# DRAW WIRE SENSOR


## Series SX50

***Key-Features:***

- *Measurement ranges 50 mm up to 1250 mm*
- *Analog Output: Potentiometer, 0...10 V, 4...20 mA*
- *Digital Output Incremental: RS422 (TTL), Push-Pull*
- *Digital Output Absolute: CANopen, SSI*
- *Linearity up to ±0.02% of full scale*
- *Protection class up to IP67*
- *Temperature range: -20...+85 °C (optional -40 °C or +120 °C)*
- *High dynamics*
- *High interference immunity factor*
- *Customised versions available*

***Content:***



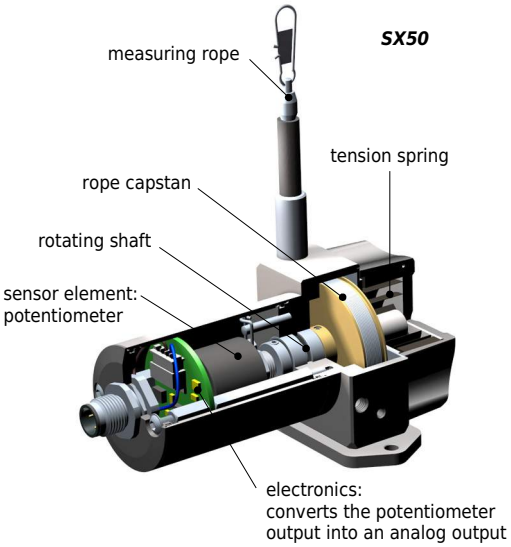
03.12.15

WayCon Positionsmesstechnik

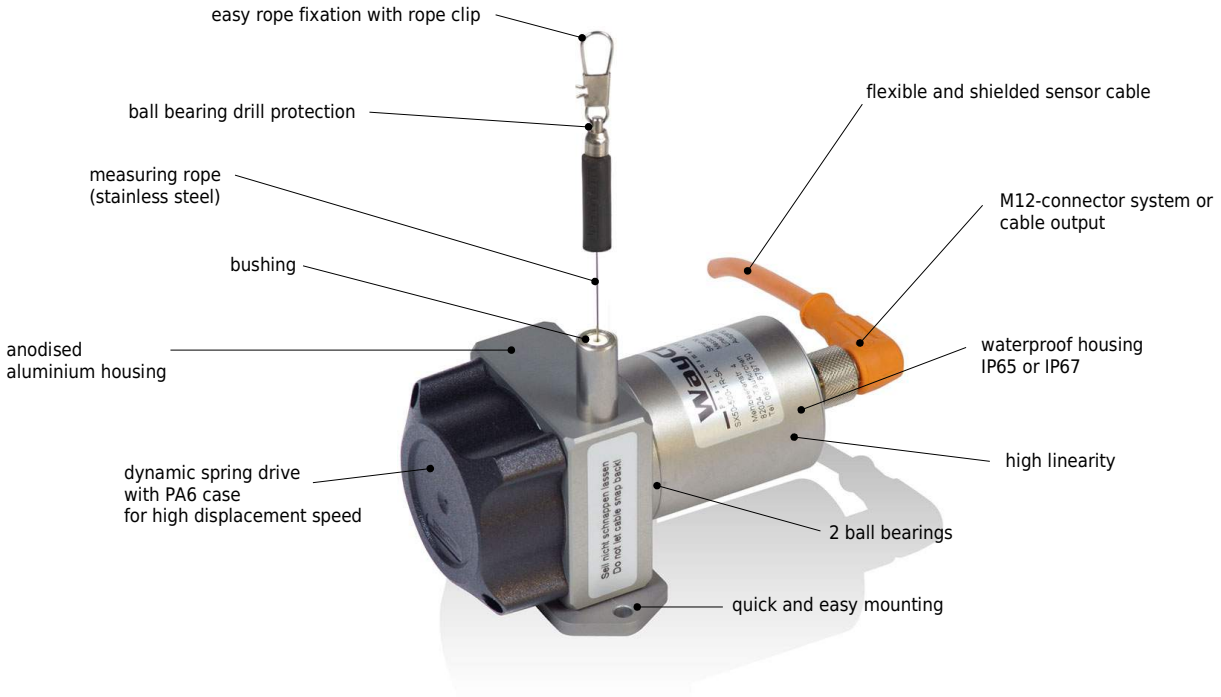
# INTRODUCTION

WayCon Positionsmesstechnik GmbH is a manufacturer of high quality draw wire position sensors for industrial use. Due to its small overall size, its short assembly time and its possible customisation, the SX sensor technology is a cost-effective and flexible solution for a wide range of industrial applications. The dynamics of the draw wire transducer allows a high motion speed and acceleration of the measuring target. Its rugged design and high quality makes applications in harsh industrial environments possible. Special instruments are available with mounting service of encoder on site, as well as customised versions of housing.

Sensor principle:
The key component of a draw wire sensor is a highly flexible steel wire rope, that is winded single-layered on an ultra light capstan. This capstan is connected to the sensor housing by a pre-stressed spring. The end of the steel wire rope, that is equipped with a rope clip gets connected to the target object. As soon as the distance between sensor and target object changes, the steel wire rope gets pulled out of the sensor and is rolled off the capstan (or vice versa). The shaft of the capstan is connected to a potentiometer (for analog output signals), or to an encoder (for digital output signals). If there is a rotation of the capstan due to a change in the distance to the target object, the sensor element will turn proportionally. This way the potentiometer, or the encoder converts a linear movement into a proportional electrical signal. If a standard analog output signal, like 0...10 V or 4...20 mA is needed, the sensor is equipped with an additional electronics.




# SPECIAL FEATURES




# WARNING NOTICES

- Don't let the rope snap back. If the rope is retracted freely, this may lead to injuries (whiplash effect) and the device may be damaged. Caution when unhooking and retracting the rope into the sensor.
- Never exceed the specified measurement range when extracting the rope!
- Do not try to open the device. The stored energy of the spring drive may lead to injuries when being mishandled.
- Do not touch the rope when operating the sensor.
- Avoid guiding the rope over edges or corners. Use a deflection pulley instead.
- Do not operate the sensor if the rope is buckled or damaged. A ripping of the rope may lead to injuries or a damaging of the sensor.

# TECHNICAL DATA ANALOG OUTPUT

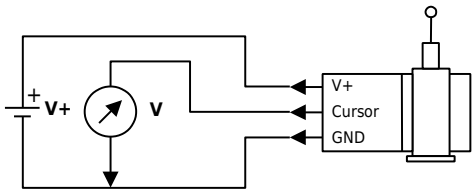
| Measurement range * | [mm] | 50 | 75 | 100 | 125 | 150 | 225 | 250 | 300 | 375 | 500 | 625 | 750 | 1000 | 1250 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Linearity | [%] | 0.50 | 0.50 | 0.50 | 0.50 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.10 | 0.10 | 0.10 |
| Improved linearity (optional) | [%] | - | - | - | - | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.05 | 0.05 | 0.05 |
| Improved linearity (optional) ** | [%] | 0.10 | 0.10 | 0.10 | 0.10 | - | - | - | - | - | - | - | - | - | - |
| Resolution | | see types of output table below | | | | | | | | | | | | | |
| Sensor element | | Hybrid Potentiometer | | | | | | | | | | | | | |
| Connection | | connector output M12 axial or cable output axial (TPE cable, standard length 2 m) | | | | | | | | | | | | | |
| Protection class | | IP65, optional IP67 | | | | | | | | | | | | | |
| Humidity | | maximum 90 % relative, no condensation | | | | | | | | | | | | | |
| Temperature | [°C] | standard: -20…+85 / optional: -40…+85 / optional: -20…+120 °C (only with Potentiometer (1R) and cable output (KA)) | | | | | | | | | | | | | |
| Mechanical data | | extraction force, maximum velocity and maximum acceleration see table page 13 | | | | | | | | | | | | | |
| Life expectancy | | approx. 2 million full strokes (dependent on the displacement speed) | | | | | | | | | | | | | |
| Weight | [g] | 300 to 500, depending on the measurement range | | | | | | | | | | | | | |
| Housing | | aluminium, anodised, spring case PA6 | | | | | | | | | | | | | |
| Accessories | | cables, connectors, digital displays, deflection pulley, rope extensions, magnetic clamp (see pages 11 and 12) | | | | | | | | | | | | | |

* other ranges on request

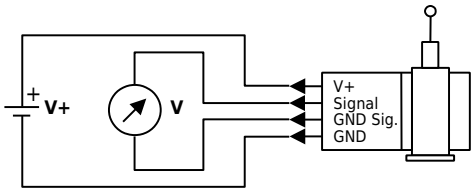
** special version with unprotected potentiometer, protection class IP40 (please contact the WayCon sales team)

# TYPES OF ANALOG OUTPUT

| **Output: Potentiometer (voltage divider)** | |
|---|---|
| Output | 1 kΩ |
| Supply | max. 30 V |
| Recommended cursor current | < 1 µA |
| Resolution | theoretically unlimited, limited by the noise |
| Noise | dependent on the quality ot the power supply |
| Working temperature | -20…+85 °C , optional: -40…+85 °C / -20…+120 °C |
| Temperature coefficient | ± 0.0025 %/K |

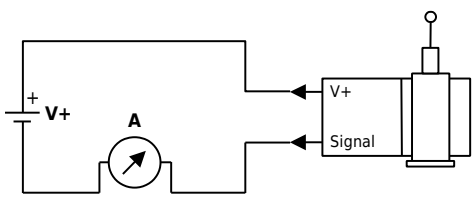



| **Output: Voltage 0...10 V** | |
|---|---|
| Output | 0…10 V, galvanically isolated, 4 conductors |
| Supply | 12…30 VDC |
| Current consumption | max. 22.5 mA (unloaded) |
| Output current | max. 10 mA, min. load 10 kOhm |
| Dynamics | < 3 ms from 0…100 % and 100…0 % |
| Resolution | limited by the noise |
| Noise | 3 $mV_{pp}$ typical, max. 37 $mV_{pp}$ |
| Inverse-polarity protection | yes, infinite |
| Short-circuit proof | yes, permanent |
| Working temperature | -20…+85 °C , optional: -40…+85 °C |
| Temperature coefficient | 0.0037 %/K |
| Electromagnetic compatibility (EMC) | according to EN 61326-1:2006 |



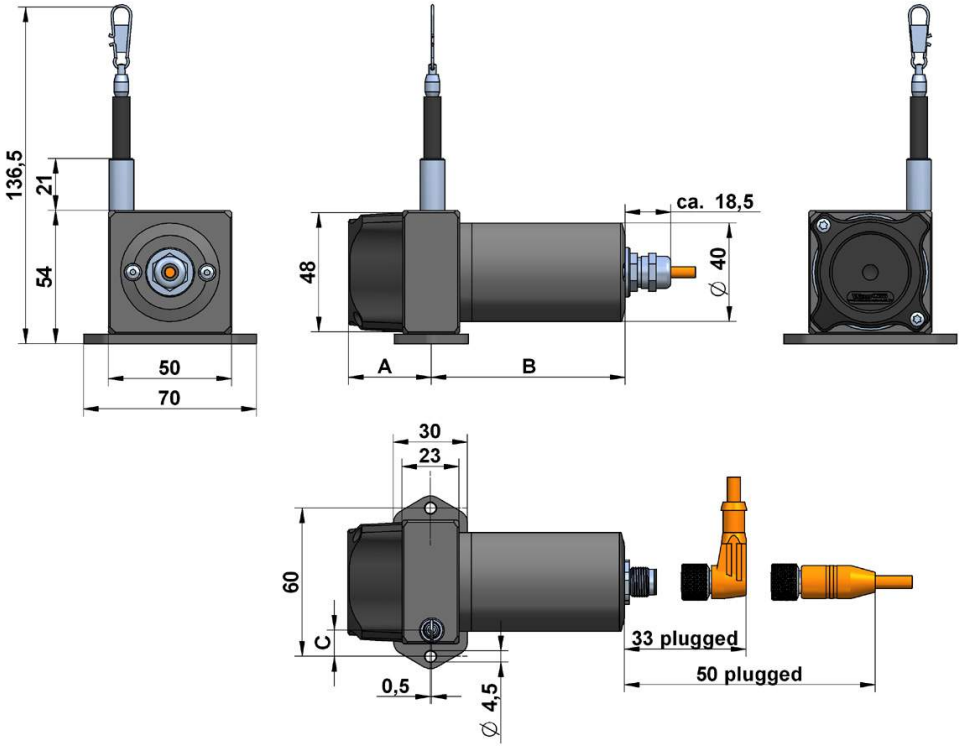

Note: GND Sig. and GND may be connected in a 3-wire system.

| **Output: Current 4...20 mA** | |
|---|---|
| Output | 4…20 mA, 2 conductors |
| Supply | 12…30 VDC |
| Output current | max. 50 mA in case of error |
| Dynamics | < 1 ms from 0…100 % and 100…0 % |
| Resolution | limited by the noise |
| Noise | 0.03 $mA_{pp}$ = 6 $mV_{pp}$ at 200 Ohm |
| Inverse-polarity protection | yes, infinite |
| Working temperature | -20…+85 °C , optional: -40…+85 °C |
| Temperature coefficient | 0.0079 %/K |
| Electromagnetic compatibility (EMC) | according to EN 61326-1:2006 |



# TECHNICAL DRAWING ANALOG OUTPUT

**Analog output**




| Measurement range | Option | A | C |
|---|---|---|---|
| 50 / 150 / 250 mm | Standard | 26.50 | 21.30 |
| 75 / 225 / 750 mm | Standard | 26.50 | 17.00 |
| 100 / 300 / 500 / 1000 mm | Standard | 26.50 | 12.75 |
| 125 / 375 / 625 / 1250 mm | Standard | 33.50 | 10.30 |
| 50 / 150 / 250 mm | HG(50) | 33.50 | 21.30 |
| 75 / 225 / 750 mm | HG(50) | 33.50 | 17.00 |
| 100 / 300 / 500 / 1000 mm | HG(50) | 33.50 | 12.75 |

| Output | B |
|---|---|
| Potentiometer | 65.0 |
| 10V / 420A | 78.5 |

# ELECTRICAL CONNECTION ANALOG OUTPUT

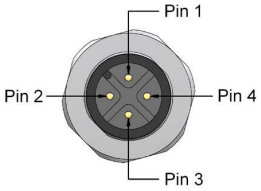
**Cable output**

| | |
|---|---|
| Cable type | TPE, flexible |
| Cable direction | axial |
| Length | standard: 2 m, (others on request) |
| Diameter | 4.5 mm |
| Wire | 0.25 mm² |
| Temperature | fixed installation -30…+85 °C |
| | flexible installation -20…+85 °C |

| Cable colour | 0…10 V | 4…20 mA | 1 kOhm |
|---|---|---|---|
| brown | V + | V + | V + |
| white | Signal | n. c. | Cursor |
| blue | GND | Signal | GND |
| black | GND Signal | n. c. | n. c. |

**Connector output**

- M12, 4 poles



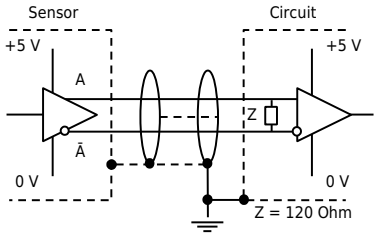
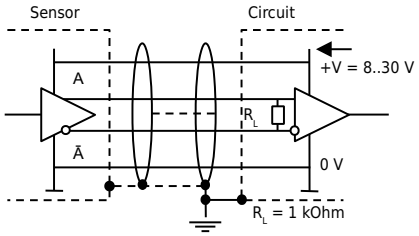

| Pin | 0…10 V | 4…20 mA | 1 kOhm |
|---|---|---|---|
| 1 | V + | V + | V + |
| 2 | Signal | n. c. | Cursor |
| 3 | GND | Signal | GND |
| 4 | GND Signal | n. c. | n. c. |

# TECHNICAL DATA DIGITAL OUTPUT INCREMENTAL

| | | |
|---|---|---|
| Measurement range * | [mm] | 500, 750, 1250 |
| Linearity | [%] | 0,05, independent of the measurement range |
| Improved linearity (optional) | [%] | 0,02, independent of the measurement range, only in combination with resolution 20 pulses/mm, or higher |
| Selectable resolution * | [pulses/mm] | 1, 4, 10, 20, 28,8, 60** (this resolution can be raised by the factor 4 using quadruple edge detection) |
| Z-Pulse distance | [mm] | 125 |
| Sensor element | | Incremental-Encoder (with optical code disk) |
| Output signal | | A/B-Pulses (90° phase-delayed), Z-Pulse (plus inverted pulses $A_{not}$, $B_{not}$, $Z_{not}$) |
| Connection | | M12 connector output or cable output (PVC, standard length 2 m) |
| Protection class | | IP65, optional IP67 |
| Humidity | | maximum 90 % relative, no condensation |
| Temperature range | [°C] | -20...+85 |
| Mechanical data | | extraction force, maximum velocity and maximum acceleration see table page 13 |
| Life expectancy | | approx. 2 million full strokes (dependent on the displacement speed) |
| Weight | [g] | 300 to 500, depending on the measurement range |
| Housing | | aluminium, anodised, spring case PA6 |
| Accessories | | digital displays, deflection pulley, rope extensions, magnetic clamp (see pages 11 and 12) |

* others on request

** Special version (please contact the WayCon sales team)

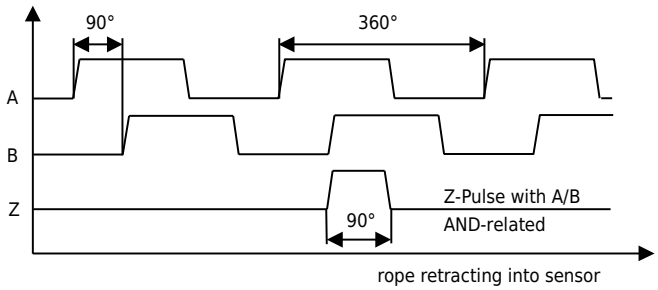
| **Electrical Data** | | **Linedriver L**<br>**RS422 (TTL-compatible)** | **Push-Pull G** |
|---|---|---|---|
| Power supply +V | [VDC] | 5, ±5 % | 8...30 |
| Current consumption (no load) | [mA] | typical 40, max. 90 | max. 40 |
| Load/ Channel | [mA] | max. ±20 | max. ±20 |
| Pulse frequency | [kHz] | max. 300 | max. 200 |
| Signal level high | [V] | min. 2.5 | min. +V – 3 |
| Signal level low | [V] | max. 0.5 | max. 0.5 |
| Recommended circuit | |  |  |

# OUTPUT SIGNAL DIGITAL OUTPUT INCREMENTAL

**Output signal**

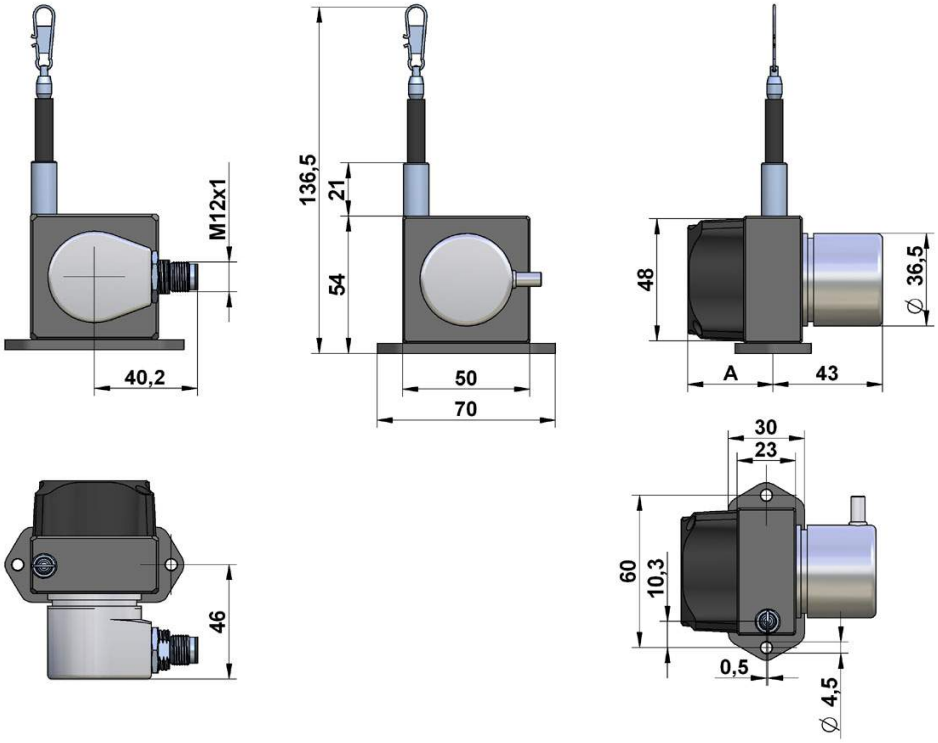
Pulses A and B are 90° phase-delayed (detection of direction). The Z-Pulse is emitted once per turn. The Z-Pulse distance is 125 mm (= circumference of the rope drum) and can be used as a reference mark.

The diagram shows the signal without inverted signals; time line for return of rope.



# TECHNICAL DRAWING DIGITAL OUTPUT INCREMENTAL

**Digital output Incremental**

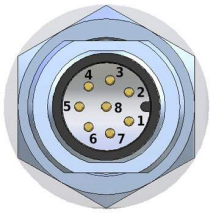



| Option | A |
|---|---|
| Standard | 33.5 |

# CONNECTION DIGITAL OUTPUT INCREMENTAL

**Connector output, M12, 8 poles**

| Signal | 0 V | +V | A | $A_{Not}$ | B | $B_{Not}$ | Z | $Z_{Not}$ |
|---|---|---|---|---|---|---|---|---|
| Pin | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |




**Cable output**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cable type | PVC, flexible | | | | | | | | | |
| Cable direction | radial | | | | | | | | | |
| Length | 2.0 m | | | | | | | | | |
| Diameter | ø 4.5 mm | | | | | | | | | |
| Wire | 10 x 0.14 mm² | | | | | | | | | |
| Temperature | fixed installation -30…+85 °C<br>flexible installation -20…+85 °C | | | | | | | | | |
| Signal | 0 V | +V | A | $A_{Not}$ | B | $B_{Not}$ | Z | $Z_{Not}$ | $0\ V_{sens}$ * | $+V_{sens}$ * |
| Cable colour | white | brown | green | yellow | gray | pink | blue | red | black | violet |

* only for Linedriver L

**Explanation**

+V: Encoder power supply +VDC

0 V: Encoder power supply ground GND (0 V)

$0\ V_{sens}$ / $+V_{sens}$: Only for Linedriver L: Using the sensor outputs of the encoder, the voltage present can be measured and if necessary increased accordingly

A, $A_{Not}$: Incremental output channel A

B, $B_{Not}$: Incremental output channel B

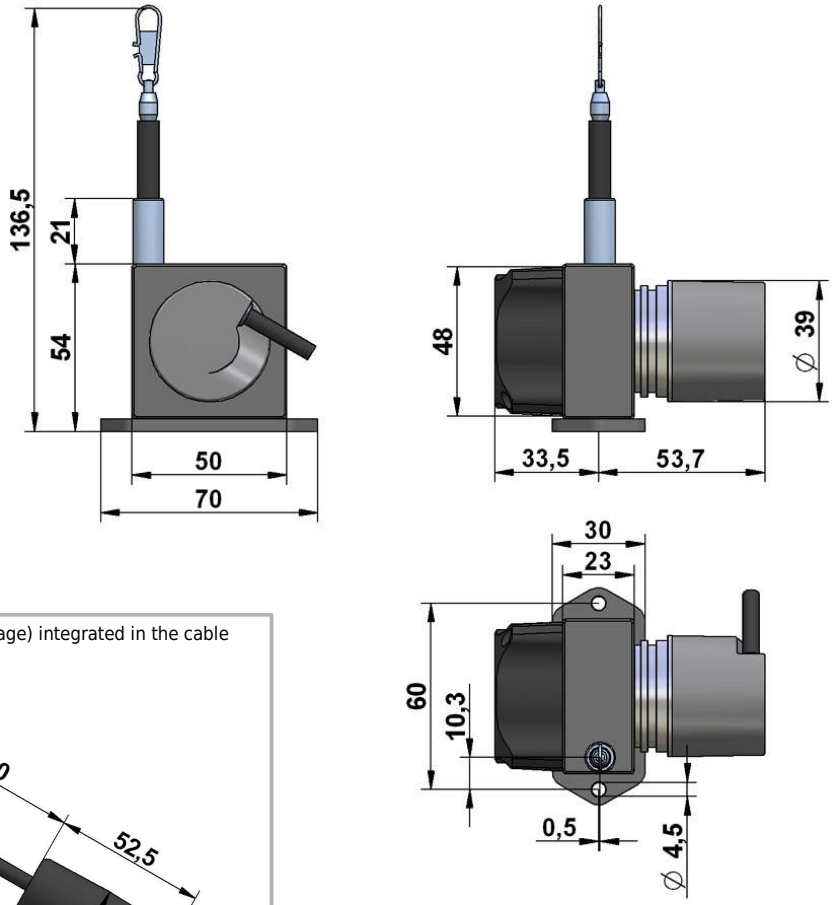
Z, $Z_{Not}$: Reference signal

# TECHNICAL DATA DIGITAL OUTPUT ABSOLUTE, CANopen, SSI

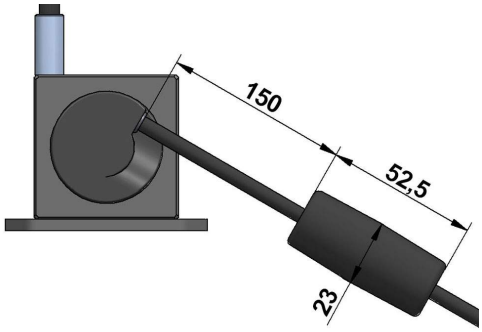
| | | CANopen | SSI |
|---|---|---|---|
| Measurement range | [mm] | 500, 750, 1250 | |
| Linearity | [%] | 0.05, independent of the measurement range | |
| Resolution scalable (with Software) | | yes | no |
| Standard resolution | [Pulses/mm] | 65.54, corresponds 0.015 mm (13 bit) | 32.77, corresponds 0.03 mm (12 bit) |
| Maximum resolution | [Pulses/mm] | 524.9, corresponds 0.0019 mm (16 bit) | - |
| Sensor element | | Multiturn-Absolute-Encoder (with optical code disk) | |
| Connection | | cable output tangential, with 1 or 5 m PUR cable | |
| Power supply | [VDC] | 10...30 (reverse polarity protection of the power supply) | |
| Current consumption (no load, at 24 VDC) | [mA] | max. 80 | max. 30 |
| Protection class | | IP65, optional IP67 | |
| Humidity | | max. 90 % relative, no condensation | |
| Temperature | [°C] | -20...+85 | |
| Mechanical data | | extraction force, maximum velocity and maximum acceleration see table page 13 | |
| Life expectancy | | approx. 2 million full strokes (dependent on the displacement speed) | |
| Weight | [g] | 300 to 500, depending on the measurement range | |
| Housing | | aluminium, anodised, spring case PA6 | |
| Accessories | | deflection pulley, rope extensions, magnetic clamp (see pages 11 and 12) | |

# TECHNICAL DRAWING DIGITAL OUTPUT ABSOLUTE

**SSI, CANopen**




Detailed view: battery (data storage) integrated in the cable



# DESCRIPTION CANopen

| Parameters of the CANopen Interface | |
|---|---|
| Code | Binary |
| Interface | CAN High-Speed acc. to ISO 11898, Basic- and Full-CAN, CAN Specification 2.0 B |
| Protocol | CANopen profile DS406 V3.2 with manufacturer-specific add-ons LSS-Service DS305 V2.0 |
| Baud rate | 10 … 1000 kbit/s (Software configurable) |
| Node address | 1…127 (Software configurable) |
| Termination switchable | Software configurable |
| LSS Protocol | CIA LSS protocol DS305, Global command support for node address and baud rate |
| | Selective commands via attributes of the identity object |

**General information about CANopen**

The CANopen encoders support the latest CANopen communication profile according to DS301 V4.02 . In addition, device-specific profiles like the encoder profile DS406 V3.2 and DS305 (LSS) are available.
The following operating modes may be selected: Polled Mode, Cyclic Mode, Sync Mode. Moreover, scale factors, preset values, limit switch values and many other additional parameters can be programmed via the CANbus. When switching the device on, all parameters, which have been saved on a flash memory to protect them against power failure, are loaded again.
The following output values may be combined in a freely variable way as PDO (PDO mapping): position, speed as well as the status of the working area.
The encoders are available with a connector or a cable connection.
The device address and baud rate can be set/modified by means of the software.
The two-colour LED located on the back indicates the operating or fault status of the CAN-bus, as well as the status of the internal diagnostics.

**CANbus Connection**

The CANopen encoders are equipped with a Bus trunk line in various lengths and can be terminated in the device.
The devices do not have an integrated T-coupler nor they are looped internally and must therefore only be used as end devices.
If possible, drop lines should be avoided, as in principle they lead to signal reflections. As a rule the reflections caused by the drop lines are not critical, if they have completely decayed before the point in time when the scanning occurs.
The sum of all the drop lines should not, for a particular baud rate, exceed the maximum length Lu.

Lu < 5 m [16.40‘] cable length for 125 Kbit
Lu < 2 m [6.56‘] cable length for 250 Kbit
Lu < 1 m [3.28‘] cable length for 1 Mbit

When used as a drop line, the termination resistor should not be activated.
For a network with 3 encoders and 250 Kbit the maximum length of the drop line/ encoder must not exceed 70 cm.

**Universal Scaling Function**

At the end of the physical resolution of an encoder, when scaling is active, an error appears if the division of the physical limit (GP_U) by the programmed total resolution (TMR) does not produce an integer.
The Universal Scaling Function remedies this problem.

**LSS Layer Setting Services DS305 V2.0**

- Global support of Node-ID and baud rate
- Selective protocol via identity object (1018h)

**CANopen Communication Profile DS301 V4.02**

Among others, the following functionality is integrated. (Class C2 functionality):

- NMT Slave
- Heartbeat Protocol
- Identity Object
- Error Behaviour Object
- Variable PDO Mapping self-start programmable (Power on to operational), 3 Sending PDO’s
- Node address, baud rate and CANbus / Programmable termination.

**CANopen Encoder Profile DS406 V3.2**

The following parameters can be programmed:

- Event mode
- 1 work area with upper and lower limit and the corresponding output states
- Variable PDO mapping for position, speed, work area status
- Extended failure management for position sensing
- User interface with visual display of bus and failure status 1 LED two colours
- Customer-specific memory - 16 Bytes
- Customer-specific protocol

“Watchdog controlled” device

**Electrical connection CANopen**

| Cable (Isolate unused wires individually before initial start-up) | | | | | |
|---|---|---|---|---|---|
| Signal | +V | 0 V | CAN_GND | CAN_H | CAN_L |
| Cable color | brown | white | grey | green | yellow |

# DESCRIPTION SSI

| Parameters of the SSI interface | |
|---|---|
| Output driver | RS485 Transceiver-type |
| Permissible load/channel | max. ±30 mA |
| Signal level | HIGH: typ 3.8 V<br>LOW: with $I_{Load}$ = 20 mA typ 1.3 V |
| Resolution | 12 bit |
| Code | Gray |
| SSI clock rate | ST-resolution: 50 kHz...2 MHz |
| Monoflop time | ≤ 15 µs |
| Data refresh rate | ≤ 1 µs |
| Status and Parity bit | on request |

**SET Input**

The encoder can be set to zero at any position by means of a HIGH signal on the SET input. Other preset values can be factory-programmed. The SET input has a signal processing time of approx. 1 ms, after which the new position data can be read via SSI or BiSS-C. Once the SET function has been triggered, the encoder requires an internal processing time of typ. 200 ms; during this time the power supply must not be switched off.
The SET function should be carried out whilst the encoder is at rest.

| SET Input | |
|---|---|
| Input | active HIGH |
| Input type | comparator |
| Signal level | HIGH: min 60% of +V, max. +V |
| (+V = power supply) | LOW: max. 30% of +V |
| Input current | <0.5 mA |
| Min. pulse duration (SET) | 10 ms |
| Input delay | 1 ms |
| New position data readable after | 1 ms |
| Internal processing time | 200 ms |

**DIR Input**

A HIGH signal switches the direction of rotation from the default CW to CCW. This inverted function can also be factory-programmed. If DIR is changed when the device is already switched on, then this will be interpreted as an error. The status output will switch to LOW.
Response time (DIR input): 1 ms

**Power-On Delay**

After Power-ON the device requires a time of approx. 150 ms before valid data can be read. Hot plugging of the encoder should be avoided.

**Status Output**

The status output serves to display various alarm or error messages. In normal operation the status output is HIGH (Open Collector with int. pull-up 22 kOhm). An active status output (LOW) displays: LED fault (failure or ageing) – over-temperature – undervoltage. In the SSI mode, the fault indication can only be reset by switching off the power supply to the device.

**Electrical connection SSI**

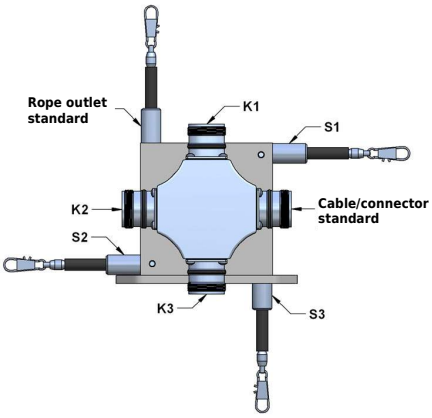
| Cable (Isolate unused wires individually before initial start-up) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Signal | 0V | +V | C+ | C- | D+ | D- | SET | DIR | Status | H |
| Cable colour | white | brown | green | yellow | grey | pink | blue | red | purple | GND |

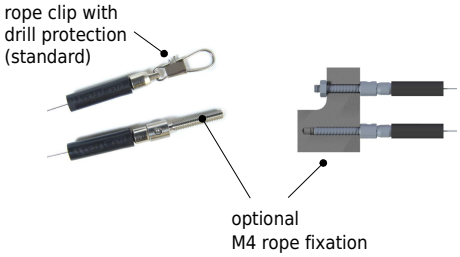
| | |
|---|---|
| + V: | Encoder power supply +VDC |
| 0 V: | Encoder power supply GND (0 V) |
| C+, C-: | Clock signal |
| D+, D-: | Data signal |
| SET: | SET Input |
| DIR: | Direction input: If this input is active, output values are counted backwards (decrease) when the shaft is turning clockwise. |
| H: | Plug connector housing (Shield) |

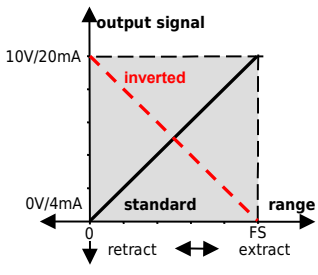
# OPTIONS

The following table gives an overview of frequently used options, with which the standard sensors can be equipped. Please pay attention that not all options can be combined. You will find the not-combinable options on page 14 and 15 in the section of the product codes.

| Option | Order code | Description |
|---|---|---|
| **Increased extraction force**<br>only in combination with analog output | HG | A reinforced spring drive provides a greater rope tension and allows a higher rope acceleration. Please note the different dimensions of the housing. (not available for ranges 125/375/625/1250 mm) |
| **Protection class IP67**<br>(instead of IP65) | IP67 | Use option IP67, if the sensor will operate in a humid environment.<br>Note that with this option there may occur a light hysteresis in the output signal due to the special sealing<br>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>only in combination with analog output | ICP | Components of the housing and the rope drum get HARTCOAT® coated.<br>Includes the options CP, IP67 and M4. |
| **Increased temperature range Low**<br>only in combination with analog output | T40 | Special components and a low temperature grease make a working temperature down to -40 °C (up to +85°C) possible. |
| **Increased temperature range High**<br>only in combination with potentiometer 1R | T120 | Sensors with potentiometer output (1R) and cable output can be operated from -20 to +120 °C when this option is used. (NOT in combination with voltage-, current- or digital output signals) |
| **Changed rope outlet** | S1, S2, S3 | S1: rope outlet sideways at the top<br>S2*: rope outlet sideways at the bottom<br>S3*: rope outlet on the bottom<br><br>* with modified mounting plate, see page 13 |
| **Changed cable or connector orientation**<br>only for digital incremental output and digital absolute output | K1, K2, K3 | Standard: sideways, opposite to the rope outlet<br>K1: at the top<br>K2: sideways, same side as the rope outlet<br>K3: at the bottom |
| **Rope fixation by M4 thread** | M4 | Optional, pivoted rope fixation with screw thread M4, length 22 mm. Ideal for attachment to through holes or thread holes M4. |
| **Ring eye** | RI | The end of the wire rope is equipped with a ring eye instead of a rope clip.<br>Inside diameter 20 mm |
| **Inverted output signal**<br>only in combination with analog output | IN | 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. |
| **Synthetic wire rope**<br>(instead of stainless steel wire rope) | COR | Synthetic wire rope, made out of abrasion resistant and enhanced Coramid.<br>(not available for ranges 50/150/250/750/1000/1250 mm) |



# ACCESSORIES

**Deflection pulley - UR2**

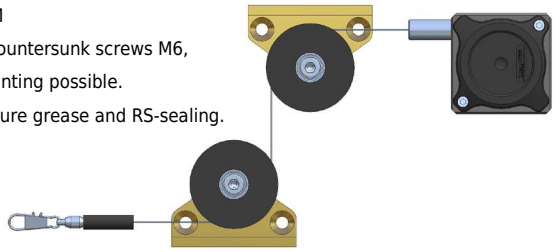
The rope must be extracted from the sensor **vertically**. The maximum variation from the vertical is 3°. A deflection pulley allows a change in the direction of the wire rope. Several pulleys may be used. The rope clip must not be guided over the deflection pulley.

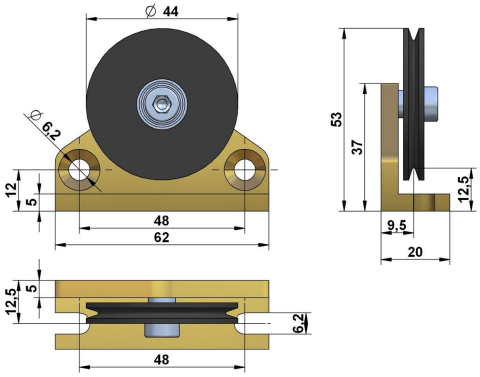
Material: anodised aluminium, POM

Mounting: by 2 hexagon socket or countersunk screws M6, vertical or horizontal mounting possible.

Ball bearings: with special low temperature grease and RS-sealing.

Temperature: -40...+80 °C.






**Rope extension - SV**

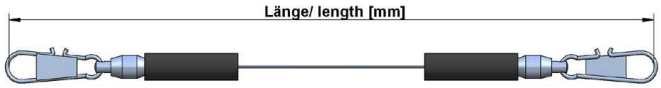
For bridging a greater distance between the measuring target and the sensor a rope extension can be applied. The rope clip must not be guided over the deflection pulley.

Please specify the length needed in your order (XXXX). The minimum length is 150 mm:

SV1-XXXX: rope extension (150...4995 mm)

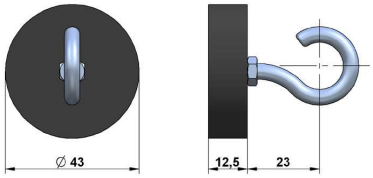
SV2-XXXX: rope extension (5000...19995 mm)

SV3-XXXX: rope extension (20000...40000 mm)



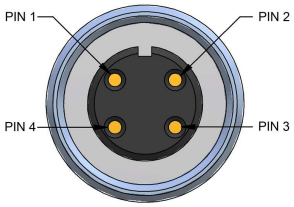

**Magnetic clamp - MGG1**

Use the magnetic clamp to quickly attach the rope to metallic objects without any assembly time. A rubber coating provides gentle contact (e. g. on varnished surfaces) and prevents from slipping due to vibration.
The magnet consists of a neodym core for an increased adhesive force of 260 N. The hook makes it easy to attach the rope clip.




# ACCESSORIES ANALOG Output

| Cable with connector M12, 4 poles, shielded | |
|---|---|
| K4P2M-S-M12 | 2 m, connector straight, IP67 |
| K4P5M-S-M12 | 5 m, connector straight, IP67 |
| K4P10M-S-M12 | 10 m, connector straight, IP67 |
| K4P2M-SW-M12 | 2 m, connector angular, IP67 |
| K4P5M-SW-M12 | 5 m, connector angular, IP67 |
| K4P10M-SW-M12 | 10 m, connector angular, IP67 |




| PIN No. | cable colour | PIN No. | cable colour |
|---|---|---|---|
| Pin 1 | brown | Pin 3 | blue |
| Pin 2 | white | Pin 4 | black |

| Mating Connector M12, 4 poles, shielded, IP67 | |
|---|---|
| D4-G-M12-S | straight, M12 for self assembly |
| D4-W-M12-S | angular, M12 for self assembly |
| | cable passage: ø 4...8 mm |
| | wire cross-section: 0.14...0.34 mm² |

**Digital display - PAXD ( for Potentiometer)**

Use the PAXD display to visualise the measured distance of the position transducer with a potentiometer as sensor element. A transmission of the measurement data to a computer or PLC can be done with interface plug-in cards.

| | |
|---|---|
| Input: | Potentiometer signal |
| Analog output (plug-in cards): | 0...20 mA, 4...20 mA, 0...10 V |
| Serial interfaces (plug-in cards): | RS485, RS232, DeviceNet, USB, Profibus, Relay output, Transistor output |
| Protection class: | IP65 (Front panel) |
| Display: | 5 digits |
| PAXD000B: | 1 channel, power supply: 85 to 250 VAC |
| PAXD001B: | 1 channel, power supply:: 11 to 36 VDC/24 VAC |


For further information please see the data sheet of the PAXD display series

# ACCESSORIES ANALOG OUTPUT

**Digital displays PAXP (1 channel) and PAXDP (2 channels) for sensors with analog output signals 0..10 V or 4..20 mA**

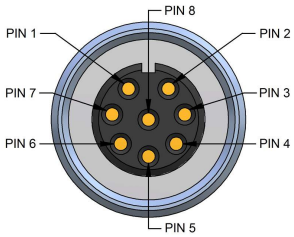
Use the PAXD or PAXDP display to visualise the measured distance of transducers with an analog output signal.
A transmission of the measurement data to a computer or PLC can be done with interface plug-in cards.


| | |
|---|---|
| Inputs: | 0...10 V or 4...20 mA, 2 independent counters (for PAXDP) |
| Analog output (plug-in cards): | 0...20 mA, 4...20 mA, 0...10 V |
| Serial interfaces (plug-in cards): | RS485, RS232, DeviceNet, USB, Profibus, Relay output, Transistor output |
| Protection class: | IP65 (front panel) |
| Display: | 5 digits |
| PAXP000B: | 1 channel, power supply: 85 to 250 VAC |
| PAXP001B: | 1 channel, power supply: 11 to 36 VDC/24 VAC |
| PAXDP000B: | 2 channels, power supply: 85 to 250 VAC |
| PAXDP001B: | 2 channels, power supply: 11 to 36 VDC/24 VAC |

For further information please see the PAXD and PAXDP data sheet.

# ACCESSORIES DIGITAL OUTPUT INCREMENTAL

| Cable with connector M12, 8 poles, shielded | |
|---|---|
| K8P2M-S-M12 | 2 m, connector straight, IP67 |
| K8P5M-S-M12 | 5 m, connector straight, IP67 |
| K8P10M-S-M12 | 10 m, connector straight, IP67 |
| K8P2M-SW-M12 | 2 m, connector angular, IP67 |
| K8P5M-SW-M12 | 5 m, connector angular, IP67 |
| K8P10M-SW-M12 | 10 m, connector angular, IP67 |




| PIN No. | cable colour | PIN No. | cable colour | PIN No. | cable colour | PIN No. | cable colour |
|---|---|---|---|---|---|---|---|
| Pin 1 | white | Pin 3 | green | Pin 5 | grey | Pin 7 | blue |
| Pin 2 | brown | Pin 4 | yellow | Pin 6 | pink | Pin 8 | red |

| Mating connector M12, 8 poles, shielded, IP67 | |
|---|---|
| D8-G-M12-S | mating connector straight |
| D8-W-M12-S | mating connector angular |
| | cable passage: ø 4...8 mm |
| | wire diameter: 0.14...0.34 mm² |

**Digital distance and speed display - WAY-D for incremental output signals**

Use the WAY-D display to visualise the measured distance or the speed (tachometer) of the position transducer. A transfer of data to a PC or PLC can be done with the RS232 interface of the WAY-DR.

| | |
|---|---|
| Protection class: | IP65 (front panel) |
| Display: | 6 digits |
| Supply: | 115 / 250 VAC |


Output Linedriver L (TTL, RS422):

| | |
|---|---|
| WAY-DS-5VH: | display only, input level TTL |
| WAY-DG-5VH: | display with two presets and switching outputs, input level TTL |
| WAY-DR-5VH: | display with serial interface RS232 / RS485, input level TTL |

Output Push-Pull G:

| | |
|---|---|
| WAY-DS: | display only, input level HTL |
| WAY-DG: | display with two presets and switching outputs, input level HTL |
| WAY-DR: | display with serial interface RS232 / RS485, input level HTL |

For further information please see the WAY-D data sheet.

# ACCESSORIES DIGITAL OUTPUT ABSOLUTE SSI

**Digital distance and speed display - WAY-SSI for SSI output signals**

Use the WAY-SSI display to visualise the measured distance or the speed (tachometer) of the position transducer.
A transfer of data to a PC or PLC can be done with the RS232 interface of the WAY-SSI-R.

| | |
|---|---|
| Protection class: | IP65 (front panel) |
| Display: | 6 digits |
| Supply: | 115 / 250 VAC |


| | |
|---|---|
| WAY-SSI-S: | display only |
| WAY-SSI-A: | display with analog output |
| WAY-SSI-G: | display with two presets and switching outputs |
| WAY-SSI-R: | display with serial interface RS232 / RS485 |

For further information please see the WAY-SSI data sheet.

# MECHANICAL DATA

| Measurement Range | Extraction force | | Speed* | Acceleration* | Increased extraction force: Option HG | | Acceleration HG |
|---|---|---|---|---|---|---|---|
| [mm] | $F_{min}$ [N] | $F_{max}$ [N] | $V_{max}$ [m/s] | $a_{max}$ [m/s²] | $F_{min}$ [N] | $F_{max}$ [N] | $a_{max}$ [m/s²] |
| 50 | 5.8 | 6.2 | 8.0 | 200 | 13.2 | 13.7 | 400 |
| 75 | 3.6 | 3.8 | 8.0 | 200 | 7.3 | 7.9 | 400 |
| 100 | 3.4 | 3.6 | 8.0 | 200 | 5.9 | 6.4 | 400 |
| 125 | 4.2 | 4.4 | 10.0 | 300 | - | - | - |
| 150 | 6.0 | 6.8 | 8.0 | 200 | 13.2 | 13.7 | 400 |
| 225 | 4.2 | 4.4 | 8.0 | 200 | 7.3 | 8.3 | 400 |
| 250 | 5.0 | 6.4 | 8.0 | 200 | 13.2 | 13.7 | 400 |
| 300 | 2.8 | 3.2 | 8.0 | 200 | 5.9 | 6.7 | 400 |
| 375 | 4.0 | 4.4 | 10.0 | 300 | - | - | - |
| 500 | 3.0 | 3.6 | 8.0 | 200 | 5.9 | 6.9 | 400 |
| 625 | 4.4 | 5.2 | 10.0 | 300 | - | - | - |
| 750 | 3.2 | 4.4 | 8.0 | 200 | 7.3 | 9.8 | 400 |
| 1000 | 2.8 | 3.4 | 8.0 | 200 | 5.9 | 7.9 | 400 |
| 1250 | 4.6 | 5.6 | 10.0 | 300 | - | - | - |

* reduced to 60 % when option IP67 is used

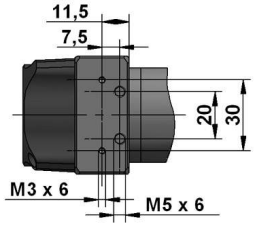
# INSTALLATION

- Mount the sensor at the designated place by using the fixing holes before extracting the rope and before attaching the rope to the measuring target.

- Open the rope clip after the sensor is fully mounted and extract the measuring rope. Hook the rope clip on the measuring object and close the bracket of the clip. For safety reasons put a screw driver trough the clip to extract the rope.
- Check the track of the measuring target on collision with the sensor housing and on exceeding the specified measurement range. When installing the sensor make sure that the rubber stopper does not touch the rope outlet.
- Connect the electronics according to the sensor type. When laying the cables be careful not to under-run the minimal allowed bending radius of the cable (5 x cable diameter).
- **The rope must be extracted from the sensor vertically**. The maximum variation from the vertical is 3°. Avoid carefully extracting the rope at an inclination, since the durability of the instrument would shorten considerably. If it is not possible to keep the limit of 3°, a deflection pulley has to be used.
- The measuring range begins after approximately 2 mm extracted rope (=**zero point)**. The mechanical reserve at the end of the measuring range is about 20 mm.
- When mounting outdoors protect the sensor and the rope from icing at temperatures below 0 °C.
- Guide the rope preferably in corners or guarded in channels to prevent pollution or accidental touch.
- When operating the sensor, take care **not to let the rope snap back** by mistake or extract the rope **over the specified measurement range,** as this might destroy the sensor.
- Maintenance: These instruments are maintenance-free. If however, the rope is soiled due to adverse environmental conditions, it can be cleaned with a cloth drenched in resin-free machine oil.

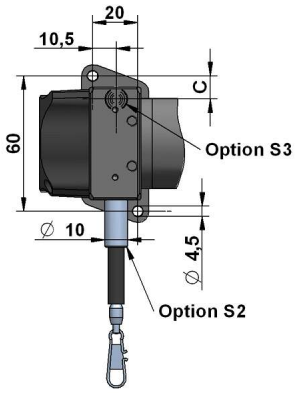
**Mounting: standard rope outlet, rope outlet sideways top (S1)**

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

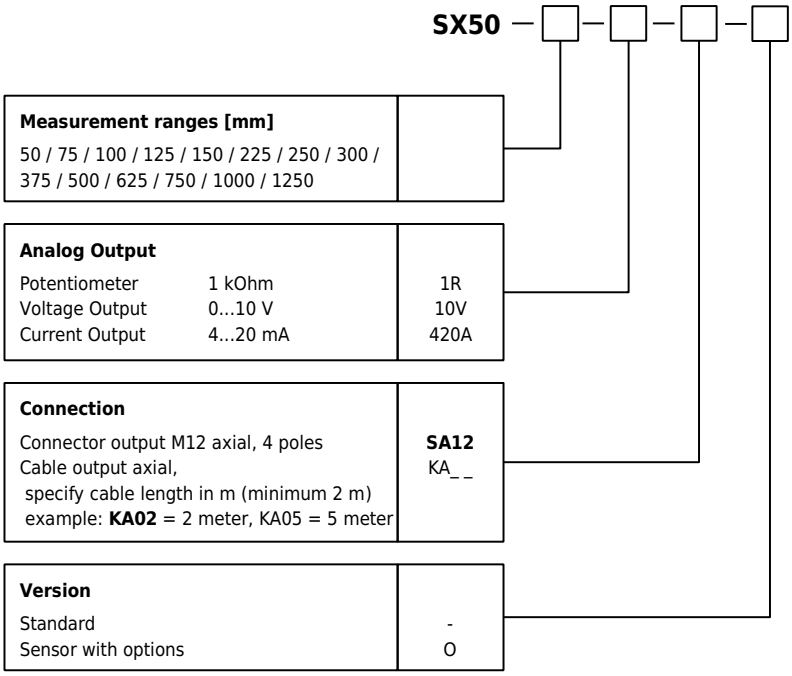



**Mounting: rope outlet sideways bottom (S2), rope outlet bottom (S3)**

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



## ORDER CODE ANALOG OUTPUT



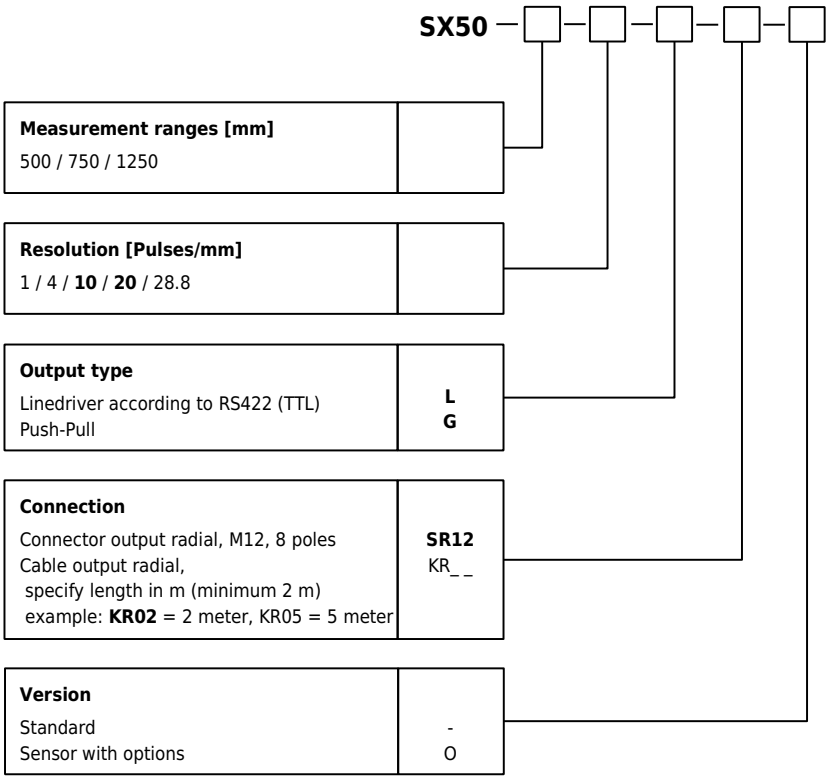

| | | |
|---|---|---|
| **Measurement ranges [mm]**<br>50 / 75 / 100 / 125 / 150 / 225 / 250 / 300 / 375 / 500 / 625 / 750 / 1000 / 1250 | | |
| **Analog Output** | | |
| Potentiometer | 1 kOhm | 1R |
| Voltage Output | 0...10 V | 10V |
| Current Output | 4...20 mA | 420A |
| **Connection** | | |
| Connector output M12 axial, 4 poles | | **SA12** |
| Cable output axial,<br>specify cable length in m (minimum 2 m)<br>example: **KA02** = 2 meter, KA05 = 5 meter | | KA_ _ |
| **Version** | | |
| Standard | | - |
| Sensor with options | | O |

| Option | Description |
|---|---|
| M4 | rope fixation M4 thread |
| COR | synthetic wire rope, made out of Coramid |
| RI | ring eye (instead of rope clip) |
| S1 | rope outlet sideways top |
| S2 | rope outlet sideways bottom |
| S3 | rope outlet bottom |
| IN | inverted output signal |
| L05 | improved linearity 0.05 % |
| L10 | improved linearity 0.10 % |
| HG | Increased extraction force |
| T40 | increased temperature range low -40...+85°C |
| T120 | increased temperature range high -20...+120 °C |
| IP67 | protection class IP67 |
| CP | corrosion protection SX50 |
| ICP | increased corrosion protection SX50 |

| Option | not combinable with |
|---|---|
| M4 | CP, ICP |
| COR | ranges 50/150/250/750/1000/1250 mm |
| RI | CP, ICP |
| HG | IP67, ranges 125/375/625/1250 mm |
| T40 | L05, L10 |
| T120 | IP67, COR, CP, ICP, 10V, 420A, SA12 |
| IP67 | HG, TEMP120, ICP |
| CP | M4, RI |
| ICP | IP67, M4, RI |

**Bold text**: standard with shorter lead time

## ORDER CODE DIGITAL OUTPUT INCREMENTAL




| | | |
|---|---|---|
| **Measurement ranges [mm]**<br>500 / 750 / 1250 | | |
| **Resolution [Pulses/mm]**<br>1 / 4 / **10** / **20** / 28.8 | | |
| **Output type** | | |
| Linedriver according to RS422 (TTL) | | **L** |
| Push-Pull | | **G** |
| **Connection** | | |
| Connector output radial, M12, 8 poles | | **SR12** |
| Cable output radial,<br>specify length in m (minimum 2 m)<br>example: **KR02** = 2 meter, KR05 = 5 meter | | KR_ _ |
| **Version** | | |
| Standard | | - |
| Sensor with options | | O |

| Option | Description |
|---|---|
| M4 | rope fixation M4 thread |
| COR | synthetic wire rope, made out of Coramid |
| RI | ring eye (instead of rope clip) |
| S1 | rope outlet sideways top |
| S2 | rope outlet sideways bottom |
| S3 | rope outlet bottom |
| K1 | cable/connector orientation top |
| K2 | cable/connector orientation left |
| K3 | cable/connector orientation bottom |
| L02 | improved linearity 0.02 % |
| IP67 | protection class IP67 |
| CP | corrosion protection SX50 |

| Option | not combinable with |
|---|---|
| M4 | CP |
| COR | ranges 750/1250 mm |
| RI | CP |
| L02 | resolutions 1 / 4 / 10 |
| CP | M4, RI |

**Bold text**: standard with shorter lead time

# ORDER CODE DIGITAL OUTPUT ABSOLUTE

**SX50** — □ — □ — □ — □

| **Measurement ranges [mm]** | |
|---|---|
| 500 / 750 / 1250 | |
| **Interfaces / Bus systems** | |
| SSI | SSI |
| CANopen | CAN |
| **Output** | |
| Cable output tangential, 1 m, PUR | KT01 |
| Cable output tangential, 5 m, PUR | KT05 |
| **Version** | |
| Standard | - |
| Sensor with options | O |

| **Option** | **Description** |
|---|---|
| M4 | rope fixation M4 thread |
| COR | synthetic wire rope, made out of Coramid |
| RI | ring eye (instead of rope clip) |
| S1 | rope outlet sideways top |
| S2 | rope outlet sideways bottom |
| S3 | rope outlet bottom |
| K1 | cable/connector orientation top |
| K2 | cable/connector orientation left |
| K3 | cable/connector orientation bottom |
| IP67 | protection class IP67 |
| CP | corrosion protection SX50 |

| **Option** | **not combinable with** |
|---|---|
| M4 | CP |
| COR | ranges 750/1250 mm |
| RI | CP |
| CP | M4, RI |

# ACCESSORIES ANALOG OUTPUT

| **Cable with mating connector M12, 4 poles, shielded** | |
|---|---|
| K4P2M-S-M12 | 2 m, straight connector |
| K4P5M-S-M12 | 5 m, straight connector |
| K4P10M-S-M12 | 10 m, straight connector |
| K4P2M-SW-M12 | 2 m, angular connector |
| K4P5M-SW-M12 | 5 m, angular connector |
| K4P10M-SW-M12 | 10 m, angular connector |

| **Mating Connector M12, 4 poles, shielded** | |
|---|---|
| D4-G-M12-S | straight, M12 for self assembly |
| D4-W-M12-S | angular, M12 for self assembly |

| **Digital display 1 channel, 0...10V/4...20 mA** | |
|---|---|
| PAXP000B | 1 channel, supply: 85 to 250 VAC |
| PAXP001B | 1 channel, supply: 11...36 VDC/24 VAC |

| **Digital display 2 channels, 0...10V/4...20 mA** | |
|---|---|
| PAXDP00B | 2 channels, supply: 85 to 250 VAC |
| PAXDP01B | 2 channels, supply: 11...36 VDC/24 VAC |

| **Digital display 1 channel, Potentiometer** | |
|---|---|
| PAXD000B | 1 channel, supply: 85 to 250 VAC |
| PAXD001B | 1 channel, supply: 11...36 VDC/24 VAC |

# ACCESSORIES DIGITAL OUTPUT INCREMENTAL

| **Cable with mating connector M12, 8 poles, shielded** | |
|---|---|
| K8P2M-S-M12 | 2 m, straight connector |
| K8P5M-S-M12 | 5 m, straight connector |
| K8P10M-S-M12 | 10 m, straight connector |
| K8P2M-SW-M12 | 2 m, angular connector |
| K8P5M-SW-M12 | 5 m, angular connector |
| K8P10M-SW-M12 | 10 m, angular connector |

| **Mating Connector M12, 8 poles, shielded** | |
|---|---|
| D8-G-M12-S | straight, M12 for self assembly |
| D8-W-M12-S | angular, M12 for self assembly |

| **Digital display 1 channel, Linedriver L (input level TTL, RS422)** | |
|---|---|
| WAY-DS-5VH | display only |
| WAY-DG-5VH | display with two presets and switching outputs |
| WAY-DR-5VH | display with serial interface RS232 / RS485 |

| **Digital display 1 channel, Push-Pull G** | |
|---|---|
| WAY-DS | display only |
| WAY-DG | display with two presets and switching outputs |
| WAY-DR | display with serial interface RS232 / RS485 |



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