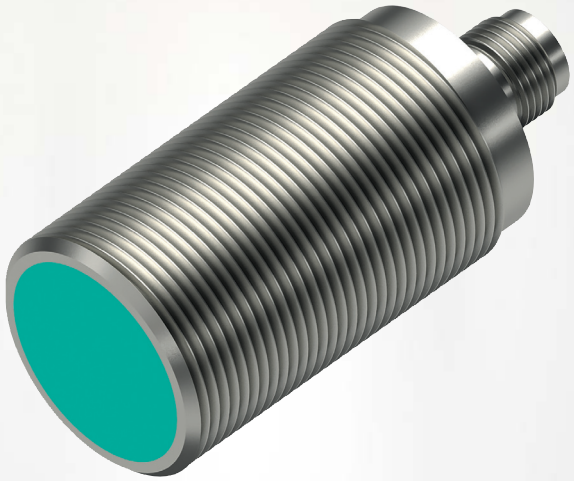
# NA...-...-IO-... Series

# Inductive Sensors for Distance Measurement with IO-Link Interface

**Manual**



IO-Link

Your automation, our passion.

PEPPERL+FUCHS

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# 1 Introduction

## 1.1 Content of this Document

This document contains information required to use the product in the relevant phases of the product life cycle. This may include information on the following:

- Product identification
- Delivery, transport, and storage
- Mounting and installation
- Commissioning and operation
- Maintenance and repair
- Troubleshooting
- Dismounting
- Disposal

**Note**

For full information on the product, refer to the further documentation on the Internet at www.pepperl-fuchs.com.

**Note**

For specific device information such as the year of construction, scan the QR code on the device. As an alternative, enter the serial number in the serial number search at www.pepperl-fuchs.com/device-information.

The documentation comprises the following parts:

- This document
- Datasheet

In addition, the documentation may comprise the following parts, if applicable:

- EU-type examination certificate
- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Instruction manual
- Functional safety manual
- Other documents

## 1.2 Target Group, Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismounting lies with the plant operator.

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismounting of the product. The personnel must have read and understood the instruction manual and the further documentation.

Prior to using the product make yourself familiar with it. Read the document carefully.

## 1.3 Symbols Used

This document contains symbols for the identification of warning messages and of informative messages.

### Warning Messages

You will find warning messages, whenever dangers may arise from your actions. It is mandatory that you observe these warning messages for your personal safety and in order to avoid property damage.

Depending on the risk level, the warning messages are displayed in descending order as follows:



**Danger!**

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.



**Warning!**

This symbol indicates a possible fault or danger.

Non-observance may cause personal injury or serious property damage.



**Caution!**

This symbol indicates a possible fault.

Non-observance could interrupt the device and any connected systems and plants, or result in their complete failure.

### Informative Symbols



**Note**

This symbol brings important information to your attention.



**Tip**

This symbol brings an useful tip to your attention.



**Example**

This symbol provides an example of the issue described.



### Action

This symbol indicates a paragraph with instructions. You are prompted to perform an action or a sequence of actions.

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## 1.4 Intended Use

The product portfolio of NA...-...-IO-... inductive distance sensors with IO-Link is optimized for highly accurate, continuous distance measurement. The integrated IO-Link interface enables clear identification of the sensor, extensive individual configuration of the parameters, switching characteristics, and operating modes, and diagnostics of the sensor status and application.

Read through this manual carefully. Familiarize yourself with the device before installing, mounting, or operating it.

Only operate the device as described in these instructions to ensure the correct functioning of the device and the connected systems. The protection of operating personnel and the plant is guaranteed only if the device is operated in accordance with its intended use.

## 1.5 General Safety Instructions

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismounting lies with the plant operator.

Installation and commissioning of all devices may be performed only by trained and qualified personnel.

It is dangerous for the user to make changes and/or repairs. Additionally, doing so voids the warranty and excludes the manufacturer from any liability. In the event of any serious errors, stop using the device. Secure the device against unintended operation. To have the device repaired, return it to your local Pepperl+Fuchs representative or your sales center.

**Note**

**Disposal**

Electronic waste is dangerous. When disposing of the equipment, observe the current statutory requirements in the relevant country of use and local regulations.

# 2 Product Description

## 2.1 Use and Application

The product portfolio of NA...-...-IO-... inductive distance sensors with IO-Link is optimized for highly accurate, continuous distance measurement.

Due to the inductive sensing principle, ferrites or magnets are not necessary as a counterpart. The position is detected by detecting a damping element mounted on a monitoring object.

The advantages of the NA...-...-IO-... inductive distance sensors with IO-Link include:

- High resolution and accuracy
- End-to-end communication between the control panel and field level via IO-Link
- Noncontact operation
- Higher immunity due to inductive sensing principle
- Internal determination of the velocity and acceleration of the damping element

NA...-...-IO-... inductive distance sensors are designed to be integrated into IO-Link systems. They provide the measured distance, virtual switch points, and additional application-specific information using the process data. This information can be used for a wide range of methods for analyzing and monitoring the application. Parameterizable limit values enable the monitoring process to be customized to the existing framework conditions for the application and allow a "Maintenance Warning" to be triggered.

Typical applications for the "Maintenance Warning" include monitoring the total operating time of a machine. The inductive distance sensor with IO-Link monitors the total operating hours and can trigger a "Maintenance Warning" in the process data when a parameterized limit value is reached. This means that the system can automatically signal that the machine requires maintenance. Other application values can also be monitored in the same way, such as the device temperature, the number of successful switching cycles, and if a defined distance range has been left. This information can then be used to automatically signal the requirement for machine maintenance.

The movement velocity and acceleration of the actuator element can also be monitored and analyzed by the inductive distance sensor. This information can be used to determine changes in motion sequences, and wear in the current application can be detected and remedied at an early stage.

The NA...-...-IO-... product group also supports SIO mode. SIO mode (standard IO mode) can be used to perform conventional signal transmission (= On/Off signal) between the device and the higher-level control panel.

**What Is IO-Link?**

IO-Link enables seamless communication and digital data transfer from the control panel level down to the sensor level. The intelligence of sensors can be used to their full potential with IO-Link, paving the way for Industry 4.0 in automation technology. The internationally standardized interface delivers impressive efficiency and sustainable cost reduction, from plant design and installation through to operation and maintenance.

Standardized device description files (IODDs) and parameterization via software tools ensure convenient configuration and integration of IO-Link sensors. Intelligent and transparent parameter management increases application flexibility and keeps downtimes to a minimum. Parameters can be customized quickly and easily, even for complex production and batch changes. Transparency right down to the sensor gives users access to a comprehensive range of parameterization options and device diagnosis functions, allowing them to perform predictive maintenance.

The technology offers particular benefits for service activities (troubleshooting, maintenance, and device exchange), for commissioning (cloning, identification, configuration, and localization), and during operation (job changeover, continuous parameter monitoring, and online diagnostics).

**Device Description File (IODD)**

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The device parameters are different for each device. A standardized description of these parameters can be found in the IODD (IO Device Description). IODDs can be integrated into a control environment to allow IO-Link devices to be used for IO-Link operation. Both parameterization and process data exchange can be performed with a PLC, for example. The IODD can also be imported into a range of engineering tools from various system providers for parameterization and diagnosis, provided these tools support IODD.

The relevant device description files (IODDs) can be found at www.pepperl-fuchs.com. Detailed information regarding IO-Link specifications and Smart Sensor profiles can be found at www.io-link.com.

**DTM (Device Type Manager)**

If a sensor is not used long-term in an IO-Link environment, but nevertheless needs to be parameterized, this can be done easily via a PC with installed FDT frame application (e.g., PACTware) and with the DTM (Device Type Manager, a kind of "device driver") available for the sensor. Unlike configuration via the IODD, this method provides extended functions and ensures improved graphic visualization and convenient operation.

**Offline parameterization**

For offline parameterization, IO-Link devices are already configured before mounting. To do this, use the Pepperl+Fuchs IO-Link USB master.

We recommend using the "PACTware" software as the FDT frame application and user interface.

Both an IODD and a DTM are available to the sensor.

The software components required in each case are collated in the latest version of the "IO-Link Offline Parameterization Tool" software package. The software package and the documentation on its installation and use can be found online at www.pepperl-fuchs.com.

If you use the "IO-Link Offline Parameterization Tool" software package, have active internet access, and have connected your device via the Pepperl+Fuchs IO-Link USB master, you can integrate the IODD directly into the IO-Link Offline Parameterization Tool via the "IODD DTM Configurator."

The device description file (IODD) required for integration into an IO-Link system and for parameterization and diagnostics is available online, along with the DTM. Visit www.pepperl-fuchs.com and navigate to the relevant product page for the NA...-...-IO-....

**Online Parameterization**

When commissioning machines and plants, master and IO-Link devices must be integrated into the relevant control environment. Depending on the components used, different software is required.

The devices can then be configured and parameterized using an IO-Link configuration tool. During ongoing operation, you can check the parameter settings for the IO-Link devices and read and monitor status data and diagnostic data. IO-Link data is integrated into an application program using function blocks.

## 2.2 Accessories

Various accessories are available.

### 2.2.1 Parameterization Aids

The following parameterization aids are available:

| Designation | Description |
|---|---|
| Pepperl-Fuchs-NA...--...-IO-...IODDx.x | IO device description (IODD)—device description for operating the sensor, integration in the system environment<br>Refer to the product page for the relevant NA...-...-IO-... at **www.pepperl-fuchs.com** |
| DTM for inductive NA*-IO* sensors | DTM (Device Type Manager)—device description and graphic user interface for parameterization of the sensor and diagnostic functions.<br>Refer to the product page for the relevant NA...-...-IO-... at **www.pepperl-fuchs.com** |
| IO-Link Offline Parameterization Tool | FDT frame application for operating IODDs and DTMs. This tool contains PACTware, IODD Interpreter DTM, and IO-Link USB Master DTM.<br>Refer to the product page for the relevant NA...-...-IO-... series sensor at **www.pepperl-fuchs.com** |
| IO-Link-Master02-USB | IO-Link USB adapter box to communicate with the IO-Link device via a PC, M12 connection for sensor |

### 2.2.2 Connecting Cable

Connecting cables are available in various lengths and in straight and angled versions for connecting NA...-...-IO-... devices with M12 or M8 connector plugs.

The following table contains just a selection of the available products. Compatible connecting cables can be found at www.pepperl-fuchs.com.

| Figure | Material | M12 x 1 connecting cable, 4-pin | M12 x 1 connecting cable, 5-pin |
|---|---|---|---|
| M12 x 1, straight  | PVC | V1-G-*-PVC-V1-G | V15-G-*-PVC-V15-G |
| | PUR | V1-G-*-PUR-V1-G | V15-G-*-PUR-V15-G |

**Note**

If the connecting cable will be used in environments with significant potential for electromagnetic interference, please use shielded single-ended female connecting cables from our extensive range of accessories.

# 3 Installation

## 3.1 Safety Information



**Caution!**

Risk of short circuit

Carrying out work while the system is energized may result in damage to the device.

- Always disconnect the supply voltage before carrying out work on the device.
- Only connect the device to the supply voltage once all work has been completed.

## 3.2 Preparation



### Unpacking the Device

1. Check the packaging and contents for damage.

   ↳ In the event of damage, inform the shipping company and notify the supplier.

2. Check the package contents against your order and the shipping documents to ensure that all items are present and correct.

   ↳ Should you have any questions, direct them to Pepperl+Fuchs.

3. Retain the original packaging in case the device is to be stored or shipped again at a later date.

## 3.3 Mounting

- Depending on the version, the device can be mounted flush or nonflush in metallic and nonmetallic environments.
- The installation conditions for all models are described in the document entitled "Installation Conditions for Inductive Proximity Sensors."
- The "measuring ranges" specified in the datasheets apply when using a square damping element that is mounted centrally in front of the sensor and is made of steel (Typ FE360/ST37).

  The exact specifications for the dimensions of the relevant damping element can be found in the datasheet for the respective sensor.

## 3.4 Connection

### Connecting the Supply Voltage

To supply voltage to the sensor, proceed as follows:

1. Connect the supply voltage to the cable strands or plugs provided.

↳ The sensor is now ready for operation.

### Communication via IO-Link

To prepare the sensor for communication via IO-Link, proceed as follows:

1. Connect the sensor to an IO-Link master. Use a three-wire or four-wire connecting cable.

↳ The sensor is now prepared for IO-Link communication.

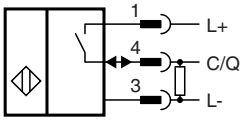
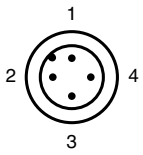
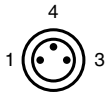
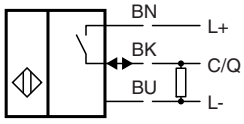
| Sensor | Electrical Connection | Pinout |
|---|---|---|
| NA...-...-IO-...V1 |  | <br> |
| NA...-...-IO-... |  | |

Table 3.1

**Note**

The list of electrical connections above represents just some of the products in our range of inductive distance equipped with IO-Link. The list is not exhaustive. Please refer to the datasheet for the connection diagram for your sensor. This datasheet is available to download from the Pepperl+Fuchs website at **www.pepperl-fuchs.com**.

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# 4 Cybersecurity and Decommissioning Information

## Security Context

From a security perspective, the following precautions must be taken for the product by the responsible plant operator:

- Physically prevent unauthorized access to the IO-Link sensor.
- Ensure that the IO-Link sensor communicates with the remote station via a point-to-point connection.

The product features a proprietary Pepperl+Fuchs service interface that uses the existing connection lines. This interface is used exclusively for initially storing and updating the firmware during production. Once switched on, the interface is deactivated after 1 second.

## Measures Required to Operate the IO-Link Sensor

Servicing and management: Check the website regularly for the release of security advisories and subscribe to the RSS feed: **https://www.pepperl-fuchs.com/global/en/29079.htm**

## Measures Required to Decommission the IO-Link Sensor

Configuration data, operating data, and log data (history, progress data, error data): The device stores adjustable parameter data and operating information.

All parameters, operating information, and reset options are specified in the "IO-Link Parameter Datasheet." Parameters and operating information that cannot be reset can only be deleted by physically destroying the device

# 5 Commissioning

## 5.1 Commissioning with IO-Link on a Control Panel (Online Parameterization)

**Note**

The device description file (IODD) required for integration into an IO-Link system and for the parameterization and diagnostics is available online. Visit **www.pepperl-fuchs.com** and navigate to the relevant product page for the NA...-...-IO-....

To activate the inductive distance sensor via IO-Link using a controller, proceed as follows:

1. Check the connection between the inductive distance sensor and the IO-Link master.
2. Set the status to IO-Link on the relevant port on the IO-Link master to which the inductive distance sensor is connected.

↳ The inductive distance sensor can now be either parameterized or diagnosed with the higher-level application using an IO-Link configuration tool. The device sends the binary switching information and the position value as process data.

## 5.2 Commissioning with IO-Link via FDT Frame Application and IODD (Offline Parameterization)

### IO-Link Offline Parameterization Tool

An IODD (IO-Link Device Description) file is available to download for parameterization of the sensor via IO-Link and diagnostics. See the product page for the relevant NA...-...-IO-... inductive distance sensor with IO-Link online at **www.pepperl-fuchs.com** or use the **IODDfinder at https://ioddfinder.io-link.com/**.

For offline parameterization, IO-Link devices are already configured before installation. To do this, use the Pepperl+Fuchs IO-Link USB master.

The software components required in each case are collated in the latest version of the "IO-Link Offline Parameterization Tool" software package. The software package and the documentation on its installation and use can be found online at **www.pepperl-fuchs.com**.

If the "IO-Link Offline Parameterization Tool" software package is used, there is active internet access, and the device is connected via the Pepperl+Fuchs IO-Link USB master, the IODD can be directly integrated into the IO-Link Offline Parameterization Tool via the "IODD DTM Configurator."

**Note**

A three-wire or four-wire M12 connecting cable is required to connect the inductive distance sensor with IO-Link to the Pepperl+Fuchs IO-Link master. You can find suitable connecting cables by visiting **www.pepperl-fuchs.com** and clicking on the product page for the relevant inductive distance sensor with IO-Link.

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To activate the inductive distance sensor via IO-Link using the corresponding IODD, proceed as follows:

1. Make sure that the "IO-Link Offline Parameterization Tool" software package is installed on your computer.
2. Connect the inductive distance sensor to an IO-Link master using a suitable M12 connecting cable for M12 sensors or an M8 connecting cable for M8 sensors.
3. Connect the IO-Link master to a USB port on your PC via a USB cable.
4. Start PACTware.

↳ PACTware automatically communicates with the inductive distance sensor with IO-Link if you are using PACTware from the "IO-Link Offline Parameterization Tool" and the IODD was found automatically online.

## 5.3 Commissioning with IO-Link via FDT Frame Application and DTM (Offline Parameterization)

### IO-Link Offline Parameterization Tool

A DTM (Device Type Manager) is available to download for parameterization of the sensor via IO-Link and diagnostics. See the product page for the relevant NA...-...-IO-... inductive distance sensor with IO-Link online at **www.pepperl-fuchs.com**.

For offline parameterization, IO-Link devices are already configured before installation. To do this, use the Pepperl+Fuchs IO-Link USB master.

The software components required in each case are collated in the latest version of the "IO-Link Offline Parameterization Tool" software package. The software package and the documentation on its installation and use can be found online at **www.pepperl-fuchs.com**.

**Note**

A three-wire or four-wire M12 connecting cable is required to connect the inductive distance sensor with IO-Link to the Pepperl+Fuchs IO-Link master. You can find suitable connecting cables by visiting **www.pepperl-fuchs.com** and clicking on the product page for the relevant inductive distance sensor with IO-Link.

### Prerequisites for Commissioning

Proceed as follows to communicate with the sensor via IO-Link using the "PACTware DC" software and the associated DTM (Device Type Manager):

1. Make sure that the "IO-Link Offline Parameterization Tool" software package and the DTM for the NA*-IO* sensors are installed.
2. Make sure that the DTM for inductive NA*-IO* sensors is installed.
3. Connect the inductive distance sensor to an IO-Link master using a suitable M12 connecting cable for M12 sensors or an M8 connecting cable for M8 sensors.
4. Connect the IO-Link USB master to a USB connection on your PC via a USB cable.
5. Start PACTware.

## Setting up Sensor Communication Using PACTware DC

1. Launch PACTware DC by double-clicking the PACTware DC icon.
2. If you have just installed the DTM for inductive NA*-IO* sensors, confirm the "Refresh PACTware device catalogue" prompt by clicking "Yes."

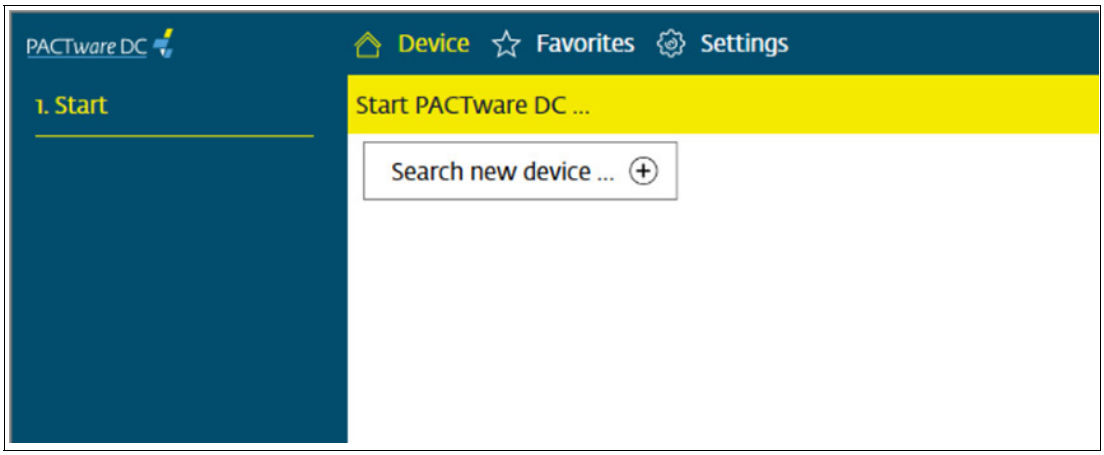



Figure 5.1

3. Click **"Search new device"** at the top.

↳ The IO-Link USB master will be detected by the PACTware DC if it is connected to the PC.

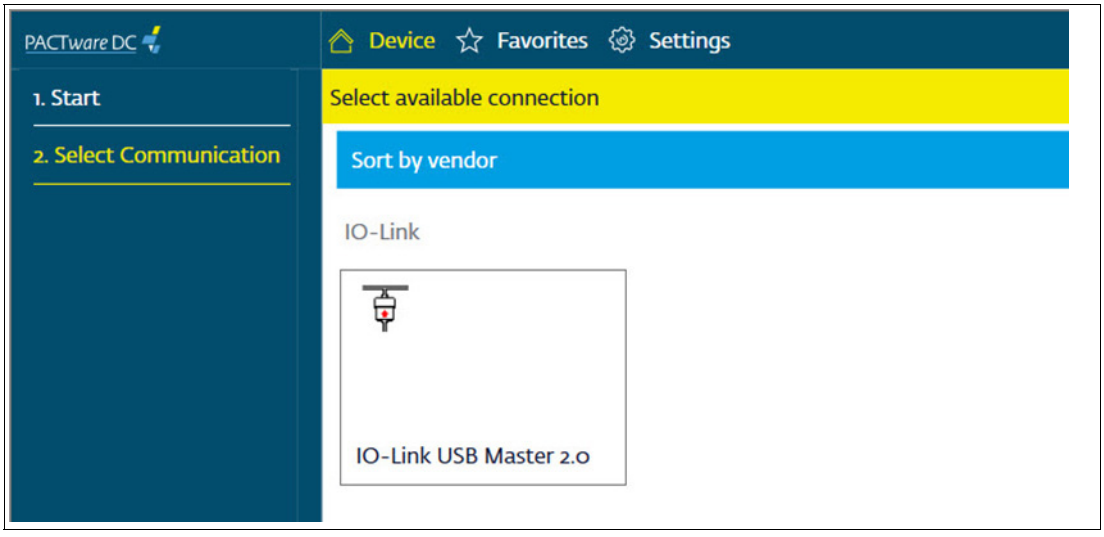



Figure 5.2

4. In the project, click **IO-Link USB Master...**

↳ The PACTware DC automatically establishes the connection to the sensor if the sensor is connected to the IO-Link USB master.

↳ The following figure shows an example of how a connection is established for the NA*-IO* sensor family.

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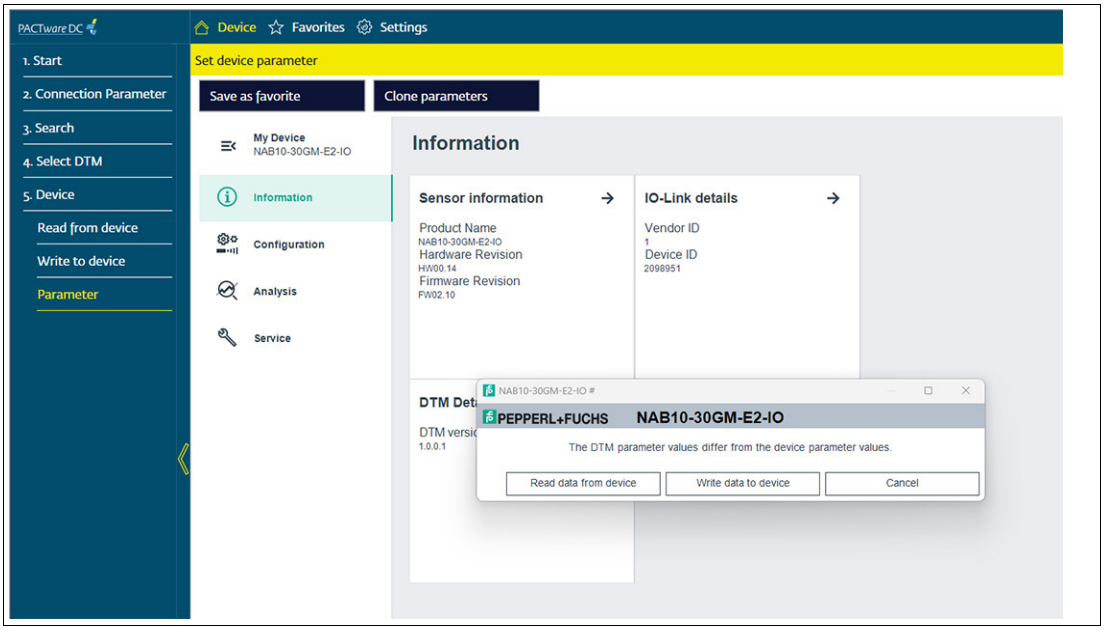



Figure 5.3

5. Select **Read data from sensor**.

↳ The PACTware DC reads and transfers the parameter values from the sensor into the DTM and starts the continuous data exchange with the sensor.

# 6 Process Data Structure

The process data of the inductive distance sensors with IO-Link consists of 32 bits (4 bytes). The following table provides an overview of the order and structure of the process data.

| Name | Long Name | Data Type | Length | Bit Offset | Value |
|---|---|---|---|---|---|
| MDC - Measurement Value | Measurement Data Channel - Measurement Value | Integer | 16 bits | 16 | <MV1_min> ... <MV1_max)<br>32764: No measurement data |
| MDC - Scale | Measurement Data Channel - Scale | Integer | 8 bits | 8 | -5: resolution 10 µm |
| DSC.3 - Acceleration Warning | Diagnosis Signal Channel 3 - Acceleration Warning | Boolean | 1 bit | 6 | 0: Inactive<br>1: Active |
| DSC.2 - Velocity Warning | Diagnosis Signal Channel 2 - Velocity Warning | Boolean | 1 bit | 5 | 0: Inactive<br>1: Active |
| DSC.1 - Maintenance Warning | Diagnosis Signal Channel 1 - Maintenance Warning | Boolean | 1 bit | 4 | 0: Inactive<br>1: Active |
| SSC.2 - Switching Signal 2 | Switching Signal Channel 2 | Boolean | 1 bit | 1 | 0 = Low<br>1 = High |
| SSC.1 - Switching Signal 1 | Switching Signal Channel 1 | Boolean | 1 bit | 0 | 0 = Low<br>1 = High |

Table 6.1

## 6.1 MDC — Measurement Value

**MDC - Measurement Data Channel - Measurement Value**

The "Measurement Value" process data content returns the current distance of the recorded damping element in the measuring range of the inductive distance sensor with IO-Link.

## 6.2 MDC — Scale

**Measurement Data Channel**—Scale

The position value contained in the process data can be converted to the base unit specified in the "MDC Descriptor—Unit Code" parameter. The exponent defined by "Scale" to base 10 is used for this purpose.

For example, a scale value of -5 together with the base unit of "m" specifies a resolution of 10^-5 m = 10 µm.

## 6.3 DSC.3 — Acceleration Warning

**Diagnosis Signal Channel 3**—Acceleration Warning

The "Acceleration Warning" is triggered as soon as at least one of the parameterized limit values for the minimum or maximum acceleration has been reached.

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## 6.4 DSC.2 — Velocity Warning

**Diagnosis Signal Channel 2**—Velocity Warning

The "Velocity Warning" is triggered as soon as at least one of the parameterized limit values for the minimum or maximum velocity for Velocity 1 or Velocity 2 has been reached. The "Maintenance Diagnostics" section (see chapter 11) can be used to find out whether Velocity 1 or 2 has triggered the "Warning." Further data can be read out in the "Observation Data" section.

## 6.5 DSC.1 — Maintenance Warning

**Diagnosis Signal Channel 1**—Maintenance Warning

The "Maintenance Warning" is triggered as soon as at least one of the parameterized limit values for maintenance data has been reached, with the exception of velocities and acceleration.

The "Maintenance Diagnostics" section can be used to find out why the "Warning" has been triggered, see chapter 11.

## 6.6 SSC.2 — Switching Signal

**Switching Signal Channel 2 - Switching Signal**

The "SSC.2 - Switching Signal" process data content refers to a signal bit used to detect a position that is critical for the application. It is part of the cyclic signal transmission. Depending on the status of the sensor or the state of the application, the signal bit can have the value "0" or "1."

The following parameters affect the switching characteristics of the SSC.2 process data:

- SSC.2 Param: SP1
- SSC.2 Param: SP2
- SSC.2 Config: Logic
- SSC.2 Config: Mode
- SSC.2 Config: Hyst
- SSC.2 Ext: SP Offset
- SSC.2 Ext: Pulse Extension
- SSC.2 Ext: Substitute Behavior

## 6.7 SSC.1 — Switching Signal

**Switching Signal Channel 1 - Switching Signal**

The "SSC.1 - Switching Signal" process data content refers to a signal bit used to detect a position that is critical for the application. It is part of the cyclic signal transmission. Depending on the status of the sensor or the state of the application, the signal bit can have the value "0" or "1."

The following parameters influence the switching characteristics of the SSC.1 process data:

- SSC.1 Param: SP1
- SSC.1 Param: SP2
- SSC.1 Config: Logic
- SSC.1 Config: Mode
- SSC.1 Config: Hyst
- SSC.1 Ext: SP Offset
- SSC.1 Ext: Pulse Extension
- SSC.1 Ext: Substitute Behavior

# 7 IO-Link Parameterization

Only the parameters of the NA...-...-IO-... product group that require explanation are listed below.

The switching parameters for the NA...-...-IO-... inductive distance sensor are described using the "SSC.1 - Switching Signal 1" process data as an example. The switching parameters for the "SSC.2 - Switching Signal 2" process data work in the same way. You can set and use both switching signal channels independently of each other.

**Note**

A comprehensive overview of all parameters for the respective inductive distance sensor with IO-Link can be found online at **www.pepperl-fuchs.com**. Navigate to the relevant product page for the NA...-...-IO-... and click on the corresponding "IO-Link Parameter Datasheet" document.

For a clear reference to the document "IO-Link Parameter Datasheet" and to make it easy to find all information on parameters, parameter names and some terms are listed below.

The abbreviations below are used in the following:

**ro** read only

**wo** write only

**rw** read and write

## 7.1 SSC.1 Param: SP1

**Switching Signal Channel 1 Parameter: Setpoint 1**

| Index | Sub | Parameter | Access | Data Type | Length |
|---|---|---|---|---|---|
| 60 (0x3c) | 1 | SSC.1 Param: SP1 | rw | Integer | 32 bits |

The "SSC.1 Param: SP1" parameter is used to set a critical limit value for "SSC.1."

The permissible value range of the "SSC.1 Param: SP1" parameter is independent of "SSC.1 Param: SP2."

## 7.2 SSC.1 Param: SP2

**Switching Signal Channel 1 Parameter: Setpoint 2**

| Index | Sub | Parameter | Access | Data Type | Length |
|---|---|---|---|---|---|
| 60 (0x3c) | 2 | SSC.1 Param: SP2 | rw | Integer | 32 bits |

The "SSC.1 Param: SP2" parameter is used to set a critical limit value for "SSC.1."

The permissible value range of the "SSC.1 Param: SP2" parameter is independent of "SSC.1 Param: SP1."

The general rule for switch points SP1 and SP2 is:

Switch points SP1 and SP2 can be set independently of one another.

- SP1 can be greater than SP2
- SP1 can be smaller than SP2
- SP1 can be equal to SP2

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## 7.3 SSC.1 Config: Logic

**Switching Signal Channel 1 Configuration: Logic**

| Index | Sub | Parameter | Access | Data Type | Length |
|---|---|---|---|---|---|
| 61 (0x3D) | 1 | SSC.1 Config: Logic | rw | UInteger | 8 bits |

The "SSC.1 Config: Logic" parameter indicates whether the "SSC.1" switching signal is transmitted as "High active" or "Low active." This allows you to set the switching function on the output of the amplifier as an NO or NC contact.

- Normally open = High active
- Normally closed = Low active

## 7.4 SSC.1 Config: Mode

**Switching Signal Channel 1 Configuration: Mode**

| Index | Sub | Parameter | Access | Data Type | Length |
|---|---|---|---|---|---|
| 61 (0x3D) | 2 | SSC.1 Config: Mode | rw | UInteger | 8 bits |

The "SSC.1 Config: Mode" parameter is used to set the evaluation mode for the signal evaluation. The resulting switching signal depends on values selected for SP1, SP2 Logic, Mode, and Offset.

Set one of the following modes:

- Deactivated
- Single Point
- Window
- Two Point
- Centered Window

The following figures show the different modes; switching signal "SSC.1" is shown as a blue line. The figures depict the switching characteristics for the "High Active" switching logic.

SP.min. corresponds to the lower measuring range end, i.e., position 0 mm on the sensor. SP.max. corresponds to the measuring range end value.

### "Deactivated" Mode

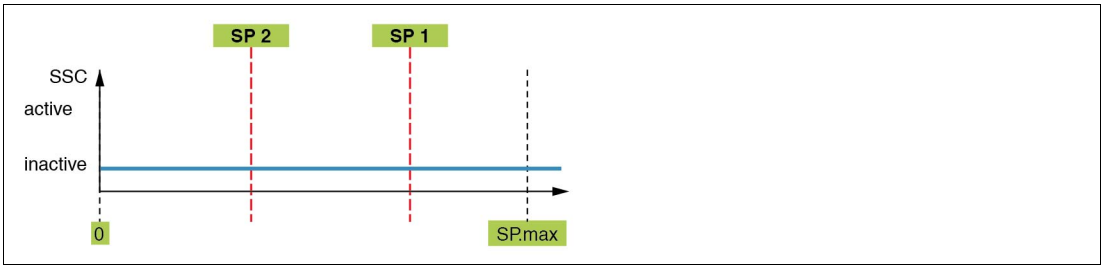



Figure 7.1

## Single Point Mode

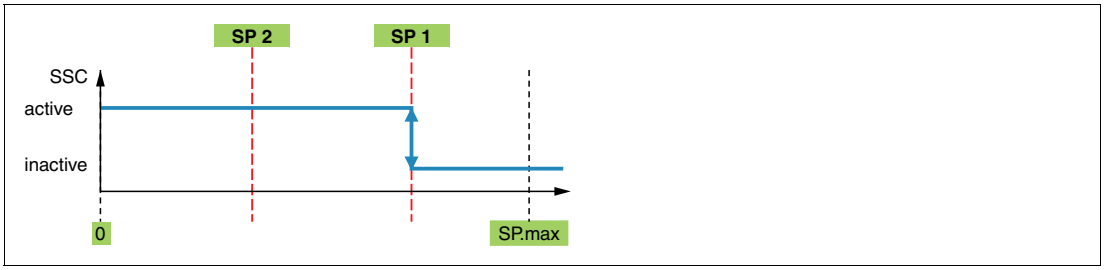



Figure 7.2

**Note**

SP2 has no effect in this mode.

## Window Mode

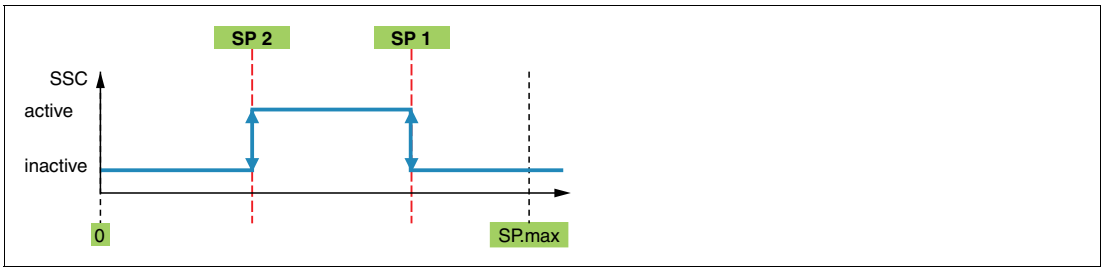



Figure 7.3

## Two Point Mode

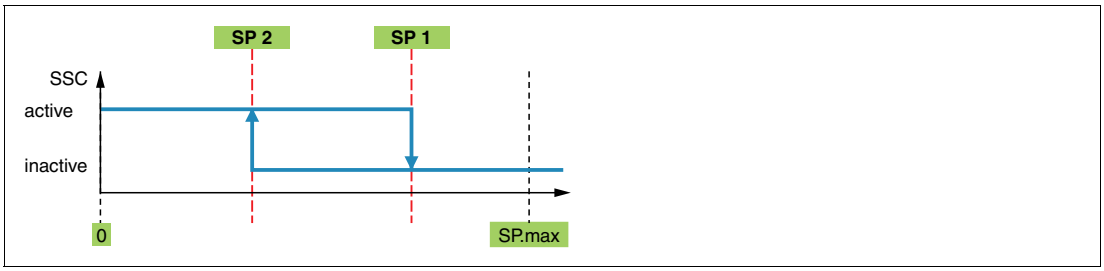



Figure 7.4

## Centered Window Mode

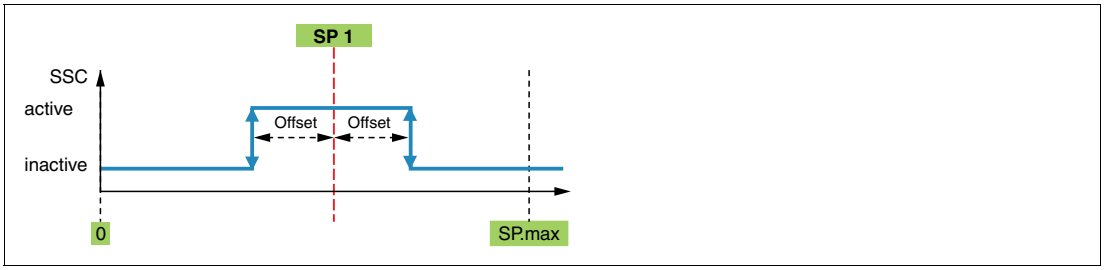



Figure 7.5

**Note**

SP2 has no effect in this mode.

## 7.5 SSC.1 Config: Hyst

**Switching Signal Channel 1 Configuration: Hysteresis**

| Index | Sub | Parameter | Access | Data Type | Length |
|---|---|---|---|---|---|
| 61 (0x3D) | 3 | SSC.1 Config: Hyst | rw | Integer | 32 bits |

The "SSC.1 Config: Hysteresis" parameter indicates the extent of a required delayed effect of the SSC.1 bit. This is despite an actual change made to the position value.

If the measured position value continuously toggles around the set critical setpoint "SSC.1 Param: SP1," the SSC.1 signal bit in the cyclic signal transmission would continuously toggle between "0" and "1." If this effect is not required, use the "SSC.1 Config: Hysteresis" parameter to create an interval between the activation and deactivation of the SSC.1 bit. To ensure stable switching characteristics, a default hysteresis of 5 % is available.

**Note**

The default hysteresis (factory setting) for the sensors is 5 % of the measuring range. Depending on the system, this can be falsely displayed as "0 mm" in some software environments.

The hysteresis function depends on the mode selected in the "SSC.1 Config: Mode" parameter. It works only for the modes "Single Point," "Window," and "Centered Window." The effect in each mode is shown in the figures below.

### Single Point Mode with Hysteresis

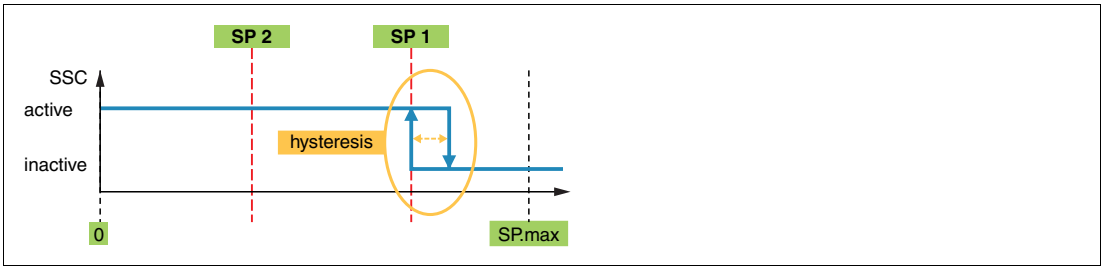



Figure 7.6

### Window Mode with Hysteresis

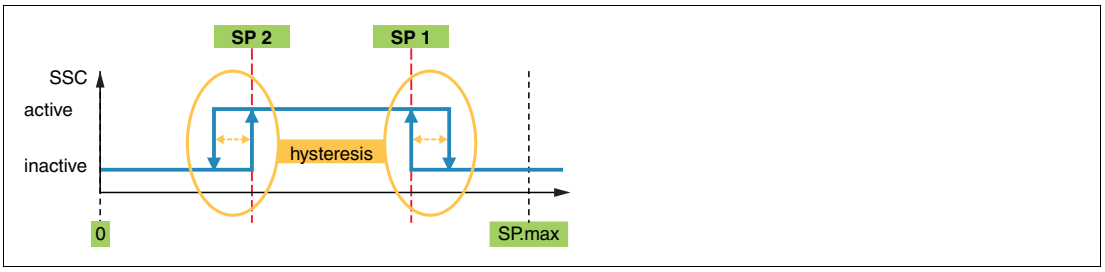



Figure 7.7

### Centered Window Mode with Hysteresis

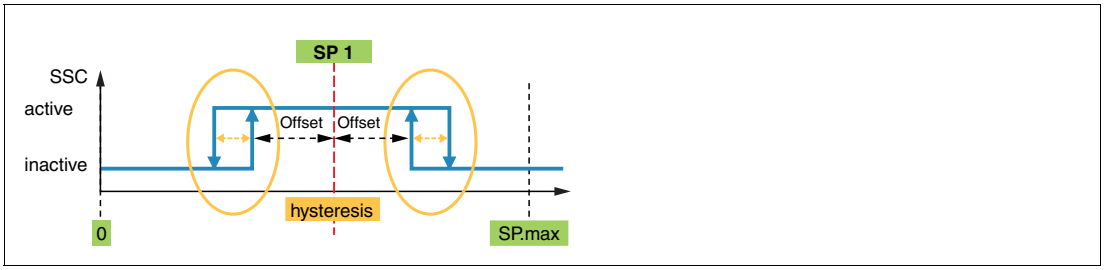



Figure 7.8

As seen in the figures for the "Window" and "Centered Window" modes, the hysteresis limit has an outward-facing effect. As seen in the figure for the "Single Point" mode, this sensing principle is used for Single Point mode.

Using the "SSC.1 Config: Logic" (0x3D Sub1) parameter, you can set the required assignment of "high active" or "low active" of the logic value to the active state.

## 7.6 SSC.1 Config Ext: SP Offset

**Switching Signal Channel 1 Extended Configuration: Setpoint Offset**

| Index | Sub | Parameter | Access | Data Type | Length |
|---|---|---|---|---|---|
| 64 (0x40) | 1 | SSC.1 Config Ext: SP Offset | rw | Integer | 32 bits |

The "SSC.1 Config Ext: SP Offset" parameter is used to set the window width in Centered Window mode.

The center of the switching window is determined by the "SSC.1 Param: SP1" setpoint. The window width (without hysteresis) is determined by the offset in both directions, i.e., the window width corresponds to the double offset.

## 7.7 SSC.1 Config Ext: Pulse Extension

**Switching Signal Channel 1 Extended Configuration: Pulse Extension**

| Index | Sub | Parameter | Access | Data Type | Length |
|---|---|---|---|---|---|
| 64 (0x40) | 2 | SSC.1 Config Ext: Pulse Extension | rw | UInteger | 8 bits |

With the "SSC.1 Config Ext: Pulse Extension" parameter, you can extend active phases (with active high signal) or inactive phases (with active low signal) of the switching signal channel 1 where required. This ensures that every relevant switching pulse from the master is detected.

You can choose between the following settings for the extension duration $t_{pulse}$:

- Off
- Auto
- 10 ms
- 100 ms
- 1000 ms

The "Auto" setting extends the signal for as long as necessary, so that even short switching events between two transmissions of the process data are reliably detected. Switching events longer than the set time $t_{pulse}$ are not additionally extended.

### Pulse Extension, Logic = High Active

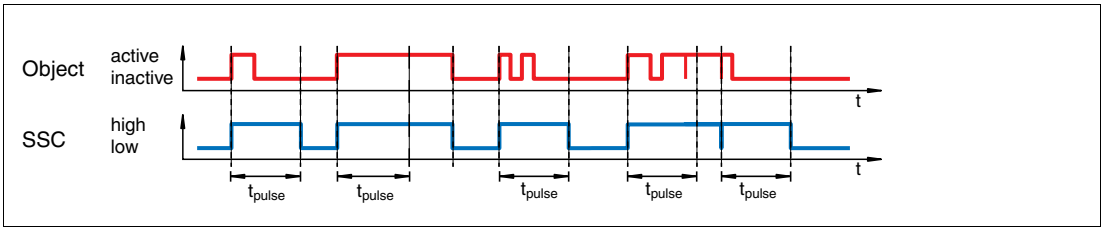



Figure 7.9

### Pulse Extension, Logic = Low Active

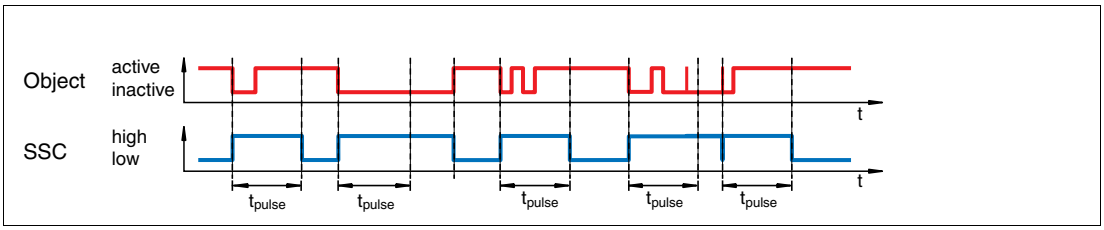



Figure 7.10

## 7.8 SSC.1 Config Ext: Substitute Behavior

**Switching Signal Channel 1 Extended Configuration: Substitute Behavior**

| Index | Sub | Parameter | Access | Data Type | Length |
|---|---|---|---|---|---|
| 64 (0x40) | 3 | SSC.1 Config Ext: Substitute Behavior | rw | UInteger | 8 bits |

The "SSC.1 Config Ext: Substitute Behavior" parameter defines the behavior of the switching signal channel 1 when the determined position is outside the measuring range ("out-of-range"), or the position cannot be determined ("no measurement data").

In these cases, either the last state is kept or one of the two values is assumed to be "inactive" or "active."

# 8 Switching Signal Characteristics

The following sections use examples to describe the switching signal characteristics of the inductive position measurement system for the "SSC.1—Switching Signal 1" process data. The switching signal characteristics for the "SSC.2—Switching Signal 2" process data work in the same way. You can set and use both switching signal channels independently of each other.

## 8.1 Window Mode with SP1 and SP2

The parameters of SP1 (setpoint 1) and SP2 (setpoint 2) can be parameterized differently to accommodate different application types. The figure below illustrates this.

### Switch point SP1 > SP2

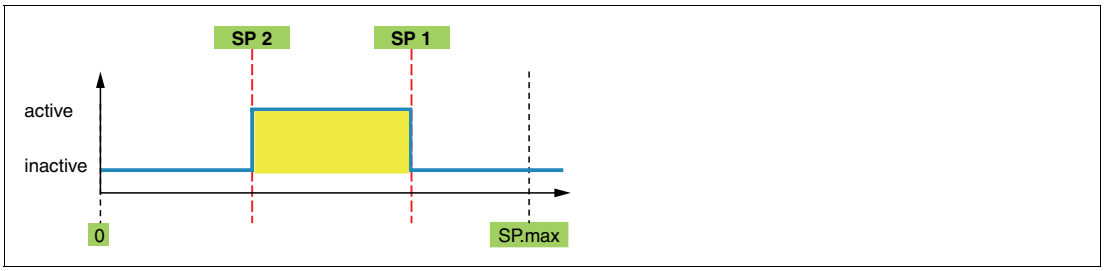



Figure 8.1

### Switch point SP2 > SP1

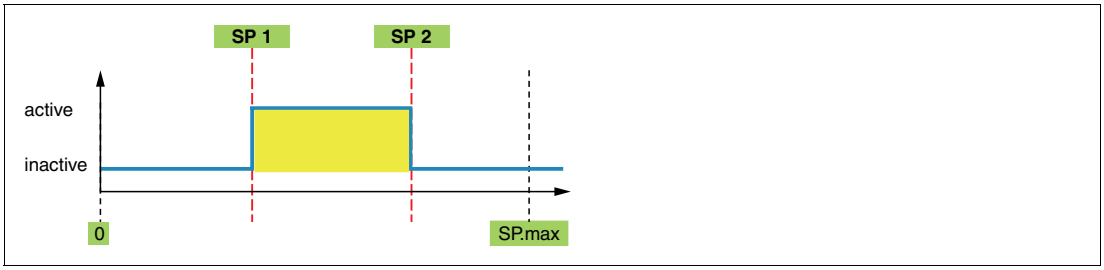



Figure 8.2

### Switch point SP1 = SP2

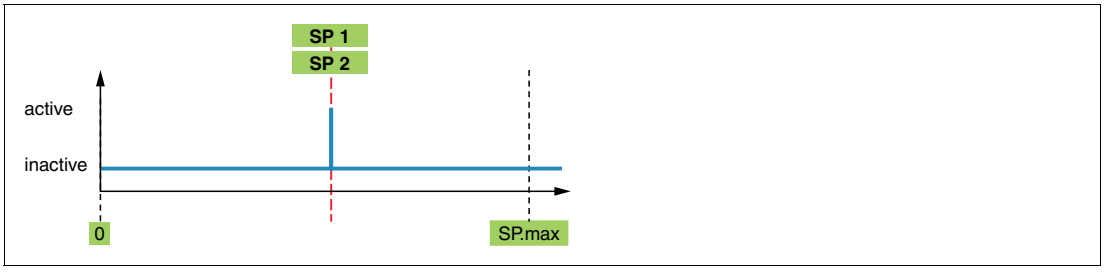



Figure 8.3

The SP1 (setpoint 1) and SP2 (setpoint 2) switch points can be used as the upper or lower switching threshold for the associated switching signal channel, depending on the assigned value. The switch point with the higher value is referred to as the upper switching limit; the switch point with the lower value is referred to as the lower switching limit. The colored value range between the lower and upper switching limit is known as the window range (=within the window).

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SP1 (setpoint 1) and SP2 (setpoint 2) can be parameterized with the same assigned value and loaded into the device. Since the upper and lower switching limits can be set to the same value despite this, the set hysteresis determines the actual window width.

Using the "SSC.1 Config: Logic" (0x3D Sub 1) parameter, you can set the required switching characteristics as "high active" or "low active."

The general rule for switch points SP1 and SP2 is:

Switch points SP1 and SP2 can be set independently of one another.

- SP1 can be greater than SP2
- SP1 can be smaller than SP2
- SP1 can be equal to SP2

## 8.2 Centered Window Mode with SP1 and Offset

You can set the window width defined by the centered window SP1 and the offset so that the window starts before the start of the measuring range or stops only after the end of the measuring range.

It should be noted that the window is automatically shortened on one side such that it starts no earlier than the start of the measuring range and stops no later than the end of the measuring range. Positions outside the measuring range never fall within the window.

The figure below illustrates this.

### Centered Window at SP.min.

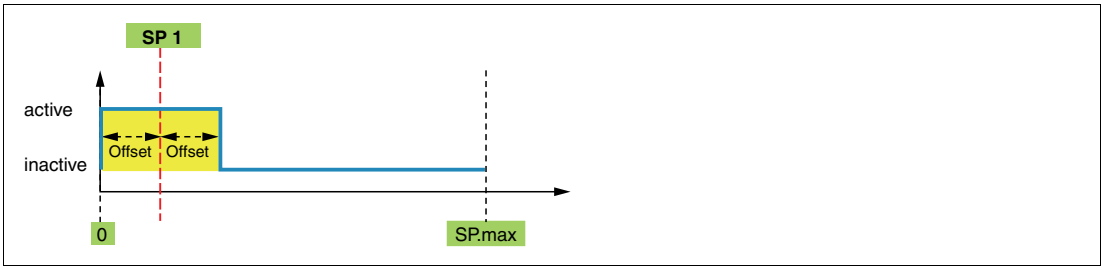



Figure 8.4

## 8.3 Hysteresis with SP1 and SP2

A uniform hysteresis range can be set for each of the switch points SP1 (setpoint 1) and SP2 (setpoint 2). Keep in mind that the hysteresis limit for Window mode and Centered Window mode has an outward-facing effect.

The inductive distance sensor accepts a hysteresis range smaller than the zero point or greater than the end of the measuring range as a permissible configuration status. However, it should be noted that the zero point and the end of the measuring range automatically work as a lower or upper switching threshold—instead of the actual hysteresis limit—when the measured value is undershot during operation.

The figure below illustrates this.

### Window with Hysteresis Range Smaller than the Zero Point

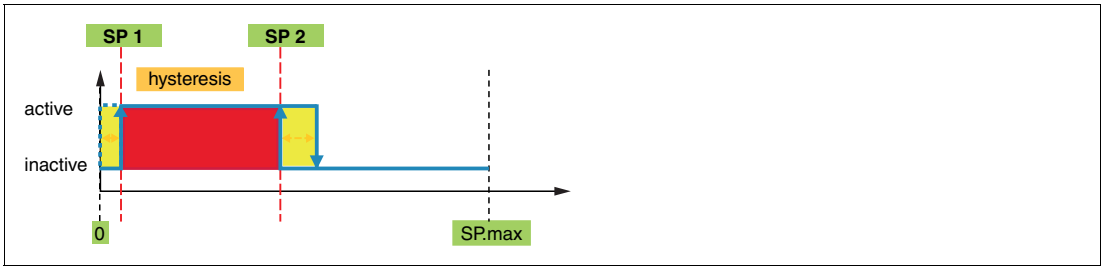



Figure 8.5

The Window mode between the switch points SP2 and SP1 is shown in red. The respective hysteresis range for each switch point is yellow. The ineffective hysteresis range smaller than the zero point is cut off.

These switching characteristics apply to the Single Point and Centered Window modes.

**Note**

The default hysteresis (factory setting) for the sensors is 5 % of the measuring range. Depending on the system, this can be falsely displayed as "0 mm" in some software environments.

## 8.4 General Provisions for Switching Characteristics

### Priorities

Combining configurations from "Switching Mode," "Pulse Extension," "Substitute Behavior," and "Hysteresis" results in different logical circuitries. The sensor prioritizes the different parameters in a unique order (1 = highest priority, 4 = lowest priority):

1. Switching Mode
2. Pulse Extension
3. Substitute Behavior
4. Hysteresis

### Example: Pulse Extension Ends in the Measuring Range End Position

If the switch state is extended using the "Pulse Extension" parameter to the point that the actuator element is outside of the measuring range when "Pulse Extension" ends, the "Substitute Behavior" is directly affected. If the substitute behavior contains the "Hold" setting, the state can be changed only when the actuator element re-enters the measuring range.

The diagram below illustrates this using the settings Mode = Window Mode, Pulse Extension = active and Substiute Behavior = hold:

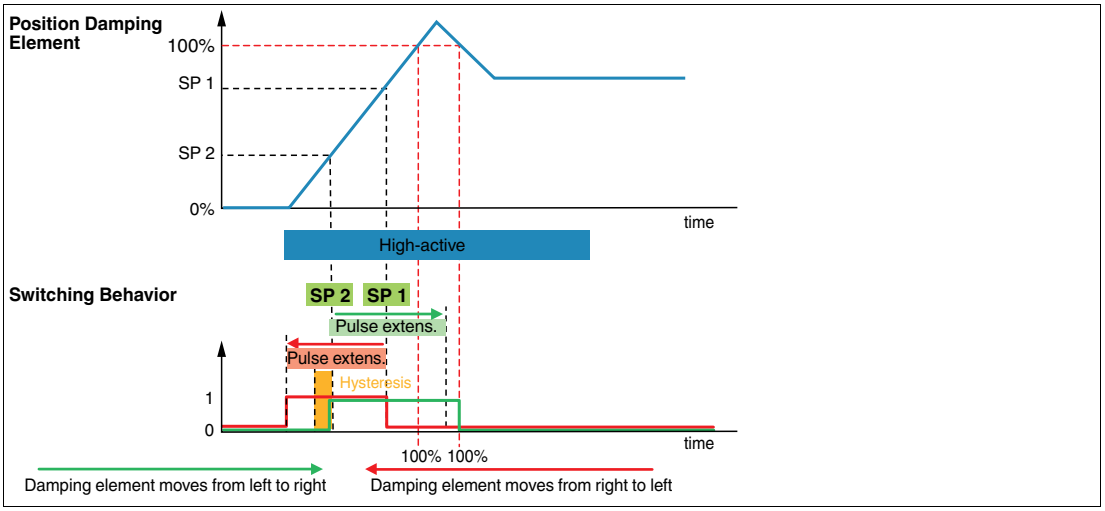



Figure 8.6

## Example: Hysteresis Range Is Smaller than the Zero Point/Greater than the Measuring Range End Value

If the "SPn-Hyst" or "SPn-Offset-Hyst" (Centered Window mode) is smaller than 0 for a decreasing measured value (position), the switch point is at 0.

If "SPn+Hyst" or "SPn+Offset+Hyst" (Centered Window mode only) is greater than the end of the measuring range for an increasing measured value (position), "Substitute Behavior" intervenes and shortens the hysteresis.

The diagram below illustrates this using the settings Mode = Single Point Mode, Pulse Extension = deactivated and Substiute Behavior = inactive:

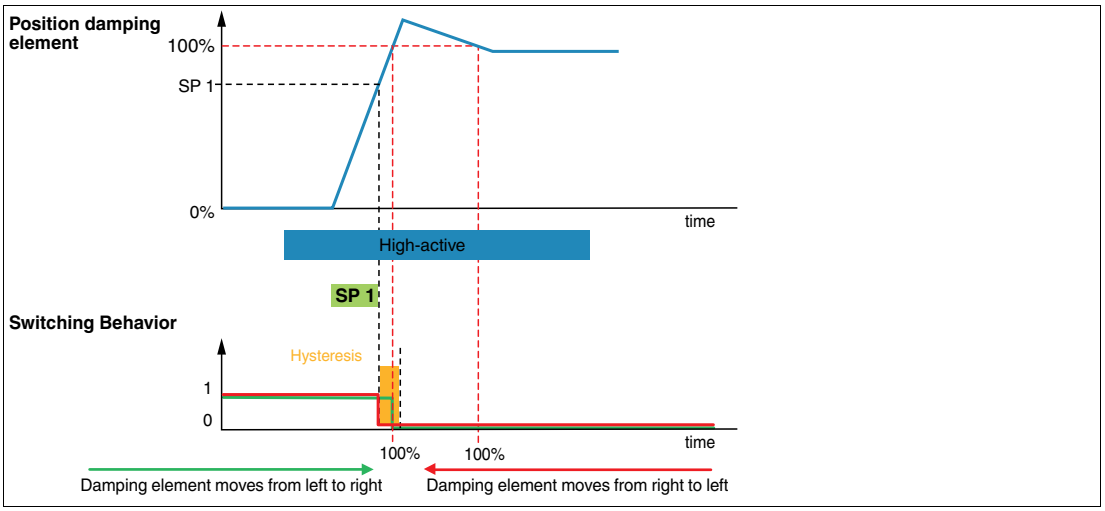



Figure 8.7

# 9 Filter Modes

As the device can be used for a wide range of requirements and applications, it is possible to use the filter to optimize the distance measurement to the current requirements and therefore obtain the best-possible measurement result:

- Standard
  Optimized balance between measurement speed and measurement accuracy. Corresponds to the factory setting. The datasheet specifications refer to operation in this filter mode.
- High Accuracy
  Optimized for accuracy and robustness against faults. The measurement speed is reduced in this case.
- High Speed
  Optimized for measurement speed.

**Note**

The internal measurement and calculation of speed and acceleration for the damping element is not influenced by the filter mode in use.

# 10 Maintenance

For the purpose of maintaining your machine or application, you can set limit values via the "Maintenance Configuration" areas and read various pieces of additional information in the "Maintenance Information" area, for example "Maintenance Monitor data."

When one or more parameterized limit values are reached, a "Maintenance Warning" is triggered. This "Maintenance Warning" is also transmitted cyclically in the process data.

The following figures illustrate the connections between all maintenance and diagnosis options. Detailed explanations of the configuration and evaluation options can be found throughout chapters 10 and 11.

The following figure shows how the DSC.1 - Maintenance Warning is triggered.

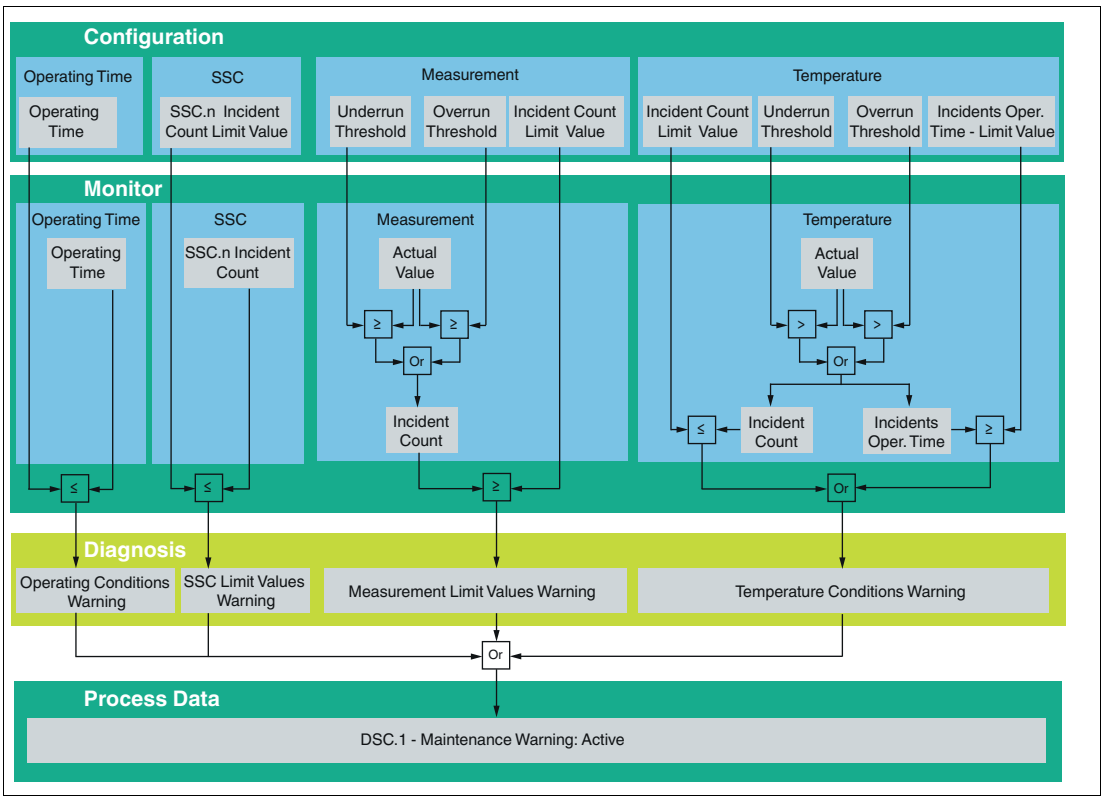



Figure 10.1

The figure below shows how the DSC.2 - Velocity Warning and DSC.3 - Acceleration Warning are triggered.

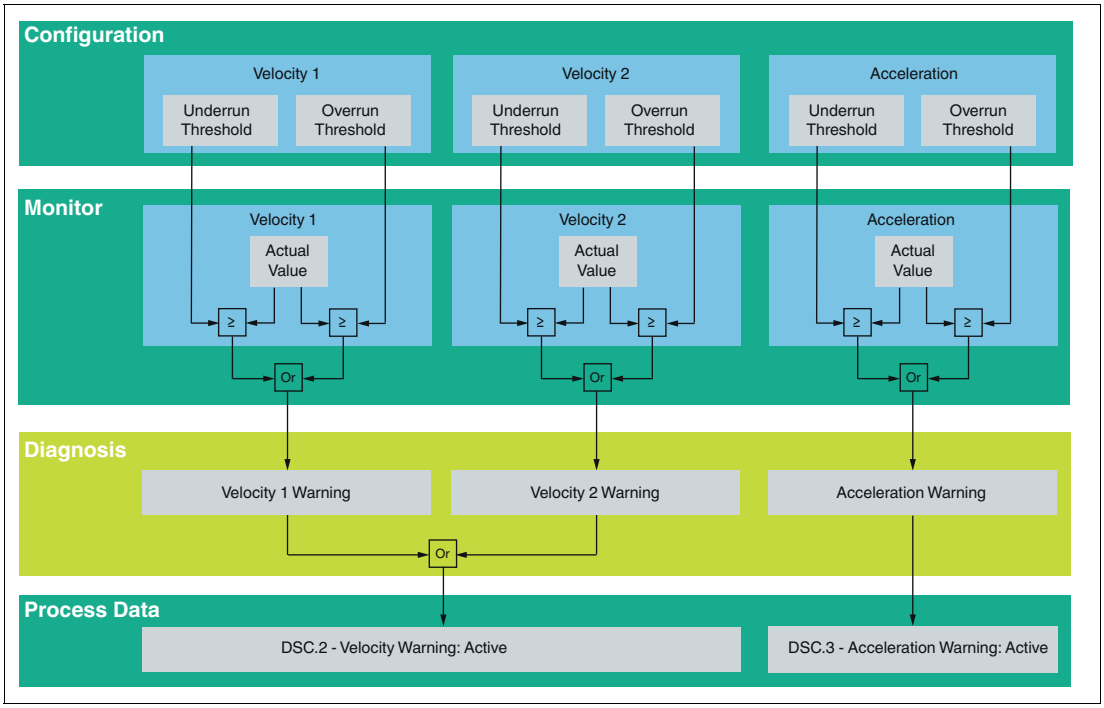



Figure 10.2

There is also the option to output a related "Maintenance Diagnosis" event, provided that this is desired and is activated using the relevant parameterization.

The figure below shows the relationship between configured events and the output of warnings using the process data (cyclic) and the Observation Data parameter (acyclic) if the event conditions are met.

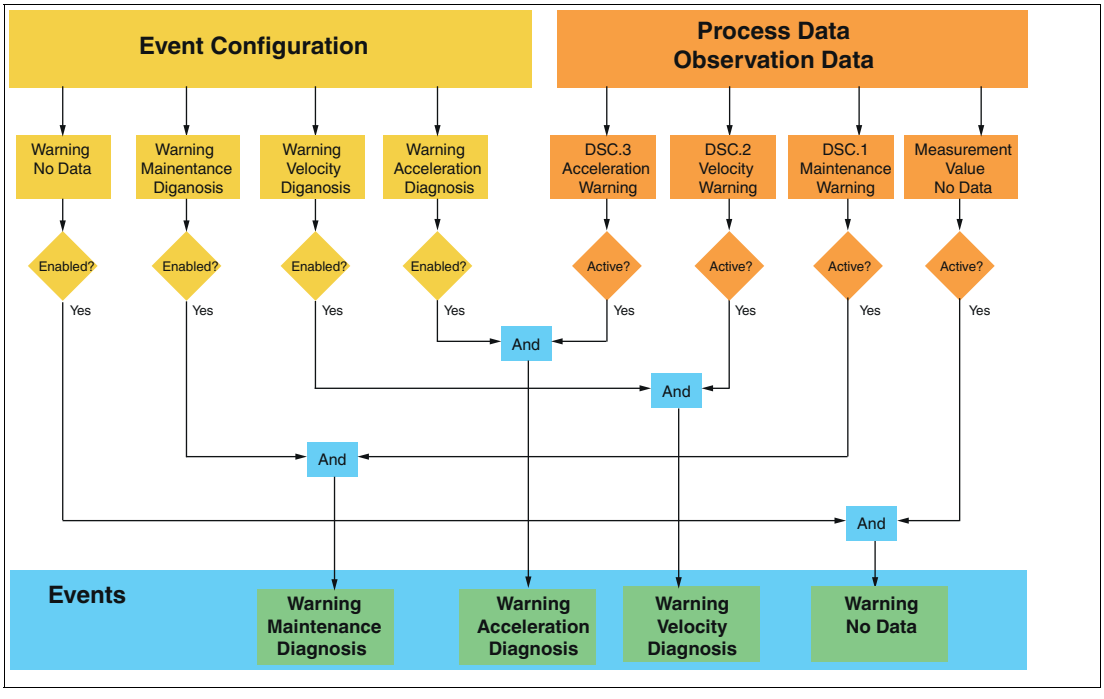



Figure 10.3

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## 10.1 Maintenance Configuration

The following parameters can be configured in the "Maintenance Configuration" section.

### Maintenance Configuration - Operating Time

A specific limit value can be parameterized for the operating time until the next maintenance procedure.

When the parameterized limit value is reached, the "Maintenance Warning" event is triggered.

### Maintenance Configuration - SSC

For the switching signals (SSC.1 and SSC.2), limit values can be parameterized for the number of switching cycles.

When the parameterized limit value is reached, the "Maintenance Warning" event is triggered.

### Maintenance Configuration - Measurement

A monitoring window can be set between a lower and an upper limit value for the measured value. A limit value can also be parameterized for the number of times that the window limits are permitted to be undershot or exceeded.

If the value is no longer within the monitoring window or if the upper or lower limit values are reached, this is registered.

The "Maintenance Warning" event is only triggered once the parameterized limit value for the maximum number of times that the limits can be exceeded or undershot is reached.

### Maintenance Configuration - Temperature

For the measured device temperature, the following situations can be parameterized as limit value settings:

- Monitoring window with upper and lower limit value
- Limit values for the number of times that the monitoring window limits are permitted to be exceeded or undershot
- A limit value for the permissible time that can be spent outside of the monitoring window

The "Maintenance Warning" event is only triggered once the parameterized limit value for the maximum number of times that the limits can be exceeded or undershot is reached or the maximum permissible time outside the limit values is reached.

### Velocities and Acceleration

For the measured velocities 1 and 2, upper and lower limit values can be parameterized in the respective parameterized measuring windows and for the determined acceleration.

The "Velocity" or "Acceleration Warning" event is only triggered once the parameterized limit value is reached.

For more information regarding velocity and acceleration measurements, see chapter 13.

## 10.2 Maintenance Monitor

Data or limit values recorded via the "Maintenance Monitor Data" are made available in the "Maintenance Information" area. The following parameters can be read acyclically.

**Note**

During ongoing operation, the current count values can be read from a volatile buffer. The counters are written to a persistent memory every 15 minutes. If the operating voltage is lost, values that have not yet been written to the persistent memory may be lost. The counter value most recently written to the persistent memory is always output during a restart.

### Maintenance Monitor - Operating Time

Indicates the operating time since the last "Maintenance-Reset," "Application-Reset," or "Back to Box" command.

### Maintenance Monitor - SSC

Indicates the number of times the parameterized limit values for the SSCs have been exceeded or undershot to date. There are separate counters for SSC.1 and SSC.2.

### Maintenance Monitor - Measurement

Indicates both the minimum and maximum measured values recorded to date and the number of times the defined monitoring window limits have been exceeded or undershot.

### Maintenance Monitor - Temperature

Indicates the minimum and maximum temperatures recorded to date, the number of times the defined monitoring window limits have been exceeded or undershot, and the total time in which the device has been operated outside of the defined monitoring window limit values.

### Velocities and Acceleration

Indicates the minimum and maximum values recorded to date for velocity measurements 1 and 2 and acceleration.

### Reset Commands

All counters in the "Maintenance Monitor" section can be reset using the following commands:

- Maintenance-Reset
- Velocity and Acceleration Reset
- Application-Reset
- Back to Box

The "Velocity and Acceleration Reset" command only resets the measured values for velocity and acceleration.

However, the "Maintenance-Reset" command resets all data in the section, including the velocity and acceleration data.

# 11 Diagnostics

## Operating Hours

Indicates the total operating time for the sensor since leaving production. This value cannot be reset.

## Temperature Indicator

Provides simple status information regarding whether the permissible temperature range is being adhered to in relation to the current temperature. Subsequent status information is displayed.

- Operating conditions OK
- Close to upper limit
- Upper limit exceeded
- Close to lower limit
- Lower limit exceeded

## Temperature Monitor

The temperature monitor provides more specific information regarding measured temperatures to date since the sensor left production. These values cannot be reset.

The following information is provided:

- **Overtemperature Operating Hours**
  The total amount of time in which the device has been operated at temperatures that exceed the permissible temperature range.
- **Overtemperature Exceed Counter**
  The number of times that the permissible temperature range has been exceeded.
- **Maximum Operating Temperature**
  Highest measured device temperature.
- **Minimum Operating Temperature**
  Lowest measured device temperature.
- **Device Operating Temperature**
  Current device temperature.

## Power Monitor

The power monitor displays more specific information regarding operation to date since the device left production. These values cannot be reset.

The following information is provided:

- **Power Cycles**
  Indicates the number of times the operating voltage has been switched on and off since the product was shipped.
- **Maximum Uptime**
  Indicates the longest continuous operating time since the product was shipped.
- **Average Uptime**
  Indicates the average operating time since the product was shipped.
- **Uptime**
  Indicates the current operating time since the last power cycle.

## Maintenance Diagnostics

If the parameterized maintenance limit values are exceeded, this is indicated in this section, see chapter 10.1. Since some exceedance events are bundled together in one data bit in the process data (Maintenance Warning and Velocity Warning), this section enables users to determine the origin of any warnings present.

The following warning messages are itemized here:

- **Operating Conditions Warning**
  Outputs a warning as soon as the parameterized "Maintenance Config Operating Time" has been reached or exceeded.
- **SSC Limit Values Warning**
  Outputs a warning as soon as one of the parameterized limit values for the number of switching cycles (SSC.1 or SSC.2) has been reached or exceeded.
- **Measurement Limit Values Warning**
  Outputs a warning as soon as the parameterized limit value for the number of incidents (Incident Count Limit Value), where operation is outside certain parameterized limit values, has been reached or exceeded.
- **Temperature Conditions Warning**
  Outputs a warning as soon as one of the parameterized limit values for the following parameters has been reached or exceeded. Exceeding and undershooting the set temperature monitoring range is weighted using an incident counter or operating time counter, so that a warning is only output when the limit values are exceeded.
  - Incident Count Limit Value: Specifies the limit value for the number of violations of the configured range.
  - Incident Operating Time Limit Value: Specifies the limit value for operating time outside the configured range.
- **Velocity 1 Warning**
  Outputs a warning as soon as one of the parameterized limit values for "Velocity 1" has been reached and/or exceeded or undershot.
- **Velocity 2 Warning**
  Outputs a warning as soon as one of the parameterized limit values for "Velocity 2" has been reached and/or exceeded or undershot.
- **Acceleration Warning**
  Outputs a warning as soon as one of the parameterized limit values for "Acceleration" has been reached and/or exceeded or undershot.

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# 12 Observation Data

Information that is relevant to operation is collated and displayed in this section.

The following data is displayed:

- **MDC - Measurement Value**
  Indicates the measured distance value.
- **SSC.1 - Switching Signal**
  Indicates the switch state for SSC.1.
- **SSC.2 - Switching Signal**
  Indicates the switch state for SSC.2.
- **DSC.1 - Maintenance Warning**
  Indicates if a "Maintenance Warning" is present.
- **DSC.2 - Velocity Warning**
  Indicates if a "Velocity Warning" from "Velocity 1" or "Velocity 2" is present.
- **DSC.3 - Acceleration Warning**
  Indicates if an "Acceleration Warning" is present.
- **Last Velocity 1 Measurement**
  Indicates the value from the most recent velocity measurement for Velocity 1.
- **Average 1 Velocity 1**
  Indicates the average value from the parameterized number of most recent Velocity 1 velocity measurements ("Average 1" see chapter 13 "Determining Averages").
- **Average 2 Velocity 1**
  Indicates the average value from the parameterized number of the most recent Velocity 1 velocity measurements ("Average 2" see chapter 13 "Determining Averages").
- **Minimum Value Velocity 1**
  Indicates the minimum velocity recorded to date for the Velocity 1 velocity measurement.
- **Maximum Value Velocity 1**
  Indicates the maximum velocity recorded to date for the Velocity 1 velocity measurement.
- **Last Velocity 2 Measurement**
  Indicates the value from the most recent Velocity 2 velocity measurement.
- **Average 1 Velocity 2**
  Indicates the average value from the parameterized number of most recent Velocity 2 velocity measurements. ("Average 1" see chapter 13 "Determining Averages".)
- **Average 2 Velocity 2**
  Indicates the average value from the parameterized number of most recent Velocity 2 velocity measurements. ("Average 2" see chapter 13 "Determining Averages".)
- **Minimum Value Velocity 2**
  Indicates the minimum velocity recorded to date for the Velocity 2 velocity measurement.
- **Maximum Value Velocity 2**
  Indicates the maximum velocity recorded to date for the Velocity 2 velocity measurement.
- **Last Acceleration Measurement**
  Indicates the value from the most recently performed acceleration measurement.
- **Average 1 Acceleration**
  Indicates the average value from the parameterized number of the most recent acceleration measurements. ("Average 1" see chapter 13 "Determining Averages".)
- **Average 2 Acceleration**
  Indicates the average value from the parameterized number of the most recent acceleration measurements. ("Average 2" see chapter 13 "Determining Averages".)
- **Minimum Value Acceleration**
  Indicates the minimum acceleration calculated to date.
- **Maximum Value Acceleration**
  Indicates the maximum acceleration calculated to date.

# 13 Velocity and Acceleration of the Damping Element

The inductive distance sensors with IO-Link can be used to determine, monitor, and analyze the velocity and acceleration of the actuator element. The following chapter contains more detailed information about how the measurements are performed and the adjustment options available.

## 13.1 Velocity Measurement

### Determining Velocity Using a Time Measurement

The velocity is determined by measuring the time between the entrance and exit of the damping element in a measuring window. For this measurement, the beginning and end of the measuring window can be freely parameterized.

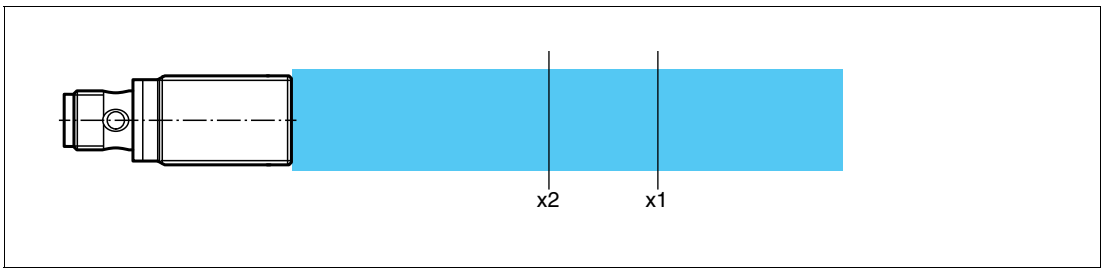



Figure 13.1

In this case, x1 > x2, x1 < x2, or x1 = x2 can be used. The order of x1 and x2 is not a decisive factor for the measured velocity. The measured velocities are always a positive value (amount).

### Two Velocity Measurements

Two velocity measurements can be parameterized, monitored, and analyzed independently of each other.

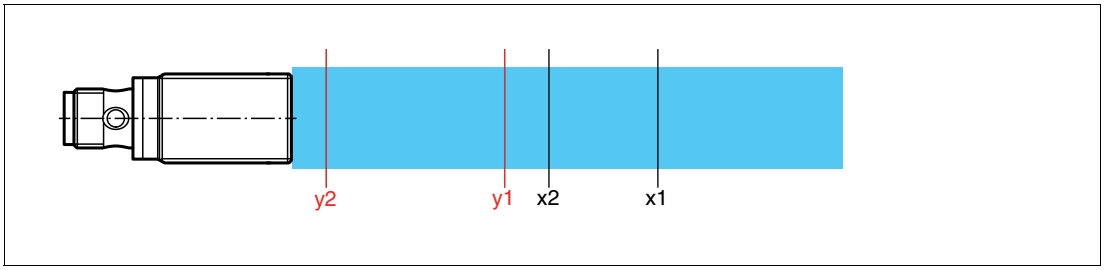



Figure 13.2

In this case, one velocity is determined for x1 to x2 (v1), and another velocity is determined for y1 to y2 (v2).

**Note**

Small measuring windows, or x1 = x2 or y1 = y2, and a damping element that is traveling at a high velocity can reduce the accuracy of the measured velocity. Enlarging the measuring window improves the accuracy of the measurement.

## Crossing the Measuring Direction

When measuring the velocity, the damping element must cross the entirety of the measuring window in order to be evaluated. If the damping element leaves the measuring window in the same direction as it entered without first crossing the end of the measuring window, all values for x1 or x2 are overwritten when the damping element re-enters the measuring window. In the figure below, only one velocity measurement has been performed with x1 and x2 being represented by the red dots.

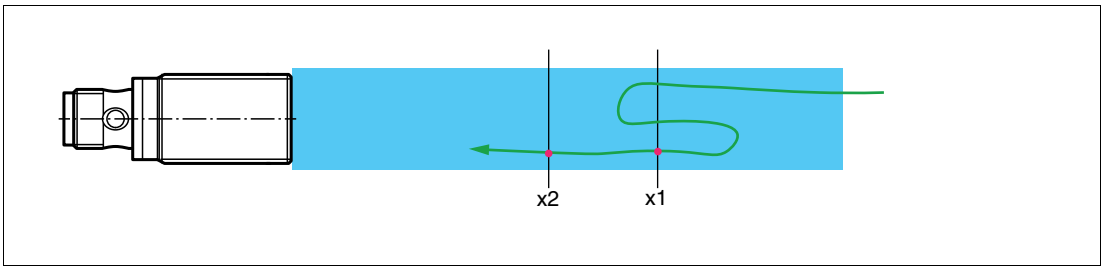



Figure 13.3

## Measuring Direction

Depending on the application, motion sequences that move toward or away from the sensor may be of interest. To rule out a mixture of measurements with varying measuring directions, select whether movements toward or away from the sensor are to be measured. The required measuring direction can be parameterized separately for the v1 and v2 velocity measurements.

**Note**

Select the measuring direction depending on the required application. Using the incorrect measuring direction will lead to incorrect data.

## Lowest Measurable Velocity

The lowest displayable velocity is 1 mm/s. Lower velocities are displayed as "out of range" as soon as the measuring window has been fully crossed.

## Hide Time

For applications in which, e.g., the damping element bounces, an option is available to hide measurements for a parameterizable time period after a successful velocity measurement. This means that no measurements are recorded that, e.g., distort the average of the measured accelerations.

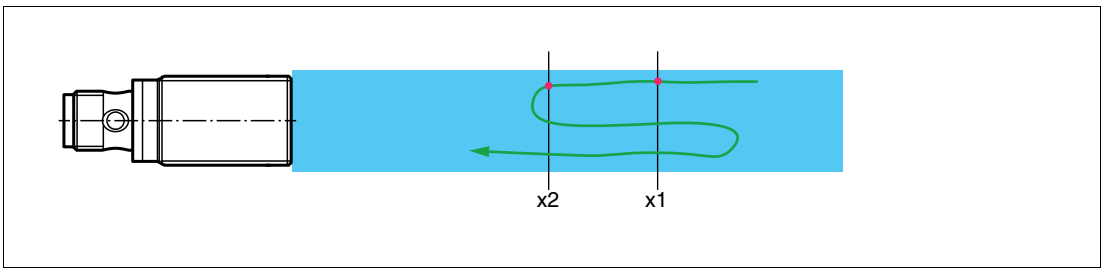



Figure 13.4

## Acceleration Measurement

The acceleration is calculated using the two determined velocities. The following formula applies:

**(v2 - v1)/**$\Delta$t

Since the determined velocities "v1" and "v2" correspond to the average velocity in the respective measuring windows, "$\Delta$t" is defined as the time interval between the midpoints of the two measuring windows for v1 and v2.

The sign of the calculated acceleration indicates whether the velocity from v1 to v2 has increased (positive value: "acceleration of the damping element") or reduced (negative value: "deceleration of the damping element").

**Note**

Therefore, ensure that the velocity measurements v1 and v2 are ordered such that the calculated acceleration leads to the desired result.

For example, for movements toward the sensor, order the measurements v1 and v2 as depicted in the graphic below. Also be sure to select the "movement toward the sensor" measuring direction for both velocity measurements. The result of the acceleration measurement therefore indicates which change of velocity v1 to v2 has taken place during a movement toward the sensor. If the acceleration measurement result is a negative value in this order, the damping element has decelerated between velocity v1 and velocity v2.

### Movement Toward the Sensor




Figure 13.5

### Movement Away from the Sensor

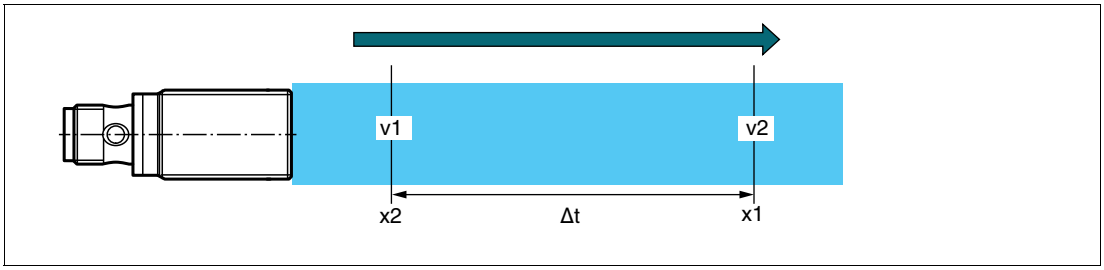



Figure 13.6

When monitoring a movement away from the sensor, the measuring windows v1 and v2 must be ordered as depicted in the following graphic, and the "movement away from the sensor" measuring direction must be selected for both velocity measurements. If the acceleration measurement result is a positive value in this order, the damping element has accelerated between velocity v1 and velocity v2.

Another potential application is monitoring the uniformity of movements toward the sensor and movements away from the sensor. In this case, the measuring windows for v1 and v2 can be in the same position and be identical sizes. However, the measuring direction must not be the same, e.g., v1 is set to movement toward the sensor and v2 to movement away from the sensor. This means that changes to the motion sequences can be detected at an early stage.

**Note**

If v1 and v2 are in the same position and are identical sizes, and are set to the same measuring direction, i.e., the start of the measuring range, the end of the measuring range, and the measuring direction for v1 and v2 are identical, it is not possible to calculate the acceleration.

## Determining Averages

Averages can be calculated for both velocity measurements and the acceleration measurement. These averages can then be called up via IO-Link. In this case, the sensor stores the previous 128 measurements. Two averages can be output respectively for Velocity 1, Velocity 2, and the acceleration measurement. Depending on the application, the number of relevant measurements can be parameterized: The previous 2, 4, 8, 16, 32, 64, or 128 measurements can be used. For example, the average of the previous 8 and the previous 128 measurements can be read out and compared for Velocity 1.

If the parameterized number of measurements have not yet been performed for the relevant average, the substitute value "No Data" is output until the required number of measurements have been performed and a valid average has been calculated. The average is recalculated after every subsequent measurement.

**Note**

The averages and the stored measurements for determining the averages are lost when the sensor is switched off.

## Measuring the Velocity of Radial Movements

Radial movements are a special case in terms of velocity measurement: Specific framework conditions are required to output a velocity value with the appropriate level of accuracy.

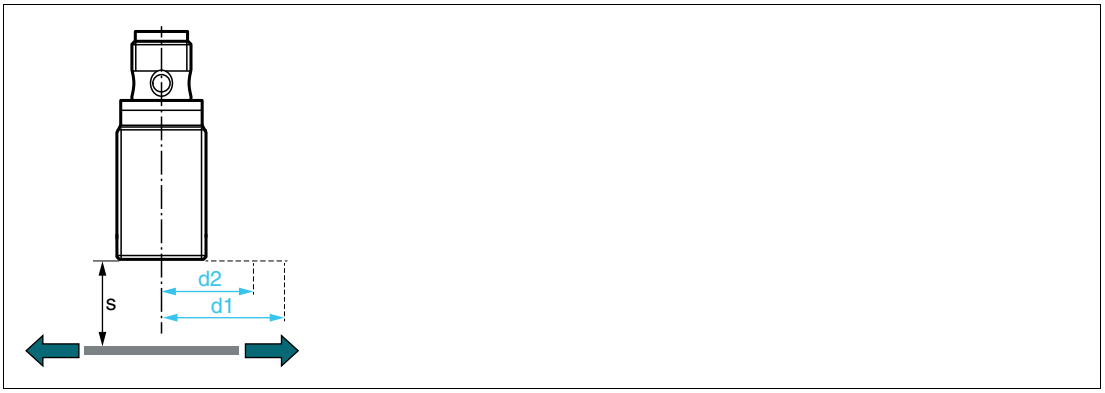



Figure 13.7

The following points are of importance when performing radial velocity measurements:

- Using a standard actuator element, see chapter 3.3.
- Maintaining a constant distance from the sensor "s"
- The specifications for the distance from the sensor given in the table below must be followed. When using the factory settings, this applies to the velocity measurements v1 and v2
- The distances "d1" and "d2" mark how far the damping element must move to fully traverse the measuring range for "v1" or "v2." In this case, the dimensions "d1" and "d2" correspond to the distance from the sensor axis to the edge of the damping element that is closer to the sensor.

### Distances Optimized for v1

| Sensor Type | Measuring Range of the Sensor | Distance "s" to Damping Element | Lateral Offset "d1" for Measurement v1 | Lateral Offset "d2" for Measurement v2 |
|---|---|---|---|---|
| NAB2-8GM*IO* | 2 mm | 0.4 mm | 4.9 mm | 4.5 mm |
| NAN4-8GM*IO* | 4 mm | 1.6 mm | 7.6 mm | 6.7 mm |
| NAB4-12GM*IO* | 4 mm | 1.2 mm | 8.8 mm | 7.8 mm |
| NAN7-12GM*IO* | 7 mm | 3.5 mm | 15.1 mm | 13.7 mm |
| NAB8-18GM*IO* | 8 mm | 3.2 mm | 16.8 mm | 15 mm |
| NAN12-18GM*IO* | 12 mm | 6 mm | 23 mm | Not applicable[1] |
| NAB10-30GM*IO* | 10 mm | 5 mm | 21 mm | 18.5 mm |
| NAN20-30GM*IO* | 20 mm | 10 mm | 37.6 mm | Not applicable [1] |
| NAN30-L2*IO* | 30 mm | 15 mm | 58.6 mm | Not applicable [1] |
| NAB8-F33*IO* | 8 mm | 3.2 mm | 17.2 mm | 15.2 mm |

Table 13.1

1. The measuring window for v2 is not fully crossed at the required distance from the damping element. Therefore, it is not possible to measure v2.

### Distances Optimized for v2

| Sensor Type | Measuring Range of the Sensor | Distance "s" to Damping Element | Lateral Offset "d1" for Measurement v1 | Lateral Offset "d2" for Measurement v2 |
|---|---|---|---|---|
| NAB2-8GM*IO* | 2 mm | 0.2 mm | 5.5 mm | 5.1 mm |
| NAN4-8GM*IO* | 4 mm | 0.8 mm | 8.1 mm | 7.4 mm |
| NAB4-12GM*IO* | 4 mm | 0.4 mm | 9.6 mm | 8.6 mm |
| NAN7-12GM*IO* | 7 mm | 2.1 mm | 15.7 mm | 14.7 mm |
| NAB8-18GM*IO* | 8 mm | 1.6 mm | 17.6 mm | 16.8 mm |
| NAN12-18GM*IO* | 12 mm | 3.6 mm | 25 mm | 23 mm |
| NAB10-30GM*IO* | 10 mm | 3 mm | 22.5 mm | 20.5 mm |
| NAN20-30GM*IO* | 20 mm | 6 mm | 40.1 mm | 36.7 mm |
| NAN30-L2*IO* | 30 mm | 9 mm | 62.2 mm | 57.3 mm |
| NAB8-F33*IO* | 8 mm | 1.6 mm | 18.4 mm | 17.2 mm |

**Note**

In case of specific questions regarding radial velocity measurements, please contact our Support.

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# 14 Maintenance and Repair

## 14.1 Maintenance Work

The sensor is maintenance free. For this reason, it is not necessary to carry out regular adjustments or maintenance work on the sensor itself. However, check that the sensor, actuator, and connector are secure as part of routine maintenance intervals. You may also want to check that the connection cable is installed and intact.

## 14.2 Resetting the Output Functions to the Factory Default

The sensor can be reset via IO-Link only.

# 15 Troubleshooting

## 15.1 What to Do in Case of Fault

In case of fault, use the following checklist to determine whether a fault in the sensor can be remedied.

If none of the information provided in the checklist solves the problem, contact Pepperl+Fuchs via your sales office with any queries. If possible, have the model number and firmware version of the sensor to hand.

### Checklist

| Error | Cause | Remedy |
|---|---|---|
| No IO-Link connection to device | The C/Q communication port on the sensor is not connected to the IO-Link master | Make sure that the C/Q communication port is connected to the IO-Link master. |
| | No voltage supply | Check whether there is a reason for the absence of the voltage supply (installation or maintenance work, etc.). Switch on the voltage supply. |
| | The IO-Link master (if used) is not ready for IO-Link operation. | If used, check the IO-Link master. |
| Damping element not detected | The distance between the sensor and the damping element is too great. | Check the mounting and establish the correct distance between the sensor and the damping element. |
| LED flashes yellow > 10 Hz | Hardware fault detected | Disconnect the sensor from the voltage supply, then reconnect it.<br>If the fault is still indicated, contact the relevant Pepperl+Fuchs sales office. |

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