OPERATING INSTRUCTIONS

MPS-M

Position sensor

SICK
Sensor Intelligence.

Described product

MPS-M

Manufacturer

SICK AG
Erwin-Sick-Str. 1
79183 Waldkirch
Germany

Legal information

Original document

This document is an original document of SICK AG.

Contents

1 About this document

1.1 Information on the operating instructions

These operating instructions provide important information on how to use sensors from SICK AG.

Prerequisites for safe work are:

- Compliance with all safety notes and handling instructions supplied.
- Compliance with local work safety regulations and general safety regulations for sensor applications.

The operating instructions are intended to be used by qualified personnel and electrical specialists.

NOTE
Read these operating instructions carefully before starting any work on the sensor, in order to familiarize yourself with the sensor and its functions.

The instructions constitute an integral part of the product and are to be stored in the immediate vicinity of the sensor so they remain accessible to staff at all times. If the sensor is passed on to a third party, these operating instructions should be handed over with it.

These operating instructions do not provide information on operating the machine in which the sensor is integrated. For information about this, refer to the operating instructions of the particular machine.

1.2 Further information

You can find the product page with further information via the SICK Product ID:
pid.sick.com/{P/N}/{S/N}
(see "Product identification via the SICK product ID", page 9).

The following information is available depending on the product:

- This document in all available language versions
- Data sheets
- Other publications
- CAD files and dimensional drawings
- Certificates (e.g., declaration of conformity)
- Software
- Accessories

1.3 Symbols and document conventions

Warnings and other notes

DANGER
Indicates a situation presenting imminent danger, which will lead to death or serious injuries if not prevented.

WARNING
Indicates a situation presenting possible danger, which may lead to death or serious injuries if not prevented.

CAUTION
Indicates a situation presenting possible danger, which may lead to moderate or minor injuries if not prevented.

NOTICE
Indicates a situation presenting possible danger, which may lead to property damage if not prevented.

NOTE
Highlights useful tips and recommendations as well as information for efficient and trouble-free operation.

Instructions to action

► The arrow denotes instructions to action.

1. The sequence of instructions is numbered.
2. Follow the order in which the numbered instructions are given.

✓ The tick denotes the results of an action.

2 Safety information

2.1 Intended use

The sensor from the MPS-M product family is an intelligent, magnetic position sensor. It is used for non-contact detection of the piston stroke of pneumatic drives with axially magnetized permanent magnets.

SICK AG assumes no liability for losses or damage arising from the use of the product, either directly or indirectly. This applies in particular to use of the product that does not conform to its intended purpose and is not described in this documentation.

2.2 Improper use

- The sensor does not constitute a safety-relevant device according to the EC Machinery Directive (2006/42/EC).
- The sensor must not be used in explosion-hazardous areas.
- Any other use that is not described as intended use is prohibited.
- Any use of accessories not specifically approved by SICK AG is at your own risk.
- The sensor is not suitable for outdoor applications.

NOTICE
Danger due to improper use!

Any improper use can result in dangerous situations.

Therefore, take note of the following information:

► The sensor should be used only in line with intended use specifications.
► All information in these operating instructions must be strictly complied with.

2.3 Limitation of liability

Applicable standards and regulations, the latest state of technological development, and our many years of knowledge and experience have all been taken into account when assembling the data and information contained in these operating instructions. The manufacturer accepts no liability for damage caused by:

- Failing to observe the operating instructions
- Improper use
- Use by untrained personnel
- Unauthorized conversions
- Technical modifications
- Use of unauthorized spare parts, consumables, and accessories

With special variants, where optional extras have been ordered, or owing to the latest technical changes, the actual scope of delivery may vary from the features and illustrations shown here.

2.4 Requirements for skilled persons and operating personnel

WARNING
Risk of injury due to insufficient training.

Improper handling of the sensor may result in considerable personal injury and material damage.

- All work must only ever be carried out by the stipulated persons.

The operating instructions state the following qualification requirements for the various areas of work:

- **Instructed personnel** have been briefed by the operating entity about the tasks assigned to them and about potential dangers arising from improper action.
- **Skilled personnel** have the specialist training, skills, and experience, as well as knowledge of the relevant regulations, to be able to perform tasks assigned to them and to detect and avoid any potential dangers independently.
- **Electricians** have the specialist training, skills, and experience, as well as knowledge of the relevant standards and provisions to be able to carry out work on electrical systems and to detect and avoid any potential dangers independently. In Germany, electricians must meet the specifications of the BGV A3 Work Safety Regulations (e.g., Master Electrician). Other relevant regulations applicable in other countries must be observed.

The following qualifications are required for various activities:

Activities	Qualification
Mounting, maintenance	▪ Basic practical technical training ▪ Knowledge of the current safety regulations in the workplace
Electrical installation, device replacement	▪ Practical electrical training ▪ Knowledge of current electrical safety regulations ▪ Knowledge of the operation and control of the devices in their particular application
Commissioning, configuration	▪ Basic knowledge of the design and setup of the described connections and interfaces ▪ Basic knowledge of data transmission ▪ Knowledge of the operation and control of the devices in their particular application
Operation of the devices in their particular application	▪ Knowledge of the operation and control of the devices in their particular application ▪ Knowledge of the software and hardware environment in the application

2.5 Hazard warnings and operational safety

Please observe the safety notes and the warnings listed here and in other chapters of these operating instructions to reduce the possibility of risks to health and avoid dangerous situations.

3 Product description

3.1 Product identification via the SICK product ID

SICK product ID

The SICK product ID uniquely identifies the product. It also serves as the address of the web page with information on the product.

The SICK product ID comprises the host name pid.sick.com, the part number (P/N), and the serial number (S/N), each separated by a forward slash.

The SICK product ID is displayed as text and QR code on the type label and/or on the packaging.

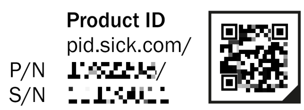


Figure 1: SICK product ID

3.2 Device view

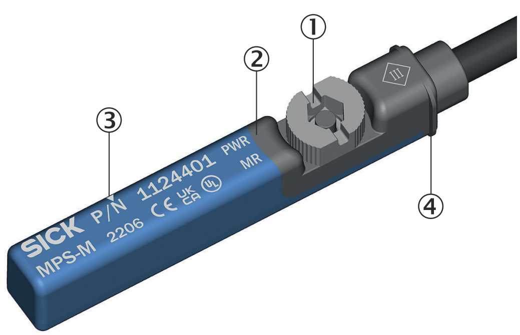


Figure 2: Operating elements and status indicators

① Fixing screw, size 2.5
② 2 x LED(**PWR** (green) = Voltage supply, **MR** (yellow) = measuring range)
③ Physical zero position
④ Retaining ribs

3.3 Product characteristics

3.3.1 Product features

The MPS-M is used as a position sensor for non-contact linear position measurement mainly on pneumatic cylinders, grippers, and slides. When using IO-Link, up to 8 switching points can also be set and additional actuator diagnostic data can be recorded and output:

- Stroke traveled
- Cycle time
- Dwell time of the piston
- Travel time of the piston
- Average piston velocity
- Current measured field strength
- Maximum measured field strength
- Cycle count
- Total distance traveled by the piston

- Operating hours
- Power-on / power-off cycles

A description of the diagnostic functions can be found in section 8.2.4.

Target applications

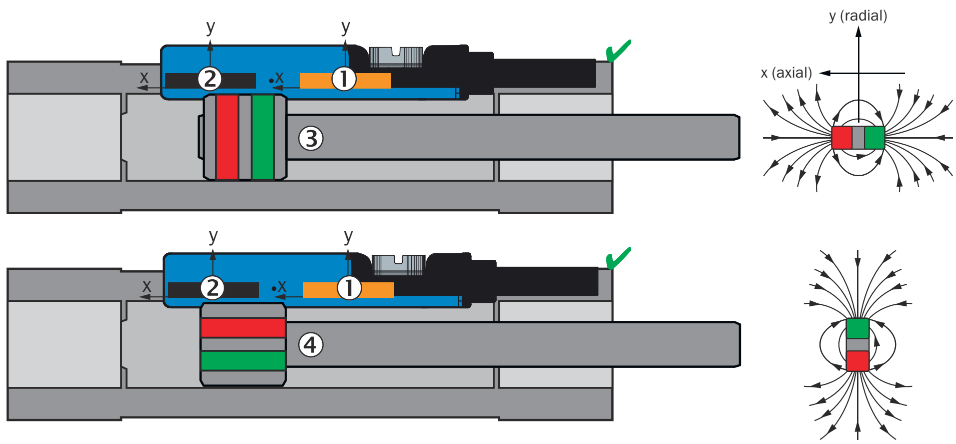
- Analog position measurement for short stroke in systems without IO-Link
- Position measurement for short stroke in systems with IO-Link
- Detection of 8 positions via 8 switching points with IO-Link

3.4 Operating principle

3.4.1 Principle of operation

The MPS-M determines the position of an encoder magnet via a row of 2 sensor elements located in the sensor head.

Axially and diametrically magnetized magnets can be detected since the two sensor elements measure the field strength in both the X- and Y-direction.



① Sensor element 1
② Sensor element 2
③ Axially magnetized magnet
④ Diametrically magnetized magnet

3.4.2 Detection range

The sensor is designed for a detection range of 50 mm. The zero point / physical zero position is marked with a triangle on the sensor head. The distance from the zero point to the cable is -25 mm, and to the top of the sensor head is + 25 mm.

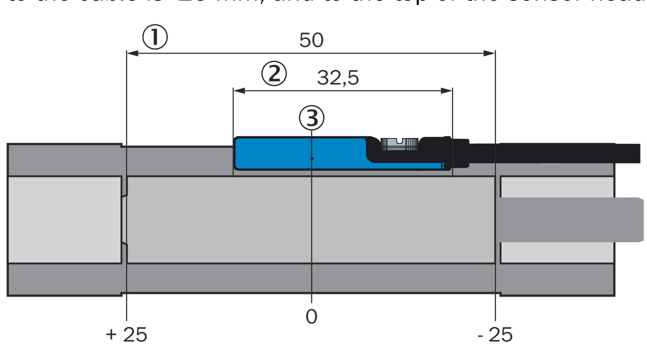


Figure 3: Detection range

① Detection range
② Housing length
③ Zero point / physical zero position

3.4.3 Position output

The sensor can output a linearized position in a detection range of approx. 50 mm (depends on the drive).

- Via IO-Link, the detection range of 50 mm (-25 mm ... 25 mm) corresponds to 5,000 digits (-2,500 digits...2,500 digits). I.e., 1 digit corresponds to 10 µm. When leaving the detection range, the value 32,760 or -32,760 digits1) is displayed. If the field strength is no longer sufficient, 32,764 is output as per the Smart Sensor profile.
- Via the analog output, the detection range of 50 mm (-25 mm ... 25 mm) corresponds to the analog output values of 0-10 V. When leaving the measuring range, 11 V or 10.5 V are output.

NOTE
The **Out-of-Range** display via the analog output or via IO-Link is always active. It is not possible to manually deactivate/activate the **Out-of-Range** display.

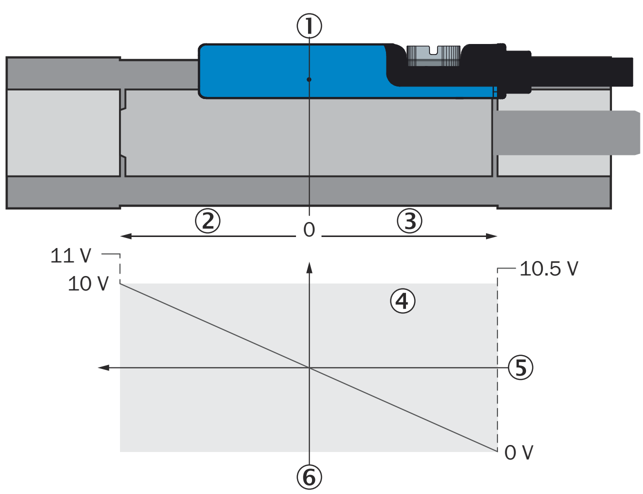


Figure 4: Zero point / physical zero position for analog output

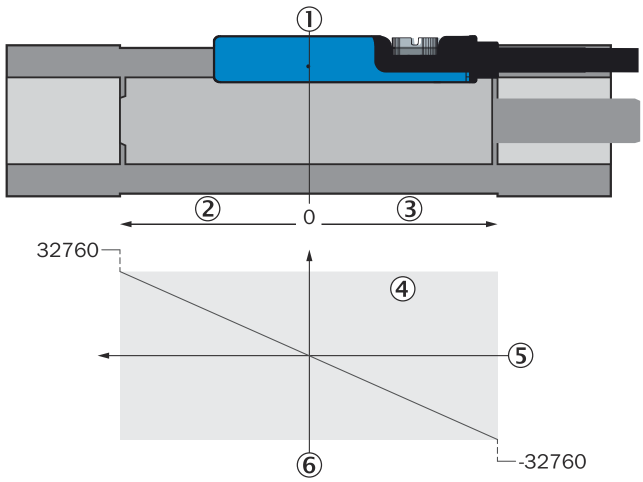


Figure 5: Zero point / physical zero position for IO-Link output

① Zero point / physical zero position
② Positive positions
③ Negative positions
④ Sensor detection range:

0 ... 10 V (analog output)

2,500 ... -2,500 digits (IO-Link output)

⑤ Piston position
⑥ Sensor position output

3.5 Operating and status indicators

3.5.1 Status indicators

There are 2 LEDs on the sensor. The **Power** LED lights up green and the measuring range LED yellow.

The table below describes the individual function displays.

Table 1: Function of the LEDs

Sensor condition	LED 1 (MR) (yellow)		LED 2 (PWR) (green)	
	Display	Meaning	Display	Meaning
SIO	● Lights up	Magnet inside the measuring range	● Lights up	Power ok
	○ Does not light up	Magnet outside the measuring range		
IO-Link	no function[1]		◐ Flashing	IO-Link active
Error	No error display via LEDs			

1 During position measurement via IO-Link, only LED2 (PWR) flashes

4 Transport and storage

4.1 Transport

For your own safety, please read and observe the following notes:

NOTE
Damage to the sensor due to improper transport.

- The device must be packaged for transport with protection against shock and damp.
- Transport should be performed by specialist staff only.
- The utmost care and attention is required at all times during unloading and transportation on company premises.
- Note the symbols on the packaging.
- Do not remove packaging until immediately before you start mounting.

4.2 Transport inspection

Immediately upon receipt at the receiving work station, check the delivery for completeness and for any damage that may have occurred in transit. In the case of transit damage that is visible externally, proceed as follows:

- Do not accept the delivery or only do so conditionally.
- Note the scope of damage on the transport documents or on the transport company's delivery note.
- File a complaint.

NOTE
Complaints regarding defects should be filed as soon as these are detected. Damage claims are only valid before the applicable complaint deadlines.

4.3 Storage

Store the device under the following conditions:

- Recommendation: Use the original packaging.
- Do not store outdoors.
- Store in a dry area that is protected from dust.
- To allow any residual dampness to evaporate, do not package in airtight containers.
- Do not expose to any aggressive substances.
- Protect from sunlight.
- Avoid mechanical shocks.
- Do not expose to strong magnetic fields.
- Storage temperature: see "Technical data", page 33.
- Relative humidity: see "Technical data", page 33.

5 Mounting

5.1 Mounting requirements

- Comply with technical parameters such as the permitted ambient conditions for the operation of the sensor (e.g., temperature range, EM interference), see "Technical data", page 33.
- Protect the sensor from direct sunlight.
- Only mount sensor with the intended accessories.

Mounting location

When selecting the mounting location, the following factors must be considered:

- The mounting location must be as free from (electro)magnetic disturbance fields as possible

5.2 Mounting

Insert sensor into the slot from above. The **PWR LED**[1] lights up green.

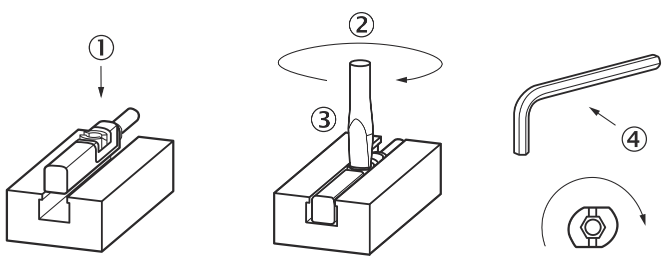


Figure 6: Installation steps

① Insert sensor
② Tighten screw
③ Tightening torque typ. 0.7 Nm
④ AF 2.5 (alternatively, use a 2.5 mm hex key)

NOTE
When tightening the screw, use a non-magnetic Allen key.

[1] PWR LED = Power LED

6 Electrical installation

6.1 Safety

6.1.1 Notes on electrical installation

CAUTION
Danger due to incorrect supply voltage!
An incorrect supply voltage may result in injuries from electric shocks and/or damage to the device.

- Only operate the sensor with safety/protective extra-low voltage (SELV/PELV).

NOTICE
Sensor damage or unpredictable operation due to working with live parts.
Working with live parts may result in unpredictable operation.

- Only carry out wiring work when the power is off.
- Only connect and disconnect electrical connections when the power is off.

- **The electrical installation must only be performed by electrically qualified personnel.**
- **Standard safety requirements must be observed when working on electrical systems!**
- Only switch on the supply voltage for the device when the connection tasks have been completed and the wiring has been thoroughly checked.
- When using extension cables with open ends, ensure that bare wire ends do not come into contact with each other (risk of short-circuit when supply voltage is switched on!). Wires must be appropriately insulated from each other.
- Wire cross-sections in the supply cable from the user's power system must be designed in accordance with the applicable standards. When this is being done in Germany, observe the following standards: DIN VDE 0100 (Part 430) and DIN VDE 0298 (Part 4) and/or DIN VDE 0891 (Part 1).
- Circuits connected to the device must be designed as SELV circuits (SELV = Safety Extra Low Voltage).
- Protect the device with a separate fuse at the start of the supply circuit.

The IP enclosure rating for the sensor is only achieved if the connected cable is completely screwed in.

6.1.2 Wiring instructions

NOTE
Pre-assembled cables can be found online at:

► www.sick.com/mps-m

Please observe the following wiring instructions:

- During installation, pay attention to the different cable groups. The cables are grouped into the following four groups according to their sensitivity to interference or radiated emissions:
  - Group 1: Cables very sensitive to interference, such as analog measuring cables
  - Group 2: Cables sensitive to interference, such as sensor cables, communication signals, bus signals

- Group 3: Cables which are a source of interference, such as control cables for inductive loads, motor brakes
- Group 4: Cables which are powerful sources of interference, such as output cables from frequency inverters, welding system power supplies, power cables

- ▶ Cables in groups 1, 2 and 3, 4 must be crossed at right angles, see figure 7.
- ▶ Cables in groups 1, 2 and 3, 4 must be routed in different cable ducts or metallic separators must be used, see figure 8 and see figure 9. This applies particularly where cables of devices with a high level of radiated emission, such as frequency converters, are laid parallel to sensor cables.

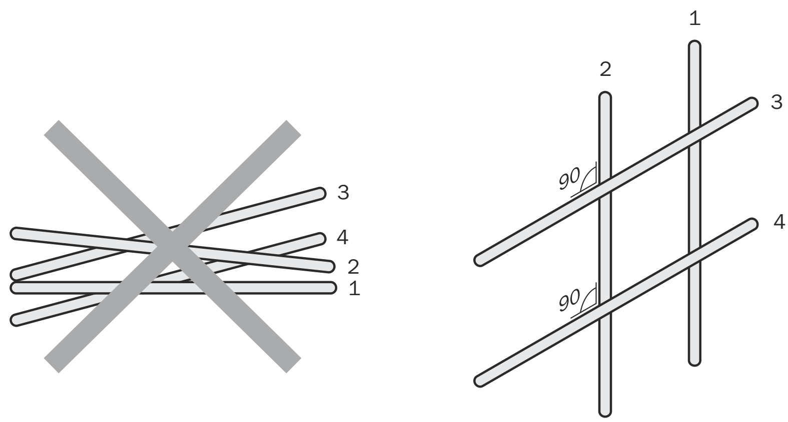


Figure 7: Cross cables at right angles

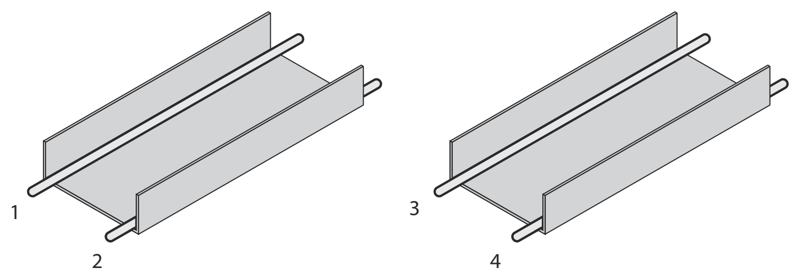


Figure 8: Ideal laying – Place cables in different cable ducts

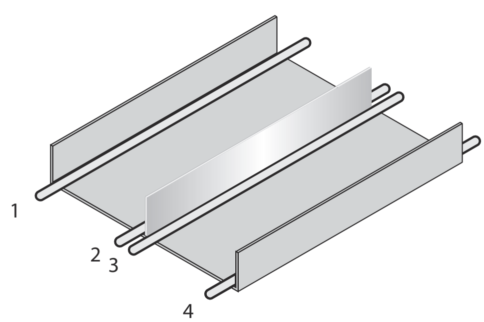


Figure 9: Alternative laying – Separate cables with metallic separators

NOTE
Prevent equipotential bonding currents via the cable shield with a suitable earthing method, see "Safety", page 15.

6.2 Connections

6.2.1 Pin assignment/Connection diagram + wire colors

Table 2: Wire assignment for flying leads, 4-wire

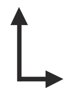
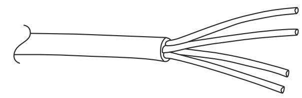
Pin	Connection	Pin assignment
1	BN	+ (L+)
2	WH	U_{OUT}
3	BU	- (M)
4	BK	IO-Link
	 0.08 mm² AWG 28	

Table 3: Pin assignment for male connector, M8, A-coded, 4-pin

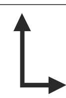
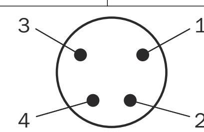
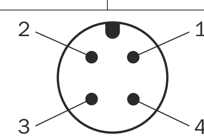
Pin	Connection	Pin assignment
1	BN	+ (L+)
2	WH	U_{OUT}
3	BU	- (M)
4	BK	IO-Link
		

Table 4: Pin assignment for male connector, M12, A-coded, 4-pin

Pin	Connection	Pin assignment
1	BN	+ (L+)
2	WH	U_{OUT}
3	BU	- (M)
4	BK	IO-Link
		

6.3 Connecting the supply voltage

The sensor must be connected to a voltage supply with the following properties:

- Supply voltage DC 13 V ... 30 V (SELV/PELV as per currently valid standards)
- Power source with at least 5 W power

Protecting the supply cables

To ensure protection against short-circuits/overload in the customer's supply cables, the wire cross-sections used must be appropriately selected and protected.

The following standards must be observed in Germany:

- DIN VDE 0100 (part 430)
- DIN VDE 0298 (part 4) and/or DIN VDE 0891 (part 1)

7 Commissioning

7.1 Overview of commissioning steps

- Connect the voltage supply.
- Commission the sensor using the factory settings.
- Configure the sensor.

7.2 Positioning on drive

To achieve the best possible performance, the sensor should be positioned centrally to the travel range of the magnet. The printed triangle on the sensor indicates the location of the physical zero position.

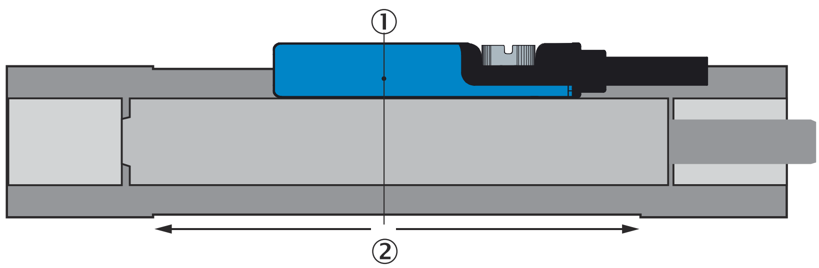


Figure 10: Positioning on drive

① Physical zero position

② Same distance in both directions

7.3 Put the sensor into operation for the first time

The sensor can optionally be operated with or without IO-Link.

If the sensor is operated via IO-Link, an associated IODD file with the appropriate version must be used. The IODD file can be downloaded at www.sick.com/mps-m. The production date in the IODD file name must match the production date on the sensor or packaging.

Teach-in procedure

For optimal sensor performance, move the drive through the entire range of movement of the drive roughly 5x. Not until teach-in is complete is the complete accuracy (minimal linearity error, correct display of measuring range) achieved. If switching points are taught before teach-in is complete, these change their position during the teach-in process. The teach-in process can be accelerated by running an **Application Reset** or **Factory Reset** or **Reset Trained Algorithm Parameter** via IO-Link after mounting the sensor. The sensor then only needs about two strokes to teach in the drive with sufficient accuracy. A detailed description of the **Application Reset** can be found in section 8.2.3.1.

Application measuring range

Monotonicity violations can occur in the edge region of drives, which in turn lead to pseudo-position detections in the edge region. To prevent this, the maximum possible measuring range of the application (drive) is determined by the sensor. The criterion for the limits of the application measuring range is the repeatability determined by the sensor.

The application measuring range can be read via IO-Link using index 16512 (0x4080) **MDC Descr**, subindex 1 (0x01) **Lower limit** and subindex 2 (0x02) **Upper limit**. The application measuring range can be influenced via the index 265 **Position noise limit for application range [mm]**:

Smaller value → Smaller application measuring range, better performance

Larger value → Larger application measuring range, poorer performance

By default, the sensor maps a measuring range of 50 mm (from - 25 mm to + 25 mm).

Analog measuring range scaling

The analog measuring range can be scaled to suit the stroke via index 207 (0xCF) **Set up analog output**. By default, the position -25 mm (-2,500 digits) corresponds to 0 V and the position +25 mm (2,500 digits) corresponds to 10 V. The analog voltage value range can be scaled for strokes shorter than 50 mm via the subindices 1 (0x01) **Measurement area start point** and 2 (0x02) **Measurement area end point** . This enables the entire analog value range from 0 to 10 V to be output even for strokes shorter than 50 mm. To do so, the desired start and end point must be entered in digits (1 digit = 10 µm) in the corresponding subindex.

8 Operation

8.1 General notes on operation

Up to 8 switching points can be taught in via IO-Link.

NOTE
The user is responsible for the correct teach process.

8.2 Operation via IO-Link

NOTE
When there is an active IO-Link connection, the analog output is deactivated and is therefore at 0 V.

8.2.1 Process data structure

IO-Link version: 1.1

Process data length 4 bytes

Byte offset								
Byte 0	31	30	29	28	27	26	25	24
Description	Measured value							
Data type	Integer 16							

Byte offset								16
Byte 1	23	22	21	20	19	18	17	16
Description	Measured value							
Subindex								1
Data type	Integer 16							

Byte offset								8
Byte 2	15	14	13	12	11	10	9	8
Description	Scale							
Subindex								2
Data type	Integer 8							

Byte offset	7	6	5	4	3	2	1	0
Byte 3	7	6	5	4	3	2	1	0
Description	Qint.X / Alert	Qint.X / Alert	Qint.X / Alert	Qint.X / Alert	Qint.X / Alert	Qint.X / Alert	Qint.X / Alert	Qint.X / Alert
Subindex	3	4	5	6	7	8	9	10
Data type	Boolean							

NOTE
Please note that the value of index 16512 **MDC Descr** subindex 1 and 2 (**Measurement Range**) may change during operation of the sensor (while the sensor is being taught-in for the drive).

8.2.2 General functions

The exact position is output in mm from -25 mm to +25 mm via byte 1 and 0 bit 16 to 31 of the process data. The scaling is specified by the sensor via byte 2 and up to 8 switching points can also be output via byte 3. Alternatively, alert notifications can be output via byte 3 instead of switching points.

For details, see Section see "Manual teach-in of up to 8 switching points", page 23.

8.2.3 Configuration options via IO-Link

The following settings can be configured using IO-Link:

- **Reset**
  - **Device Reset**
  - **Restore Factory Settings**
  - **Reset diagnostic parameters**
  - **Reset all present alerts**
  - **Reset operating hours counter**
  - **Reset power cycles counter**
  - **Reset actuator cycles counter**
  - **Reset total actuator travel**
  - **Reset all actuator diagnostics parameters**
  - **Application reset**
  - **Reset Trained Algorithm Parameter**
- **Position offset**
- Manual teach-in of up to 8 switching points
- Switching point modes
- Switching point logic (invert)
- Switching point hysteresis
- Switching point tolerance
- Switching point width
- Alert notifications

8.2.3.1 Reset

Device Reset

No values/settings are deleted during this restart except for the volatile parameters. An overview of the volatile and non-volatile parameters can be found below, (index 2 (0x02) **System Command**, value 128):

Table 5: Volatile and non-volatile parameters

Index	Object name	Volatile / non-volatile
4372 (0x1114)	**Actuator travel [x10 µm]**	Volatile
4380 (0x111C)	**Cycle time [ms]**	Volatile
4381 (0x111D)	**Dwell time [ms]**	Volatile
4379 (0x111B)	**Actuator travel time [ms]**	Volatile
4375 (0x1117)	**Average actuator velocity [m/s]**	Volatile
4602 (0x11FA)	**Current field strength [mT]**	Volatile
4604 (0x111FC)	**Peak field strength**	Volatile
4374 (0x1116)	**Total actuator travel [sum m]**	Non-volatile
4382 (0x111E)	**Cycle count [sum]**	Non-volatile
	Qint. 1-8 SP1 / SP2 **Qint. 1-8 Configuration**	Non-volatile

Restore Factory Settings

When this command is executed, all settings made are reset to their default values, but not the indices 4356 (0x1104 **Operating hours**), 4357 (0x1105) **Power cycles**, subindex 1, 4382 (0x111E) **Cycle count [sum]** and 4374 (0x1116) **Total actuator travel [sum m]** (index 2 (0x02) **System Command**, value 130). The measured values of the algorithm are also reset, see **Reset trained algorithm parameter.**

Reset Diagnostic Parameters

This command resets the indices 4356 (0x1104) **Operating hours**, subindex 2 (0x02) **Since last reset**, 4357 (0x1105) **Power cycles**, subindex 2 (0x02) **Since last reset**, 4382 (0x111E) **Cycle count [sum]**, 4374 (0x1116) **Total actuator travel [sum m]** (index 2 (0x02) **System Command**, value 228).

Reset all present alerts

This command resets all set alert notifications (index 2 (0x02) **System Command**, value 229).

Reset operating hours counter

This command resets index 4356 (0x1104) **Operating hours**, subindex 2 (0x02) **Since last reset** (index 2 (0x02) **System Command**, value 228).

Reset power cycles counter

This command resets index 4357 (0x1105) **Power cycles** (index 2 (0x02) **System Command**, value 228).

Reset actuator cycles counter

This command resets index 4382 (0x111E) **Cycle Count [sum]** (index 4398 (0x112E) **Reset actuator diagnostics parameters**, value 2).

Reset total actuator travel

This command resets the index 4374 (0x1116) **Total actuator travel [sum m]** (index 4398 (0x112E) **Reset actuator diagnostics parameters**, value 1).

Application reset

This command behaves the same as **Restore factory settings**, except in this case the identification parameters (Index 24, 25, 26 and 64) are not reset (Index 2 (0x02) **System Command**, Value 129).

Reset trained algorithm parameter

This command has no effect on the diagnostic data or the settings made, only the measured values of the algorithm are reset. If the sensor is remounted from the taught-in drive onto a new drive, it is useful to perform this reset. This enables the sensor to be optimally taught in for the new drive in 2 strokes (index 2 (0x02) **System Command**, value 192).

8.2.3.2 Position offset

The position offset value in µm is added to the actual position value. This value can be set in 10 µm increments via index 257 (0x101) **Position offset [x10µm].**

When the position offset in index 257 (0x101) **Position offset [x10 µm]** is changed, then the values in index 260 (0x104) **Detection range [x10 µm]** and index 16512 (0x4080) **MDC Descr**, subindex 1 and 2, change accordingly.

8.2.3.3 Manual teach-in of up to 8 switching points

In the following, the typical sequence of the manual teach-in is explained using Qint.1:

The start and end point of the switching point width can be set via index 60 (0x3C) **Qint.1 SP1 / SP2**. The start and end point can only be set in the **Window Mode** and **Two-point Mode** switching point mode. The switching point logic (subindex 1 (0x01) **Switchpoint Logic**), switching point mode (subindex 2 (0x02) **Switchpoint Mode**) and switching point hysteresis (subindex 3 (0x03) **Switchpoint Hysteresis**) can be set via index 61 (0x3D) **Qint.1 Configuration.** The index for configuring setpoint 2 directly follows the index for setpoint 1 Qint. 1.

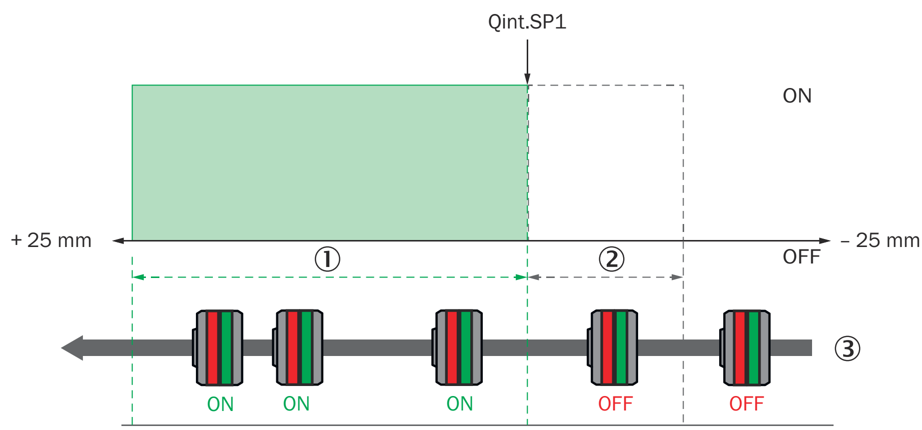
The switching points 3 to 8 can be configured from index 16384 (0x4000) to 16395 (0x400B). For manual teach-in, the distance between 2 switching points can be less than 1 mm. The only limiting factors here are repeatability and resolution.

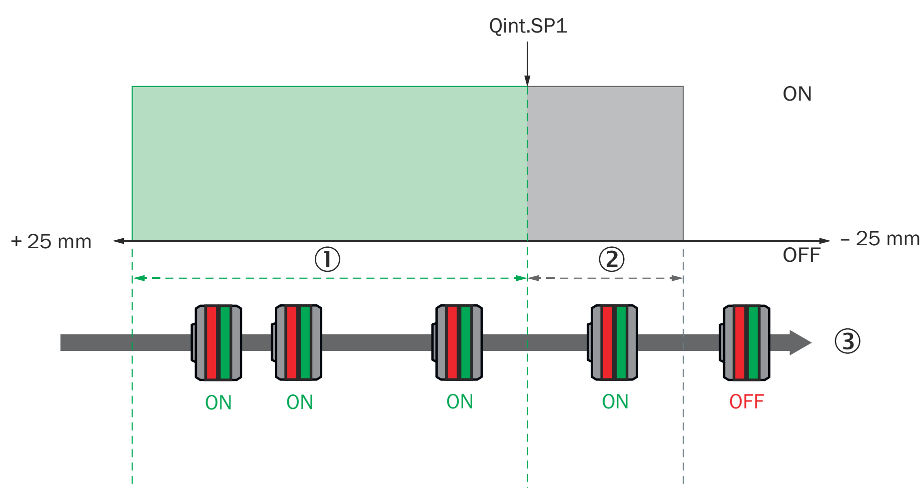
An exact description of the manual teach-in can be found in see "Put the sensor into operation for the first time", page 18.

8.2.3.4 Switching point modes

For switching points 1 to 8, the corresponding **Switchpoint Mode** index can be used to select between 4 different switching point modes after manual teach-in: **Single point mode**, **Window mode**, **Two-point mode** and **Cylinder switch mode** (default).

- **Single point mode**: The switch-on point is defined by Qint.SP1. For all positions above this, the switching signal is **high**. The switch-off point is defined by Qint.SP1 minus hysteresis. For all positions below this point, the switching signal is **low**.

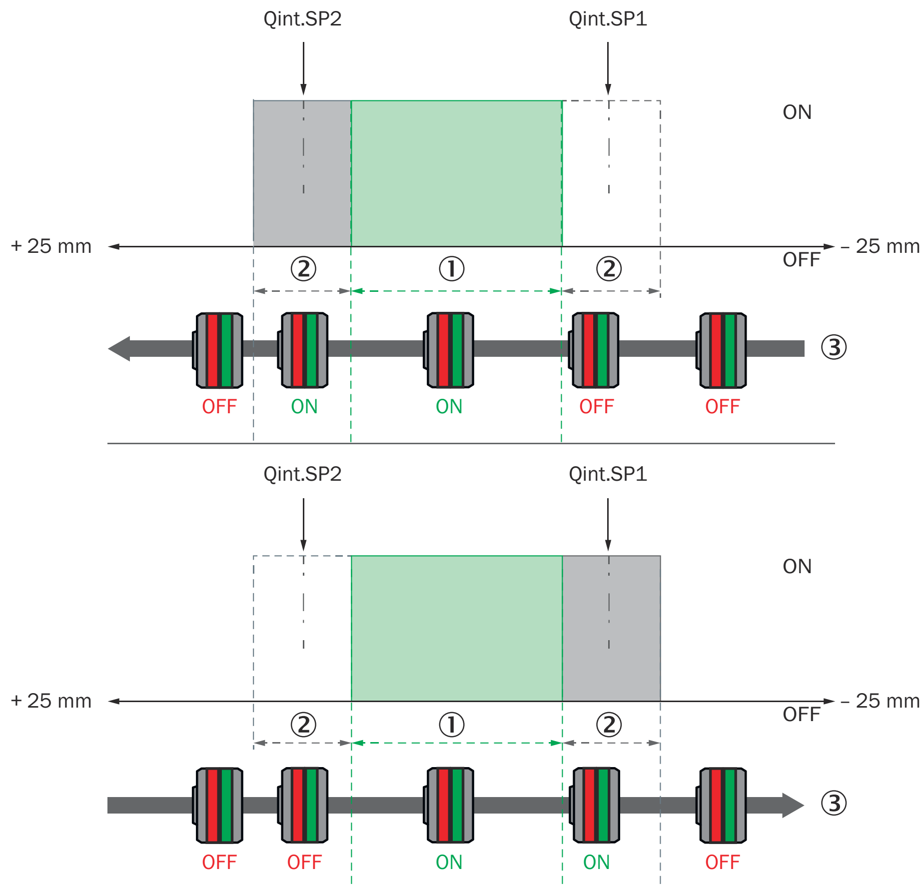




① Switching range

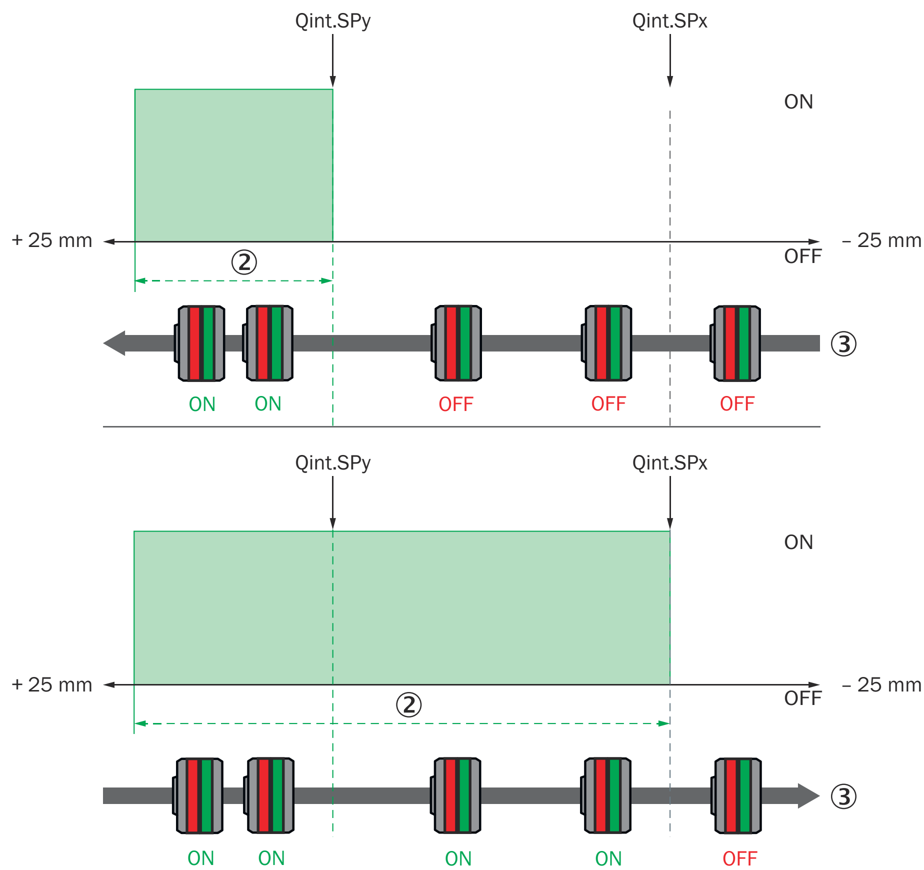
② Hysteresis
③ Direction of movement of the magnet

- **Window mode:** Qint.SP1 and Qint.SP2 define a switching window within which the switching signal is **high.** The hysteresis is symmetrical around each Qint.SP.



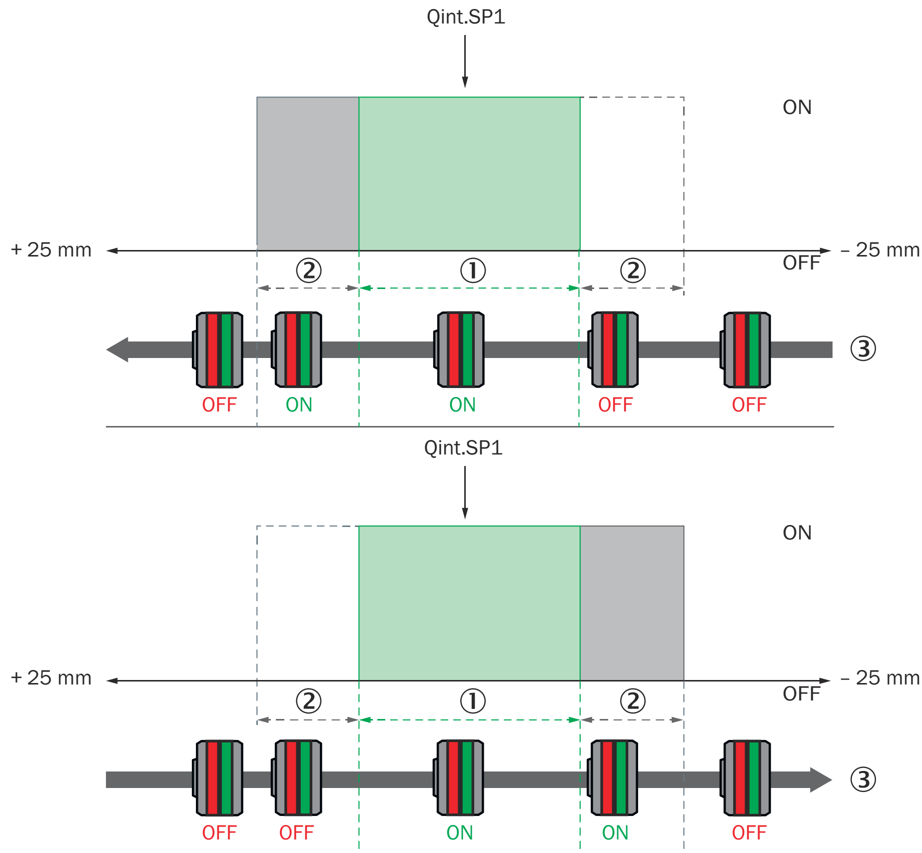
① Switching window
② Hysteresis
③ Direction of movement of the magnet

- **Two point mode:** Qint.SPx and Qint.SPy are determined. As soon as the magnet has passed Qint.SPx and Qint.SPy, the signal is **high**. As soon as the magnet is below Qint.SPx, the signal is **low.** (Qint.SPx < Qint.SPy)



② Switching range
③ Direction of movement of the magnet

- **Cylinder switch mode:** within the width of the switching point, the switching signal is **high**. The hysteresis is symmetrical around Qint.SP1.
  The switching signals switches to **high** as soon as the piston moves into the switching width and switches to **low** as soon as the piston leaves the hysteresis.



① Width of the switching point
② Hysteresis
③ Direction of movement of the magnet

8.2.3.5 Inverting the switchpoint logic

The logic of the taught-in switching points can be inverted using subindex 1 (0x01) **Switchpoint Logic.** By default, the switching points are **high** in the case of an overrun.

8.2.3.6 Switching point hysteresis

After teaching in the switching point, the hysteresis is 0.7 mm. The hysteresis can be adjusted in 10 µm increments via subindex 3 (0x03) **Switchpoint Hysteresis** (maximum hysteresis: 327.67 mm and minimum hysteresis: 0.01 mm).

8.2.3.7 Switching point width

After a manual teach-in, the width of the taught-in switching points can be determined via index 170 (0xAA) **Switchpoint width [x10µm].** The default switching point width is 2 mm and the maximum switching point width is 10 mm.

NOTE
This applies to the **Cylinder switch mode** switching point mode only.

8.2.3.8 Alert notifications

In general, the alert notifications are always activated and can be issued and read out when the set alert threshold is exceeded.

There are two ways to issue and read out the alert notifications: with the corresponding index in the service data or via the process data. By default, the alert is not output via the process data, but can be read out via the following indices:

- Index 4370 (0x1112) **DD - Alert flags**
- Index 4400 (0x1130) **Actuator alerts**

The alert thresholds can be changed using the following indices:

- Index 4369 (0x1111) **DD - Alert limit**
- Index 4399 (0x112F) **Actuator alert limits**

The process data can be set to alert notifications instead of switching points using the settings accessed via index 67 (0x43) **Process data user definition**. The output via the process data has the advantage that the alert notifications do not have to be checked manually, but are transmitted on a regular basis.

- 60 = **Group alert: Cycle time** (type: event)
  Contents: index 4400 (0x1130) **Actuator alerts**, Subindex 2 (0x02) **Min. cycle time alert** and Subindex 3 (0x03) **Max. cycle time alert**
- 65 = **Direct alert: Operating hours max.** (type: event)
- 68 = **Direct alert: Power cycles max.** (type: event)
- 69 = **Direct alert: Cycle count max.** (type: event)
- 90 = **Direct alert: Total actuator travel max.** (type: event)

An alert delay time can be set for the alert notifications via index 4842 (0x12EA), subindex (0x01) **Alert delay time [ms]** and an automatic alert reset via subindex 2 (0x02) **Automatic alert reset time [ms]**. The alert delay time in ms is the time by which the alert bits are delayed. An alert is only output if the corresponding alert condition is met for longer than the alert delay time defined here. The alert delay time can be set between 0 and 1,000 s in ms increments. The configured alert delay time only affects alert notifications of type “Status”. Alert notifications of type “Event” occur immediately after falling below or exceeding the configured limit. The automatic alert reset specifies the time after which alerts are automatically reset if the alert bits in the process data do not change. The automatic alert reset can be set between 0 and 1,000 s in ms increments. A negative value deactivates the automatic reset of alert notifications. By default, these two functions are not active.

8.2.4 Actuator diagnostic functions

During the application, the MPS-M Smart Sensor also monitors:

- Traveled stroke(**Actuator travel**)
- **Cycle time**
- **Dwell time start position** and **Dwell time stop position**
- Travel time of the piston during extension (**Actuator travel time extend**) and during retraction (**Actuator travel time retract**)
- Average piston velocity during extension (**Average actuator velocity extend**) and during retraction (**Average actuator velocity retract**)
- Current measured field strength at sensor element 1 (**Current field strength (sensor element 1)**) and sensor element 2 (**Current field strength (sensor element 2)**)
- Maximum measured field strength at sensor element 1 (**Peak field strength (sensor element 1)**) and sensor element 2 (**Peak field strength (sensor element 2)**)

- **Cycle count**
- Total distance traveled by the piston (**Total actuator travel** [sum])
- **Operating hours count**
- Power-on/power-off cycles (**Power cycles**)

The individual values are output via the IO-Link interface.

The following sections describe the actuator diagnostic functions.

8.2.4.1 Traveled stroke(Actuator travel)

The measured travel of the last stroke in mm is output via index 4372 (0x1114) **Actuator travel [x10µm]**.

8.2.4.2 Cycle time

The duration of the last cycle in ms is output via index 4380 (0x111C) **Cycle time [ms]**. One cycle corresponds to 2 strokes: start position - stop position - start position.

The start position is in the direction of the sensor cable.

The stop position is in the direction of the top of the sensor head.

A lower and upper threshold for the cycle time in ms can be defined via index 4399 (0x112F), subindex 2 (0x02) **Min. cycle time limit** and subindex 3 (0x03) **Max. cycle time limit.** An alert is output via the process data when the value falls below the lower threshold or exceeds the upper threshold via index 4400 (0x1130), subindex 2 (0x02) **Min. cycle time alert** and subindex 3 (0x03) **Max. cycle time alert.**

8.2.4.3 Dwell time at start position and stop position (Dwell time [ms])

The dwell time in ms at the start position and at the stop position can be read via index 4381 (0x111D) **Dwell time [ms]**, subindex 1 (0x01) **Start position** and subindex 2 (0x02) **Stop position.** The start position is in the direction of the cable of the sensor and the stop position is in the direction of the top of the sensor head.

8.2.4.4 Travel time of the piston during extension and retraction (Actuator travel time [ms])

The duration of the last stroke in ms in the positive direction (extension of the piston) can be read via index 4379 (0x111B) **Actuator travel time [ms]**, subindex 1 (0x01) **Extend (positive direction).** The duration of the last stroke in ms in the negative direction (retraction of the piston) can be read via index 4379 (0x111B) **Actuator travel time [ms],** subindex 2 (0x02) **Retract (negative direction).** The positive direction goes in the direction of the sensor fixing screw. One stroke corresponds to movement in a direction.

Direction of movement during extension: Stop position – start position.

The start position is in the direction of the sensor cable.

The stop position is in the direction of the top of the sensor head.

The negative direction goes in the direction of the sensor cable.

One stroke corresponds to movement in a direction.

Direction of movement during retraction: Start position - stop position.

The start position is in the direction of the sensor cable.

The stop position is in the direction of the top of the sensor head.

8.2.4.5 Average piston velocity during extension and retraction (Average actuator velocity [m/s])

The average velocity in m/s of the piston in the positive direction (extension of the piston) can be read via index 4375 (0x1117) **Average actuator velocity [m/s]**, subindex 1 (0x01) **Extend (positive direction).** The average velocity in m/s of the piston in the negative direction (retraction of the piston) can be read via index 4375 (0x1117) **Average actuator velocity [m/s]**, subindex 2 (0x02) **Retract (negative direction).** The positive direction goes in the direction of the sensor fixing screw. The negative direction goes in the direction of the sensor cable.

8.2.4.6 Current measured field strength at the sensor elements (Current field strength [mT])

The current measured field strength for sensor element 1 in mT (**Sensor element 1**) and sensor element 2 in mT (**Sensor element 2**) can be read via index 4602 (0x11FA) **Current field strength [mT]**, subindex 1 (0x01) **Current1** and subindex 2 (0x02) **Current2**. Sensor element 1 is in the direction of the cable of the sensor and sensor element 2 is in the direction of the fixing screw of the sensor.

8.2.4.7 Maximum measured field strength at the sensor elements (Peak field strength [mT])

The maximum measured field strength for sensor element 1 in mT (**Sensor element 1**) and sensor element 2 in mT (**Sensor element 2**) since the last **Power cycle** can be read via index 4604 (0x11FC) **Peak field strength [mT]**, subindex 1 (0x01) **Current1** and subindex 2 (0x02) **Current2.** Sensor element 1 is in the direction of the cable of the sensor and sensor element 2 is in the direction of the fixing screw of the sensor.

8.2.4.8 Cycle count

The maximum measured field strength for sensor element 1 in mT (**Sensor element 1**) and sensor element 2 in mT (**Sensor element 2**) since the last **Power cycle** can be read via index 4604 (0x11FC) **Peak field strength [mT]**, subindex 1 (0x01) **Current1** and subindex 2 (0x02) **Current2.** Sensor element 1 is in the direction of the cable of the sensor and sensor element 2 is in the direction of the fixing screw of the sensor.

8.2.4.9 Total distance traveled by the piston (Total actuator travel)

The total distance traveled by the piston in m can be read via index 4374 (0x1116) **Total actuator travel [sum m].** The total distance traveled by the piston is only stored in the EEPROM every 10 m.

If the voltage supply is interrupted after a travel distance of 9.99 m, 0.0 m is read again via IO-Link after the voltage cycle.

8.2.4.10 Operating hours

The operating hours in h is output via the index 4356 (0x1104) **Operating hours.** This index has three sub-indices, which corresponds to 3 different counters.

The first counts the absolute operating hours (1 (0x01) **Total**). The second counts the operating hours since the last **reset** (2 (0x02) **Since last reset**), and the third counts the time since the last **Power-on** (3 (0x03) **Since startup**).

8.2.4.11 Power-on / power-off cycles (Power cycles)

The **Power-on** / **power-off** cycles specify the number of times the device was switched on and off. 1 cycle corresponds to one **power-on** and one **power-off**. The **Power-on/ power-off cycles** can be read via index 4357 **Power cycles** (total number (subindex 1 (0x01) **Total**) and number since last reset (subindex 2 (0x02) **Since last reset**)).

9 Troubleshooting

Table 6: Possible error displays via the LEDs

LED/fault pattern / Fault pattern	Cause	Measures
Green LED does not light up	No voltage or voltage below the limit values	Check the power supply, check all electrical connections (cables and plug connections)
Sensor position is imprecise	Mounting position unfavorable	Position sensor head as recommended in the operating instructions and run voltage reset
End positions are lost	Sensor was not yet completely taught in to drive	Perform several strokes (> 5) and reset end positions
Both LEDs flash quickly	Incorrect sensor configuration detected	Perform a **factory reset**

10 Maintenance

SICK sensors are maintenance-free.

We do, however, recommend that the following activities are undertaken regularly:

- Clean the sensor surfaces
- Check the fittings and plug connectors

No modifications may be made to devices.

Subject to change without notice. Specified product properties and technical data are not written guarantees.

11 Decommissioning

11.1 Replace device

The **IO-Link Data Storage** function can be used to save previous parameters and transmit them to the exchange device. This prevents complete re-parameterization of the exchange device.

11.2 Disassembly and disposal

Disassembling the device

1. Switch off the supply voltage to the device.
2. Detach all connecting cables from the device.
3. If the device is being replaced, mark its position and alignment on the bracket or surroundings.
4. Detach the device from the bracket.

Disposing of the device

Any device which can no longer be used must be disposed off in an environmentally friendly manner in accordance with the applicable country-specific waste disposal regulations.

NOTE

Disposal of batteries, electric and electronic devices

- According to international directives, batteries, accumulators and electrical or electronic devices must not be disposed of in general waste.
- The owner is obliged by law to return this devices at the end of their life to the respective public collection points.
-  This symbol on the product, its package or in this document, indicates that a product is subject to these regulations.

11.3 Returning devices

► Do not dispatch devices to the SICK Service department without consultation.

NOTE

To enable efficient processing and allow us to determine the cause quickly, please include the following when making a return:

- Details of the contact person
- Description of the application
- Description of the fault that occurred

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12 Technical data

Table 7: Technical data

Cylinder type	T-slot[1)]
Detection zone	0 ... 50 mm[2)]
Supply voltage U_B	13 ... 30 V DC[3)]
Power consumption	≤ 400 mW
Analog output(voltage)	0 V ... 10 V
Required magnetic field strength, typ.	≥ 2 mT
Time delay before availability	0.15 s
Resolution typ.	0.01 mm[4)]
Linearity typ.	0.3 mm[5)]
Repeatability (response time) typ.	0.05 mm[6)]
Sampling rate typ.	1 ms
IO-Link	1.1
Enclosure rating	IP67
Protection class	III
Circuit protection	A, B, D[7)]
Ambient temperature, operation	-20 °C ... +70 °C[8)]

1) Can be used for the following cylinder designs with adapter (see SICK accessories):
Profile cylinder, tie-rod cylinder, round cylinder, dove-tail groove cylinder, CDQ2 SMC rail, ECDQ2 SMC slide
2) Deviations are possible depending on the drive.
3) 12 V DC ... 30 V DC with **Out-of-Range** indicator disabled.
4) Applies to IO-Link; 0.013 mm for analog output
5) At 25 °C, the linearity error (maximum deviation) depends on response curve and minimum deviation function.
6) At 25 °C, repeatability with magnet movement from one direction.
7) A = UB connections reverse polarity protected
B = Inputs and outputs reverse polarity protected, voltage output not reverse polarity protected
C = Interference suppression
D = Outputs overcurrent and short-circuit protected
8) Installed in the drive groove.

12.1 Dimensional drawing

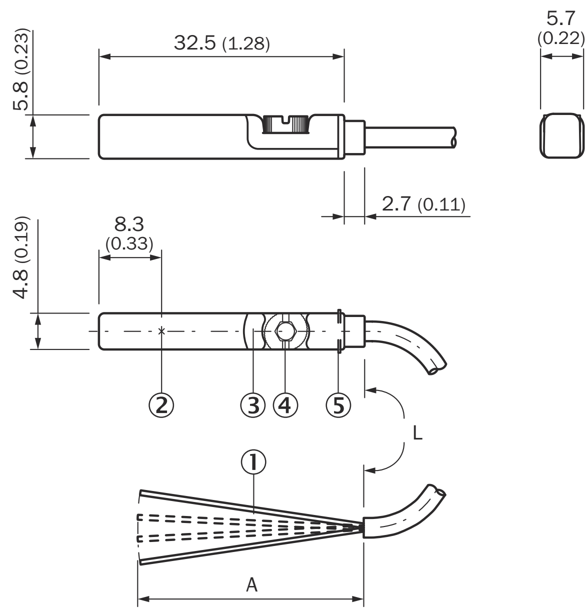

Figure 11: Dimensional drawing of cable

①	Connection
②	Physical zero position
③	LED
④	Fixing screw, size 2.5
⑤	Retaining ribs
A	For length of cable, see data sheet

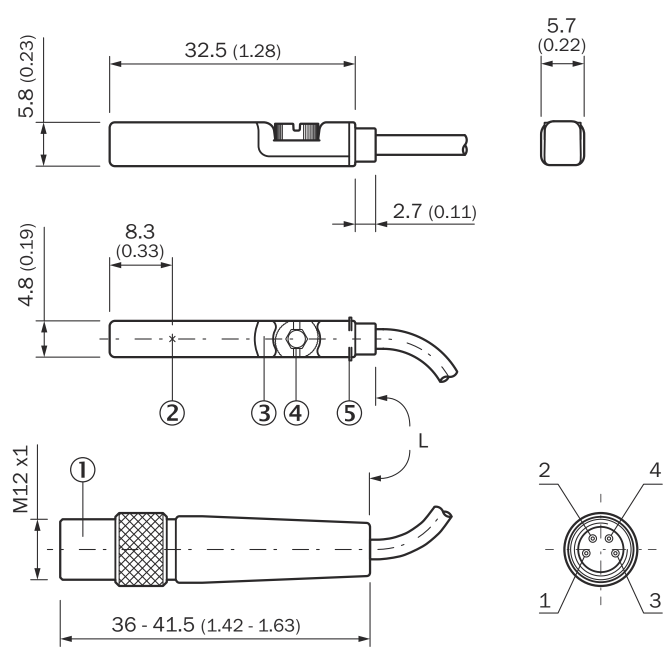

Figure 12: Dimension drawing of cable with M8 male connector

①	Cable with M8 male connector
②	Physical zero position
③	LED
④	Fixing screw, size 2.5

⑤ Retaining ribs

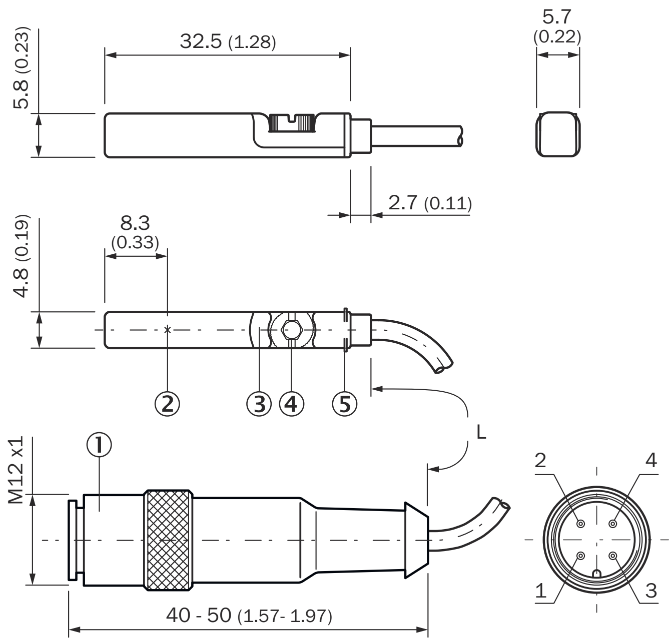

Figure 13: Dimension drawing of cable with M12 male connector

① Cable with M12 male connector

② Physical zero position

③ LED

④ Fixing screw, size 2.5

⑤ Retaining ribs

13 Glossary

Detection range	The detection range describes the maximum physical range in which the sensor can determine a position. The detection range is max. +30 mm and - 30 mm around the physical zero position.
Linearity error	The linearity error describes the maximum deviation of the output signal from an ideal straight line. It is measured in millimeters. The linearity error depends on the drive on which the sensor is mounted and is typically 0.3 mm.
Measuring range	The measuring range can be anywhere inside the detection range. The measuring range must always be completely inside the detection range.
Offset	The offset is added to the position identified by the sensor. Negative position values can be output depending on the positioning of the sensor on the drive. If you do not want this, an offset value can be defined around which all position values are added. Position output = identified position of the sensor + offset value. The offset value is specified in digits. 1 digit corresponds to 10 µm.
Out-of-Range display	The **Out-of-Range** display is used to display the analog position output when the magnet has left the measuring range. If 11 V is output, the magnet has left the measuring range in the positive direction (upper side of the sensor head). If 10.5 V is output, the magnet has left the measuring range in the negative direction (on the cable side of the sensor).
Range of movement	The range of movement describes the actual path traveled by the piston.
Repeatability	Repeatability is defined as any move to a preset position from the same direction in every case. The repeatability depends on the drive on which the sensor is mounted and is typically ≥ 0.05 mm.
Resolution	The sensor resolution describes the minimum, specifiable magnet route change as output by the sensor. The resolution depends on the drive on which the sensor is mounted and is typically ≥ 0.01 mm.
Sampling rate	The sampling rate indicates the time interval in which the signal is updated at the outputs. The sampling rate is min. 2 kHz.

14 Annex

14.1 Conformities and certificates

You can obtain declarations of conformity, certificates and the current documentation for the product at www.sick.com. To do so, enter the product part number in the search field (part number: see the entry in the “P/N” or “Ident. no.” field on the type label).

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Sensor Intelligence.