fixed to center</td>
<td>Fixed to 10 mm from left end of effective length</td>
<td></td>
</tr>
<tr>
<td>Output signal</td>
<td>Absolute screwed bi-directional signal, compliant with EtherCAT</td>
<td>Compliant with DRIVE-Cliq</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compatible controllers</td>
<td>FANUC, Mitsubishi Electric, Siemens AG</td>
<td>Mitsubishi Electric, Siemens AG</td>
<td>Mitsubishi Electric, Siemens AG</td>
<td>Mitsubishi Electric, Siemens AG</td>
</tr>
<tr>
<td>Resolution</td>
<td>Selectable from 0.001 μm, 0.005 μm, 0.01 μm</td>
<td>Selectable from 0.001 μm, 0.005 μm, 0.01 μm</td>
<td>Selectable from 0.001 μm, 0.005 μm, 0.01 μm</td>
<td></td>
</tr>
<tr>
<td>Maximum response speed</td>
<td>200 m/min</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Functional safety**

Please consult with each controller manufacturer regarding support for functional safety.

**Legal compliance**

- FCC Part15 Subpart B Class A
- CE/EN 55011 Gp1 Class A
- EN61000-6-2
- EN61800-5-2:2007
- EN55011 Gp1 Class A, EN61000-6-2

**Scale**

- SR27A: x x x x x

**Dimensions**

- Slim type
- Mounting holes: 2-φ10 hole, 6-φ5.5 mm hole
- Effective length mark: 150 μm
- Effective length: 150 μm

**Cables**

- CH22: 1,058 mm
- CH23: 870 mm
- CH24: 858 mm
- CH25: 435 mm
- CH26: 385 mm
- CH27: 355 mm
- CH28: 305 mm
- CH29: 255 mm
- CH30: 205 mm
- CH31: 155 mm
- CH32: 105 mm
- CH33: 55 mm
- CH34: 25 mm
- CH35: 10 mm

**Japanese text and diagrams**

- Mitsubishi Electric
- FANUC
- Siemens AG

---

*Details of model designation*
Absolute linear encoder
Robust type

SR67A

- High rigidity provides resistance to shock and vibration
- Magnetic system allows use even in environments with condensation, oil, and other adverse conditions
- Enables direct communication using the protocol of each supporting manufacturer without the requirement of an amplifier
- Same thermal expansion as iron

Features

- Model name: SR67A
- Robust type
- Fixed to 10 mm from left end of effective length
- Absolute serial bidirectional signal, compliant with EIA-485
- Compliant with DRIVE-Cliq
- Resolution: Selectable from 0.001*, 0.005, 0.01, 0.05 and 0.1

Specifications

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective length (L, mm)</td>
<td>140</td>
<td>3,640</td>
<td>140</td>
</tr>
<tr>
<td>Thermal expansion coefficient</td>
<td>12.0 x 10^-6°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy (at 25°C)</td>
<td>(±6L/1,000) μm/pc, effective length 140 to 3,040 mm; (±8L/1,000) μm/pc effective length 140 to 3,640 mm; (±10L/1,000) μm/pc effective length 140 to 3,640 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference point</td>
<td>Center or user-specified position (saturation damping) Fixed to center</td>
<td>Fixed to 10 mm from left end of effective length</td>
<td></td>
</tr>
<tr>
<td>Output signal</td>
<td>Absolute serial bidirectional signal, compliant with EIA-485</td>
<td>Compliant with DRIVE-Cliq</td>
<td></td>
</tr>
<tr>
<td>Compatible controllers</td>
<td>FANUC, Mitsubishi Electric, Siemens AG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>Selectable from 0.001*, 0.005, 0.01, 0.05 and 0.1 μm/pc (Factory set) Selectable from 0.01, 0.005 and 0.001 μm/pc (Factory set)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum response speed</td>
<td>200 m/min</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Functional safety

Please consult with each controller manufacturer regarding support for functional safety.

Legal compliance

- FCC Part15 Subpart B Class A
- IEC 61508:2010
- EN 62061:2005
- EN61131-2:2007

Operating temperature range

0 to +50°C

Storage temperature range

-20 to +85°C

Vibration resistance

250 m/s² (50 Hz to 3,000 Hz)

Impact resistance

450 m/s² (11 ms)

Protective design grade

IP54 (Air purge not included), IP65 (Air purge included)

Power supply voltage range

DC±4.75 to ±5.25 V

DC±17 to ±30.8 V

Maximum consumption current

0.3W or less (4.75V or 5.25V)

1.3W or less (4.75V or 5.25V)

Maximum consumption current (when the controller is connected)

75mA (24V) (when the controller is connected)

Consumption current

1.70W or less

0.85W or less

Mass

- Approx. 0.9kg + 5.2kg/m or less
- Approx. 3FTPMVUJPO + 5.2kg/m or less

Compatible cables

- CH23-***NVF + CH22-***NSMF + CH22-***NSMF
- CH22-***NSMY + CH23-***NMF
- CH23-***NSMF + CH23-***NSMY

Maximum cable length

450 m (with repeated bending)

R25 (without repeated: with conduit)

R20 (without repeated: without conduit)

Total length

1,480 mm

1,580 mm

1,680 mm

1,780 mm

2,040 mm

2,140 mm

2,440 mm

2,540 mm

2,840 mm

3,040 mm

3,240 mm

3,440 mm

3,640 mm

Notes

- The surface indicated by the ▲ marks is the installation surface.
- Movement outside the effective length (L) will damage the scale head. It is recommended that the mechanical movable length (stroke) be set to 10 mm or more to the inside of both ends of the effective length (L).

Dimensions
Incremental linear encoder

**Slim type**

- Slim type allows installation in narrow spaces
- Magnetic system allows use even in environments with condensation, oil, and other adverse conditions
- Same thermal expansion coefficient as iron

### Specifications

- **Model name**: SR74
- **Effective length (L):** 75-2,040
- **Thermal expansion coefficient**: 12x1 x 10^-6/°C
- **Accuracy (20°C)**: (3+3L/1,000) μm/p or (5+5L/1,000) μm/p
- **Reference point**: Center point, Multi point (±1.65 mm), Signed-type (standard pitch 20 mm), User-selected point (±1.65 mm)
- **Output signal**: A/B/Reference point line driver signal, compliant with EIA-422
- **Resolution**: Selectable from 0.05, 0.1, 0.5, and 1 μm (Set at factory shipping)
- **Maximum response speed**: 50m/min (Resolution: 0.1 μm, Minimum phase difference: ±50 ns)
- **Functional safety**: —

### Legal compliance

- **FCC Part15 Subpart B Class A**
- **ICES-003 Class A Digital Device**
- **EN55011 Gp1 Class A, EN61000-6-2 (60 V DC or less)**

### Operating environment

- **Temperature range**: 0 to +50°C
- **Storage temperature range**: -20 to +55°C

### Vibration resistance/Impact resistance

- **Vibration resistance**: 150 m/s² (50 Hz to 3,000Hz)
- **Impact resistance**: 350 m/s² (11 ms)

### Protective design grade

- **Power supply voltage range**: DC±4.75 to +5.25 V
- **Maximum consumption current**: 1.0W or less (4.75V or 5.25V)
- **Consumption current**: 200mA (5V) (when the controller is connected)
- **Mass**: Approx. 0.27kg ± 1.36kg/m or less

### Dimensions (cable left-lead out direction)

- **Dimensions (mm)**: 2 x Φ 15
- **Unit**: mm

### Protective design grade

- **IP54 (Air purge not included), IP65 (Air purge included)**

### Options

- **Foot plate**
- **Hexagonal sinkhole**
- **Machine guide**
- **Intermediate foot plate**: One location when L = 720 mm, two locations when L = 1,440 mm

---

**Notes**

- The surface indicated by the ▲ marks is the installation surface.
- Screws indicated in the diagram are supplied as standard accessories.
- Movement outside the effective length (L) will damage the scale head. It is recommended that the mechanical movable length (stroke) be set to 10 mm or more to the inside of both ends of the effective length (L).

---

**Details of model designation**

**Scale**

- **SR74**: Length (mm) on units
- **Cable**: Length (mm) on units

**Cable**

- **CH33 - □□□□□□□□**
- **CH33-10NEA**: Length (mm) on units
- **Connection part**: Length (mm) on units

---

**Dimensions**

- **Effective length**: L
- **Total length**: L₁, L₂, L₃, L₄, L₅
- **Number of intermediate foot plates**: n
- **Mounting pitch**: L₁, L₂, L₃, L₄, L₅

---

**Material**

- **Magnetic material allows use even in environments with condensation, oil, and other adverse conditions**
- **Same thermal expansion coefficient as iron**

---

**Legal compliance**

- **FCC Part15 Subpart B Class A**
- **ICES-003 Class A Digital Device**
- **EN55011 Gp1 Class A, EN61000-6-2 (60 V DC or less)**

---

**Operational environment**

- **Temperature range**: 0 to +50°C
- **Storage temperature range**: -20 to +55°C

---

**Vibration resistance/Impact resistance**

- **Vibration resistance**: 150 m/s² (50 Hz to 3,000Hz)
- **Impact resistance**: 350 m/s² (11 ms)

---

**Protective design grade**

- **Power supply voltage range**: DC±4.75 to +5.25 V
- **Maximum consumption current**: 1.0W or less (4.75V or 5.25V)
- **Consumption current**: 200mA (5V) (when the controller is connected)
- **Mass**: Approx. 0.27kg ± 1.36kg/m or less

---

**Dimensions (cable left-lead out direction)**

- **Dimensions (mm)**: 2 x Φ 15
- **Unit**: mm

---

**Options**

- **Foot plate**
- **Hexagonal sinkhole**
- **Machine guide**
- **Intermediate foot plate**: One location when L = 720 mm, two locations when L = 1,440 mm

---

**Notes**

- The surface indicated by the ▲ marks is the installation surface.
- Screws indicated in the diagram are supplied as standard accessories.
- Movement outside the effective length (L) will damage the scale head. It is recommended that the mechanical movable length (stroke) be set to 10 mm or more to the inside of both ends of the effective length (L).
Specifications

Model name: SR84
Effective length (L mm): 140-3,040
Thermal expansion coefficient: 12x10⁻⁶/°C
Accuracy at 20°C: (3xL/1,000) μm-p or (5xL/1,000) μm-p
Reference point: None, Center point, Multi point, Signatrue-type, User-selected point (1 mm pitch)
Output signal: A/B/Reference point line driver signal, compliant with EIA-422
Resolution: Selectable from 0.05, 0.1, 0.5, and 1 μm (Set at factory shipping)
Maximum response speed: 50 mm/min (Resolution: 0.1 μm, Minimum phase difference: ±50° at 5 Hz)

Functional safety
- Legal compliance:
  - FCC Part15 Subpart B Class A
  - ICES-003 Class A Digital Device
  - EN55011 Gp1 Class A
  - EN61000-6-2 Safety standards not applicable (60 V DC or less)

- Thermal properties:
  - Thermal expansion coefficient: (μm-p or (5+5L/1,000) μm-p)
  - Effective temperature range: -20 to +55°C

- Electrical properties:
  - Power consumption when the controller is connected: 200mA (5V)
  - Suitable servo amplifiers: CH33-***CP/CE

- Dimensions:
  - Effective length: L1 = L2 = 138 L2 ≥ (100 x 0.1) + (L1-1)
  - Dimensions (cable left-lead out direction):
    - Hole of air purge: (W1: Both sides)
    - Mounting size (machine guide): M5: Both ends

- Mass:
  - Approx. 1.24kg + 4kg/m or less

- Legal compliance:
  - FCC Part15 Subpart B Class A
  - ICES-003 Class A Digital Device
  - EN55011 Gp1 Class A
  - EN61000-6-2 Safety standards not applicable (60 V DC or less)

- Notes:
  - When selecting the effective length (L), it is recommended that the mechanical movable length (stroke) be set to 10 mm or more to the inside of both ends of the effective length (L).
  - The surface indicated by the ▲ mark is the installation surface.
  - Screws indicated in the diagram are supplied as standard accessories.
  - Movement outside the effective length (L) will damage the scale head. It is recommended that the mechanical movable length (stroke) be set to 10 mm or more to the inside of both ends of the effective length (L).
  - Magnetic system allows use even in environments with condensation, oil, and other adverse conditions.
Absolute angle encoder
Exposed type

RS97-1024E

- Enables direct communication using the protocol of each supporting manufacturer without the requirement of an amplifier
- Magnetic system allows use even in environments with condensation, oil, and other adverse conditions
- 96mm diameter through hole allows for design and mounting flexibility
- Dual lead configuration reduces the effect of axial runout

Specifications

Model name | RS97-1024EGA | RS97-1024EGO | RS97-1024EGZ
---|---|---|---
Output wave number | 1,024 waves/revolution
Through hole diameter | φ56 mm
Accuracy(at 20°C) | ±2.5°
Output signal | Absolute serial bidirectional signal, compliant with EIA-485
Compatible controllers | FANUC Mitsubishi Electric SIEMENS AG
Resolution | 23 bits (6,388,608 pulses/revolution)
Maximum response revolutions | 5,000 min^{-1}

Functional safety

Please consult with each controller manufacturer regarding support for functional safety.

Legal compliance

FCC Part15 Subpart B Class A
ICES-003 Class A Digital Device
EN ISO13849-1:2008 Cat.3
EN61800-5-2:2007

Specifications

- Absolute position zero output position
- Output wave number
- Through hole diameter
- Accuracy
- Output signal
- Compatible controllers
- Resolution
- Maximum response revolutions
- Functional safety
- Legal compliance

Dimensions

<table>
<thead>
<tr>
<th>FANUC</th>
<th>Mitsubishi Electric</th>
<th>SIEMENS</th>
</tr>
</thead>
</table>

Cables

<table>
<thead>
<tr>
<th>CH22</th>
<th>CH23</th>
</tr>
</thead>
</table>

Details of model designation

Scale

| RS97-1024EG | |

R20 (without repeated bending)
R50 (with repeated bending)
Outer diameter φ5.6mm

R20 (without repeated bending)
Outer diameter φ7.8mm

CH23-***NPFA CH23-***NPMA CH22-***NSFY
30 m
30 m
30 m

Compatible cables

- CH22-***NPFA + CH23-***NPMA
- CH22-***NSFY + CH23-***NSFF
- CH22-***NSFF + CH22-***NSFY

Dimensions

<table>
<thead>
<tr>
<th>0.02</th>
<th>0.02</th>
</tr>
</thead>
</table>

R20 (without repeated bending)
R50 (with repeated bending)

Unit: mm

Cables

RS97-1024EG

Dimensions

<table>
<thead>
<tr>
<th>0.02</th>
<th>0.02</th>
</tr>
</thead>
</table>

R20 (without repeated bending)
R50 (with repeated bending)

Unit: mm

Cables

<table>
<thead>
<tr>
<th>CH22</th>
<th>CH23</th>
</tr>
</thead>
</table>

Details of model designation

Scale

| RS97-1024EG | |

R20 (without repeated bending)
R50 (with repeated bending)
Outer diameter φ5.6mm

R20 (without repeated bending)
Outer diameter φ7.8mm

CH23-***NPFA CH23-***NPMA CH22-***NSFY
30 m
30 m
30 m

Compatible cables

- CH22-***NPFA + CH23-***NPMA
- CH22-***NSFY + CH23-***NSFF
- CH22-***NSFF + CH23-***NSFY

Dimensions

<table>
<thead>
<tr>
<th>0.02</th>
<th>0.02</th>
</tr>
</thead>
</table>

R20 (without repeated bending)
R50 (with repeated bending)

Unit: mm

Cables

<table>
<thead>
<tr>
<th>CH22</th>
<th>CH23</th>
</tr>
</thead>
</table>

Details of model designation

Scale

| RS97-1024EG | |

R20 (without repeated bending)
R50 (with repeated bending)
Outer diameter φ5.6mm

R20 (without repeated bending)
Outer diameter φ7.8mm

CH23-***NPFA CH23-***NPMA CH22-***NSFY
30 m
30 m
30 m

Compatible cables

- CH22-***NPFA + CH23-***NPMA
- CH22-***NSFY + CH23-***NSFF
- CH22-***NSFF + CH23-***NSFY

Dimensions

<table>
<thead>
<tr>
<th>0.02</th>
<th>0.02</th>
</tr>
</thead>
</table>

R20 (without repeated bending)
R50 (with repeated bending)

Unit: mm

Cables

<table>
<thead>
<tr>
<th>CH22</th>
<th>CH23</th>
</tr>
</thead>
</table>
**Specifications**

- **Model name**: RS97-1024NGA, RS97-1024NGD, RS97-1024NGZ
- **Output wave number**: 1,024 waves/revolution
- **Through hole diameter**: 6.180 mm
- **Accuracy (at 20°C)**: ±2.5°
- **Output signal**: Absolute serial bidirectional signal, compliant with EIA-485
- **Compatible controllers**: FANUC, Mitsubishi Electric, SIEMENS AG
- **Resolution**: 23 bits (8,388,608 pulses/revolution)
- **Maximum response revolutions**: 5,000 min⁻¹

**Legal compliance**

- **FCC Part15 Subpart B Class A**
- **ICES-003 Class A Digital Device**

**Dimensions**

- **Rotor mounting**
- **Stator**
- **Shielded lead-out cable** (Outer diameter: 5.6 mm)
- **When stator is fixed and rotor rotate clockwise, addition is performed.**

**Cables**

- **CH22**: (Extraction length: 30 m)
- **CH23**: (Extraction length: 30 m)

**Details of model designation**

- **Scale**
- **Communication protocol**
- **Head cable length**

**Dimensions**

- **RS97-1024NGA**: 180 mm

**Features**

- Enables direct communication using the protocol of each supporting manufacturer without the requirement of an amplifier.
- Magnetic system enables use even in environments with condensation, oil, and other adverse conditions.
- 180mm diameter through-hole allows for design and mounting flexibility.
- Dual head configuration reduces the effect of axial runout.

**Model and Availability**

- FANUC
- Mitsubishi Electric
- SIEMENS AG

**Safety**

Please consult with each controller manufacturer regarding support for functional safety.
**Specifications**

**Model name**
- RU97-2048AJZ
- RU97-2048BJZ

**Output wave number**
2,048 waves/revolution

**Through hole diameter**
A: ø20 mm, B: ø22 mm

**Accuracy at 20°C**
±2.5" ±2.5" ±2.5" ±2.5"

**Output signal**
Compliant with DRIVE-CLiQ, single turn absolute type

**Resolution**
25 bit (33,554,432 pulses/revolution)

**Maximum response revolutions**
3,000 min⁻¹

**Maximum mechanical revolutions**
2,000 min⁻¹

**Functional safety**
EN ISO13849-1:2008 Cat.3

**Legal compliance**
FCC Part15 Subpart B Class A
ICES-003 Class A Digital Device
EN55011 Gp1 Class A, EN61000-6-2

**Operating temperature range**
0 to +60°C

**Storage temperature range**
-10 to +60°C

**Impact resistance**
1,000 m/s² (11 ms)

**Mass**
Approx. 1.2 kg or less

**Dimensions**
- Depth 3.3±0.1
- Height 7
- Diameter 9.4×10⁻⁵ kgm² or less
- Width 0.8 Nm or less
- Length 30 m

**Resolution (at 20°C)**
2,000 min⁻¹

**Maximum consumption current**
1.6 W or less (17 V or 30.8 V)

**Power supply voltage range**
DC+17 to +30.8 V

**Reference mark**
- When scale axis rotates counter clockwise, addition is performed.
- Made by Phoenix Contact

**Details of model designation**

- RU97-2048 AJZ

**Cables**
- CH22: NSF, CH22: NSFF + CH22: NSFY

**Power supply**
- EU: 24 V

**Model name**
- RU97-2048AJZ
- RU97-2048BJZ

**Output wave number**
2,048 waves/revolution

**Accuracy at 20°C**
±2.5"

**Output signal**
Compliant with DRIVE-CLiQ, single turn absolute type

**Resolution**
25 bit (33,554,432 pulses/revolution)

**Maximum response revolutions**
3,000 min⁻¹

**Maximum mechanical revolutions**
2,000 min⁻¹

**Functional safety**
EN ISO13849-1:2008 Cat.3

**Legal compliance**
FCC Part15 Subpart B Class A
ICES-003 Class A Digital Device
EN55011 Gp1 Class A, EN61000-6-2

**Operating temperature range**
0 to +60°C

**Impact resistance**
1,000 m/s² (11 ms)

**Mass**
Approx. 1.2 kg or less

**Dimensions**
- Depth 3.3±0.1
- Height 7
- Diameter 9.4×10⁻⁵ kgm² or less
- Width 0.8 Nm or less
- Length 30 m

**Reference mark**
- When scale axis rotates counter clockwise, addition is performed.
- Made by Phoenix Contact

**Details of model designation**

- RU97-2048 AJZ

**Cables**
- CH22: NSF, CH22: NSFF + CH22: NSFY

**Power supply**
- EU: 24 V

**Model name**
- RU97-2048AJZ
- RU97-2048BJZ

**Output wave number**
2,048 waves/revolution

**Accuracy at 20°C**
±2.5"

**Output signal**
Compliant with DRIVE-CLiQ, single turn absolute type

**Resolution**
25 bit (33,554,432 pulses/revolution)

**Maximum response revolutions**
3,000 min⁻¹

**Maximum mechanical revolutions**
2,000 min⁻¹

**Functional safety**
EN ISO13849-1:2008 Cat.3

**Legal compliance**
FCC Part15 Subpart B Class A
ICES-003 Class A Digital Device
EN55011 Gp1 Class A, EN61000-6-2

**Operating temperature range**
0 to +60°C

**Impact resistance**
1,000 m/s² (11 ms)

**Mass**
Approx. 1.2 kg or less

**Dimensions**
- Depth 3.3±0.1
- Height 7
- Diameter 9.4×10⁻⁵ kgm² or less
- Width 0.8 Nm or less
- Length 30 m

**Reference mark**
- When scale axis rotates counter clockwise, addition is performed.
- Made by Phoenix Contact

**Details of model designation**

- RU97-2048 AJZ

**Cables**
- CH22: NSF, CH22: NSFF + CH22: NSFY

**Power supply**
- EU: 24 V

**Model name**
- RU97-2048AJZ
- RU97-2048BJZ

**Output wave number**
2,048 waves/revolution

**Accuracy at 20°C**
±2.5"

**Output signal**
Compliant with DRIVE-CLiQ, single turn absolute type

**Resolution**
25 bit (33,554,432 pulses/revolution)

**Maximum response revolutions**
3,000 min⁻¹

**Maximum mechanical revolutions**
2,000 min⁻¹

**Functional safety**
EN ISO13849-1:2008 Cat.3

**Legal compliance**
FCC Part15 Subpart B Class A
ICES-003 Class A Digital Device
EN55011 Gp1 Class A, EN61000-6-2

**Operating temperature range**
0 to +60°C

**Impact resistance**
1,000 m/s² (11 ms)

**Mass**
Approx. 1.2 kg or less

**Dimensions**
- Depth 3.3±0.1
- Height 7
- Diameter 9.4×10⁻⁵ kgm² or less
- Width 0.8 Nm or less
- Length 30 m

**Reference mark**
- When scale axis rotates counter clockwise, addition is performed.
- Made by Phoenix Contact

**Details of model designation**

- RU97-2048 AJZ
Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>RU77-4096A</th>
<th>RU77-4096A:B</th>
<th>RU77-4096A:F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output wave number</td>
<td>4,096</td>
<td>4,096</td>
<td>4,096</td>
</tr>
<tr>
<td>Through hole diameter</td>
<td>80 mm</td>
<td>80 mm</td>
<td>80 mm</td>
</tr>
<tr>
<td>Accuracy (at 20°C)</td>
<td>±4.2°</td>
<td>±4.2°</td>
<td>±4.2°</td>
</tr>
<tr>
<td>Output signal</td>
<td>Absolute serial bidirectional signal, compliant with EIA-485</td>
<td>Absolute serial bidirectional signal, compliant with EIA-485</td>
<td>Absolute serial bidirectional signal, compliant with EIA-485</td>
</tr>
<tr>
<td>Compatible controllers</td>
<td>FANUC</td>
<td>Mitsubishi Electric</td>
<td>Yaskawa Electric</td>
</tr>
<tr>
<td>Maximum resolution</td>
<td>2,000</td>
<td>2,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Maximum mechanical resolution</td>
<td>3,000</td>
<td>3,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Functional safety</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Legal compliance</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>0 to +60°C</td>
<td>0 to +60°C</td>
<td>0 to +60°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>-10 to +80°C</td>
<td>-10 to +80°C</td>
<td>-10 to +80°C</td>
</tr>
<tr>
<td>Vibration resistance</td>
<td>150 m/s² (50 Hz to 2000 Hz)</td>
<td>150 m/s² (50 Hz to 2000 Hz)</td>
<td>150 m/s² (50 Hz to 2000 Hz)</td>
</tr>
<tr>
<td>Impact resistance</td>
<td>1,000 m/s² (11 ms)</td>
<td>1,000 m/s² (11 ms)</td>
<td>1,000 m/s² (11 ms)</td>
</tr>
<tr>
<td>Protective design grade</td>
<td>IP65</td>
<td>IP65</td>
<td>IP65</td>
</tr>
<tr>
<td>Power supply voltage range</td>
<td>±145V (±250V)</td>
<td>±145V (±250V)</td>
<td>±145V (±250V)</td>
</tr>
<tr>
<td>Consumption current</td>
<td>200mA (at 120G termination)</td>
<td>200mA (at 120G termination)</td>
<td>200mA (at 120G termination)</td>
</tr>
<tr>
<td>Moment of inertia</td>
<td>9.4×10³ kgm² or less</td>
<td>9.4×10³ kgm² or less</td>
<td>9.4×10³ kgm² or less</td>
</tr>
<tr>
<td>Starting torque (at 20°C)</td>
<td>0.1 Nm or less</td>
<td>0.1 Nm or less</td>
<td>0.1 Nm or less</td>
</tr>
<tr>
<td>Mass</td>
<td>Approx. 1.2kg or less</td>
<td>Approx. 1.2kg or less</td>
<td>Approx. 1.2kg or less</td>
</tr>
<tr>
<td>Standard compatible cable</td>
<td>CE28-****</td>
<td>CE28-****</td>
<td>CE28-****</td>
</tr>
<tr>
<td>Maximum cable length</td>
<td>15 m</td>
<td>15 m</td>
<td>15 m</td>
</tr>
</tbody>
</table>

Dimensions

- Magnetic system enables use even in environments with condensation, oil, and other adverse conditions
- Enables direct communication using the protocol of each supporting manufacturer without the requirement of an amplifier
- Internal coupling allows for design and mounting flexibility

Absolute angle encoder
Enclosed type
RU77-4096

FANUC  Mitsubishi Electric  Yaskawa Electric

Scale

<table>
<thead>
<tr>
<th>Revolution</th>
<th>Number of pulse/revolution</th>
<th>Number of binary</th>
<th>FSC-compatibility protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4,096×10³</td>
<td>2,000</td>
<td>21bit (2,097,152 pulse/revolution)</td>
</tr>
<tr>
<td>2</td>
<td>4,096×10³</td>
<td>2,000</td>
<td>21bit (2,097,152 pulse/revolution)</td>
</tr>
<tr>
<td>3</td>
<td>4,096×10³</td>
<td>2,000</td>
<td>21bit (2,097,152 pulse/revolution)</td>
</tr>
<tr>
<td>4</td>
<td>4,096×10³</td>
<td>2,000</td>
<td>21bit (2,097,152 pulse/revolution)</td>
</tr>
<tr>
<td>5</td>
<td>4,096×10³</td>
<td>2,000</td>
<td>21bit (2,097,152 pulse/revolution)</td>
</tr>
</tbody>
</table>

Cable

CE28-0502U  CE28-0502F

Dimensions

- Unit: mm
- Dimensions (when installing from top)
- Dimensions (when installing from bottom)
Other Models

Absolute linear encoder

**slim type SR77**

- **Effective length:** 70,120,170,200,270,320,370,420,470,520,570,620,720,770,820,920,1020,1140,1240,1340,1440,1540,1640,1740,1840,2040 mm
- **Maximum resolution:** 0.01 μm
- **Accuracy:** (3+3L/1,000) μm-p-L mm (6+6L/1,000) μm-p-L mm
- **Maximum response speed:** 200 mm/min
- **Protective design grade:** IP66

**Cable**

- **Type:** CE28
- **Maximum resolution:** 0.01 μm
- **Accuracy:** ±2.5°
- **Number of pulses/revolution:** Approx. 1°/10,000

**Panasonic**

- **Resolution, rotation direction and polarity:** Approx. 1°/10,000
- **Accuracy:** ±2.5°
- **Number of pulses/revolution:** Approx. 1°/10,000

**Yaskawa Electric**

- **Resolution, rotation direction and polarity:** Approx. 1°/10,000
- **Accuracy:** ±2.5°
- **Number of pulses/revolution:** Approx. 1°/10,000


Absolute linear encoder

**robust type SR87**

- **Effective length:** 140,240,340,440,540,640,740,840,940,1040,1140,1240,1340,1440,1540,1640,1740,1840,2040,2240,2440,2640,2840,3040 mm
- **Maximum resolution:** 0.01 μm
- **Accuracy:** (3+3L/1,000) μm-p-L mm (6+6L/1,000) μm-p-L mm
- **Maximum response speed:** 200 mm/min
- **Protective design grade:** IP66

**Cable**

- **Type:** CE28
- **Maximum resolution:** 0.01 μm
- **Accuracy:** ±2.5°
- **Number of pulses/revolution:** Approx. 1°/10,000

**Panasonic**

- **Resolution, rotation direction and polarity:** Approx. 1°/10,000
- **Accuracy:** ±2.5°
- **Number of pulses/revolution:** Approx. 1°/10,000

**Yaskawa Electric**

- **Resolution, rotation direction and polarity:** Approx. 1°/10,000
- **Accuracy:** ±2.5°
- **Number of pulses/revolution:** Approx. 1°/10,000


Incremental linear encoder

**slim type SR75**

- **Effective length:** 70,120,170,200,270,320,370,420,470,520,570,620,720,770,820,920,1020,1140,1240,1340,1440,1540,1640,1740,1840,2040 mm
- **Maximum resolution:** 0.01 μm
- **Accuracy:** (3+3L/1,000) μm-p-L mm (6+6L/1,000) μm-p-L mm
- **Maximum response speed:** 200 mm/min
- **Protective design grade:** IP66

**Cable**

- **Type:** CE28
- **Maximum resolution:** 0.01 μm
- **Accuracy:** ±2.5°
- **Number of pulses/revolution:** Approx. 1°/10,000

**Panasonic**

- **Resolution, rotation direction and polarity:** Approx. 1°/10,000
- **Accuracy:** ±2.5°
- **Number of pulses/revolution:** Approx. 1°/10,000

**Yaskawa Electric**

- **Resolution, rotation direction and polarity:** Approx. 1°/10,000
- **Accuracy:** ±2.5°
- **Number of pulses/revolution:** Approx. 1°/10,000


Incremental angle encoder

**enclosed type RU74**

- **Hollow diameter:** φ20
- **Resolution:** Approx. 1/10,000°, Approx. 1/10,000°
- **Accuracy:** ±2.5°
- **Maximum response revolution:** As the table on the right
- **Protective design grade:** IP66

**Cable**

- **Type:** CE28
- **Maximum resolution:** 0.01 μm
- **Accuracy:** ±2.5°
- **Number of pulses/revolution:** Approx. 1°/10,000

**Panasonic**

- **Resolution, rotation direction and polarity:** Approx. 1°/10,000
- **Accuracy:** ±2.5°
- **Number of pulses/revolution:** Approx. 1°/10,000

**Yaskawa Electric**

- **Resolution, rotation direction and polarity:** Approx. 1°/10,000
- **Accuracy:** ±2.5°
- **Number of pulses/revolution:** Approx. 1°/10,000
## List of Adapter Cables

<table>
<thead>
<tr>
<th>Scale</th>
<th>Controller side Connector</th>
<th>List of Adapter Cables</th>
<th>Scale side Connector</th>
<th>Maximum cable length</th>
<th>Cable bending radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR27A</td>
<td>Controller side HORNOU TSC02-4010/PL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controller side SUNITEC 9R05/04010F/E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relay connector JAC 38010050/PL</td>
<td>Relay connector JAC 38010050/PL</td>
<td>12 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controller side HORNOU TSC02-4010/PL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controller side SUNITEC 9R05/04010F/E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relay connector JAC 38010050/PL</td>
<td>Relay connector JAC 38010050/PL</td>
<td>12 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controller side HORNOU TSC02-4010/PL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controller side SUNITEC 9R05/04010F/E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relay connector JAC 38010050/PL</td>
<td>Relay connector JAC 38010050/PL</td>
<td>30 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controller side HORNOU TSC02-4010/PL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controller side SUNITEC 9R05/04010F/E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relay connector JAC 38010050/PL</td>
<td>Relay connector JAC 38010050/PL</td>
<td>30 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controller side HORNOU TSC02-4010/PL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controller side SUNITEC 9R05/04010F/E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relay connector JAC 38010050/PL</td>
<td>Relay connector JAC 38010050/PL</td>
<td>30 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controller side HORNOU TSC02-4010/PL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controller side SUNITEC 9R05/04010F/E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relay connector JAC 38010050/PL</td>
<td>Relay connector JAC 38010050/PL</td>
<td>30 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controller side HORNOU TSC02-4010/PL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controller side SUNITEC 9R05/04010F/E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relay connector JAC 38010050/PL</td>
<td>Relay connector JAC 38010050/PL</td>
<td>30 m</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Cables

### CH22 - \[\text{Description}\]
- Typical cable length: 10 m
- Used for flow control signal (up to 5 V)
- Can be used for various purposes

### CH23 - \[\text{Description}\]
- Typical cable length: 5 m
- Used for flow control signal (up to 5 V)
- Can be used for various purposes

### CH28 - \[\text{Description}\]
- Typical cable length: 10 m
- Used for flow control signal (up to 5 V)
- Can be used for various purposes

### CH33 - \[\text{Description}\]
- Typical cable length: 10 m
- Used for flow control signal (up to 5 V)
- Can be used for various purposes
**Technology**

**Air purging**

If scale is used in a dusty or misty environment, it is recommended that air is introduced into the scale to alleviate any unwanted effects. Attach air nipples to MS holes for air introduction that are provided at both ends of the scale to supply air into the scale. When introducing air into the scale, supply air via an air filter (nominal filtration rating: 5 μm), mist separator (nominal filtration rating: 0.3 μm), and a regulator to remove dust, dirt, and mist. As a guide, the amount of air supplied to the scale is 10-20 l/min.

**Traceability**

**Traceability Flow Chart (Length)**

- National Primary Standards: National Institute of Advanced Industrial Science and Technology (AIST)
- National Standards: Optical comb
- International Standards: International Committee for Weights and Measures (CIPM)
- Manufacturing Reference Standard: Stabilized He-Ne Laser (633nm)
- Magnescale Corporation

**Safety**

**No compromise for high-accuracy products**

The total quality control system that operates throughout the entire design and production process ensures products with enhanced safety, high quality, and high reliability that match our customers’ requirements. The company is certified for length calibration in compliance with the traceability system required by the “Weights and Measures Act,” and has been granted ISO 9001 certification, which is the international standard for quality assurance.

**Our products comply with CE Marking requirements, have acquired UL certifications and meet other regulations, ensuring safe use the world over.**

- EMC Directives (CE) EMI: EN 55011 Group 1 Class A / 91 EMS: EN 61000-6-2
- FCC regulation: FCC Part 15 Subpart B Class A

<table>
<thead>
<tr>
<th>for Products with built-in AC power supply:</th>
<th>for Products with Laser:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• UL61010-1 • EN61010-1</td>
<td>• DHHS (21CFR1040.10) • IEC60825-1</td>
</tr>
</tbody>
</table>

*When using our devices with machines to which the European Machinery Directive applies, please make sure that the devices when installed on the machines fulfill the applicable requirements of the Directive.*

*Standards or regulations in other countries may vary by product.*

**Functional Safety**

Recently, great importance has been placed on human safety around industrial machines and machine tools. In 2010, the European Machinery Directive mandated compliance with functional safety for electrical equipment used in the safety systems of machines subject to the Machinery Directory. These safety demands are anticipated to spread across many additional regions and industries in the future. Magnescale leads the competition with its lineup of feedback scale that have acquired third-party functional safety certification in order to meet global demands for safety.

**Certification standards**

- EN ISO 13849-1 Cat. 3 / PL d
- EN69800:5-2

**Models that have acquired certification**

- Angle encoders RS97-1024EGZ series
  - RS97-1024NGZ series
  - RU97-2048 Z series
- Linear encoders SR27A-AZ series
  - SR67A-AZ series

*Consult our sales representative for details.*