

MANUAL

PMIxxx-F90-...-IO-...

Inductive Position Measurement System with IO-Link



With regard to the supply of products, the current issue of the following document is applicable: The General Terms of Delivery for Products and Services of the Electrical Industry, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship"

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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!

Visit www.pepperl-fuchs.com to access further documentation for full information about the product.

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
- 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.



Action

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

1.4 Intended Use

The PMIxxx-F90 inductive position measurement system with IO-Link is optimized for highly accurate, continuous position detection. Based on the precise evaluation of several coil systems, the device combines a proven inductive sensor with innovative microcontroller technology. Depending on the product variant, the compact design of the F90 enables position detection tasks to be carried out in a noncontact, wear-free process to a measuring length of 40 mm, 80 mm, or 120 mm.



Note!

The optimum measurement accuracy is achieved at a damping element distance of 0.5 mm ... 1.5 mm.

Only use recommended original accessories.

1.5 General Safety Instructions

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

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

User modification and or repair are dangerous and will void the warranty and exclude the manufacturer from any liability. If serious faults occur, stop using the device. Secure the device against inadvertent operation. In the event of repairs, return the device to your local Pepperl+Fuchs representative or sales office.



Note!

Disposal

Electronic waste is hazardous waste. When disposing of the equipment, observe the current statutory requirements in the respective country of use, as well as local regulations.

1.6 Declaration of conformity

This product was developed and manufactured under observance of the applicable European standards and guidelines.



Note!

A Declaration of Conformity can be requested from the manufacturer.

The product manufacturer, Pepperl+Fuchs GmbH, D-68307 Mannheim, has a certified quality assurance system that conforms to ISO 9001.



2 Product Description

2.1 Use and Application

The PMIxxx-F90-...-IO-... inductive position measurement system with IO-Link is optimized for highly accurate, continuous position detection. Based on the highly precise evaluation of several coil systems, the device combines a proven inductive sensor with innovative microcontroller technology.

The compact and robust design of the F90 enables position detection tasks to be carried out in a noncontact and wear-free process to measuring lengths of 40 mm, 80 mm, and 120 mm. With its integrated temperature compensation feature, the PMIxxx-F90-...-IO-... is also ideal for use in harsh environments and for critical positioning tasks.

As standard, the PMIxxx-F90-...-IO-... has three binary switching signal channels in the process data transfer that are parameterizable via IO-Link. The sensor is not only available as a pure measuring sensor with distance-proportional current or voltage output signal, but also as a measuring sensor with switching outputs or as a combination of these functions.

Due to the inductive functional principle, ferrites or magnets are not necessary as a counterpart. The detection of the position takes place through the detection of a damping element mounted on a monitoring object. For precise detection, the damping element must keep to specified measurements (see Section "Damping Element"). A typical area of application for the PMIxxx-F90-...-IO-... is monitoring spindles in clamping systems.

The PMIxxx-F90-...-IO-... is designed for operation with one damping element, or with two damping elements for product variants with measuring lengths of 80 mm and 120 mm. While operation with one damping element is designed for absolute position measurement, operation with two damping elements is designed for relative distance measuring between the two damping elements. The detection of a damping element is set by the factory. You can set operation with two damping elements via the IO-Link parameterization.

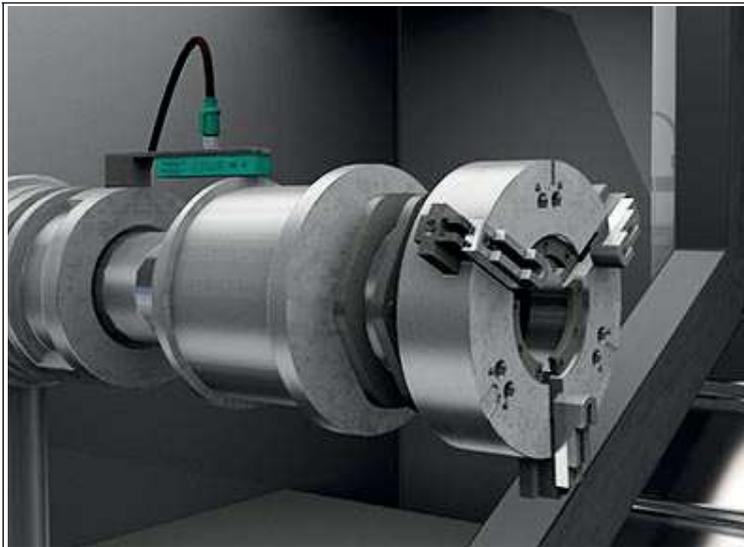


Figure 2.1

The PMIxxx-F90-...-IO-... is fitted with IO-Link V1.1 and provides a multitude of parameter and analysis options.

The advantages of the PMIxxx-F90-...-IO-... inductive position measurement system are:

- Noncontact operation
- Measuring and switching windows and their start and end-points are parameterizable via IO-Link
- IO-Link V1.1 including data storage functionality (data storage)
- High resolution and accuracy
- Minimal temperature drift
- Absolute position measurement with one damping element
- Relative distance measurement between two damping elements (only for measuring lengths of 80 mm and 120 mm)
- Minimal susceptibility to interference due to the inductive functional principle

IODD device description file

The device description file (IODD) required for integration in an IO-Link system and for the parameterization and diagnosis is available online at www.pepperl-fuchs.com on the relevant product page for the PMIxxx-F90-...-IO-...

What is IO-Link?

IO-Link is a new dimension of communication of and with sensors. The possibility of making the intelligence that is already integrated in each and every sensor fully available to users opens up new possibilities for automation. The use of IO-Link produces positive effects for all fields of application in factory automation. The technology offers particular benefits with regard to servicing (troubleshooting, maintenance, and device replacement), during the commissioning process (cloning, identification, configuration, and localization) and during operation (job changeover, continuous parameter monitoring, and online diagnostics). Reducing the variety of interfaces offers users significant savings potential. This variety of interfaces often results from having analog sensor inputs and the complex installation required in this case.

2.2

LED Indicators

Der PMIxxx-F90-...-IO-... has four LEDs for displaying the operating status and diagnosis information in the case of a fault. Depending on the product variant, the LEDs of sections S1 ... S3 could be without function. The LED S3 can have two different meanings depending on the product variant. Information on which LEDs are assigned to a product variant can be found in the respective datasheet.

In addition to standard display behavior determined by the factory, certain display information can also be activated or deactivated using the IO-Link parameterization. Details can be found in the following section.

The LEDs indicate the following behavior, depending on their function:

- On
- Off
- Flashing (approx. 4 Hz), pulsating flashing (approx. 0.8 Hz), short flashes on and off

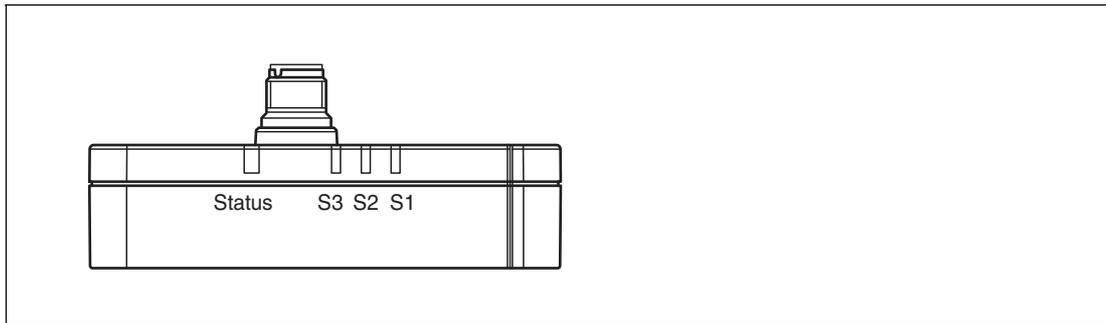


Figure 2.2

Standard display behavior of LEDs

LED	Color	Description
Status	Green	<ul style="list-style-type: none"> ■ On = supply voltage is OK ■ Off = no supply voltage ■ Short flashes on and off = IO-Link communication is active
Status	Red	<ul style="list-style-type: none"> ■ Flashing (approx. 4 Hz) = a short circuit to a sensor output has been detected ■ Pulsating flashing (approx. 0.8 Hz) = Low voltage of the supply voltage has been detected <p>Note: If activated via IO-Link, On = no damping element is detected in the detection range (max. measuring range). See table below.</p>
S1	Yellow	<p>Switching state of switching output 1:</p> <ul style="list-style-type: none"> ■ On = switching output has switched, because a damping element is on the switch point or in the switching window ■ Off = switching output has not switched
S2	Yellow	<p>Switching state of switching output 2:</p> <ul style="list-style-type: none"> ■ On = switching output has switched, because a damping element is on the switch point or in the switching window ■ Off = switching output has not switched
S3	Yellow	<p>Only for sensors with three switching outputs</p> <p>Switching state of switching output 3:</p> <ul style="list-style-type: none"> ■ On = switching output has switched, because a damping element is on the switch point or in the switching window ■ Off = switching output has not switched
S3	Yellow	<p>Only for sensors with analog output</p> <p>Detection of the damping element:</p> <ul style="list-style-type: none"> ■ On = a damping element is detected in the configured analog measuring range ■ Off = no damping element is detected in the configured measuring range



Note!

The display behavior described below are deactivated on delivery as standard, as they are only useful in some application scenarios. You can activate and deactivate these via the IO-Link parameterization.

Display behavior can be activated via IO-Link

LED	Color	Description
Status	Red	<p>Permanent additional information on the detection of the damping element for all product variants.</p> <ul style="list-style-type: none"> ■ On = no damping element is detected in the detection range (max. measuring range) ■ Off = a damping element is detected in the detection range (max. measuring range) <p>Activation via parameter "0x78, subindex 1 = no damping element detected (warning)" to value "1" or via the Parameter menu, "Event configuration" section, "No Damping Element detected (Warning)" function set to "Enabled."</p>
S1 ... S3 and status	Yellow, green	<p>Localization function</p> <ul style="list-style-type: none"> ■ LEDs S1 ... S3 flashing simultaneously in yellow and the LED status in green. <p>To easily detect the sensor installed in a machine or plant, conspicuous LED flashing behavior can be activated and deactivated again via IO-Link for the sensor search. After isolating the sensor from the supply voltage, the flashing behavior is deactivated again as standard.</p> <p>Activation via parameter "0x7f = Locator Indication" to value 1 or via the Diagnosis menu, "Service function" function, indication setting set to "Locator Indication."</p>



2.3 Accessories

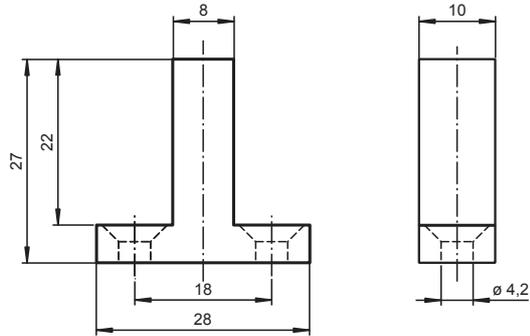
Various accessories are available.

2.3.1 Damping Element

We recommend using the BT-F90-W damping element.

BT-F90-W

Material: ST37 steel



Using Your Own Damping Element

In principle, it is possible to use your own damping element. The damping element must have the following properties to be able to make use of the sensor's specified accuracy:

Material: construction steel such as S235JR+AR (previously St37-2)

Dimensions (L x W x H): $\geq 18 \text{ mm} \times 8 \text{ mm} \times \geq 4 \text{ mm}$

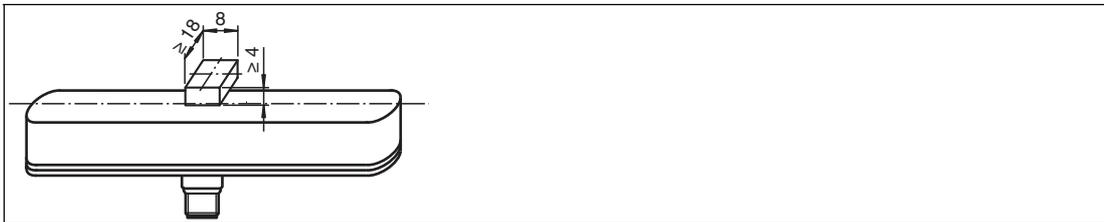


Figure 2.3



Note!

The exact width of the damping element of $8 \text{ mm} \pm 0.1 \text{ mm}$ must be observed. The edges should be broken with a maximum chamfer of 0.1 mm . If the width of the damping element deviates from this value, the position values will differ.

2.3.2 Parameterization Aids

The following parameterization aids are available:

Designation	Description
PACTware	FDT frame application for operating IODDs and DTMs
Pepperl-Fuchs-PMlxxx-F90-...-IO-...IODDx.x	IODD IO Device Description—device description for operating the sensor, integrated in the system environment See the product page for the PMlxxx-F90-...-IO-... online at www.pepperl-fuchs.com
IODD Interpreter DTM	Software for integrating IODDs into an FDT frame application (e.g., PACTware)
IO-Link-Master02 USB	USB to IO-Link adapter box for controlling an IO-Link sensor via a PC
IO-Link-Master02-USB DTM	Device Type Manager – software for operating the IO-Link-Master02 USB via FDT
Pepperl + Fuchs PACTware IO-Link Connection Wizard	Software tool for automatically launching the PACTware software installed on your PC and for automatically connecting PACTware to the sensor.

2.3.3 M12 Connection Cable, 5-Pin

The following single-ended female cordsets, which are available in various lengths, are suitable for the electrical connection of the PMlxxx-F90...-IO-... devices:

Illustration	Material	M12 x 1 single-ended female cordset, 5-pin	M12 x 1 cordset, 5-pin
	PVC	V15-G-*-PVC	V15-G-*-PVC-V15-G
	PUR	V15-G-*-PUR	V15-G-*-PUR-V15-G
	PVC	V15-W-*-PVC	
	PUR	V15-W-*-PUR	V15-W-*-PUR-V15-G



Note!

If the cordset is to be used in environments with significant potential for electromagnetic interference, please use shielded single-ended female cordsets 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 Definition of the Measuring Range/Position

A reference mark (1) indicates the start of the measuring range on the position measurement system.

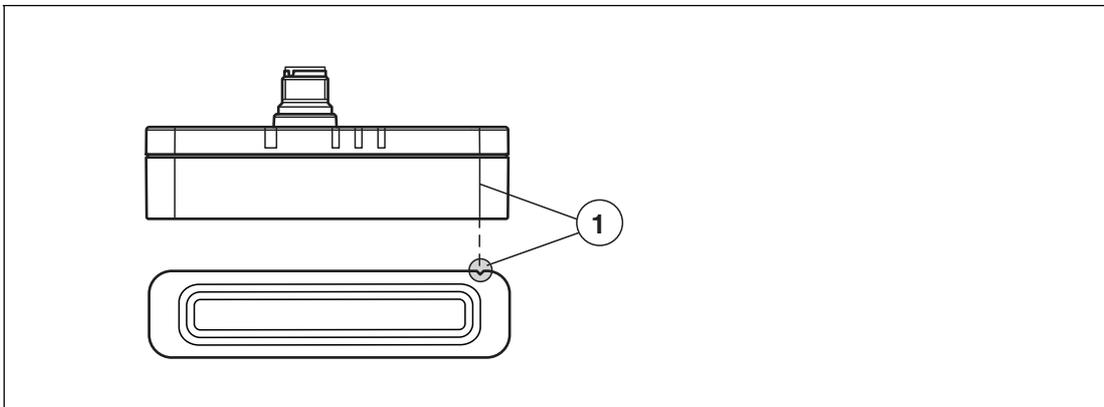


Figure 3.1

The position of the damping element defined by the position measurement system relates to half of the width (center) of the damping element. The measuring range begins and ends with the half coverage provided by the damping element when moving lengthwise.

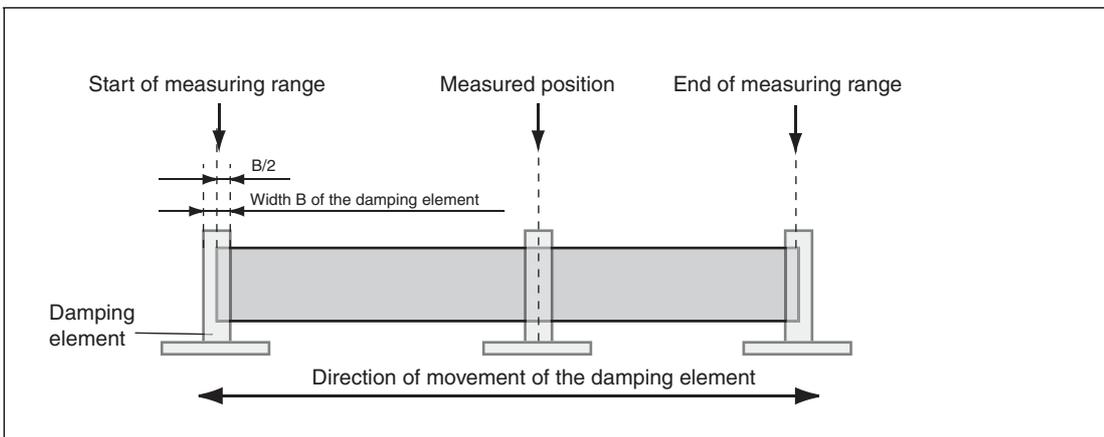


Figure 3.2

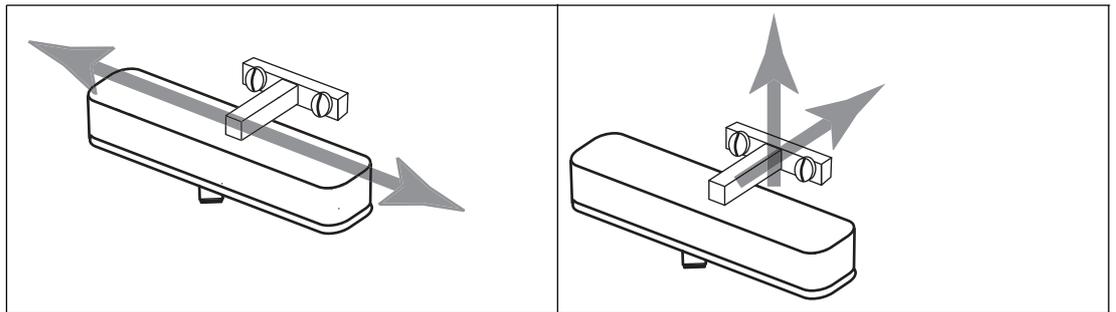
Behavior when leaving the measuring range

The specified measurement accuracy is achieved at a damping element distance to the measuring range surface of 0.5 mm ... 1.5 mm.

If the damping element leaves the measuring range, there are different output values depending on the fault output behavior set. With the use of two damping elements, the fault output behavior is identical once a damping element leaves the detection range. Details see chapter 7.

The following fault output behavior is set on delivery by the factory:

- Analog voltage output or current output: output value freeze
- Switching outputs: low level



3.3 Preparation



Unpacking the unit

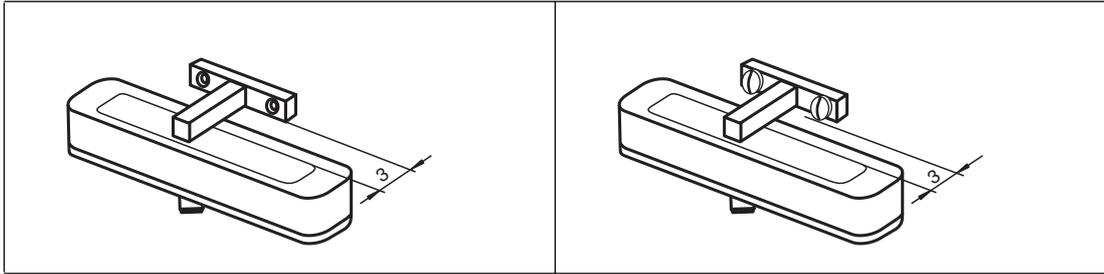
1. Check that all package contents are present and undamaged.
 - ↳ If anything is damaged, inform the shipper and contact the supplier.
2. Check that all items are present and correct based on your order and the shipping documents.
 - ↳ If you have any questions, please contact Pepperl+Fuchs.
3. Keep the original packing material in case you need to store or ship the unit at a later time.

3.4 Mounting

- A flush mount is possible in metallic and nonmetallic environments.
- To extend the measuring range, the PMIxxx-F90-...-IO-... can be connected side by side or end to end with no minimum distance.
- Operation with one or two damping elements can be set via the IO-Link parameterization. During operation with two damping elements, these must be mounted with a minimum distance of 32 mm. If the minimum distance is not met, invalid position values could be output.
- The distance between the measuring field (framed area at the front of the sensor) and the mounting base or fastening screws on the damping element must be at least 3 mm.

Watch out for any protruding metal parts such as screw heads when mounting the device.
- The damping element must be attached to the sensor at a right angle to guarantee the relevant measurement accuracy.
- The distance between the damping element and the sensor must not exceed 3 mm.

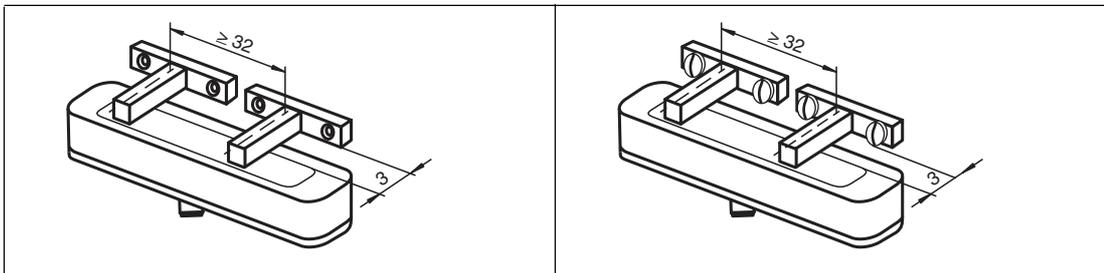
Distance from sensor with one damping element



Note!

The option to detect two damping elements simultaneously with the PMIxx-F90-...-IO-... is only available with product variants that have measuring lengths of 80 mm and 120 mm.

Distance from sensor, horizontal minimum distance with two damping elements



Note!

The measurement specification for the minimum distance between two damping elements is based in each case on the center of a damping element.

3.5

Connection



Connecting the Supply Voltage

To supply voltage to the sensor, proceed as follows:

1. Insert the prepared connection cable into the connector plug provided for this purpose on the underside of the housing.
2. Screw the lock nut onto the connector plug as far as it will go. This ensures that the power cable cannot be pulled out inadvertently.
3. Now connect the supply voltage to the cable provided.

↳ The sensor is now ready for operation.



Control via IO-Link

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

1. Connect the sensor to an IO-Link master. Use a 5-strand sensor cable for the connection.
2. Screw the lock nuts onto the connector plug as far as they will go. This ensures that the cable cannot be inadvertently pulled out.

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

Sensor	Electrical Connection	Pinout
PMIxxx-F90-IU-IO-V15*		
PMIxxx-F90-IU2EP-IO-V15* PMIxxx-F90-IU2EP-IO-V15-3G-3D		
PMIxxx-F90-3EP-IO-V15*		

Table 3.1



Note!

The list of electrical connections above represents just some of the products in our range of position measurement systems equipped with IO-Link. The list does not claim to be complete. 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.



4 Commissioning

4.1 Commissioning without IO-Link



1. Check that the distance between the damping element and the sensor is correct (See chapter 3.4).
2. Switch on the supply voltage. The operating indicator on the sensor lights up green.
↳ The sensor will now function using the preset parameters.



Note!

Changes to the configuration can only be made by parameterizing via IO-Link!

4.2 Commissioning with IO-Link to a Controller



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

1. Check the connection between the sensor and the IO-Link master.
2. Set the corresponding port on the IO-Link master to which the sensor is connected to IO-Link status.
3. Once communication has been successfully established, the green LED on the sensor will flash briefly in one-second intervals.
↳ The sensor can then be parameterized or diagnosed using the modulated application. The sensor sends the digital switching information and the position value as process data.

4.3 Commissioning with IO-Link Using PACTware and IODD



Note!

A 5-pin M12 cordset is necessary to connect the sensor to the Pepperl und Fuchs IO-Link master. You can find suitable connection cables by visiting www.pepperl-fuchs.com and clicking on the product page for the relevant sensor.

An IODD (IO-Link Device Description) device description file is available to download for parameterization of the sensor via IO-Link. See the product page for the relevant sensor on www.pepperl-fuchs.com.

This manual sets out how to perform parameterization using the "PACTware" FTD framework application into which the relevant IODD is loaded. In principle you can use other appropriate FDT framework applications.

To integrate the IODD into PACTware, the IODD must first be converted into a Quasi-DTM using the "IODD Interpreter DTM" software. The IODD must then be recorded in the PACTware device catalog. Visit www.pepperl-fuchs.com to download the "IODD Interpreter DTM."

The "Pepperl + Fuchs PACTware Connection Wizard" is available to help you launch and connect the sensor easily. The wizard takes you through all the necessary steps for opening a PACTware project. The prerequisite is that all of the required software components are installed on the PC. Alternatively you can launch PACTware directly and add devices such as the IO-Link master and the sensor, as well as the IODD, and initiate the connection set-up step-by-step.



Prerequisites for Commissioning

Proceed as follows to communicate with the sensor via IO-Link using the "PACTware" software and the associated IODD:

1. Make sure that PACTware and the DTM for the IO-Link master and the required IODD device description for the sensor are installed.
2. Connect the sensor to an IO-Link master via a suitable M12 cordset.
3. Connect the IO-Link master to a USB port on your PC via a USB cable.

➤ Setting Up Sensor Communication using PACTware via "Pepperl + Fuchs PACTware Connection Wizard"

In addition to the aforementioned prerequisites, the "Pepperl + Fuchs PACTware Connection Wizard" must also be installed on the PC. The sensor and IO-Link master must also be connected to the PC.

Double-click the "Pepperl + Fuchs PACTware Connection Wizard" icon.

↳ PACTware and the associated DTM/IODD are loaded and the connection to the sensor is automatically established.

➤ Setting Up Sensor Communication using PACTware (Step-by-Step)

1. Launch PACTware by double-clicking on the PACTware icon.

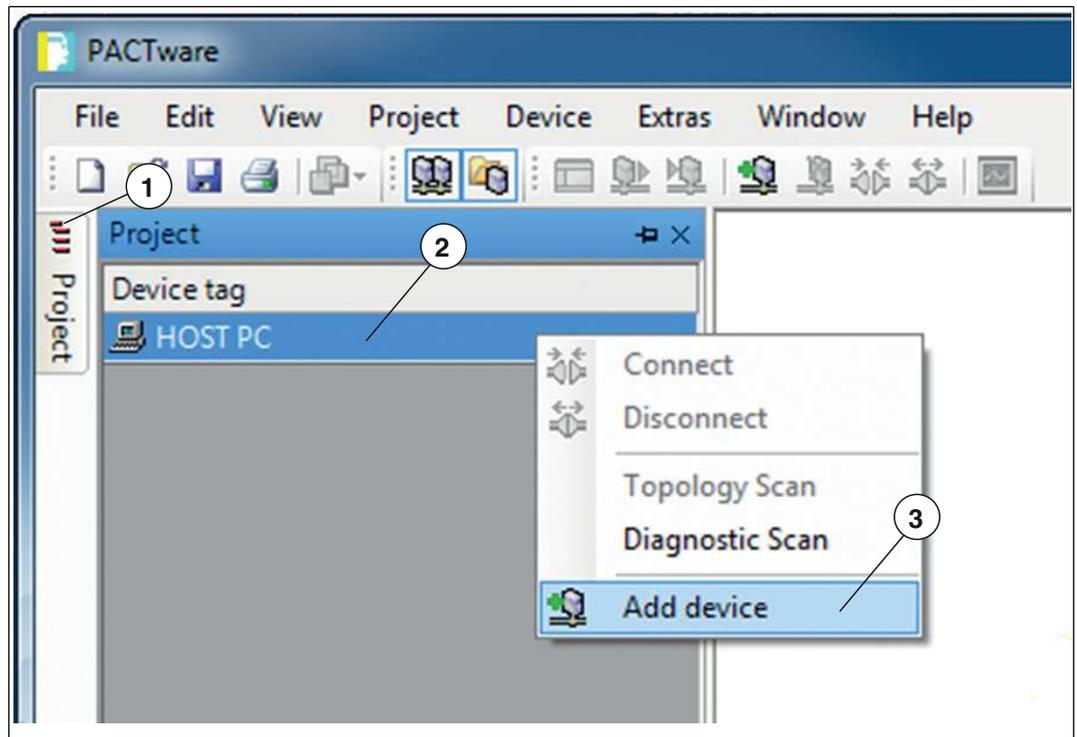


Figure 4.1

2. Click on **Project** (1) at the top left.
3. Click on **Host PC** (2), then click the right mouse button and click **Add device** (3).
↳ Displays a window for selecting the device
4. Check "IO-Link USB master..." in the window and confirm with **OK**.
↳ The IO-Link USB master is installed as a device in the project.

- Click in the project on the **IO-Link USB master...** (4), then click the right mouse button and then on **Add device** in the now extended display. Next, you must integrate the IODD for the required sensor into the project.

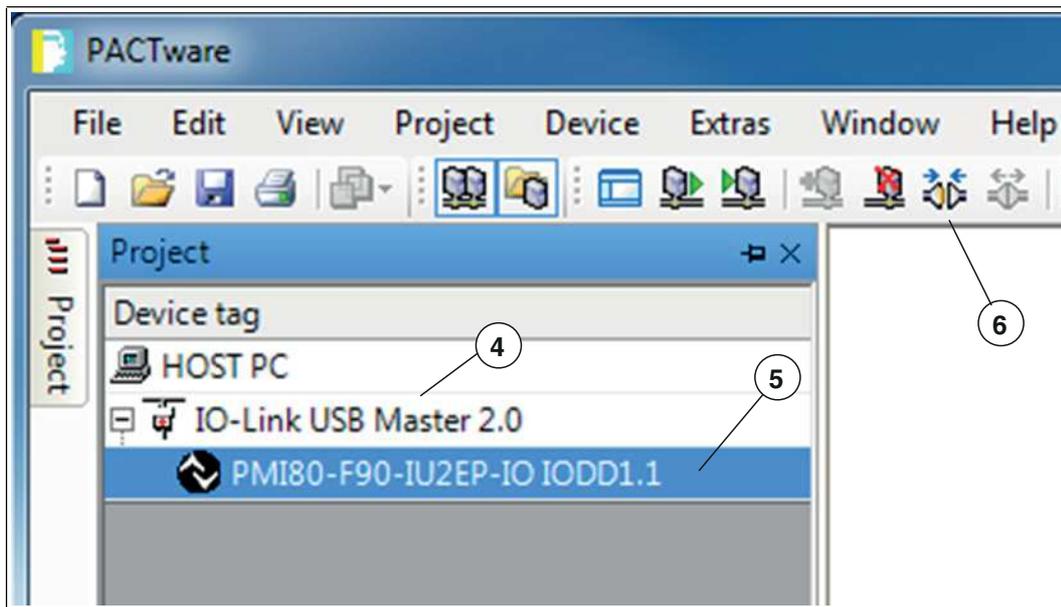


Figure 4.2

↳ The window for selecting devices is displayed again with all available DTMs and IODDs.



Note!

To integrate the IODD into PACTware, the IODD must first be converted into a Quasi-DTM using the "IODD Interpreter DTM" software and be recorded in the PACTware device catalog.

- Select the required IODD and press OK to confirm.

↳ The IODD is installed in the project (5); "PMI80-F90-IU2EP-IO-V15" is shown here as an example.

- Double-click on the IODD in the project (5); "PMI80-F90-IU2EP-IO-V15" is shown here as an example.

↳ The selected IODD interface is displayed.

- Click on the icon to set up the connection (6).

↳ Data connection to the sensor is established. Status information "connected" will be displayed in the bottom left of the menu if connection is successful.

4.4

Commissioning with IO-Link in an FDT Environment



To activate the sensor via IO-Link in an FDT environment, proceed as follows:

- Check the connection between the sensor and the IO-Link master.
- Make sure that an FDT frame application (e.g., PACTware), the necessary DTMs (device type manager), and the IODD device description for the sensor, IO-Link master, and any required communication DTMs for upstream components (e.g., IO-Link master) are installed.
- Establish a connection between the PACTware application (or other FDT environment) and the sensor.

↳ You can now use the software to read data from the sensor or modify settings on the sensor.

5 IO-Link Parameterization

5.1 Overview

The sensor parameters are different for each device. These parameters are described in a standardized format in the device description IODD (IO Device Description). The IODD can be imported into various engineering tools from different system providers, providing they support IODD. The sensor can then be parameterized or diagnosed using the relevant tool (e.g., PACTware) and a user interface generated from the IODD.



Note!

By pressing buttons under individual menu items of PACTware, it is possible to read/write data from the sensor or to activate cyclic update of dynamic variables. These features allow corresponding values to be cyclically read from and written to the sensor in the event of parameter changes. The buttons are displayed in the image below. Hover over the buttons with the mouse to view the description of the buttons.



Figure 5.1



Note!

The following screenshots regarding IODD and descriptions are taken from the PACTware framework program for all PMIxxx-F90-...-IO-... product variants, using the PMI80-F90-IU2EP-IO-V15 sensor as an example. Individual sensors of the product family vary in terms of the number of switching outputs or in terms of whether they are fitted with or without analog output, for example. Consequently the IODDs of the respective product variants may differ from the following screenshots.

5.2 Identification Menu Item

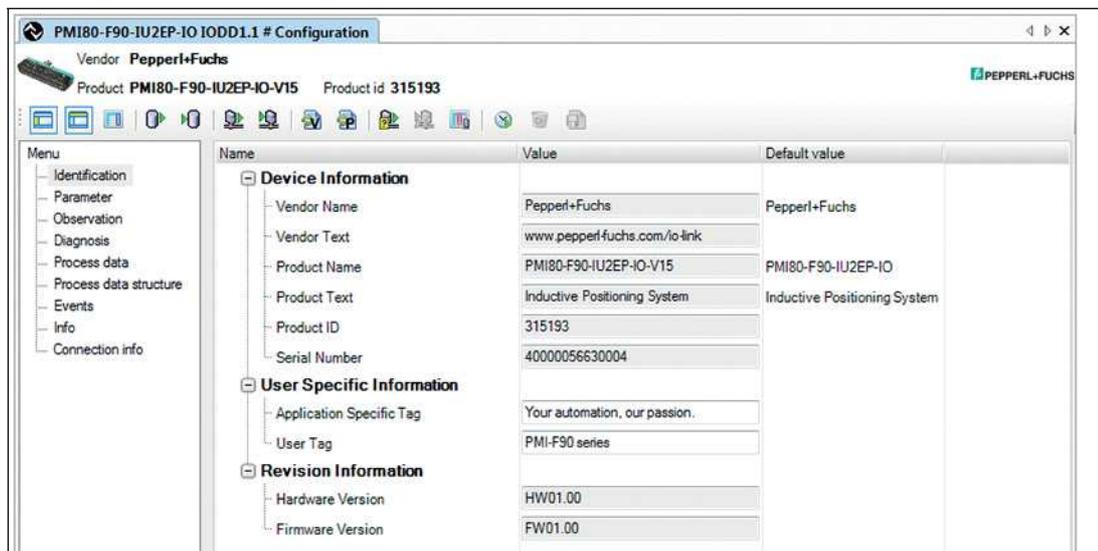


Figure 5.2

The **Identification** menu item is divided into three areas:

- **Device Information:** Displays permanently programmed manufacturer and device information. These are read-only fields.
- **User Specific Information:** These fields can be edited freely by the user, e.g., to distinguish between several sensors of the same type within a network. Text information (string) can be entered in the "Application Specific Tag" field and "User Tag" fields.
- **Revision Information:** Displays the firmware and hardware versions. Please have this information ready when contacting our Service Center. These are read-only fields.

5.3 Parameter Menu Item

Overview of the Parameter Menu Item



Figure 5.3

All switching signal channels and switching outputs, as well as the analog signal, can be parameterized and configured in the **Parameter** menu item. You can also set certain event behaviors and device locks.

Adjusting Device Settings



Figure 5.4

In the **Device Settings** section, you can set whether the sensor is used for absolute position measurement with 1 damping element or for relative distance measurement from 2 damping elements.

Adjusting Switching Signal Channels/Switching Outputs

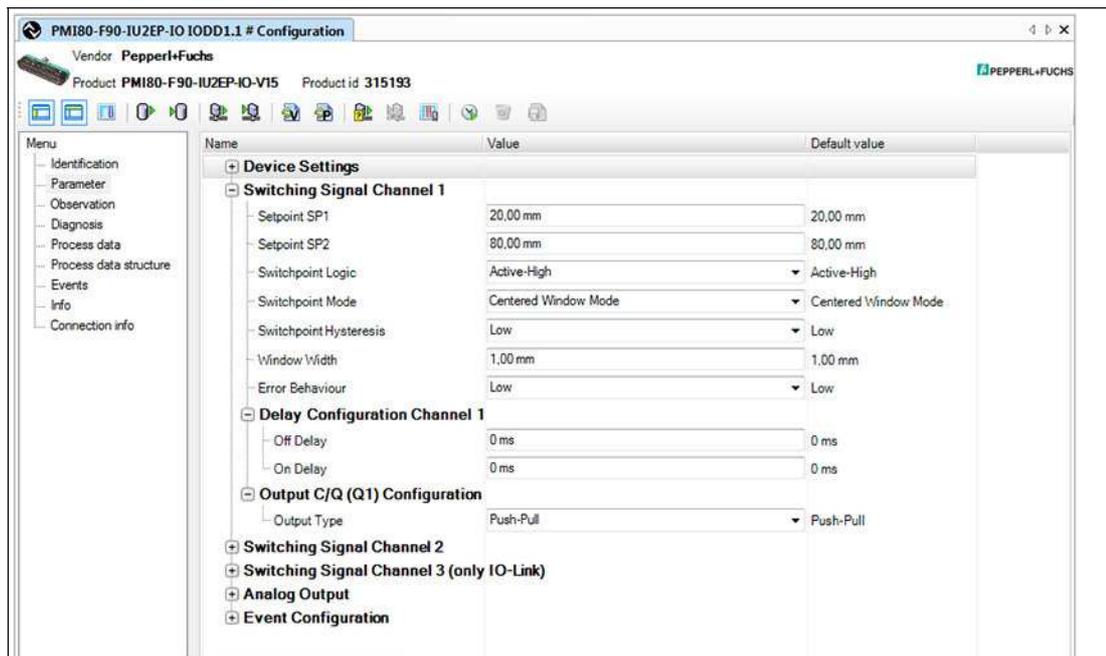


Figure 5.5

In the **Switching Signal Channel x** section, you can set the behavior of the respective binary switching signal channel in the process data transfer as well as the available switching outputs for certain product variants.

In doing so, you can set functions such as setpoints of switch points 1 and 2, switchpoint logic, switchpoint mode, switchpoint hysteresis, window width, error behavior, delay settings, and output type (only for switching output).

As standard, all product variants of the PMIxxx-F90-...-IO-... have 3 switching signal channels. These are visible in the process data. Depending on the product variants, some are available as switching outputs, from 0 to 3 switching outputs according to the product variant. The information "(only IO-Link)" states that the switching signal channel is only intended for process data transfer and has no switching output. In this case, the adjustment option "Output Qx Configuration" is not available.

Links between Process Data Value and Output Logic of a Switching Output

The process data value of the switching signal can have the status "Active (1)" or "Inactive (0)." For sensors with switching outputs, this process data value is converted into an output level depending on the configuration and circuit. Depending on the setting of the output type and the external circuit of the switching output, the process data value of the "switching signal channel x" (see menu "Process Data" -> Switching Signal x) for the corresponding switching output can be assigned different levels. The following table indicates the possible combinations. Further information regarding the link between the "position of the damping element" and switching signal are explained in Chapter "Switchpoint Mode."

Process data value: Switch signal		Behavior of the switching output with output type setting		
Status	Logic	PNP	NPN	Push-Pull
Inactive	0	High impedance	High impedance	Mains voltage L-
Active	1	Mains voltage L+	Mains voltage L-	Mains voltage L+

Setting the Analog Output

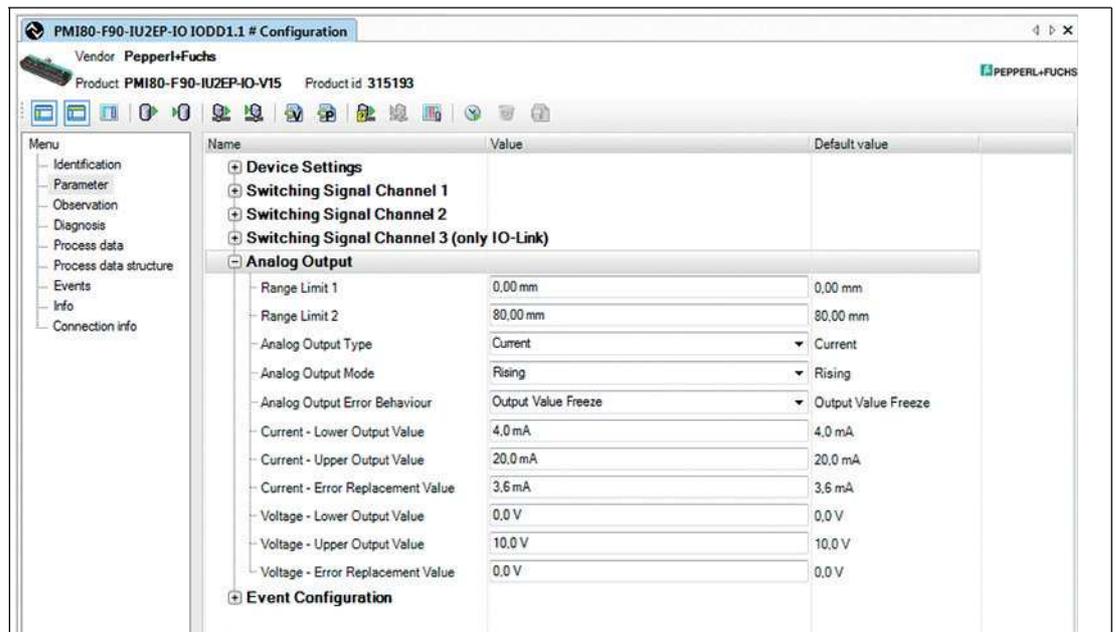


Figure 5.6

In the **Analog Output** section, you can set functions such as range limits, analog output type (current/voltage), analog output mode, analog output error behavior and current or voltage limitations for the physical analog output.

Event Configuration

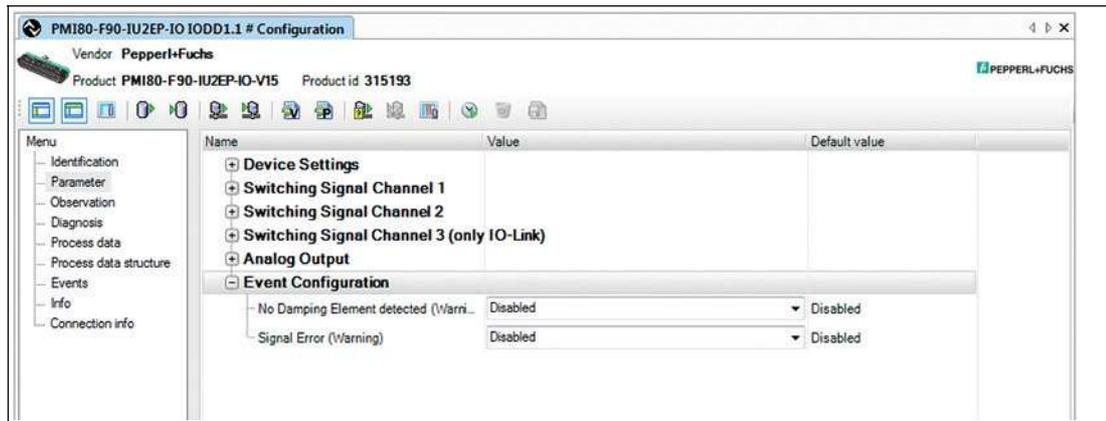


Figure 5.7

In the **Event Configuration** section, you can determine whether instances of the damping element leaving the position range (max. measuring range) should be transmitted as an event to the master. If you switch on the "No Damping Element detected (Warning)" function, leaving the detection range is also indicated via the "Status" LED illuminating in red. The "Signal Error (Warning)" event signals that a damping element is too far away from the sensor. Both functions are disabled by default in the factory settings on delivery.

5.4 Observation Menu Item

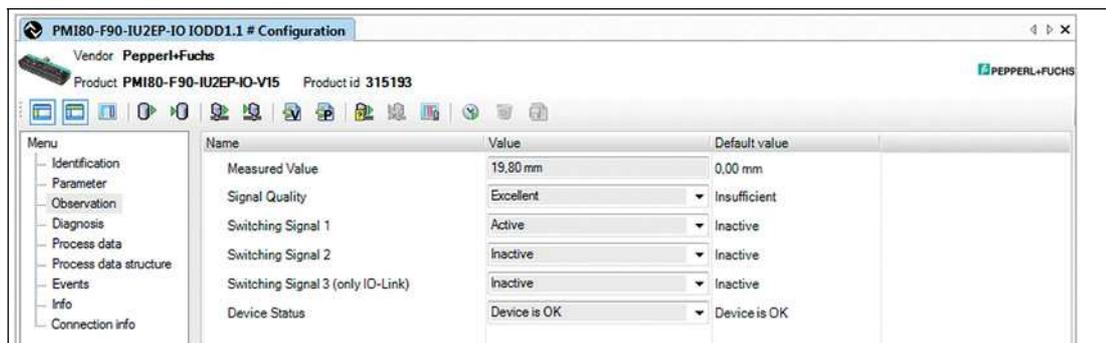


Figure 5.8

The **Observation** menu item displays the measured value, signal quality, and the statuses of individual switching signals. These are read-only fields.

If the damping element is outside of the position range (X direction) or is too far away (Y direction), "Insufficient" is displayed as the diagnosis information for **Signal Quality**.

Under **Device Status**, information is displayed about whether there is a signal error or whether no damping element has been detected, on the condition that this has been configured under the menu item **Parameter, Event Configuration** section.

5.5 Diagnosis Menu Item

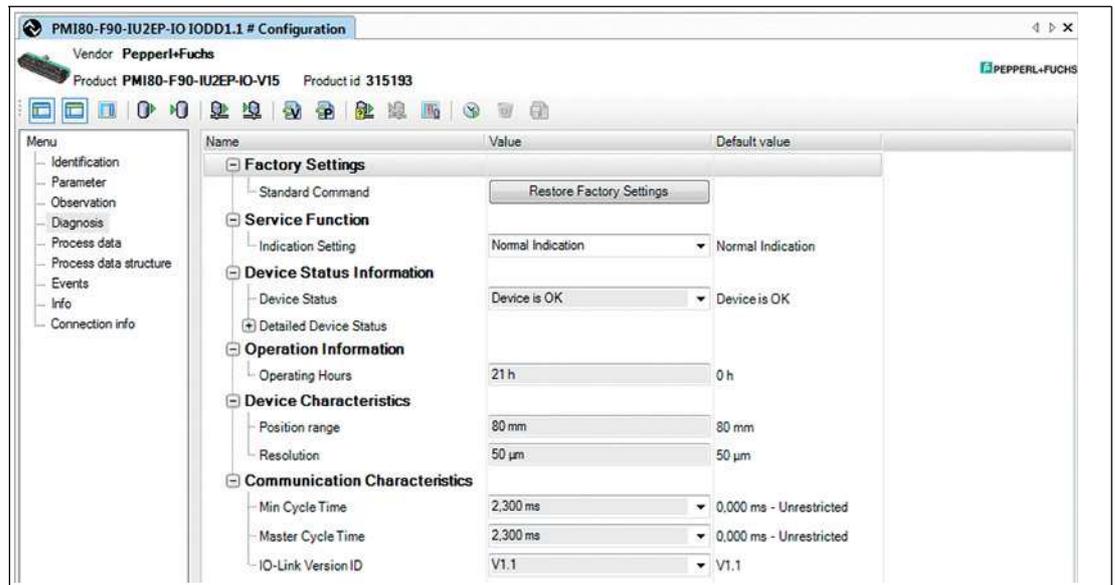


Figure 5.9

The **Diagnosis** menu item is divided into four areas.

- **Factory Settings:** Activating the **Restore Factory Settings** switch resets the sensor to the default settings. All previous parameter changes are lost as a result of this.
- **Service Function:** The indication setting is set to "Normal Indication" as standard. This means that the LEDs display status and diagnosis information. Setting the indication setting to "Locator Indication" causes the LEDs S1...S3 to simultaneously flash in yellow and the LED "Status" in green. This function can be used to locate a sensor in a plant or machine more easily.
- **Device Status Information:** If the sensor is not operated correctly, e.g., if the damping element is outside of the position range or is too far away, the device status changes from "0 (Device is OK)" to "2 (Out of Specification)." This is a read-only field.
- **Operation Information:** Provides details of the operating hours of the sensor. This is a read-only field.
- **Device Characteristics** Specifies the maximum position range of the sensor and the resolution (smallest measuring step size). These are read-only fields.
- **Communication Characteristics:** Provides details of the minimum cycle time, master cycle time, and IO-Link version ID. These are read-only fields.

5.6 Process Data Menu Item

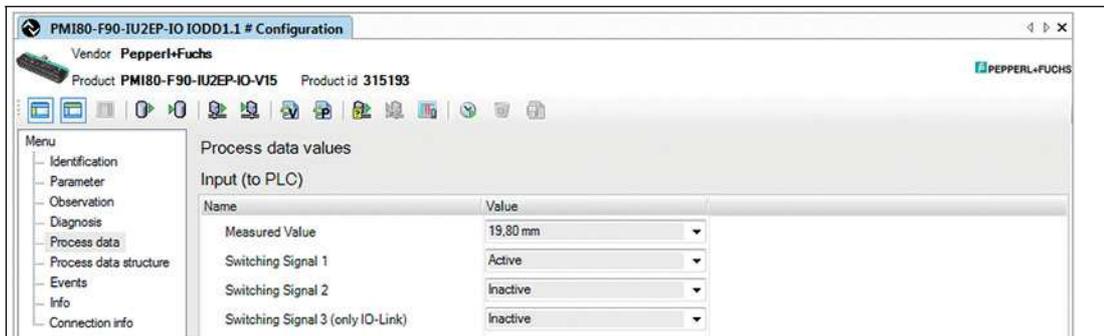


Figure 5.10

The **Process data** menu item displays the position of the damping element as a measured value (decimal value) and the status of the switching signals. These are read-only fields.

5.7 Process Data Structure Menu Item

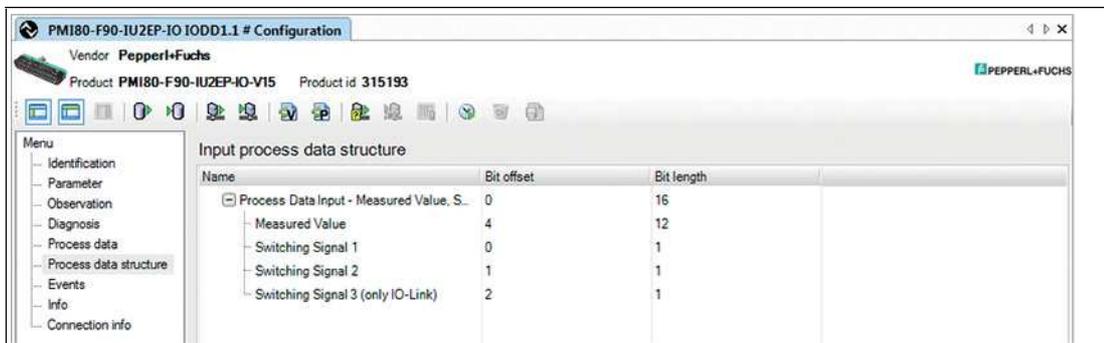


Figure 5.11

The **Process Data Structure** menu item displays the bit assignment of the position data and the binary switching signals. These are read-only fields.

5.8 Events Menu Item

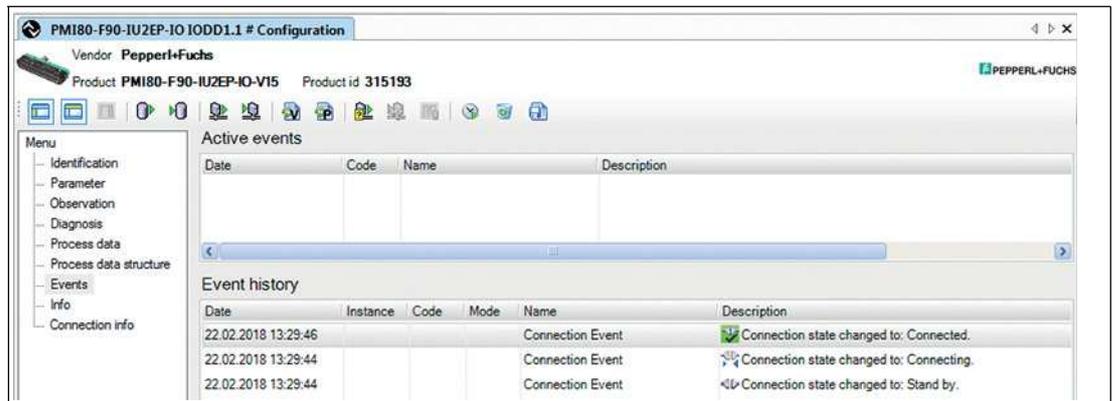


Figure 5.12

The **Events** menu item details all current and past events when the "Activate Event Monitor" check box is ticked. These are read-only fields.

5.9 Info Menu Item



Figure 5.13

In the **Info** menu item, the DTM/Interpreter version is displayed.



5.10 Connection Info Menu Item

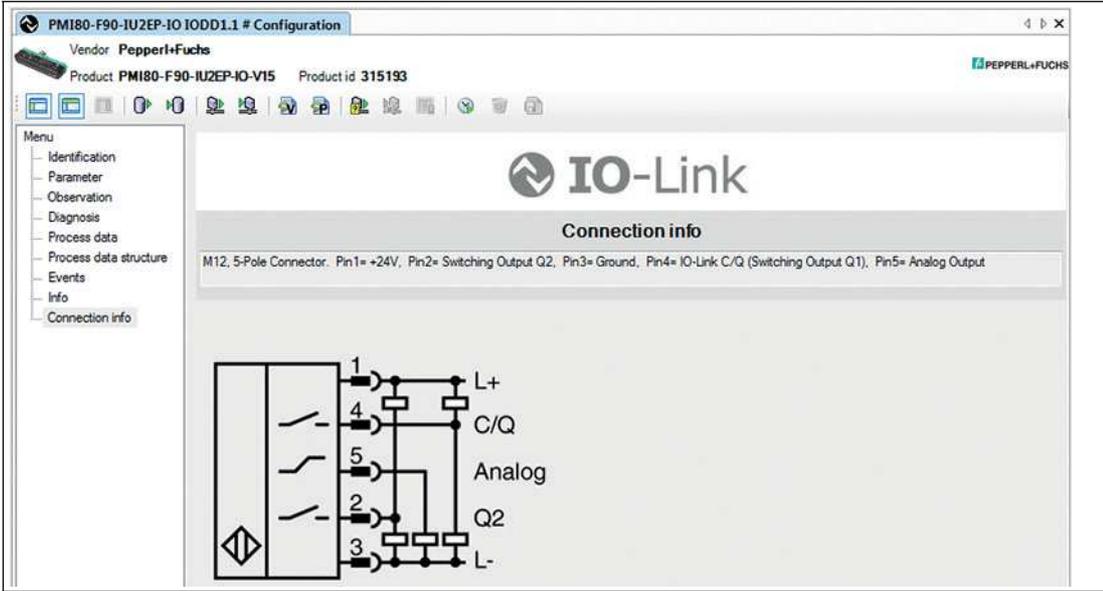


Figure 5.14

In the **Connection Info** menu item, the electrical connection of the sensor is displayed.

6 Switchpoint Mode

The switchpoint mode is configured via the IO-Link device parameter.

In an FDT environment, the configuration process is executed under the **Parameter** menu item.



Note!

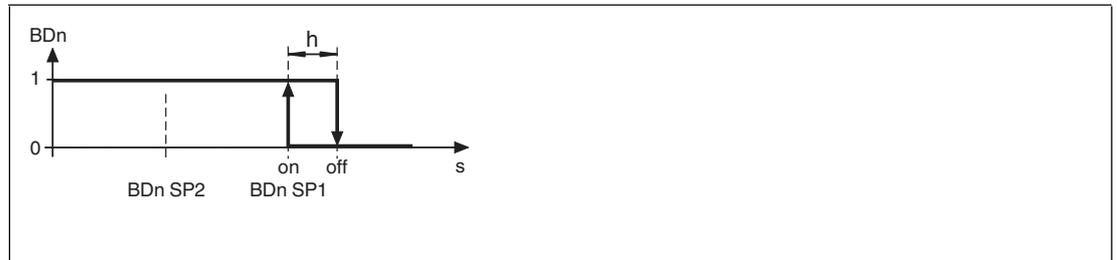
The inversion of the switching signal takes place by setting the switchpoint logic parameters (active-high/active-low).

To suppress unstable conditions, all setpoints (SPx) are assigned a switchpoint hysteresis h . The switchpoint hysteresis can be set to "low" (0.4 mm), medium (0.7 mm), and high values (1 mm).

An on or off delay can also be defined for the switching signal for extremely short events.

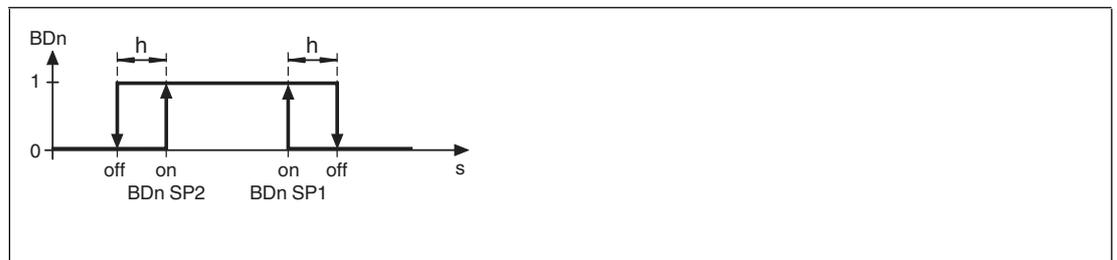
The following descriptions relate to the switchpoint logic setting "active-high." With the "active-low" setting, the logic values and levels are inverted to the following description:

1. BDn single point mode



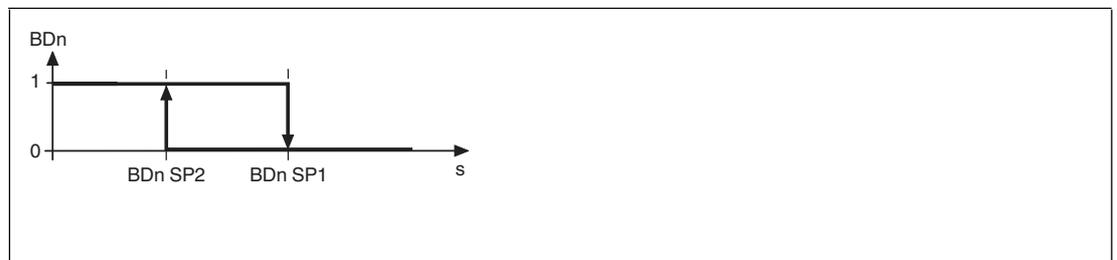
The switching signal is "active" (1), if the position value is smaller than the setpoint SP1. The value in SP2 is not used.

2. BDn window mode



The switching system is "active" (1) if the position value is between setpoints SP1 and SP2. $\text{SP1} < \text{SP2}$ does not invert the behavior.

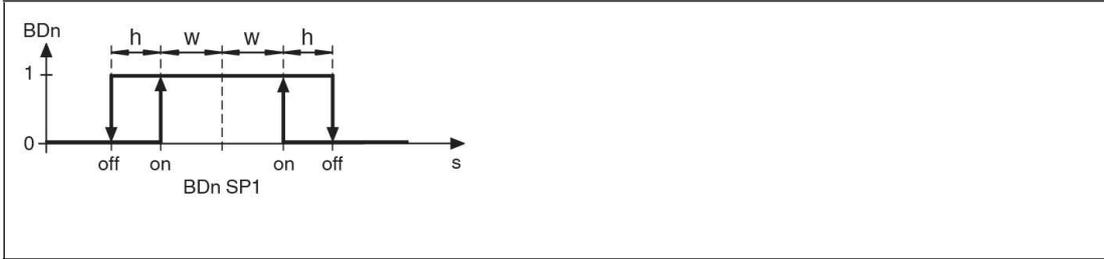
3. BDn two point mode



The switching signal is "active" (1) if the position value does not reach the lower setpoint SP2 and low "inactive" (0) if the position value exceeds the position value of setpoint SP1. $\text{SP1} < \text{SP2}$ does not invert the behavior.



4. BDn centered window mode



Setpoint SP1 defines the center of the window.

The switching signal is "active" (1) if the position value is within the range of setpoint SP1, which is defined by SP1 and the window width "w." The value in SP2 is not used.



7 Error Behaviour
7.1 Process data, position value

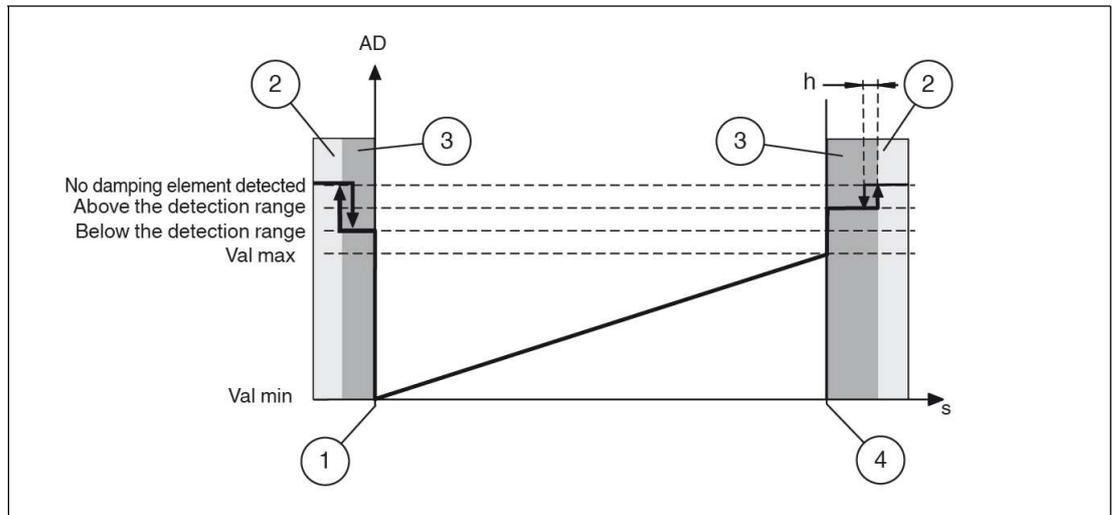


Figure 7.1

AD: position value
Val max: maximum position value
Val min: minimum position value
h: hysteresis

1: lower limit of detection range
2: no damping element detected
3: outside detection range
4: upper limit of detection range



7.2 Analog Output Error Behaviour

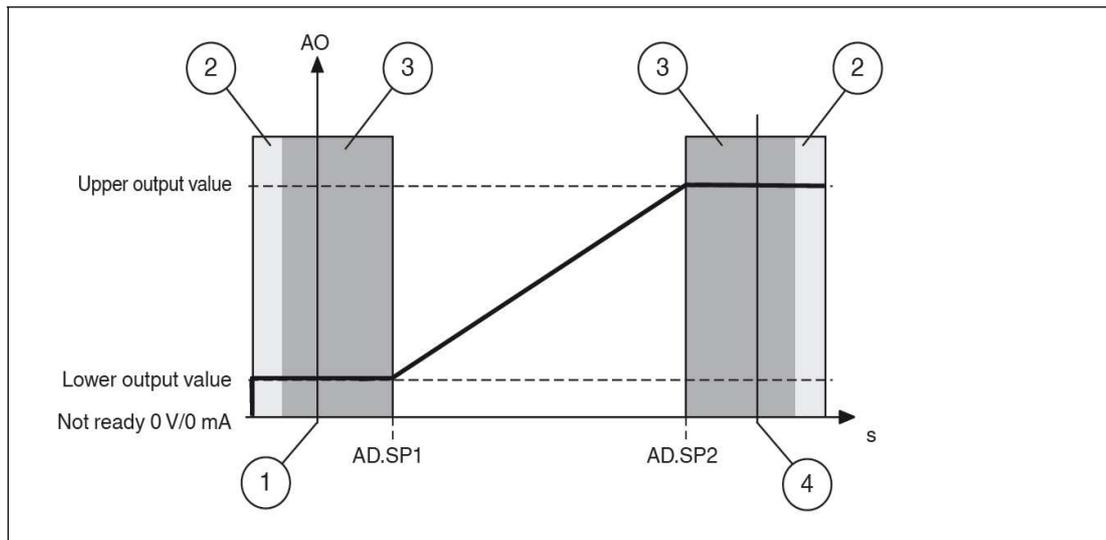


Note!

This section only applies to devices with analog output. The following diagrams apply for the parameterization of the outputs as current output or as voltage output.

The "Analog Output Error Behaviour" can be set in the **Parameter** menu item, "Analog Signal" section. This section includes the adjustment options described below. See chapter 10.2.3 in the list of parameters. The upper and lower output value correspond to the limit values for current I or voltage U in the menu item in the "Analog Signal" section.

"Output Value Freeze" Function



AO: analog output in volts/mA
AD.SP1: position value range limit 1
AD.SP2: position value range limit 2

1: lower limit of detection range
2: no damping element detected
3: outside of the measuring range
4: upper limit of detection range

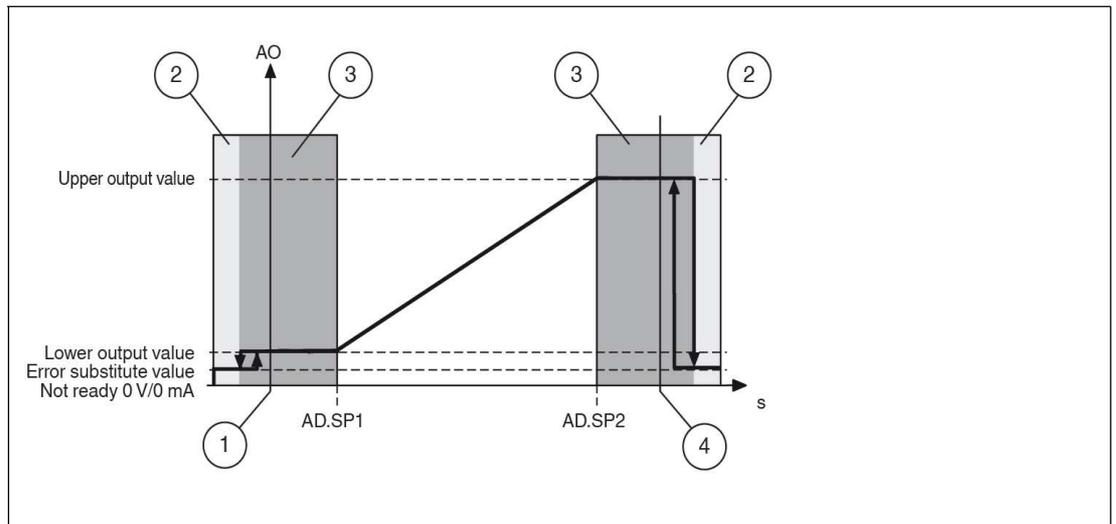
If the damping element is outside of the measuring range (3) or completely removed from the sensor, the last measured position value within the set measuring range is output.



Note!

- If no damping element has been measured after switching on the sensor, the parameterized value for I or U (AD.SP1) for position 0 mm is output.
- AD.SP2 < AD.SP1 does not invert the properties. This can be set using the **Analog Output** menu item.

"Error Substitute Value" function



AO: analog output in volts/mA
AD.SP1: position value range limit 1
AD.SP2: position value range limit 2

1: lower limit of detection range
2: no damping element detected
3: outside of the measuring range
4: upper limit of detection range

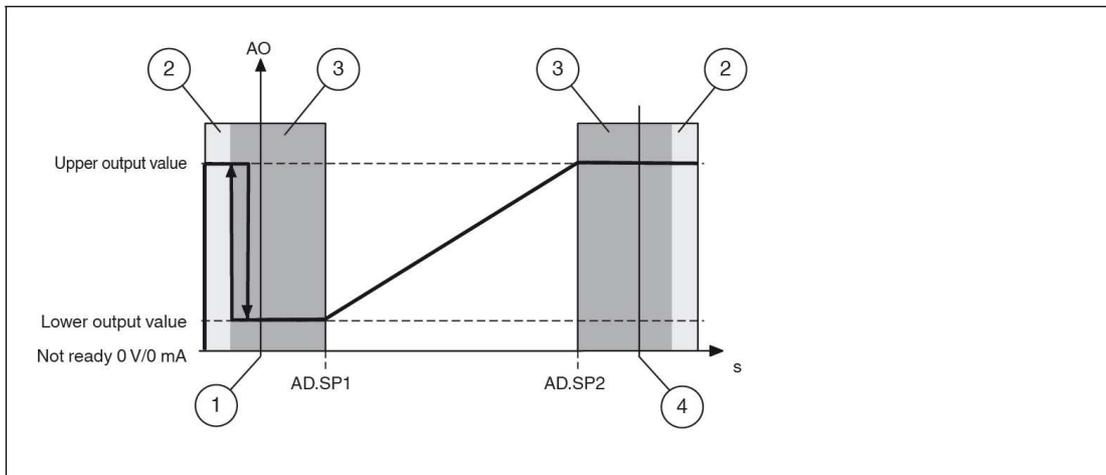
If the damping element is outside of the measuring range, but within the detection range (3), the last measured position value from within the set measuring range is output. If the damping element is outside of the detection range (1,4), the parametrized error substitute value for I or U is output. E.g., the value 3.6 mA. for current output 4 ... 20 mA.



Note!

- If no damping element has been measured after switching on the sensor, the parametrized error substitute value for I or U is output.
- AD.SP2 < AD.SP1 does not invert the properties. This can be set using the **Analog Output** menu item.

"Maximum Position" Function



AO: analog output in volts/mA
AD.SP1: position value range limit 1
AD.SP2: position value range limit 2

1: lower limit of detection range
2: no damping element detected
3: outside of the measuring range
4: upper limit of detection range

If the damping element is outside of the measuring range, but within the detection range (3), the last measured position value from within the set measuring range is output. If the damping element is outside of the detection range (1, 4), the parameterized value for I or U for the maximum position (AD.SP2) is output.



Note!

- If no damping element has been measured after switching on the sensor, the parameterized value for I or U for the maximum position (AD.SP2) is output.
- AD.SP2 < AD.SP1 does not invert the properties. This can be set using the **Analog Output** menu item.



8 Maintenance and Repair

8.1 Maintenance

The sensor's transmission properties are stable over long periods. For this reason, regular adjustments to, and maintenance on the sensor itself, are not necessary. Nevertheless check in the course of normal maintenance intervals that the sensor, the actuator and the connector are securely attached. Also check that the connecting cable is intact and correctly routed.

8.2 Resetting the Output Functions to the Factory Default

The sensor can be reset via IO-Link only.

9 Troubleshooting

9.1 What to Do in Case of a Fault

In case of a fault, check whether a sensor error can be remedied according to the following checklist.

If none of the information specified in the checklist solves the problem, in the event of queries contact Pepperl+Fuchs via your sales office. Have details of the model number and firmware version of the sensor ready if possible.

Checklist

Fault	Cause	Remedy
"Status" LED does not light up	The power supply is switched off.	Check whether there is a reason why the power supply is switched off (installation or maintenance work, etc.). Switch on the power supply if appropriate.
"Status" LED does not light up	The plug is not connected to the connector on the sensor.	Connect the plug to the sensor and tighten the cap nut by hand.
"Status" LED does not light up	Wiring fault in the splitter or switch cabinet.	Check the wiring carefully and repair any wiring faults.
"Status" LED does not light up	Supply cable to the sensor is damaged.	Replace the damaged cable.
No IO-Link connection to the 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 IO-Link connection to the device	No power supply	Check whether there is a reason for the absence of the power supply (installation or maintenance work, etc.). Switch on the power supply.
Damping element is not detected	Sensor is too far away from the item to be detected	Check the mounting and, if necessary, adjust the sensor to the correct distance.

10 Appendix

10.1 Process Data Structure

Input process data

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Position value												0	Switching signals		
AD11	AD10	AD9	AD8	AD7	AD6	AD5	AD4	AD3	AD2	AD1	AD0	res	BD3	BD2	BD1

Function

BD1	Switching Signal 1
BD2	Switching Signal 2
BD3	Switching Signal 3
AD	Position value

Values

BDn	bool	0	Switched off
		1	Switched on
AD	uint12	0 ... max. position	Valid position value in 1/20 mm <ul style="list-style-type: none"> ■ PMI40-F90...: 0 ... 800 ■ PMI80-F90...: 0 ... 1600 ■ PMI120-F90...: 0 ... 2400
		4092	Insufficient signal quality
		4093	Outside of the value range (below the value range)
		4094	Outside of the value range (above the value range)
		4095	No damping element

Configuration

BD1 switchpoint logic	Index 0x3D subindex 1	
	0 (high active)	1 (low active)
BD1—switching signal 1:		
Damping element outside of the limits	0	1
Damping element within the limits	1	0

BD2 switchpoint logic	Index 0x3F subindex 1	
	0 (high active)	1 (low active)
BD2—switching signal 2:		
Damping element outside of the limits	0	1
Damping element within the limits	1	0



BD3 switchpoint logic	Index 0x4001 subindex 1	
	0 (high active)	1 (low active)
BD3—switching signal 3:		
Damping element outside of the limits	0	1
Damping element within the limits	1	0



Note!

See Chapter "Switchpoint Mode" for additional switching signal channel parameterization.

10.2 Telegram Types

10.2.1 IO-Link Communication and ID Parameters

Direct Parameter Page 1—Index 0x00							
Sub	Address hex	Name	Type	Data type	Attribute	Value	Comment
Communication Control							
1	0x00	Master Command	R/W	uint8	Volatile		Written by master
2	0x01	Master cycle time	R/W	uint8	Volatile		Written by master
3	0x02	Min. cycle time	R	uint8	Constant	0x17	2.3 ms
4	0x03	M-sequence capability	R	uint8	Constant	0x21	ISDU support
5	0x04	Revision ID	R	uint8	Constant	0x11	IO-Link version 1.1
6	0x05	Process Data In	R	uint8	Constant	0x50	16bit Pdin, SIO support
7	0x06	Process data out	R	uint8	Constant	0x00	n/a
Identification Parameter							
8	0x07	IO-Link Vendor ID 1 (MSB)	R	uint8	Constant	0x00	Pepperl+Fuchs
9	0x08	IO-Link Vendor ID 2 (LSB)	R	uint8	Constant	0x01	
10	0x09	Device ID 1 (MSB)	R	uint8	Constant	0x20	Inductive Sensors PMIxxx-F90-...-IO-...
11	0x0A	Device ID 2	R	uint8	Constant	0x02 for PMI40...	
						0x03 for PMI80...	
						0x04 for PMI120...	
12	0x0B	Device ID 3 (LSB)	R	uint8	Constant	0x01 for PMxxx-F90-IU-IO-...	
						0x02 for PMxxx-F90-3EP-IO-...	
						0x03 for PMxxx-F90-IU2EP-IO-...	
						0x04 for PMxxx-F90-IU2EP-IO-...-3G-3D	
13	0x0C	Function ID 1 (MSB)	R/W	uint8	Static	0x00	Not used
14	0x0D	Function ID 2 (LSB)	R/W	uint8	Static	0x00	

10.2.2 IO-Link Standard Parameters

System Command (Index 0x02)

Value hex	Function
0x82	Restore factory settings

Profile ID (Index 0x0D)

Subindex	Value hex	Function
1	0x0001	Smart sensor profile supported
2	0x8000	Device identification
3	0x8001	Binary data channel
4	0x8002	Process data variable
5	0x8003	Device diagnosis

PD input descriptor (Index 0x0E)

Subindex	Value hex	Function
1	0x010300	SetFBool3.0
2	0x020C04	UIntegerT12.4

Parameters for Identification

Index hex	Name	Type	Data type
0x10	Vendor name	R	char [18]
0x11	Vendor text	R	char [max 32]
0x12	Product name	R	char [max 32]
0x13	Product ID	R	char [11]
0x14	Product text	R	char [max 32]
0x15	Serial number	R	char [14]
0x16	Hardware revision	R	char [7]
0x17	Firmware revision	R	char [7]
0x18	Application specific name	R/W	char [max 32]
0xC0	User tag	R/W	char [max 32]

10.2.3 IO-Link Device Parameters



Note!

The existing indexes for the various sensors differ according to their properties. For example, indexes for parameterizing an analog output are only available for sensors with an analog output.

Index	Sub-index	Name	Type	Data type	Value	Default	Unit
Device Settings (Data Storage = yes)							
0x61		Operation Mode	R/W	uint8	0: One Damping Element (Absolute Position Measurement) 1: Two Damping Elements (Relative Position Measurement)	0	
Switching Signal Channel 1 (Data Storage = yes)							
0x3C	1	Setpoint SP1	R/W	uint16	PMI40: 0 ... 800 PMI80: 0 ... 1600 PMI120: 0 ... 2400	200 400 600	1/20 mm
	2	Setpoint SP2	R/W	uint16	PMI40: 0 ... 800 PMI80: 0 ... 1600 PMI120: 0 ... 2400	800 1600 2400	1/20 mm
0x3D	1	Switchpoint Logic	R/W	uint8	0: Active-High 1: Active-Low	0	
	2	Switchpoint Mode	R/W	uint8	0x01—Single Point Mode 0x02—Window Mode 0x03—Two Point Mode 0x80—Centered Window Mode	0x80	
	3	Switchpoint Hysteresis	R/W	uint16	0: Low 1: Medium 2: High	0	
0x40	1	Window Width	R/W	uint16	PMI40: 1 ... 800 PMI80: 1 ... 1600 PMI120: 1 ... 2400	20	1/20 mm
	2	Off Delay	R/W	uint16	0 ... 60000	0	ms
	3	On Delay	R/W	uint16	0 ... 60000	0	ms
	4	Error Behavior	R/W	uint8	0: State Freeze 1: Maximum Position 2: High 3: Low	3	
Switching Signal Channel 2 (Data Storage = yes)							
0x3E	1	Setpoint SP1	R/W	uint16	PMI40: 0 ... 800 PMI80: 0 ... 1600 PMI120: 0 ... 2400	600 1200 1800	1/20 mm
	2	Setpoint SP2	R/W	uint16	PMI40: 0 ... 800 PMI80: 0 ... 1600 PMI120: 0 ... 2400	800 1600 2400	1/20 mm

Index	Sub-index	Name	Type	Data type	Value	Default	Unit
0x3F	1	Switchpoint Logic	R/W	uint8	0: Active-High 1: Active-Low	0	
	2	Switchpoint Mode	R/W	uint8	0x01—Single Point Mode 0x02—Window Mode 0x03—Two Point Mode 0x80—Centered Window Mode	0x80	
	3	Switchpoint Hysteresis	R/W	uint16	0: Low 1: Medium 2: High	0	
0x41	1	Window Width	R/W	uint16	PMI40: 1 ... 800 PMI80: 1 ... 1600 PMI120: 1 ... 2400	20	1/20 mm
	2	Off Delay	R/W	uint16	0 ... 6000	0	ms
	3	On Delay	R/W	uint16	0 ... 6000	0	ms
	4	Error Behavior	R/W	uint8	0: State Freeze 1: Maximum Position 2: High 3: Low	3	
Switching Signal Channel 3 (Data Storage = yes)							
0x4000	1	Setpoint SP1	R/W	uint16	PMI40: 0 ... 800 PMI80: 0 ... 1600 PMI120: 0 ... 2400	400 800 1200	1/20 mm
	2	Setpoint SP2	R/W	uint16	PMI40: 0 ... 800 PMI80: 0 ... 1600 PMI120: 0 ... 2400	800 1600 2400	1/20 mm
0x4001	1	Switchpoint Logic	R/W	uint8	0: Active-High 1: Active-Low	0	
	2	Switchpoint Mode	R/W	uint8	0x01—Single Point Mode 0x02—Window Mode 0x03—Two Point Mode 0x80—Centered Window Mode	0x80	
	3	Switchpoint Hysteresis	R/W	uint16	0: Low 1: Medium 2: High	0	
0x43	1	Window Width	R/W	uint16	PMI40: 1 ... 800 PMI80: 1 ... 1600 PMI120: 1 ... 2400	20	1/20 mm
	2	Off Delay	R/W	uint16	0 ... 6000	0	ms
	3	On Delay	R/W	uint16	0 ... 6000	0	ms
	4	Error Behavior	R/W	uint8	0: State Freeze 1: Maximum Position 2: High 3: Low	3	
Output Configuration (Data Storage = yes)							
0x70	1	Output Type Q1	R/W	uint8	0: Push-Pull 1: PNP (Sourcing) 2: NPN (Sinking)	0	

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Index	Sub-index	Name	Type	Data type	Value	Default	Unit
0x71	1	Output Type Q2	R/W	uint8	0: Push-Pull 1: PNP (Sourcing) 2: NPN (Sinking)	0	
0x73	1	Output Type Q3	R/W	uint8	0: Push-Pull 1: PNP (Sourcing) 2: NPN (Sinking)	0	
Analog Output (Data Storage = yes)							
0x42	1	Range Limit 1	R/W	uint16	PMI40: 0 ... 800 PMI80: 0 ... 1600 PMI120: 0 ... 2400	0	1/20 mm
	2	Range Limit 2	R/W	uint16	PMI40: 0 ... 800 PMI80: 0 ... 1600 PMI120: 0 ... 2400	800 1600 2400	1/20 mm
0x72	1	Analog Output Type	R/W	uint8	0: Current 1: Voltage	0	
	2	Analog Output Mode	R/W	uint8	0: Rising 1: Falling	0	
	3	Current - Lower Output Value	R/W	uint8	0 ... 200	40	0.1 mA
	4	Current - Upper Output Value	R/W	uint8	0 ... 200	200	0.1 mA
	5	Voltage - Lower Output Value	R/W	uint8	0 ... 100	0	0.1 V
	6	Voltage - Upper Output Value	R/W	uint8	0 ... 100	100	0.1 V
	7	Analog Output Error Behavior	R/W	uint8	0: Output Value Freeze 1: Maximum Position 2: Error Replacement Value	0	
	8	Current - Error Replacement Value	R/W	uint8	0 ... 200	36	0.1 mA
	9	Voltage - Error Replacement Value	R/W	uint8	0 ... 100	0	0.1 V
Event Configuration (Data Storage = yes)							
0x78	1	No Damping Element detected (Warning)	R/W	bool	0: Disabled 1: Enabled	0	
	2	Signal Error (Warning)	R/W	bool	0: Disabled 1: Enabled	0	
Service Function (Data Storage = no)							
0x7F		Indication Setting	R/W	uint8	0: Normal Indication 1: Locator Indication	0	
Device Access Locks (Data Storage = yes)							
0x0C		Data Storage Lock (Bit 1)	R/W	bool	0: false (Data Storage activated) 1: true (Data Storage locked)	0	

Index	Sub-index	Name	Type	Data type	Value	Default	Unit
Device Status Information (Data Storage = no)							
0x24		Device Status	R	uint8	0: Device is OK 2 = Out of Specification	0	
0x25		Detailed Device Status	R	uint8 [9]	Active Events, see IO-Link 1.1-Specification		
Operation Information (Data Storage = no)							
0xE0		Operating Hours	R	uint32	0: 0x3FFFFFFF, Resolution 0.25 h		0.25 h
User Specific Information (Data Storage = yes)							
0x18		Application Specific Tag	R/W	uint8 [32]	Your automation, our passion (Modification by user possible)		
0xC0		User Tag	R/W	uint8 [32]	PMI-F90 Series (Modification by user possible)		
Device Characteristics (Data Storage = yes)							
0xE8	1	Position Range	R	uint16	800 (PMI40) 1600 (PMI80) 2400 (PMI120)		
	2	Resolution	R	uint16	50 µm		
Process Data (Data Storage = no)							
0x28		Process Data Values	R	uint16	See Process Data Structure		



Note!

With the following parameter "0xEC", you can only read the complete parameter. Access to the subindex is not possible here!

Index	Sub-index	Name	Type	Data type	Value	Default	Unit
Observation (Data Storage = no)							
0xEC	1	Measured Value	R	uint16	PMI40: 0 ... 800 PMI80: 0 ... 1600 PMI120: 0 ... 2400		1/20 mm
	2	Signal Quality	R	uint8	0: Insufficient 1: Acceptable 2: Good 3: Excellent		
	3	Switching Signal 1	R	uint8	0: Inactive 1: Active		
	4	Switching Signal 2	R	uint8	0: Inactive 1: Active		
	5	Switching Signal 3	R	uint8	0: Inactive 1: Active		

10.2.4 Error Codes

In case of a fault, the sensor transmits the error codes detailed in the following table. The error code consists of 2 bytes. The higher value byte, here 0x80, represents the IO-Link device as the emitter. The lower value byte represents the actual fault

Error	Error code	Comment
Device application error	0x8000	Device application error, the required service is not operated by the sensor.
Index unavailable	0x8011	R/W access to unavailable parameter index
Unavailable subindex	0x8012	R/W access to unavailable parameter subindex
Service temporarily unavailable	0x8020	Write/read access to parameter limited by the device status is not possible.
Service temporarily unavailable—device control panel	0x8022	Write/read access to parameter limited by window control access to the sensor is not possible.
Access denied	0x8023	Write attempt to read-only address
Invalid value range, parameter	0x8030	For all R/W parameters outside of the valid value range
Parameter value too large	0x8031	For all R/W parameters above the valid value range
Parameter value too small	0x8032	For all R/W parameters beneath the valid value range
Parameter length is too large	0x8033	Too much data has been transmitted for the parameter (more bytes)
Parameter length is too small	0x8034	Too little data has been transmitted for the parameter (too few bytes)
Application not ready	0x8082	Device application error, the required service is not operated by the sensor

10.2.5 Event Data

The sensor is capable of transmitting events that occur:

Event	Instance	Type	Mode	Event qualifier	Event code	Description
Signal faults	APP	Warning	Appear/ Disappear	0xE4/0x A4	0x8D40	Damping element is too far from the sensor.
No measured value	APP	Warning	Appear/ Disappear	0xE4/0x A4	0x8D41	No damping element or no position detection possible.

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