

# Datasheet

## Features at a glance

Our SGA series of **draw-wire encoders** are a compact and cost-effective position measuring system that is particularly quick and easy to install. Our displacement measuring system is potentiometric, optionally available with a current, voltage or resistance output. They are used in all areas of research and industry due to their high reliability, durability and accuracy.

- Measuring ranges from 50 to 1,250 mm
- Analog Output: Potentiometer, Voltage, Current
- Linearity up to  $\pm 0.02\%$  of the measuring range
- Protection class up to IP67
- Temperature range:  $-20...+85\text{ }^{\circ}\text{C}$   
(optional  $-40\text{ }^{\circ}\text{C}$  or  $+120\text{ }^{\circ}\text{C}$ )
- High dynamics and immunity to interference
- Customer-specific designs



### Please read carefully before commissioning!

Unpacking and checking:

Lift the device out of the packaging by grasping the case. **DO NOT pull on the rope.**

After unpacking, check the device and accessories for completeness and any transport damage. If necessary, please contact the freight forwarder or Willtec Messtechnik directly so that a damage report can be drawn up.

## Maintenance



The devices are maintenance-free. However, if the rope becomes dirty due to adverse environmental conditions, this must be cleaned with a slightly oil-soaked cloth as required.

To do this, use resin-free machine oil.

## Technical features

| Measurement range MR <sup>1)</sup>          | [mm] | 50                                                                          | 75 | 100       | 125 | 150 | 225 | 250 | 300        | 375 | 500 | 625 | 750 | 1000                    | 1250 |
|---------------------------------------------|------|-----------------------------------------------------------------------------|----|-----------|-----|-----|-----|-----|------------|-----|-----|-----|-----|-------------------------|------|
| Linearity                                   | [%]  |                                                                             |    | $\pm 0.5$ |     |     |     |     | $\pm 0.15$ |     |     |     |     | $\pm 0.1$ <sup>2)</sup> |      |
| Improved linearity (optional) <sup>2)</sup> | [%]  |                                                                             |    | -         |     |     |     |     | $\pm 0.1$  |     |     |     |     | $\pm 0.05$              |      |
| Improved linearity (optional) <sup>3)</sup> | [%]  |                                                                             |    | $\pm 0.1$ |     |     |     |     |            |     |     |     |     |                         |      |
| Resolution                                  |      | see output types below                                                      |    |           |     |     |     |     |            |     |     |     |     |                         |      |
| Sensor element                              |      | Hybrid Potentiometer                                                        |    |           |     |     |     |     |            |     |     |     |     |                         |      |
| Connection                                  |      | connector output M12 axial or cable output axial (TPE cable)                |    |           |     |     |     |     |            |     |     |     |     |                         |      |
| Protection class                            |      | IP65, optional IP67                                                         |    |           |     |     |     |     |            |     |     |     |     |                         |      |
| Humidity                                    |      | max. 90 % relative, no condensation                                         |    |           |     |     |     |     |            |     |     |     |     |                         |      |
| Temperature                                 |      | see output types below                                                      |    |           |     |     |     |     |            |     |     |     |     |                         |      |
| Mechanical data                             |      | extraction force, max. velocity and max. acceleration see „Mechanical Data“ |    |           |     |     |     |     |            |     |     |     |     |                         |      |
| Housing                                     |      | aluminium, anodised, spring case PA6                                        |    |           |     |     |     |     |            |     |     |     |     |                         |      |
| Draw wire                                   |      | stainless steel V2A $\varnothing 0.5\text{ mm}$                             |    |           |     |     |     |     |            |     |     |     |     |                         |      |
| Weight                                      | [g]  | 300 to 500, depending on the measurement range                              |    |           |     |     |     |     |            |     |     |     |     |                         |      |

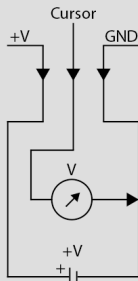
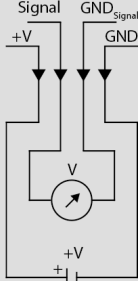
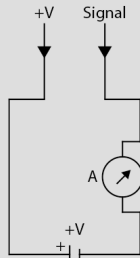
<sup>1)</sup> other ranges on request

<sup>2)</sup> linearity max.  $\pm 0.15\%$  in combination with outputs 5R and 10R

<sup>3)</sup> special version with unprotected potentiometer, protection class IP40, only in combination with potentiometer output 1R (please contact the sales team)

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## Technical features

| Output type                 | Potentiometer                                                                       |                  |                   | Voltage <sup>1)</sup>                                                                |         |           |             | Current                                                                               |
|-----------------------------|-------------------------------------------------------------------------------------|------------------|-------------------|--------------------------------------------------------------------------------------|---------|-----------|-------------|---------------------------------------------------------------------------------------|
| Order Code                  | 1R                                                                                  | 5R <sup>2)</sup> | 10R <sup>2)</sup> | 4,5V                                                                                 | 5V      | 55V       | 10V         | 420A                                                                                  |
| Output                      | 1 kΩ                                                                                | 5 kΩ             | 10 kΩ             | 0.5...4.5 V                                                                          | 0...5 V | -5...+5 V | 0...10 V    | 4...20 mA                                                                             |
| Supply                      | max. 30 V                                                                           |                  |                   | 8...30 VDC                                                                           |         |           | 12...30 VDC | 12...30 VDC <sup>3)</sup>                                                             |
| Recommended cursor current  | <1 μA                                                                               |                  |                   | -                                                                                    |         |           |             |                                                                                       |
| Current consumption max.    | -                                                                                   |                  |                   | max. 25 mA (no load)                                                                 |         |           |             |                                                                                       |
| Power consumption max.      | -                                                                                   |                  |                   |                                                                                      |         |           |             |                                                                                       |
| Output current              | -                                                                                   |                  |                   | max. 10 mA, min. load 10 kΩ                                                          |         |           |             | max. 50 mA<br>in case of error <sup>4)</sup>                                          |
| Dynamics                    | -                                                                                   |                  |                   | <3 ms from 0...100 % and 100...0 %                                                   |         |           |             | <1 ms from 0...100 %<br>and 100...0 %                                                 |
| Resolution                  | theoretically unlimited, limited by the noise                                       |                  |                   |                                                                                      |         |           |             |                                                                                       |
| Noise                       | depends on the quality of<br>the power supply                                       |                  |                   | 0.5 mV <sub>eff</sub>                                                                |         |           |             | 1.6 μA <sub>eff</sub>                                                                 |
| Inverse-polarity protection | -                                                                                   |                  |                   | yes                                                                                  |         |           |             |                                                                                       |
| Short-circuit proof         | -                                                                                   |                  |                   | yes                                                                                  |         |           |             | -                                                                                     |
| Operating temperature       | -20...+85 °C / optional:<br>-40...+85 °C or -20...+120 °C                           |                  |                   | -20...+85 °C / optional: -40...+85 °C                                                |         |           |             |                                                                                       |
| Temperature coefficient     | ±0.0025 %/K                                                                         |                  |                   | 0.0037 %/K                                                                           |         |           |             | 0.0079 %/K                                                                            |
| EMC                         | -                                                                                   |                  |                   | according to EN 61326-1:2013                                                         |         |           |             |                                                                                       |
| Circuit                     |  |                  |                   |  |         |           |             |  |

<sup>1)</sup> Galvanically isolated

<sup>2)</sup> only for measurement ranges  $\geq 150$  mm

<sup>3)</sup> Load: 250  $\Omega$  (max. 500  $\Omega$ )

<sup>4)</sup> Load max. 0.5 k $\Omega$

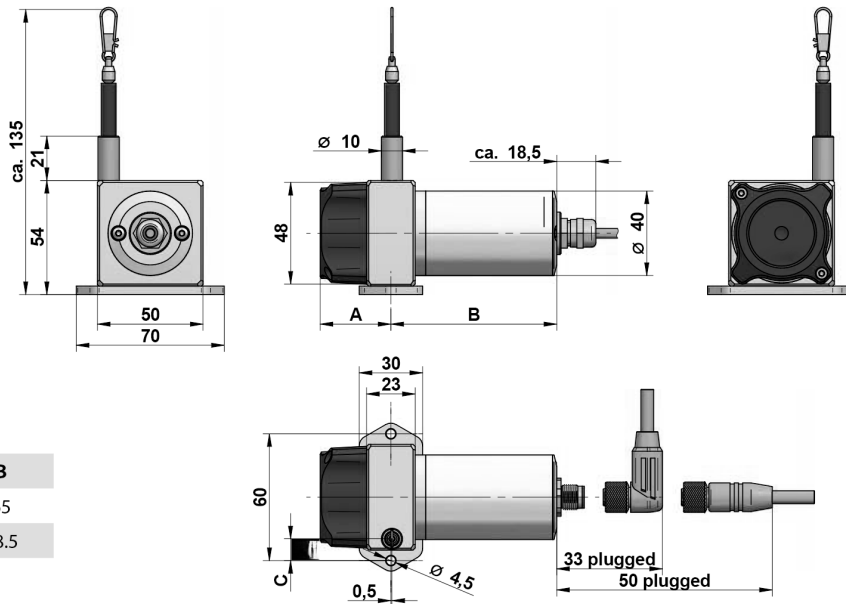
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## Mechanical properties

| Measurement range<br>[mm] | Extraction force     |                      | Speed <sup>1)</sup><br>V <sub>max</sub> [m/s] | Acceleration <sup>1)</sup><br>a <sub>max</sub> [m/s <sup>2</sup> ] | Extraction force: Option HG |                      | Acceleration: Option HG<br>a <sub>max</sub> [m/s <sup>2</sup> ] |
|---------------------------|----------------------|----------------------|-----------------------------------------------|--------------------------------------------------------------------|-----------------------------|----------------------|-----------------------------------------------------------------|
|                           | F <sub>min</sub> [N] | F <sub>max</sub> [N] |                                               |                                                                    | F <sub>min</sub> [N]        | F <sub>max</sub> [N] |                                                                 |
| 50                        | 5.4                  | 6.8                  | 8                                             | 250                                                                | 9.8                         | 12.4                 | 350                                                             |
| 75                        | 3.8                  | 4.6                  | 8                                             | 150                                                                | 7                           | 8.4                  | 300                                                             |
| 100                       | 3                    | 3.6                  | 8                                             | 150                                                                | 5.4                         | 6.4                  | 250                                                             |
| 125                       | 4.2                  | 5.2                  | 10                                            | 200                                                                | -                           |                      |                                                                 |
| 150                       | 5.8                  | 7.4                  | 8                                             | 250                                                                | 10.9                        | 13.2                 | 350                                                             |
| 225                       | 3.8                  | 4.8                  | 8                                             | 150                                                                | 6.6                         | 8.6                  | 300                                                             |
| 250                       | 5.6                  | 7.2                  | 8                                             | 250                                                                | 10                          | 13.2                 | 350                                                             |
| 300                       | 3                    | 3.6                  | 8                                             | 150                                                                | 5.4                         | 6.6                  | 250                                                             |
| 375                       | 4.4                  | 5.4                  | 10                                            | 200                                                                | -                           |                      |                                                                 |
| 500                       | 3                    | 4                    | 8                                             | 150                                                                | 5.8                         | 7.2                  | 250                                                             |
| 625                       | 4                    | 5.4                  | 10                                            | 200                                                                | -                           |                      |                                                                 |
| 750                       | 3.6                  | 5.2                  | 8                                             | 150                                                                | 6.6                         | 9.4                  | 300                                                             |
| 1000                      | 2.8                  | 4                    | 8                                             | 150                                                                | 5                           | 7.2                  | 250                                                             |
| 1250                      | 3.8                  | 5.6                  | 10                                            | 200                                                                | -                           |                      |                                                                 |

<sup>1)</sup> reduced to 60 % with option IP67

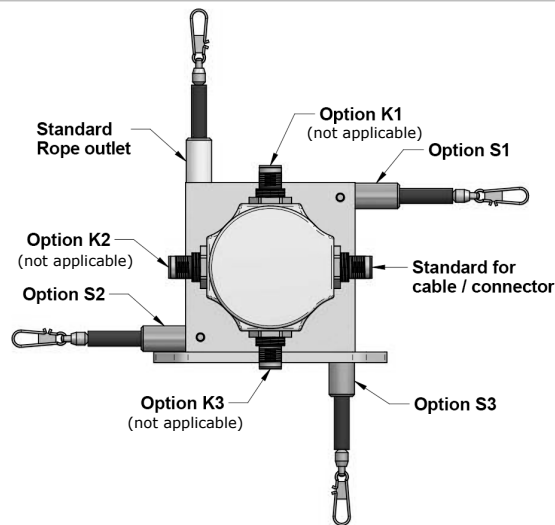
## Technical Drawing



| Output            | B    |
|-------------------|------|
| Potentiometer     | 65   |
| Voltage / Current | 78.5 |

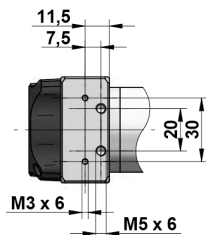
| Measurement range      | Option          | A    | C     |
|------------------------|-----------------|------|-------|
| 50 / 150 / 250         | Standard        | 26.5 | 21.3  |
| 75 / 225 / 750         | Standard        | 26.5 | 17    |
| 100 / 300 / 500 / 1000 | Standard        | 26.5 | 12.75 |
| 125 / 375 / 625 / 1250 | Standard        | 33.5 | 10.3  |
| 50 / 150 / 250         | IP67 / ICP / HG | 33.5 | 21.3  |
| 75 / 225 / 750         | IP67 / ICP / HG | 33.5 | 17    |
| 100 / 300 / 500 / 1000 | IP67 / ICP / HG | 33.5 | 12.75 |

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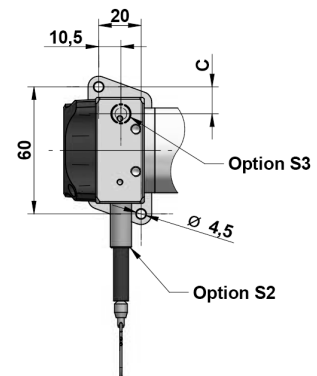
## Mounting: standard rope outlet, rope outlet sideways top (S1)

The sensor is usually installed by using the regular mounting plate (see technical drawing above). By disassembling the mounting plate, there are 4 threads (2 x M3, 2 x M5) in the sensor housing for alternative installation.



## Mounting: rope outlet sideways bottom (S2), rope outlet bottom (S3)

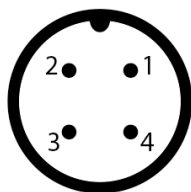
Sensors with option rope outlet S2 and S3 have a modified base plate:



| Measurement range      | C     |
|------------------------|-------|
| 50 / 150 / 250         | 21.3  |
| 75 / 225 / 750         | 17    |
| 100 / 300 / 500 / 1000 | 12.75 |
| 125 / 375 / 625 / 1250 | 10.3  |

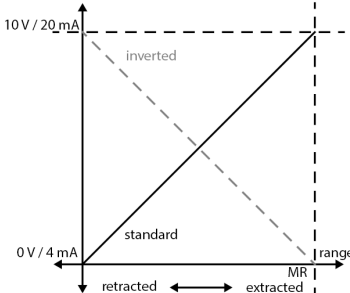
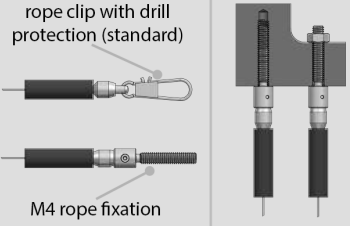
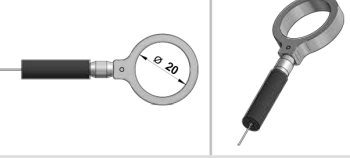
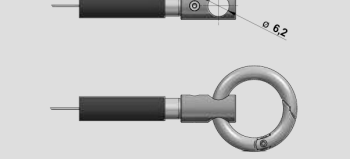
## Electrical connection

| Cable output cable colours | Connector output M12, male | Potentiometer output | Voltage output        | Current output |
|----------------------------|----------------------------|----------------------|-----------------------|----------------|
| BN                         | Pin 1                      | +V                   | +V                    | +V             |
| WH                         | Pin 2                      | Cursor               | Signal                | n. c.          |
| BU                         | Pin 3                      | GND                  | GND                   | Signal         |
| BK                         | Pin 4                      | n. c.                | GND <sub>Signal</sub> | n. c.          |



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## Options

| Option                                                                             | Order code | Description                                                                                                                                                                                                                                                                 |
|------------------------------------------------------------------------------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Improved linearity                                                                 | L05, L10   | Improved linearity 0.05 % (L05) or 0.1 % (L10)                                                                                                                                                                                                                              |
| Inverted output signal<br>(analog output only)                                     | IN         | <p>The analog signal of the sensor is increasing by extracting the rope (standard). Option IN inverts the signal, i.e. the signal of the sensor declines by extracting the rope.</p>     |
| Changed rope outlet                                                                | S1, S2, S3 | <p>Standard: rope outlet at the top<br/> S1: rope outlet sideways at the top<br/> S2: rope outlet sideways at the bottom (modified mounting plate, see page 7)<br/> S3: rope outlet on the bottom (modified mounting plate, see page 7)</p>                                 |
| Synthetic wire rope                                                                | COR        | Synthetic wire rope, made out of abrasion resistant and enhanced Coramid. We recommend COR at stable temperatures due to the coefficient of expansion.                                                                                                                      |
| Rope fixation by M4 thread                                                         | M4         | <p>Optional, pivoted rope fixation with screw thread M4, length 22 mm. Ideal for attachment to through holes or thread holes M4.</p>                                                    |
| Rope fixation by eyelet                                                            | RI         | <p>The end of the wire rope is equipped with a eyelet instead of a rope clip.<br/> Inside diameter 20 mm</p>                                                                           |
| Rope fixation with cylindrical pin and M6 through bore                             | ZH, ZR     | <p>ZH: cylindrical pin with M6 through bore<br/> ZR: cylindrical pin with M6 through bore and carbine ring</p>                                                                         |
| Protection class IP67                                                              | IP67       | Use option IP67, if the sensor will operate in a humid environment. Note that with this option there may occur a light hysteresis in the output signal due to the special sealing. The max. acceleration and displacement speed are reduced to 60 % of the specified value. |
| Corrosion protection                                                               | CP         | Includes a V4A wire rope, stainless steel bearings and option M4. The sensors rope drum gets HARTCOAT® coated. This coating is a hard-anodic oxidation that protects the sensor from corrosion by aggressive media (e. g. sea water) with a hard ceramics-like layer.       |
| Increased corrosion protection<br>(analog output only)                             | ICP        | Components of the housing and the rope drum get HARTCOAT® coated. Includes the options CP, IP67 and M4.                                                                                                                                                                     |
| Increased extraction force<br>(analog output only,<br>not for MR 125/375/625/1250) | HG         | A reinforced spring drive provides a greater rope tension and allows a higher rope acceleration. Please note the different dimensions of the housing.                                                                                                                       |
| Increased temperature range High<br>(potentiometer output only)                    | H120       | Sensors with potentiometer output and cable output can be operated from -20 to +120 °C when this option is used.                                                                                                                                                            |
| Increased temperature range Low<br>(analog output only)                            | T40        | Special components and a low temperature grease make a working temperature down to -40 °C (up to +85 °C) possible.                                                                                                                                                          |

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Attach the sensor to the mounting holes in the designated location before pulling out the rope or before attaching the rope to the target.

- The sensor can be mounted using the mounting plate. By unscrewing the mounting plate, threaded holes are alternatively available for assembly. For rope exit S2 and S3, the sensor has a modified mounting plate.
- Open the rope clip (not with M4 threaded screw) after the sensor has been securely mounted and pull out the measuring rope. Hook the rope clip onto the object and close the bracket of the rope clip. To be on the safe side, use a thin screwdriver and guide it through the rope clip to pull out the rope.



When handling the sensor, make sure that you do not accidentally snap the rope or pull the rope out over the specified measurement range. This can destroy the sensor.

- The rope must be pulled vertically out of the sensor during operation. The maximum deviation from the vertical is 3°. Avoid pulling out the measuring rope at an angle at all costs. The service life of the device would be shortened as a result. If the tolerance limit of 3° cannot be maintained, a pulley must be used.
- Preferably lay the rope in corners or protected under guides to avoid dirt or accidental contact.
- Avoid running the rope over edges or corners. Use the pulley if necessary.
- Do not operate the sensor if there are kinks or damage in the measuring rope.

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## Ordering example

**Type** **SGA-50** - **50** - **420A** - **SA12** -  
**SGA-50** = Draw-wire sensor

### Measuring range MB (mm)

**50** = 50 mm  
**75** = 75 mm  
**100** = 100 mm  
**125** = 125 mm  
**150** = 150 mm  
**225** = 225 mm  
**250** = 250 mm  
**300** = 300 mm  
**375** = 375 mm  
**500** = 500 mm  
**625** = 625 mm  
**750** = 750 mm  
**1000** = 1.000 mm  
**1250** = 1.250 mm

### Output signal

**420A** = Current 4 ... 20 mA  
**1R** = Potentiometer 1 k $\Omega$   
**5R** <sup>1)</sup> = Potentiometer 5 k $\Omega$   
**10R** <sup>1)</sup> = Potentiometer 10 k $\Omega$   
**4,5 V** = Voltage 0.5 ... 4.5 V  
**5 V** = Voltage 0 ... 5 V  
**55 V** = Voltage -5 ... +5 V  
**10 V** = Voltage 0 ... 10 V

### Connection

**SA12** = M12 connector output, axial, 4-pin  
**KA02** = Cable output, axial, 2 m, 4-pole  
**KA05** = Cable output, axial, 5 m, 4-pin  
**KA10** <sup>2)</sup> = Cable output, axial, 10 m, 4-pole

### Version

**-** = Standard  
**S1** = Rope exit side top  
**S2** = Rope exit side bottom  
**S3** = Rope exit side floor  
**IN** = Inverted output signal  
**COR** = Plastic measuring rope made of coramide  
**CP** = Corrosion protection  
**ICP** = Increased corrosion protection  
**HG** = Increased rope acceleration  
**H120** = Temperature range -20...+120 °C  
**M4** = Rope attachment with M4 thread  
**RI** = Rope attachment with ring eye  
**ZH** = Cylindrical Pin Rope Attachment  
**ZR** = Cylindrical pin rope attachment with carabiner ring  
**IP67** = IP67 degree of protection  
**L05** = Improved linearity  $\pm 0,05$  %  
**L10** = Improved linearity  $\pm 0,1$  %  
**T40** = Temperature range -40...+85 °C

<sup>1)</sup> Only for measuring ranges from 150 mm

<sup>2)</sup> Longer lengths on request

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Versions that cannot be generated from the order key may be available as a special version on request.

The manufacturer reserves the right, without prior notice, to make any changes to the products that he deems necessary for their improvement.

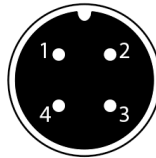
## Accessories

### Cable with M12 connector

#### Analog output and power supply Profibus, EtherCat and Profinet

##### Cable with mating connector M12 (female), 4 poles

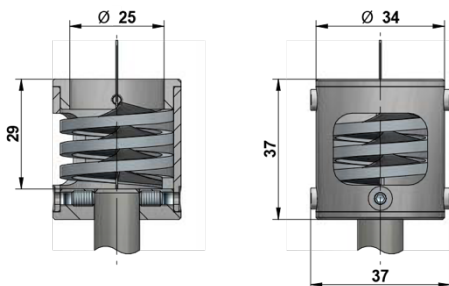
|                |                                          |
|----------------|------------------------------------------|
| C04-2M-S-M12   | 2 m, straight connector, IP67, shielded  |
| C04-5M-S-M12   | 5 m, straight connector, IP67, shielded  |
| C04-10M-S-M12  | 10 m, straight connector, IP67, shielded |
| C04-2M-SW-M12  | 2 m, angular connector, IP67, shielded   |
| C04-5M-SW-M12  | 5 m, angular connector, IP67, shielded   |
| C04-10M-SW-M12 | 10 m, angular connector, IP67, shielded  |



| Pin | Cable colour |
|-----|--------------|
| 1   | BN           |
| 2   | WH           |
| 3   | BU           |
| 4   | BK           |

### Rope scraper CM- SGA-50

Use the CM-SGA-50 rope scraper to remove dirt from the measuring rope of the sensor. Please note that the maximum measuring range of the sensor is reduced by 29 mm and the CM-SGA-50 is not compatible with Option RI.



## Warning



Do not attempt to open the device. The high stored energy of the drive spring can lead to injuries if handled incorrectly.

- Do not touch the moving rope during operation.
- Protect the sensor and rope from ice build-up when mounting outdoors in sub-zero temperatures.

The use of a pulley leads to de-icing of the measuring rope.

- In a humid environment, install a sensor with a rope outlet facing downwards, otherwise water will collect inside the sensor.