TECHNICAL INFORMATION

# Photoelectric sensors

## SICK Smart Sensors / IO-Link

Device configuration – Advanced operating instructions

SICK
Sensor Intelligence.

SMART SENSORS

IO-Link

**Product described**

IO-Link – photoelectric sensors

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**Legal information**



**Original document**

This document is an original document of SICK AG.

# Contents

# 1 About this document

## 1.1 Purpose of this document

The ISDU descriptions in this document apply to IO-Link-enabled photoelectric sensors (Smart Sensors) with the following principles of operation:
WTB, WTF, WTL, WTS, WTT, WL, WLA, WLG, WE, WEO.

In some cases, functions may be described in this document which are not supported by individual sensors. The functions in question are marked accordingly (see "Symbols", page 4).
The specific functional scope of an individual sensor is described in full in the **Addendum to operating instructions** on the relevant product page under www.sick.com.

## 1.2 Intended use

Use IO-Link only as described in this documentation.

## 1.3 Symbols

**NOTICE**
This symbol indicates important information.

**NOTE**
This symbol provides additional information, e.g., dependencies / interactions between the described function and other functions, or when individual functions are not supported by every sensor.

# 2 Description of IO-Link

**IO-Link and control integration**

IO-Link is a non-proprietary internationally standardized communication technology, which makes it possible to communicate with sensors and actuators in industrial environments (IEC 61131-9).

IO-Link devices communicate with higher-level control systems via an IO-Link master. The IO-Link devices (slaves) are connected to these via a point-to-point connection.
Different variants of IO-Link master are available. In most cases, they are remote fieldbus gateways or input cards for the backplane bus of the control used.

To make it possible for an IO-Link sensor to communicate with the control, both the IO-Link master and the IO-Link sensor must be integrated in the hardware configuration in the control manufacturer's Engineering Tool.

To simplify the integration process, SICK provides sensor-specific device description files (IODD = IO-Link Device Description) for IO-Link devices.
You can download these device description files free of charge: www.sick.com/[device-part number].

Not all control system manufacturers support the use of IODDs. If third-party IO-Link masters are used, it is possible to integrate the IO-Link sensor by manually entering the relevant sensor parameters directly during the hardware configuration.

To ensure that the IO-Link sensor can be easily integrated into the control program, SICK also provides function blocks for many control systems. These function blocks make it easier to read and write the individual sensor parameters, for example, and provide support when it comes to interpreting the process data supplied by the IO-Link sensor. You can also download them free of charge from the homepage: www.sick.com/[device-part number].

On the SICK YouTube channel, you can find a number of tutorials, which will help you to integrate SICK IO-Link masters: www.youtube.com/SICKSensors.

If you have any questions, SICK's Technical Support is available to help all over the world.

# 3 Accessories for visualization, configuration, and integration

Using the SiLink2-Master, you can easily connect IO-Link sensors from SICK to a PC or a laptop via USB. You can then quickly and easily test or configure the connected sensors using the SOPAS ET program (SICK Engineering Tool with graphic user navigation and convenient visualization).

The corresponding visualization files (SDD = SOPAS Device Description) are available for many devices so that you can operate the IO-Link sensors using SOPAS ET.

You can download SOPAS ET and the device-specific SDDs directly and free of charge from the SICK homepage: www.sick.com.

Various IO-Link masters are available from SICK for integrating IO-Link masters using fieldbus. For more details, see: www.sick.com.

# 4 Data repository

When the current IO-Link standard V1.1 was introduced, the automatic data repository (Data Storage) was added to IO-Link's range of functions. The data repository allows the machine operator to replace defective IO-Link devices with corresponding replacement devices without having to reconfigure these manually.

When the data repository is activated, the IO-Link 1.1 master always saves the last valid setting parameters of all connected IO-Link 1.1 devices in its local memory. If you replace one of the connected IO-Link devices with another device which is compatible with the function, the IO-Link master will transfer the last valid parameter set of the previous sensor to the new sensor automatically.

The data repository therefore means that devices can be replaced in a plug-and-play manner within a matter of seconds – without complex reconfiguration, special hardware or software tools, and specific specialist knowledge.

**NOTE**

- To use the data repository, you must activate it in the IO-Link master.
- When the conversion of one or several sensor parameters is initiated via the control, then the control must activate the **Data Storage Upload Request-Flag** as the final command in the sensor. Only this initiates the data repository.
- Uploading / downloading sensor parameters using the data repository function can take between a few hundred milliseconds and three seconds depending on the volume of data and the IO-Link master used (typical values; values can differ in practice).
- For details on using the data repository, see IO-Link Interface and System Specification, V1.1.2, chapter 10.4 Data Storage (DS) at www.io-link.com, Downloads menu item.

# 5 Physical layer

The physical layer describes the basic IO-Link device data. The device data is automatically shared with the IO-Link master. It is important to ensure that the used IO-Link master supports this performance data.

**NOTICE**
The maximum current consumption of the IO-Link sensor (including load at the outputs) must not exceed the permissible output current of the relevant port on the IO-Link master.

The individual IO-Link device data differs from device to device and can be found in the online data sheet of the respective sensor as well as its addendum to operating instructions:

www.sick.com/[part number] --> Downloads --> Documentation

# 6 Process data

Process data are transmitted cyclically. There is no confirmation of receipt.
The master determines the cycle time, whereby this must not be less than the minimum cycle time of the sensor.

**NOTE**
The service data (acyclic data) does not influence the cycle time.

### Process data structure for WTBxx, WTFxx, WTLxx, WTSxx, WLAxx, WLGxx, WSExx, each with “Base logic” Smart Task

*Table 1: Process data structure – Basic logic*

| Byte offset | Byte 0 | | | | | | | | Byte 1 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bit offset** | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| **Name** | Reserved | | | | | | | | | | | | | | $Q_{L2}$ | $Q_{L1}$ |
| **Data type** | – | | | | | | | | | | | | | | Boolean | Boolean |
| **Description** | Reserved | | | | | | | | | | | | | | 0 = OFF<br>1 = ON | 0 = OFF<br>1 = ON |

### Process data structure for WTBxx, WTFxx, WTLxx, WTSxx, WLAxx, WLGxx, WSExx, each with “Time measurement and debouncing” Smart Task

*Table 2: Process data structure – Time measurement and debouncing*

| Byte offset | Byte 0 | | | | | | | | Byte 1 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bit offset** | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| **Name** | Time measurement value (tmsval) | | | | | | | | | | | | | | $Q_{L2}$ | $Q_{L1}$ |
| **Data type** | Unsigned integer 14 | | | | | | | | | | | | | | Boolean | Boolean |
| **Description** | [ms or 10 ms or 100 ms] | | | | | | | | | | | | | | 0 = OFF<br>1 = ON | 0 = OFF<br>1 = ON |

### Process data structure for WTBxx, WTFxx, WTLxx, WTSxx, WLAxx, WLGxx, WSExx, each with “Counter and debouncing” Smart Task

*Table 3: Process data structure – Counter and debouncing*

| Byte offset | Byte 0 | | | | | | | | Byte 1 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bit offset** | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| **Name** | Count value (cntval) | | | | | | | | | | | | | | $Q_{L2}$ | $Q_{L1}$ |
| **Data type** | Unsigned integer 14 | | | | | | | | | | | | | | Boolean | Boolean |
| **Description** | – | | | | | | | | | | | | | | 0 = OFF<br>1 = ON | 0 = OFF<br>1 = ON |

### Process data structure for WTBxx, WTFxx, WTLxx, WTSxx, WLAxx, WLGxx, WSExx, each with “Speed and length measurement” Smart Task

*Table 4: Process data structure – Speed and length measurement*

| Byte offset | Byte 0 | | | | | | | | Byte 1 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bit offset** | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| **Name** | Measurement value length (lngval) resp. Measurement value speed (spdval) | | | | | | | | | | | | | | Qint. 1 | $Q_{L1}$ |
| **Data type** | Integer 14 | | | | | | | | | | | | | | Boolean | Boolean |
| **Description** | [mm] or [mm/s] | | | | | | | | | | | | | | 0 = OFF<br>1 = ON | 0 = OFF<br>1 = ON |

### Process data structure for WTFxx, WTLxx, WTSxx, WLAxx, WLGxx, WSExx, each with “Object and gap monitor” Smart Task

*Table 5: Process data structure – Object and gap monitor*

| Byte offset | Byte 0 | | | | | | | | Byte 1 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bit offset | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Name | Time measurement value (tmsval) | | | | | | | | | | | | | Qint.1 | $Q_{L\ Gap}$ | $Q_{L\ Object}$ |
| Data type | Unsigned integer 13 | | | | | | | | | | | | | Boolean | Boolean | Boolean |
| Description | [ms] | | | | | | | | | | | | | 0 = OFF<br>1 = ON | 0 = OFF<br>1 = ON | 0 = OFF<br>1 = ON |

**NOTE**

In order to be able to use the maximum switching frequency for the switching output via pin 2 at the same time as IO-Link communication, configure pin 2 as Q/or Qint.1. **Pin 2/5 configuration** (ISDU 121).

### Process data structure for WTBxx, WTFxx, WTLxx, WTSxx, WLAxx, WLGxx, WSExx, each with “Load mapping” Smart Task

*Table 6: Process data structure – load mapping*

| Byte offset | Byte 0 | | | | | | | | Byte 1 | | | | | | | | Byte 2 | | | | | | | | Byte 3 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bit offset | 63 | 62 | 61 | 60 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 52 | 51 | 50 | 49 | 48 | 47 | 46 | 45 | 44 | 43 | 42 | 41 | 40 | 38 | 37 | 36 | 35 | 34 | 33 | 32 |
| Name | Load Mapping positions occupied | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Data type | Unsigned integer 32 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Description | Bit mask: Bit = 1 –> Object present; Bit = 0 –> No object present; Bit 32-55 in use for load mapping, Bit 56-63 is not in use | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

*Table 7: Process data structure – load mapping*

| Byte offset | Byte 4 | | | | | | | | Byte 5 | | | | | | | | Byte 6 | | | | | | | | Byte 7 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bit offset | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Name | Number of objects in last pattern seen | | | | | | | | Reserved | | | | | | | | | | | Status | | | | Invalid pattern clipping | Reserved | | | | | | Qint.1 | QL1 |
| Data type | Unsigned integer 8 | | | | | | | | - | | | | | | | | | | | Uint 4 | | | | Boolean | - | | | | | | Boolean | |
| Description | | | | | | | | | Reserved | | | | | | | | | | | - | | | | 0 = OFF<br>1 = ON | Reserved | | | | | | 0 = OFF<br>1 = ON | 0 = OFF<br>1 = ON |

### Process data structure for WTT with or without "Base logic” Smart Task

*Table 8: Process data structure – WTTxx with or without "Base logic" Smart Task*

| Byte offset | Byte 0 | | | | | | | | Byte 1 | | | | | | | | Byte 2 | | | | | | | | Byte 3 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bit offset | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Name | Distance to object | | | | | | | | | | | | | | | | Reserved | | | | | | Qint.8 | Qint.7 | Qint.6 | Qint.5 | Qint.4 | Qint.3 | Qint.2 | Qint.1 | QL2 | QL1 |
| Data type | Unsigned integer 16 | | | | | | | | | | | | | | | | - | | | | | | Boolean | | | | | | | | | |
| Description | [mm] | | | | | | | | | | | | | | | | Reserved | | | | | | 0 = OFF<br>1 = ON | | | | | | | | | |

# 7 Service data

Service data is only exchanged between the control and IO-Link sensor via the IO-Link master on request by the control (acyclically).

The respective counterpart confirms receipt of the data.

If the sensor does not answer within five seconds, the master reports a communication error.

**NOTE**
Not every function described in this document is available in every sensor. The complete list of the parameters available in the individual devices can be found in the “Addendum to operating instructions” document, which is found on the web page of the respective device: www.sick.com/[part number] --> Downloads --> Documents.

## 7.1 Device identification

*Table 9: Device identification*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 16 | 10 | - | Vendor name | String | - | 7 byte | ro | SICK AG | |
| 18 | 12 | | Product name | | | 18 byte | | | |
| 19 | 13 | | Product ID | | | 13 byte | | see ISDU 219 | |
| 219 | DB | 0 | Product ID | Record | | 7 byte | | | |
| | | 1 | Product ID IO-Link device | String | | 7 byte | | | |

The **Product ID** also contains the part number of the connected IO-Link device. For reasons of standardization, this may also contain a reference to ISDU 219. In this case, the **Product ID** (part number) is filed under ISDU 219.

*Table 10: Device identification – Product text/serial number*

| ISDU | | | Name | Data type | Data Storage | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 20 | 14 | - | Product text | String | - | 45 bytes | ro | | |
| 21 | 15 | - | Serial Number | | | 8 bytes | | | |

Serial number format:
YYWWnnnn (Y = year, W = week, n = sequential numbering)

**NOTE**
The serial number combined with the part number (**Product ID**) enables the device to be clearly identified.

*Table 11: Device identification – Specific tag / specific name*

| ISDU | | | Name | Data type | Data Storage | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 24 | 18 | - | Application-specific tag | String | yes | 32 bytes | rw | ******* | |
| 64 | 40 | - | Device-specific name | | No | | | ******* | |

In **Application Specific Tag**, you can store any text with a maximum of 32 characters. This can be useful for describing the exact position or task of the sensor in the overall machine. The **Application Specific Tag** is saved via the **Data repository**.

In **Device Specific Name**, you can also store any text with a maximum of 32 characters. This name is NOT saved via the **Data repository** and is therefore available for information which is valid temporarily or for information which is only applicable to this sensor.

*Table 12: Device identification – Version*

| ISDU | | | Name | Data type | Data reposi-tory | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 22 | 16 | - | Hardware version | String | yes | 4 byte | ro | xxxx | |
| 23 | 17 | - | Firmware version | | | 12 byte | | Vxxx.xxx.xxx | |

This ISDU indicates the hardware and software versions.

*Table 13: Device identification – Find me*

| ISDU | | | Name | Data type | Data reposi-tory | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 204 | CC | - | Find me | UInt | No | 8 bit | rw | 0 | 0 = Find me deactivated<br>1 = Find me activated |

The sensor can be uniquely identified using **Find me**. For machines with several identical sensors, it is therefore possible to uniquely identify the device with which communication is currently taking place.
When **Find me** is activated, the yellow indicator LED of the sensor flashes at 1 Hz.

## 7.2 General device settings

*Table 14: General device settings – Standard command*

| ISDU | | | Name | Data type | Data stor-age | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 2 | 02 | - | Standard command | UInt | - | 1 Byte | wo | | 130 = Restore Factory Settings |

**Restore Factory Settings:** The sensor is reset to factory settings.

*Table 15: General device settings – Device access locks*

| ISDU | | | Name | Data type | Data reposi-tory | Length | Access | Default value | Value/range | |
|---|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | | |
| DEC | HEX | | | | | | | | | |
| 12 | 02 | - | Device access locks (key lock) | Record | yes | 2 byte | rw | | Bit no. | |
| | | | | | | | | | 0 | |
| | | | Data storage lock | | | | | 0 | 1 | 0 = Unlocked<br>1 = Locked |
| | | | Not available | | | | | | 2 | Not available |
| | | | Local user interface lock | | | | | 0 | 3 | 0 = Unlocked<br>1 = Locked |
| | | | Not available | | | | | | 4 – 15 | Not available |

With **Device access locks**, you can lock or unlock various sensor functions. The functionality has been recorded in the IO-Link interface specification.

Bit 1 **Data storage lock** You can lock the data repository functionality using bit 1. When the bit is set, the sensor rejects data repository write requests from the IO-Link master with an error message. For newer devices, the data repository function can no longer be deactivated.

Bit 3 **Local user interface lock** The local control elements on the sensor are locked when the bit is set. The lock can be disabled for 30 seconds: Press the teach-in button for 8 seconds. The control elements are then locked again automatically once 30 seconds have passed. **Local user interface lock** is not available when the sensor does not have any housing con-trol elements.

*Table 16: General device settings – Physical input/output type configuration pin 2*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 92 | 5C | - | Physical input/output type configuration pin 2 | UInt | yes | 1 byte | rw | 3 | 1 = PNP<br>2 = NPN<br>3 = Push/Pull |

**Physical input/output type configuration pin 2** makes it possible to determine the wiring on pin 2. If the device is used in an NPN network and pin 2 should be used as an input function, this parameter must be set to 2 = NPN in advance.

**NOTE**
Dependency: **Pin 2 configuration** (ISDU 121)

*Table 17: General device settings – Sender configuration*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 97 | 61 | - | Sender configuration | UInt | - | 1 byte | rw | 0 | 0 = Sender active<br>1 = Sender not active |

This ISDU can be used to switch off the Send LED.
Alternatively, the sensor's Send LED can be deactivated using the HIGH signal on pin 2 (when **Pin 2 configuration** (ISDU 121) is **Sender off**).
If the settings contradict one another, the **Switch-off** signal is dominant.
If the sensor does not have a Send LED (e.g., the WExx): **Sender configuration** is not available.

**NOTE**
Dependency: **Pin 2 configuration Sender off** (ISDU 121)

*Table 18: General device settings - Process data select*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| Dec | Hex | | | | | | | | |
| 120 | 78 | - | Process data select | UInt | yes | 1 byte | rw | 0 | 0 = device specific<br>1 = device specific<br>2 = device specific<br>3 = ...<br>... |

**Process data select** can be used to determine which process data structure of the sensor is to be output cyclically. The possible process data structures are fixed. See the respective device documentation for details on the process data structures.

*Table 19: General device settings – Pin 2 configuration*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 121 | 79 | - | Pin2 configuration | UInt | yes | 1 byte | rw | 32 resp. 40 | 0 = Deactivated/no function<br>Inputs:<br>1 = External input (Smart Task)<br>16 = Sender off<br>17 = Teach-in<br>Outputs:<br>32 = Detection output Q/<br>33 = Quality of run alarm output<br>34 = Switching signal QL2<br>35 = Detection output Qint.1<br>36 = Detection output Qint.2<br>39 = Switching signal QL1<br>40 = Switching signal QL1/<br>43 = Health output |

**Pin 2 configuration** can be used to assign a range of input and output functions to pin 2 in the device connector (or the white wire when using a connecting cable).

| | |
|---|---|
| **Deactivated** | The signal level at pin 2 is not evaluated. |
| **External input (Smart Task)** | Input signal; is processed in Smart Task (if present). |
| **Sender off** | Input signal;<br>Level at pin 2 HIGH [1]: Sender LED of the sensor switched off<br>Level at pin 2 LOW [2]: Sender LED of the sensor switched on (if this is not deactivated via the **Sender configuration** (ISDU 97).<br>Does not apply for WExx devices. |
| **Teach-in** | Input signal;<br>Level at pin 2 HIGH for at least 1 second [1]: Triggers the teach command.<br>For WTBxx, WTFxx, WTLxx, WTSxx, WTTxx; the current distance between the sensor and the object in the light beam is set as the sensing range, if necessary corrected by the set **Teach-in offset** value (ISDU 90).<br>For WLxx, WLGxx, WLAxx and, if necessary, WExx; the sensor's sensitivity is adjusted to the current energetic situation. |
| **Detection output Q/** | Output signal; signal level device specific<br>WTBxx, WTFxx, WTLxx, WTSxx: LOW[2] if the detection object is detected by the sensor. WLxx, WLGxx, WLAxx, WExx: HIGH[1] if the detection object is detected by the sensor. |
| **Quality of run alarm output** | Output signal; HIGH[1] if the **Quality of run** value (ISDU 175) undercuts the set alarm threshold (**Quality of run alarm threshold**, ISDU 176). |
| **Switching signal QL2** | Output signal; switching signal generated from Smart Task. |
| **Detection output Qint.1** | Output signal; HIGH[1] when detection object is detected by sensor via Qint.1 channel. |
| **Detection output Qint.2** | Output signal; HIGH[1] when detection object is detected by sensor via Qint.2 channel. |
| **Switching signal QL1** | Output signal; switching signal generated from Smart Task. |
| **Switching signal QL1/** | Output signal; inverted signal to **QL1**. |
| **Health output** | Output signal; inverted signal to **Quality of run alarm output**. |

1) HIGH = Signal level to L+
2) LOW = Signal level at ground or pin/wire not connected

**NOTE**
Not every device supports each individual pin 2 function. See IODD of the respective device for more information.

*Table 20: General device settings – Notification handling*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 227 | E3 | - | Notification handling | UInt | - | 1 byte | rw | 0 | 0 = All enabled<br>1 = All disabled<br>2 = Events enabled, PD invalid flag disabled<br>3 = Events disabled, PD invalid flag enabled |

**Notification handling** enables the generation of IO-Link events in the sensor and the function for marking the process data as invalid to be activated/deactivated.

*Table 21: Installation/Diagnostics – Eco mode*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 235 | IB | 0 | Eco mode | UInt | - | 3 byte | ro | 0 | 0 = Off<br>1 = On |

When activating eco mode, the display is deactivated 20 s after the last entry.

*Table 22: General device settings – Inverter external input*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Subindex | | | | | | | |
| Dec | Hex | | | | | | | | |
| 1093 | 445 | - | Inverter external input | UInt | yes | 1 byte | rw | 0 | 0 = Not inverted<br>1 = Inverted |

If the **Inverter external input** is activated, all binary input signals read via pin 2 are inverted before device-internal processing. Teach-in input signals are exceptions. These are always processed non-inverted regardless of the **Inverter external input** setting.

**NOTE**
Depending on the device generation, the **Inverter external input** only functions for Smart Task input signals and therefore depending on the setting under ISDU 121 **Pin 2 configuration**.

## 7.3 Teach-in/Detection settings for WTB, WTF, WTL and WTS devices

*Table 23: Teach-in/Detection – Standard command*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Subindex | | | | | | | |
| DEC | HEX | | | | | | | | |
| 2 | 2 | - | Standard command | UInt | - | 1 byte | wo | - | 65 = Single value teach |

After the teach-in command has been triggered, the current distance between the sensor and the object in the light beam is set as the sensing range. **Qint.1 SP1 sensing range** (ISDU 60) and **Qint.2 SP1 sensing range** (ISDU 62) change accordingly.

**NOTE**
The same effect is achieved by:

- Triggering teach-in using the teach-in button on the sensor housing (if present).
- Triggering teach-in using the HIGH signal (L+) on pin 2 (when **Pin 2 configuration** (ISDU 121)) is set to **Teach-in**).

**NOTE**
Dependency:

- **Teach-in channel** (ISDU 58)
- **Qint.1 SP1 sensing range** (ISDU 60)
- **Qint.2 SP1 sensing range** (ISDU 62)
- **Quality of Teach** (ISDU 114)

*Table 24: Teach-in/Detection – Teach-in channel/Teach state*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Subindex | | | | | | | |
| DEC | HEX | | | | | | | | |
| 58 | 3A | - | Teach-in channel | UInt | - | 1 byte | rw | 0 | 0 to 2 = Default BDC |
| 59 | 3B | - | Teach-in state | Record | - | 1 byte | ro | - | |
| | | | Teach flags | | | 1 bit<br>(offset 4 bit) | | | 0 = Teachpoint 1 not taught<br>1 = Teachpoint 1 successfully taught |
| | | | Teach state | | | 4 bit<br>(offset 0 bit) | | | 0 = IDLE<br>1 = SP1 SUCCESS<br>5 = BUSY<br>7 = ERROR |

Selection of the Qint. channel that is affected by the **Single value teach** (ISDU 2, value 65) system command.
Only one teach-in channel is available for the teach-in process for WTB, WTS and WTL devices. Only the preset teach-in channel can be used.

The **Teach state** shows the current status of the teach-in process.
A teach-in process can only be performed when the status is **IDLE**, **SP1 SUCCESS** and **ERROR**.

The status always refers to the Qint. channel selected in **Teach-in channel** (ISDU 58). The **Teach flags** have no function for WTB, WTS, and WTL devices.

*Table 25: Teach-in / detection – Qint.1*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 60 | 3C | 0 | Qint.1 SP1 / SP2 | Record | yes | 3 byte | rw | - | |
| | | 1 | Qint.1 SP1 sensing range | | | 16 bit | | Device specific | 0 to 65535 |
| | | 2 | Qint.1 SP2 sensing range | | | 8 bit | | - | Not used |
| 61 | 3D | 0 | Qint.1 configuration | Record | yes | 4 byte | rw | - | |
| | | 1 | Qint.1 Switchpoint logic | | | 8 bit (Offset 24 bit) | | 128 | 128 = Vendor specific |
| | | 2 | Qint.1 Switchpoint mode | | | 8 bit (Offset 16 bit) | | 128 | 128 = Vendor specific |
| | | 3 | Qint.1 Switchpoint hysteresis | | | 16 bit (Offset 0 bit) | | 0 | 0 = Auto-defined hysteresis |

**Qint.1 SP1 sensing range** can be used to adjust the sensor's sensing range (in mm).
The value range is restricted by the sensor's "max. sensing range" (see sensor data sheet for "max. sensing range").

If the current distance between sensor and detection object is the same or less than the set **Qint.1 SP1 sensing range** value, the Qint.1 detection signal switches to HIGH.

The selected sensing range can be overwritten by:

- Triggering teach-in using the teach-in button on the sensor housing.
- Triggering teach-in using the HIGH signal (L+) on pin 2 (when **Pin 2 configuration** (ISDU 121) is set to **Teach-in**).

**Qint.1 SP2 sensing range** has no function.

Depending on the device, **Qint.1 SP1 / SP2** (ISDU 60) and **Qint.2 SP1 / SP2** (ISDU 62) are synchronized.
Any changes made to one of the ISDUs are automatically accepted by the other ISDU.

**NOTE**
Dependency:

- System command **Single value teach** (ISDU 2, value 65).
- **Qint.2 SP1 sensing range** (ISDU 62).

**Qint.1 Switchpoint logic** has no function.
**Qint.1 Switchpoint mode** has no function.
**Qint.1 Switchpoint hysteresis**has no function.

*Table 26: Teach-in / detection – Qint.2*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 62 | 3E | 0 | Qint.2 SP1 / SP2 | Record | yes | 3 byte | rw | - | |
| | | 1 | Qint.2 SP1 sensing range | | | 16 bit | | Device specific | 0 to 65535 |
| | | 2 | Qint.2 SP2 sensing range | | | 8 bit | | - | Not used |
| 63 | 3F | 0 | Qint.2 configuration | Record | yes | 4 byte | rw | - | |
| | | 1 | Qint.2 Switchpoint logic | | | 8 bit (Offset 24 bit) | | 128 | 128 = Vendor specific |
| | | 2 | Qint.2 switchpoint mode | | | 8 bit (Offset 16 bit) | | 128 | 128 = Vendor specific |
| | | 3 | Qint.2 switchpoint hysteresis | | | 16 bit (Offset 0 bit) | | 0 | 0 = Auto-defined hysteresis |

**Qint.2 SP1 sensing range** can be used to adjust the sensor's sensing range (in mm).

The value range is restricted by the sensor's "max. sensing range" (see sensor data sheet for "max. sensing range").

If the current distance between sensor and detection object is the same or less than the set **Qint.2 SP1 sensing range** value, the Qint.2 detection signal switches to HIGH.

The selected sensing range can be overwritten by:

- Triggering teach-in using the teach-in button on the sensor housing.
- Triggering the teach-in via HIGH[1] signal at pin 2 (if **pin 2 configuration** (ISDU 121) is set to **Teach-in**).

**Qint.2 SP2 sensing range** has no function.

Depending on the device, **Qint.1 SP1 / SP2** (ISDU 60) and **Qint.2 SP1 / SP2** (ISDU 62) are synchronized. Any changes made to one of the ISDUs are automatically accepted by the other ISDU.

**NOTE**
Dependency:

- System command **Single value teach** (ISDU 2, value 65).
- **Qint.1 SP1 sensing range** (ISDU 60)

**Qint.2 Switchpoint logic** has no function.
**Qint.2 Switchpoint mode** has no function.
**Qint.2 Switchpoint hysteresis** has no function.

*Table 27: Teach-in/Detection - Detection mode*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 83 | 53 | - | Detection mode | UInt | yes | 1 byte | rw | 0 | 0 = Switching mode<br>1 = Distance measuring mode |

Photoelectric proximity sensors which can not only detect binary detection signals, but also the distance to the object, feature the **Detection mode** function. Depending on the setting, the photoelectric proximity sensor is in switching or measuring mode.

The setting of **Detection mode** also affects **Process data select** (ISDU120):

- In the 0 = Switching mode setting, **Process data select** is automatically set to 0 = Switching signals.
- In the 1 = Distance measuring mode setting, **Process data select** is automatically set to 1 = Distance to object.

**NOTE**
Dependency:

**Process data select** (ISDU 120)

*Table 28: Teach-in/Detection – Teach-in offset*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Subindex | | | | | | | |
| Dec | Hex | | | | | | | | |
| 90 | 5A | - | Teach-in offset | Int | yes | 1 byte | rw | 0 | -100 ... +100<br>Alternatively:<br>-50 ... +50 |

When this function is in use, when triggering a teach-in command (via the teach-in button on the sensor housing or via the **Single value teach** system command (ISDU 2, value 65)), the defined detection point is corrected by the set value.

This function makes it possible to increase detection reliability, especially for teach-in ongoing processes, by moving the detection point with the **Teach-in offset** e.g. "into the object".

1) HIGH = signal level at L+

**NOTE**
Dependency:
**Single value teach** system command (ISDU 2, value 65)

**NOTE**
The **Teach-in offset** does not work if a sensing range is set directly via **Qint.x SP1/SP2** (ISDU 60/62).

*Table 29: Teach-in/Detection – Current receiver level*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 180 | B4 | - | Current receiver level (live) | UInt | - | 1 byte | ro | - | 0 ... 16383 |

**Current receiver level (live)** shows the sensor's current energy-related receiver level as an absolute value in digits. This value therefore delivers additional information about the object on which the sensor light spot falls at the time of read out.

The displayed value is not affected by the teach-in or from other sensor settings. It also does not directly affect the detection behavior of the sensor. The value is not calibrated and can fluctuate from sensor to sensor.

*Table 30: Teach-in/Detection - Distance to object*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 229 | E5 | 0 | Distance to object | Record | - | 3 byte | ro | - | |
| | | 1 | Distance | UInt | | 16 bit (offset 8) | | | 0 ... 30000 |
| | | 2 | Distance qualifier | UInt | | 2 bit (offset 0) | | | 0 = Distance in range/valid<br>3 = No distance information/distance invalid |

This parameter can be used to output the measured distance to the object or the background (if available and in sensing range) as a **Distance** in mm or 1/10 mm (depending on the device – see IODD of the respective device for details). If no measured value can be detected (e.g. because the sensor is facing empty space) or if the measured value is outside of the specified sensing range, the sensor delivers output value "30,000", which is to be interpreted as an invalid measurement.

Each measured value must be linked with the **Distance qualifier.** This value specifies whether the current output measured value is valid or not.

**NOTE**
Separate access to sub-index 1 or 2 is not possible.

## 7.4 Teach-in / detection settings for WL and WLA devices

*Table 31: Teach-in/Detection – Standard command*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 2 | 2 | - | Standard command | UInt | - | 1 byte | wo | - | 65 = Single value teach |

For WL devices, we recommend performing a teach-in process after connecting the sensor and aligning it to the reflector. This automatically adjusts the sensor's receiver sensitivity, taking into account the current light receiver level, so that the detection signal is as reliable as possible.

For WLA devices, a teach-in process is not required for detector-related reasons, as these systems guarantee reliable and robust object detection even at maximum sensitivity (= delivery status).

To be able to use all of the following functions/parameters to their full extent, a teach-in process must be triggered:

- **Qint.1 SP1 / SP2** (ISDU 60) or **Qint.2 SP1 / SP2** (ISDU 62)
- **Quality of run** (ISDU 175)
- **Quality of run alarm** (ISDU 176)
- **Current receiver level** (ISDU 180)

With every teach-in process, the sensor’s current light receiver level, **Current receiver level** (live) (ISDU 180), is standardized at 100%. These 100% levels are the energy-based reference values for the aforementioned functions and parameters. If the teach-in process is not performed, the reference value is undefined and the listed functions and parameters do not deliver any valid information.

To achieve the same effect as the “Single value teach” standard command, you can trigger teach-in using the teach-in pushbutton on the sensor housing (if present) or trigger teach-in via the HIGH signal (L+) at pin 2 (when **Pin 2 configuration** (ISDU 121) is set to **Teach-in**).

**NOTE**

Dependency:

- **Qint.1 SP1 / SP2** (ISDU 60)
- **Qint.2 SP1 / SP2** (ISDU 62)
- **Quality of run** (ISDU 175)
- **Quality of run alarm** (ISDU 176)
- **Current receiver level (live)** (ISDU 180)

*Table 32: Teach-in/Detection – Teach-in channel/Teach state*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 58 | 3A | - | Teach-in channel | UInt | - | 1 byte | rw | 0 | 0 to 2 = Default BDC |
| 59 | 3B | - | Teach-in state | Record | - | 1 byte | ro | - | |
| | | | Teach flags | | | 1 bit<br>(offset 4 bit) | | | 0 = Teachpoint 1 not taught<br>1 = Teachpoint 1 successfully taught |
| | | | Teach state | | | 4 bit<br>(offset 0 bit) | | | 0 = IDLE<br>1 = SP1 SUCCESS<br>5 = BUSY<br>7 = ERROR |

Selection of the Qint. channel that is affected by the **Single value teach** (ISDU 2, value 65) system command.
Only one teach-in channel is available for the teach-in process for WL and WLA devices. Only the preset teach-in channel can be used.

The **Teach state** shows the current status of the teach-in process.
A teach-in process can only be performed when the status is **IDLE**, **SP1 SUCCESS** and **ERROR**.
The status always refers to the Qint. channel selected in **Teach-in channel** (ISDU 58).

The **Teach flags** have no function for WL and WLA devices.

*Table 33: Teach-in / detection – Qint.1*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 60 | 3C | 0 | Qint.1 SP1 / SP2 | Record | yes | 2 byte | rw | - | |
| | | 1 | SP1 upper threshold (switch-on) | | | 8 bit<br>(Offset 8 bit) | | 50 | 50 |
| | | 2 | SP2 lower threshold (switch-off) | | | 8 bit<br>(Offset 0 bit) | | 45 | 45 |
| 61 | 3D | 0 | Qint.1 configuration | Record | | 4 byte | | - | |
| | | 1 | Switchpoint logic | | | 8 bit<br>(Offset 24 bit) | | 128 | 128 = Vendor specific |
| | | 2 | Switchpoint mode | | | 8 bit<br>(Offset 16 bit) | | | |
| | | 3 | Switchpoint hysteresis | | | 16 bit<br>(Offset 0 bit) | | 0 | 0 = Auto-defined hysteresis |

**Qint.1 SP1 / SP2** is used to defined the switch-on and switch-off threshold for the detection signal (as percentages). The selected values are based on the energy-based receiver value (=100%) defined during the last teach-in process.

**SP1 upper threshold (switch-on):** Switch-on threshold.
If the **Current receiver level (live)** (ISDU 180) exceeds the selected switch-on threshold, the **Qint.1** detection signal changes to LOW (no object detected in beam path).

**SP2 lower threshold (switch-off):** Switch-off threshold.
If the **Current receiver level (live)** (ISDU 180) falls below the set switch-off threshold, the **Qint.1** detection signal switches to HIGH (object detected in beam path).

**NOTE**
The default switch-on and switch-off thresholds cannot be adjusted in WL / WLA devices. This is only possible in WLG devices (see "Teach-in / detection settings for WLG devices", page 21). The settings and their effects are redundant to those in ISDU 62.

**NOTE**
Dependency:

- **Qint.2 SP1 / SP2** (ISDU 62)
- **Current receiver level** (live) (ISDU 180)

**Switchpoint logic** has no function.
**Switchpoint mode** has no function.
**Switchpoint hysteresis** has no function.

*Table 34: Teach-in / detection – Qint.2*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 62 | 3E | 0 | Qint.2 SP1 / SP2 | Record | yes | 2 byte | rw | - | |
| | | 1 | SP1 upper threshold (switch-on) | | | 8 bit (Offset 8 bit) | | 50 | 50 |
| | | 2 | SP2 lower threshold (switch-off) | | | 8 bit (Offset 0 bit) | | 45 | 45 |
| 63 | 3F | 0 | Qint.2 configuration | Record | | 4 byte | | - | |
| | | 1 | Switchpoint logic | | | 8 bit (Offset 24 bit) | | 128 | 128 = Vendor specific |
| | | 2 | Switchpoint mode | | | 8 bit (Offset 16 bit) | | | |
| | | 3 | Switchpoint hysteresis | | | 16 bit (Offset 0 bit) | | 0 | 0 = Auto-defined hysteresis |

**Qint.2 SP1 / SP2** is used to defined the switch-on and switch-off threshold for the detection signal (as percentages). The selected values are based on the energy-based receiver value (=100%) defined during the last teach-in process.

**SP1 upper threshold (switch-on):** Switch-on threshold.
If the **Current receiver level (live)** (ISDU 180) exceeds the selected switch-on threshold, the **Qint.1** detection signal changes to LOW (no object detected in beam path).

**SP2 lower threshold (switch-off):** Switch-off threshold.
If the **Current receiver level (live)** (ISDU 180) falls below the selected switch-off threshold, the **Qint.1** detection signal changes to HIGH (object detected in beam path).

**NOTE**
The default switch-on and switch-off thresholds cannot be adjusted in WL / WLA devices. This is only possible in WLG devices (see "Teach-in / detection settings for WLG devices", page 21). The settings and their effects are redundant to those in ISDU 60.

**NOTE**
Dependency:

- **Qint.1 SP1** / **SP2** (ISDU 60)
- **Current receiver level (live)** (ISDU 180)

**Switchpoint logic** has no function.
**Switchpoint mode** has no function.
**Switchpoint hysteresis** has no function.

*Table 35: Teach-in / detection – Current receiver level*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 180 | B4 | - | Current receiver level (live) | UInt | - | 1 byte | ro | - | 0 to 255 |

**Current receiver level (live)** shows the sensor’s current energy-related receiver level (as a percentage). The reference point (equivalent to 100%) is the **Current receiver level (live)** at the time of the last teach-in.
For further details, see the **Single value teach** standard command (ISDU 2, value 65).

**NOTE**
Dependency:

- System command **Single value teach** (ISDU 2, value 65)

## 7.5 Teach-in / detection settings for WLG devices

*Table 36: Teach-in/Detection – Standard command*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 2 | 2 | - | Standard command | UInt | - | 1 byte | wo | - | 65 = Single value teach |

For WLG devices, a teach-in process must be performed after connecting the sensor and aligning it to the reflector. This automatically adjusts the sensor’s receiver sensitivity, taking into account the current light receiver level, so that the detection signal is as reliable as possible, even for highly transparent objects.
In addition, with every teach-in, the current light receiver level of the sensor, the **Current receiver level (live)** (ISDU 180), is standardized at 100%. These 100% levels are the energy-based reference values for the following device functions:

- **Qint.1 SP1** / **SP2** (ISDU 60) or **Qint.2 SP1** / **SP2** (ISDU 62)
- **Quality of teach** (ISDU 114)
- **Quality of run** (ISDU 175)
- **Upper threshold (switch-on) dynamic** (ISDU 181); effective detector-related switch-on and switch-off thresholds
- **Lower threshold (switch-off) dynamic** (ISDU 182); effective detector-related switch-on and switch-off thresholds

The teach-in process must be repeated each time the sensor or reflector is realigned or whenever the sensor or reflector is replaced in order to guarantee that the energy-related reference signal is always up-to-date, e.g., for assessing contamination on the sensor’s front screen or the reflector. This also applies to the use of the data repository function (see "Data repository", page 7).

If the teach-in process is not performed, the reference value is undefined and the listed functions and parameters do not deliver any valid information.

The **Single value teach** standard command has the same effect:

- Triggering teach-in using the teach pushbutton on the sensor housing (if present).
- Triggering teach-in using the HIGH signal (L+) on pin 2 (when **Pin 2 configuration** (ISDU 12) is set to **Teach-in**).

**NOTE**
Dependency:

- **Qint.1 SP1 / SP2** (ISDU 60)
- **Qint.2 SP1 / SP2** (ISDU 62)
- **Quality of run** (ISDU 175)
- **Quality of run alarm** (ISDU 176)
- **Current receiver level (live)** (ISDU 180)
- **Upper threshold (switch-on) dynamic** (ISDU 181)
- **Lower threshold (switch-off) dynamic** (ISDU 182)

*Table 37: Teach-in/Detection – Teach-in channel/Teach state*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 58 | 3A | - | Teach-in channel | UInt | - | 1 byte | rw | 0 | 0 to 2 = Default BDC |
| 59 | 3B | - | Teach-in state | Record | - | 1 byte | ro | - | |
| | | | Teach flags | | | 1 bit<br>(offset 4 bit) | | | 0 = Teachpoint 1 not taught<br>1 = Teachpoint 1 successfully taught |
| | | | Teach state | | | 4 bit<br>(offset 0 bit) | | | 0 = IDLE<br>1 = SP1 SUCCESS<br>5 = BUSY<br>7 = ERROR |

Selection of the Qint. channel that is affected by the **Single value teach** (ISDU 2, value 65) system command.
Only one teach-in channel is available for the teach-in process for WLG devices. Only the preset teach-in channel can be used.

The **Teach state** shows the current status of the teach-in process. A teach-in process can only be performed when the status is **IDLE**, **SP1 SUCCESS**, and **ERROR**.
The status always refers to the Qint. channel currently selected via the **Teach-in channel** (ISDU 58).
The **Teach flags** do not have a function for WLG devices.

*Table 38: Teach-in / detection – Qint.1*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 60 | 3C | 0 | Qint.1 SP1 / SP2 | Record | yes | 2 byte | rw | - | |
| | | 1 | SP1 upper threshold (switch-on) | | | 8 bit<br>(Offset 8 bit) | | 90 | 10 to 90<br>110 to 200 |
| | | 2 | SP2 lower threshold (switch-off) | | | 8 bit<br>(Offset 0 bit) | | 85 | 5 to 85<br>105 to 195 |
| 61 | 3D | 0 | Qint.1 configuration | Record | | 4 byte | | - | |
| | | 1 | Switchpoint logic | | | 8 bit<br>(Offset 24 bit) | | 128 | 128 = Vendor specific |
| | | 2 | Switchpoint mode | | | 8 bit<br>(Offset 16 bit) | | | |
| | | 3 | Switchpoint hysteresis | | | 16 bit<br>(Offset 0 bit) | | 0 | 0 = Auto-defined hysteresis |

*Table 39: Teach-in / detection – Qint.2*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 62 | 3E | 0 | Qint.2 SP1 / SP2 | Record | | 2 byte | | - | |
| | | 1 | SP1 upper threshold (switch-on) | | | 8 bits<br>(Offset 8 bit) | | 90 | 10 to 90<br>110 to 200 |
| | | 2 | SP2 lower threshold (switch-off) | | | 8 bit<br>(Offset 0 bit) | | 85 | 5 to 85<br>105 to 195 |
| 63 | 3F | 0 | Qint.2 configuration | Record | yes | 4 byte | rw | - | |
| | | 1 | Switchpoint logic | | | 8 bit<br>(Offset 24 bit) | | 128 | 128 = Vendor specific |
| | | 2 | Switchpoint mode | | | 8 bit<br>(Offset 16 bit) | | | |
| | | 3 | Switchpoint hysteresis | | | 16 bit<br>(Offset 0 bit) | | 0 | 0 = Auto-defined hysteresis |

**Qint.1 / Qint.2 SP1 / SP2** is used to define the switch-on and switch-off threshold for the detection signal (as percentages). The selected values are based on the energy-based receiver value (=100%) defined during the last teach-in process.

**SP1 upper threshold (switch-on):** Switch-on threshold.
If the **Current receiver level (live)** (ISDU 180) exceeds the selected switch-on threshold or the dynamic switch-on threshold (see **AutoAdapt**, ISDU 112), the **Qint.1** detection signal changes to LOW (no object detected in beam path).

**SP2 lower threshold (switch-off):** Switch-off threshold.
If the Current receiver level (live) (ISDU 180) falls below the selected switch-off threshold or the dynamic switch-off threshold (see **AutoAdapt**, ISDU 112), the **Qint.1** detection signal changes to HIGH (object detected in beam path).

The switch-on threshold must always be higher than the switch-off threshold.
The minimum distance between the switch-on and switch-off threshold is 5% (= hysteresis).
Both switching thresholds must always be both below 100% or above 100%.

Depending on the mode selected under **Detection mode** (ISDU 83), the switch-on and switch-off thresholds are automatically adjusted.

**Qint.1 SP1 / SP2** (ISDU 60) and **Qint.2 SP1 / SP2** (ISDU 62) are always synchronous.
Any changes made to one of the ISDUs are accepted by the other ISDU.

**NOTE**
Dependency:

- **Qint.1 SP1 / SP2** (ISDU 60)
- **Qint.2 SP1 / SP2** (ISDU 62)
- **Current receiver level (live)** (ISDU 180)

**Switchpoint logic** has no function.
**Switchpoint mode** has no function.
**Switchpoint hysteresis** has no function.

*Table 40: Teach-in / detection – Detection mode*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 83 | 53 | - | Detection mode | UInt | yes | 1 byte | rw | 0 | **Value / Range set 1:**<br>0 = Highly-transparent objects<br>1 = Semi-transparent objects<br>2 = Opaque objects<br>3 = Bottles / trays<br>4 = Foil tear<br>255 = Manual<br>**Value / Range set 2:**<br>0 = Transparent object mode<br>1 = Transparent film mode<br>2 = Non-transparent mode<br>3 = Manual mode |

**Value / Range set 1** or **Value / Range set 2** is implemented depending on the device type.

**Detection modes** can be used to select how the sensor detects pre-defined object types.
The following factors change depending on the settings:

- The switch-on and switch-off thresholds **Qint.1 SP1 / SP2** (ISDU 60) and **Qint.2 SP1 / SP2** (ISDU 62).
- The settings for **AutoAdapt / Continuous threshold adaption** (ISDU 112) according to the table below.

*Table 41: Thresholds*

| | Switch-on threshold | Switch-off threshold | AutoAdapt / Continuous threshold adaption |
|---|---|---|---|
| Highly-transparent objects | 90% | 85% | On – time based |
| Semi-transparent objects | 82% | 77% | On – time based |
| Opaque objects | 50% | 45% | On – time based |
| Bottles / trays | 90% | 50% | On – time based |
| Foil tear | 110% | 105% | On – time based |
| Transparent object mode | 90% | 85% | On – time based |
| Transparent film mode | 110% | 105% | On – time based |
| Non-transparent mode | 50% | 45% | Off |
| Manual | As before | As before | As before |

Manual mode is activated as soon as the user manually accesses **Qint.1 SP1 / SP2** (ISDU 60), **Qint.2 SP1 / SP2** (ISDU 62), or **AutoAdapt / Continuous threshold adaption** (ISDU 112). Switching to manual mode itself does not change any of the remaining parameters.

**NOTE**
Dependency:

- **Qint.1 SP1 / SP2** (ISDU 60) or **Qint.2 SP1 / SP2** (ISDU 62); nominal detector-related switch-on and switch-off thresholds
- **AutoAdapt / Continuous threshold adaption** (ISDU 112)
- **Threshold presetting** (ISDU 113)

*Table 42: Teach-in / detection – AutoAdapt*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 112 | 70 | - | AutoAdapt / Continuous threshold adaption | UInt | yes | 1 byte | rw | 0 | 0 = Off<br>1 = On – time based<br>2 = On – event based |

**AutoAdapt** or **Continuous threshold adaption** causes the detector-related switch-on and switch-off thresholds to be automatically adjusted when the sensor detects gradual contamination of the sensor's front screen or the reflector.
As a result, object detection remains stable and secure for longer, even for highly transparent objects. In addition, cleaning cycles can be extended.

**NOTE**
The automated adjustment of switch-on and switch-off thresholds using **AutoAdapt** affects the dynamic switch-on and switch-off thresholds **Upper threshold (switch-on) dynamic** (ISDU 181) and **Lower threshold (switch-off) dynamic** (ISDU 182).
The adjustable switch-on and switch-off thresholds **Qint.1 SP1 / SP2** (ISDU 60) and **Qint.2 SP1 / SP2** (ISDU 62) remain unaffected.
If the **AutoAdapt** function causes the switch-on and switch thresholds under **Qint.1 / Qint.2** to deviate from the dynamic switch-on and switch-off thresholds, the dynamic values are always used to evaluate object detection.

**Off** — **AutoAdapt** is deactivated.

**On – time based** — When this setting is used, the dynamic switching thresholds are adjusted as soon as the sensor detects that its front screen or reflector is contaminated. This setting is recommended as the default setting.

**On – event based** When this setting is used, the dynamic switching thresholds are adjusted incrementally with each object detection (= event) when the sensor front screen or the reflector is contaminated.

**NOTE**
Dependency:

- **Detection mode** (ISDU 83)
- **Upper threshold (switch-on) dynamic** (ISDU 181)
- **Lower threshold (switch-off) dynamic** (ISDU 182)

*Table 43: Teach-in / Threshold presetting*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 113 | 71 | - | Threshold presetting | UInt | yes | 1 byte | rw | 0 | 0 = 10% (Transparent mode)<br>1 = 18% (Transparent mode)<br>2 = 40% (Transparent mode)<br>3 = Non-transparent mode<br>4 = Manual mode |

For the **Detection modes Transparent object mode** and **Transparent foil mode** (ISDU 83), the **Threshold presetting** function can be used to determine the signal attenuation level at which object detection should be triggered. The highest sensitivity setting is 10% and the lowest is 40%.

If the detection mode **Non-transparent objects** is selected, the **Threshold presetting** automatically jumps to **Non-transparent** mode. If the switch-on and switch-off thresholds are manually adjusted using **Qint.1 SP1 / SP2** (ISDU 60 or 62), **Threshold presetting** jumps to manual mode.

**NOTICE**
Changes to **Threshold presetting** can cause the **Detection mode** (ISDU 83) to change.

**NOTE**
This function is not available in all WLG devices.

**NOTE**
Dependency:

- **Detection mode** (ISDU 83)
- **Upper threshold (switch-on) dynamic** (ISDU 181)
- **Lower threshold (switch-off) dynamic** (ISDU 182)
- **Qint.1 SP1 / SP2** (ISDU 60)
- **Qint.2 SP1 / SP2** (ISDU 62)

*Table 44: Teach-in/Detection – Current receiver level*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 180 | B4 | - | Current receiver level (live) | UInt | - | 1 byte | ro | - | 0 ... 255 |

**Current receiver level (live)** shows the sensor's current energy-related receiver level (as a percentage). The reference point (equivalent to 100%) is the light receiver level at the time of the last teach-in.
For further details, see the **Single value teach** standard command (ISDU 2, value 65).

**NOTE**
Dependency:

- System command **Single value teach** (ISDU 2, value 65)

*Table 45: Teach-in/Detection – Threshold*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 181 | B5 | - | Upper threshold (switch-on) dynamic | UInt | - | 1 byte | ro | 0 | 0 ... 255 |
| 182 | B6 | - | Lower threshold (switch-off) dynamic | UInt | - | 1 byte | ro | 0 | 0 ... 255 |

The automated adjustment of switch-on and switch-off thresholds (as percentages) using **AutoAdapt/Continuous threshold adaption** (ISDU 112) affects the dynamic switch-on and switch-off thresholds **Upper threshold (switch-on) dynamic** (ISDU 181) and **Lower threshold (switch-off) dynamic** (ISDU 182).
The switch-on and switch-off thresholds that can be adjusted by the operator **Qint.1 SP1 / SP2** (ISDU 60) and **Qint.2 SP1 / SP2** (ISDU 62) remain unaffected.

If the **AutoAdapt** function causes the switch-on and switch thresholds under **Qint.1 / Qint.2** to deviate from the dynamic switch-on and switch-off thresholds, the dynamic values are always used to evaluate object detection.

**NOTE**
Dependency:

- **AutoAdapt** (ISDU 112)

## 7.6 Teach-in / detection settings for WE / WEO devices

*Table 46: Teach-in/Detection – Standard command*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 2 | 2 | - | Standard command | UInt | - | 1 byte | wo | - | 65 = Single value teach |

After connecting the sender and receiver devices and aligning them with one another, a teach-in process must be triggered to be able to use the functions described below to their full extent.
With every teach-in process, the sensor's current light receiver level is standardized at 100%. These 100% levels are the energy-based reference values for the following device functions:

- **Quality of teach** (ISDU 114)
- **Quality of run** (ISDU 175)

The teach-in process should be repeated each time the sender or receiver is realigned or whenever the sender or receiver is replaced in order to guarantee that the energy-related reference signal is always up-to-date, e.g., for assessing contamination on the sender's or receiver's front screen.

For WE/WEO devices, the teach-in process automatically adjusts the sensor's receiver sensitivity, taking into account the current light receiver level, so that the detection signal is as reliable as possible.

To achieve the same effect as the "Single value teach" standard command, you can trigger teach-in using the teach-in pushbutton on the sensor housing (if present) or trigger teach-in via the HIGH signal (L+) at pin 2 (when **Pin 2 configuration** (ISDU 121) is set to Teach-in ), if present.

**NOTE**
Dependency:

- **Quality of run** or **Operating reserve** (ISDU 175)

*Table 47: Teach-in/Detection – Teach-in channel/Teach state*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 58 | 3A | - | Teach-in channel | UInt | - | 1 byte | rw | 0 | 0 to 2 = Default BDC |

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 59 | 3B | - | Teach-in state | Record | - | 1 byte | ro | - | |
| | | | Teach flags | | | 1 bit<br>(offset 4 bit) | | | 0 = Teachpoint 1 not taught<br>1 = Teachpoint 1 successfully taught |
| | | | Teach state | | | 4 bit<br>(offset 0 bit) | | | 0 = IDLE<br>1 = SP1 SUCCESS<br>5 = BUSY<br>7 = ERROR |

Selection of the Qint. channel that is affected by the **Single value teach** (ISDU 2, value 65) system command.
Only one teach-in channel is available for the teach-in process for WE/WEO devices. Only the preset teach-in channel can be used.

The **Teach state** shows the current status of the teach-in process.
A teach-in process can only be performed when the status is **IDLE**, **SP1 SUCCESS**, and **ERROR**.
The status always refers to the Qint. channel selected in **Teach-in channel** (ISDU 58).
The **Teach flags** do not have a function for WE/WEO devices.

*Table 48: Teach-in / detection – Qint.1*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 60 | 3C | 0 | Qint.1 SP1 / SP2 | Record | yes | 2 bytes | rw | - | |
| | | 1 | SP1 upper threshold (switch-on) | | | 8 bits<br>(Offset 8 bits) | | 0 | 0 |
| | | 2 | SP2 lower threshold (switch-off) | | | 8 bits<br>(Offset 0 bits) | | 0 | 0 |
| 61 | 3D | 0 | Qint.1 configuration | Record | | 4 bytes | | - | |
| | | 1 | Switchpoint logic | | | 8 bits<br>(Offset 24 bits) | | 128 | 128 = Vendor specific |
| | | 2 | Switchpoint mode | | | 8 bits<br>(Offset 16 bits) | | | |
| | | 3 | Switchpoint hysteresis | | | 16 bits<br>(Offset 0 bits) | | 0 | 0 = Auto-defined hysteresis |

**SP1 upper threshold (switch-on)** has no function.
**SP2 lower threshold (switch-off)** has no function.
**Switchpoint logic** has no function.
**Switchpoint mode** has no function.
**Switchpoint hysteresis** has no function.

*Table 49: Teach-in / detection – Qint.2*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 62 | 3E | 0 | Qint.2 SP1 / SP2 | Record | yes | 2 byte | rw | - | |
| | | 1 | SP1 upper threshold (switch-on) | | | 8 bit<br>(Offset 8 bit) | | 0 | 0 |
| | | 2 | SP2 lower threshold (switch-off) | | | 8 bit<br>(Offset 0 bit) | | 0 | 0 |
| 63 | 3F | 0 | Qint.2 configuration | Record | | 4 byte | | - | |
| | | 1 | Switchpoint logic | | | 8 bit<br>(Offset 24 bit) | | 128 | 128 = Vendor specific |
| | | 2 | Switchpoint mode | | | 8 bit<br>(Offset 16 bit) | | | |
| | | 3 | Switchpoint hysteresis | | | 16 bit<br>(Offset 0 bit) | | 0 | 0 = Auto-defined hysteresis |

**SP1 upper threshold (switch-on)** has no function.
**SP2 lower threshold (switch-off)** has no function.
**Switchpoint logic** has no function.
**Switchpoint mode** has no function.
**Switchpoint hysteresis** has no function.

## 7.7 Teach-in/Detection settings for WTT devices

*Table 50: Teach-in/Detection – Teach command*

| ISDU Index DEC | ISDU Index HEX | Sub-index | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 02 | - | Standard command | UInt | - | 1 byte | wo | | 65 = Single Value Teach SP1<br>66 = Single Value Teach SP2 |

After the teach-in command has been triggered, the current distance between the sensor and the object in the light beam is set as the sensing range. Depending on the selected **Teach-in channel** (ISDU 58), the **Qint.x SP1 sensing range** or **Qint.x SP2 sensing range** (ISDU 60, 62, 16384, 16386, 16388, 16390, 16392 oder 16394) change accordingly.

**NOTE**
Dependency:

- **Teach-in channel** (ISDU 58)
- **Qint.x SP1 sensing range** or **Qint.x SP2 sensing range** (ISDU 60, 62, 16384, 16386, 16388, 16390, 16392 oder 16394)

*Table 51: Teach-in/Detection – Teach-in channel/Teach state*

| ISDU Index DEC | ISDU Index HEX | Sub-index | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| 58 | 3A | - | Teach-in channel | UInt | - | 1 byte | rw | 0 | 0 = Default Qint = Qint.1<br>1 = Qint.1<br>2 = Qint.2<br>3 = Qint.3<br>4 = Qint.4<br>5 = Qint.5<br>6 = Qint.6<br>7 = Qint.7<br>8 = Qint.8 |
| 59 | 3B | 0 | Teach-in state | Record | - | 1 byte | ro | - | |
| | | 1 | Teach flag SP2 | | | 1 bit (offset: 6 bits) | | | 0 = Teachpoint not taught<br>1 = Teachpoint successfully taught |
| | | 2 | Teach flag SP1 | | | 1 bit (offset 4 bit) | | | 0 = Teachpoint not taught<br>1 = Teachpoint successfully taught |
| | | 3 | Teach state | | | 4 bit (offset 0 bit) | | | 0 = IDLE<br>1 = SP1 SUCCESS<br>2 = SP2 SUCCESS<br>5 = Busy<br>7 = ERROR |

Selection of the Qint. channel that is affected by the **Single value teach SP1** / **SP2** system command (ISDU 2, value 65 or 66).

The **Teach state** shows the current status of the teach-in process.
A teach-in process can only be performed when the status is **IDLE**, **SP1 SUCCESS**, **SP2 SUCCESS** and **ERROR**.
The status always refers to the Qint. channel selected in **Teach-in channel** (ISDU 58). The **Teach flags** have no function for WTT devices.

*Table 52: Teach-in/Detection - Qint.1 ... Qint.8*

| ISDU Index DEC | ISDU Index HEX | Sub-index | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| 60 | 3C | 0 | Qint.1 SP1 / SP2 | Record | yes | 4 bytes | rw | - | |
| | | 1 | Qint.1 SP1 sensing range | UInt | | 16 bit<br>(offset 16 bit) | | Device specific | 0 ... 65535 |
| | | 2 | Qint.1 SP2 sensing range | UInt | | 16 bit<br>(offset 0 bit) | | Device specific | 0 ... 65535 |

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 61 | 3D | 0 | Qint.1 configuration | Record | yes | 4 byte | rw | - | |
| | | 1 | Qint.1 Switchpoint logic | UInt | | 8 bit (offset 24 bit) | | 0 | 0 = not inverted |
| | | 2 | Qint.1 Switchpoint mode | UInt | | 8 bit (offset 16 bit) | | 1 | 0 = Deactivated<br>1 = Single point mode<br>2 = Window mode<br>3 = Two point mode |
| | | 3 | Qint.1 Switchpoint hysteresis | UInt | | 16 bit (offset 0 bit) | | 0 | 0 = Vendor specific default |
| 62 | 3E | 0 | Qint.2 SP1 / SP2 | Record | Yes | 4 byte | rw | - | |
| | | 1 | Qint.2 SP1 sensing range | UInt | | 16 bit (offset 16 bit) | | Device specific | 0 ... 65535 |
| | | 2 | Qint.2 SP2 sensing range | UInt | | 16 bit (offset 0 bit) | | Device specific | 0 ... 65535 |
| 63 | 3F | 0 | Qint.2 configuration | Record | yes | 4 byte | rw | - | |
| | | 1 | Qint.2 Switchpoint logic | UInt | | 8 bit (offset 24 bit) | | 0 | 0 = not inverted |
| | | 2 | Qint.2 switchpoint mode | UInt | | 8 bit (offset 16 bit) | | 1 | 0 = Deactivated<br>1 = Single point mode<br>2 = Window mode<br>3 = Two point mode |
| | | 3 | Qint.2 switchpoint hysteresis | UInt | | 16 bit (offset 0 bit) | | 0 | 0 = Vendor specific default |
| 16384 | 4000 | 0 | Qint.3 SP1 / SP2 | Record | yes | 4 byte | rw | - | |
| | | 1 | Qint.3 SP1 sensing range | UInt | | 16 bit (offset 16 bit) | | Device specific | 0 ... 65535 |
| | | 2 | Qint.3 SP2 sensing range | UInt | | 16 bit (offset 0 bit) | | Device specific | 0 ... 65535 |
| 16385 | 4001 | 0 | Qint.3 configuration | Record | yes | 4 byte | rw | - | |
| | | 1 | Qint.3 switchpoint mode | UInt | | 8 bit (offset 24 bit) | | 0 | 0 = not inverted |
| | | 2 | Qint.3 switchpoint mode | UInt | | 8 bit (offset 16 bit) | | 1 | 0 = Deactivated<br>1 = Single point mode<br>2 = Window mode<br>3 = Two point mode |
| | | 3 | Qint.3 switchpoint hysteresis | UInt | | 16 bit (offset 0 bit) | | 0 | 0 = Vendor specific default |
| 16386 | 4002 | 0 | Qint.4 SP1 / SP2 | Record | yes | 4Byte | rw | - | |
| | | 1 | Qint.4 SP1 sensing range | UInt | | 16 bit (offset 16 bit) | | Device specific | 0 ... 65535 |
| | | 2 | Qint.4 SP2 sensing range | UInt | | 16 bit (offset 0 bit) | | Device specific | 0 ... 65535 |
| 16387 | 4003 | 0 | Qint.4 configuration | Record | yes | 4 byte | rw | - | |
| | | 1 | Qint.4 switch point logic | UInt | | 8 bit (offset 24 bit) | | 0 | 0 = not inverted |
| | | 2 | Qint.4 switchpoint mode | UInt | | 8 bit (offset 16 bit) | | 1 | 0 = Deactivated<br>1 = Single point mode<br>2 = Window mode<br>3 = Two point mode |
| | | 3 | Qint.4 switchpoint hysteresis | UInt | | 16 bit (offset 0 bit) | | 0 | 0 = Vendor specific default |
| 16388 | 4004 | 0 | Qint.5 SP1 / SP2 | Record | yes | 4 byte | rw | - | |
| | | 1 | Qint.5 SP1 sensing range | UInt | | 16 bit (offset 16 bit) | | Device specific | 0 ... 65535 |
| | | 2 | Qint.5 SP2 sensing range | UInt | | 16 bit (offset 0 bit) | | Device specific | 0 ... 65535 |
| 16389 | 4005 | 0 | Qint.5 configuration | Record | yes | 4 byte | rw | - | |
| | | 1 | Qint.5 Switchpoint logic | UInt | | 8 bit (offset 24 bit) | | 0 | 0 = not inverted |
| | | 2 | Qint.5 switchpoint mode | UInt | | 8 bit (offset 16 bit) | | 1 | 0 = Deactivated<br>1 = Single point mode<br>2 = Window mode<br>3 = Two point mode |
| | | 3 | Qint.5 switchpoint hysteresis | UInt | | 16 bit (offset 0 bit) | | 0 | 0 = Vendor specific default |

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 16390 | 4006 | 0 | Qint.6 SP1 / SP2 | Record | yes | 4 byte | rw | - | |
| | | 1 | Qint.6 SP1 sensing range | UInt | | 16 bit (offset 16 bit) | | Device specific | 0 … 65535 |
| | | 2 | Qint.6 SP2 sensing range | UInt | | | | Device specific | 0 … 65535 |
| 16391 | 4007 | 0 | Qint.6 configuration | Record | yes | 4 byte | rw | - | |
| | | 1 | Qint.6 Switchpoint logic | UInt | | 8 bit (offset 24 bit) | | 0 | 0 = not inverted |
| | | 2 | Qint.6 switchpoint mode | UInt | | 8 bit (offset 16 bit) | | 1 | 0 = Deactivated<br>1 = Single point mode<br>2 = Window mode<br>3 = Two point mode |
| | | 3 | Qint.6 switchpoint hysteresis | UInt | | 16 bit (offset 0 bit) | | 0 | 0 = Vendor specific default |
| 16392 | 4008 | 0 | Qint.7 SP1 / SP2 | Record | yes | 4 byte | rw | - | |
| | | 1 | Qint.7 SP1 sensing range | UInt | | 16 bit (offset 16 bit) | | Device specific | 0 … 65535 |
| | | 2 | Qint.7 SP2 sensing range | UInt | | 16 bit (offset 0 bit) | | Device specific | 0 … 65535 |
| 16393 | 4009 | 0 | Qint.7 configuration | Record | yes | 4 byte | rw | - | |
| | | 1 | Qint.7 Switchpoint logic | UInt | | 8 bit (offset 24 bit) | | 0 | 0 = not inverted |
| | | 2 | Qint.7 switchpoint mode | UInt | | 8 bit (offset 16 bit) | | 1 | 0 = Deactivated<br>1 = Single point mode<br>2 = Window mode<br>3 = Two point mode |
| | | 3 | Qint.7 switchpoint hysteresis | UInt | | 16 bit (offset 0 bit) | | 0 | 0 = Vendor specific default |
| 16394 | 400A | 0 | Qint.8 SP1 / SP2 | Record | yes | 4 byte | rw | - | |
| | | 1 | Qint.8 SP1 sensing range | UInt | | 16 bit (offset 16 bit) | | Device specific | 0 … 65535 |
| | | 2 | Qint.8 SP2 sensing range | UInt | | | | Device specific | 0 … 65535 |
| 16395 | 400B | 0 | Qint.8 configuration | Record | yes | 4 byte | rw | - | |
| | | 1 | Qint.8 switch point logic | UInt | | 8 bit (offset 24 bit) | | 0 | 0 = not inverted |
| | | 2 | Qint.8 switchpoint mode | UInt | | 8 bit (offset 16 bit) | | 1 | 0 = Deactivated<br>1 = Single point mode<br>2 = Window mode<br>3 = Two point mode |
| | | 3 | Qint.8 switchpoint hysteresis | UInt | | 16 bit (offset 0 bit) | | 0 | 0 = Vendor specific default |

**Qint.x SP1 sensing range** or **Qint.x SP2 sensing range** can be used to adjust the sensing range of the individual detection channels of the sensor (in mm). The value range is restricted by the sensor's "max. sensing range" (see sensor data sheet for "max. sensing range").

**Qint.x Switchpoint logic** and **Qint.x Switchpoint hysteresis** are fixed parameters and cannot be changed.

**Qint.x Switchpoint mode** adjustments:

Deactivated = No function. The binary output state of Qint.x is set to "0", regardless of the current detection status.

Single point mode = The output state of Qint.x switches to "1" if the currently measured distance value between the sensor and object/background is less than or equal to the value set under **Qint.x SP1 sensing range.**

Window mode = The output state of Qint.x switches to "1" If the currently measured distance value between the sensor and object / background is between the set values of **Qint.x SP1 sensing range** and **Qint.x SP2 sensing range.**

Two point mode = If the distance measurement value is falling, the output state of Qint.x switches to "1" if the distance value between the sensor and object/background is less than or equal to the value set under **Qint.x SP2 sensing range.**

If the distance measurement value is rising, the output state of Qint.x switches to "0" if the currently measured distance value between the sensor and object/background is greater than or equal to the value set under **Qint.x SP1 sensing range.**

*Table 53: Teach-in/Detection - Measurement averaging*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 89 | 59 | - | Measurement averaging | UInt | yes | 1 byte | rw | 0 | 0 = 1<br>1 = 2<br>2 = 4<br>3 = 8<br>4 = 16<br>5 = 32<br>6 = 64<br>7 = 128<br>8 = 256<br>9 = 512 |

The **Measurement averaging** function results in a smoothing of the distance measurement value output in the process data and under **Distance to object** (ISDU 229). A moving average filter is generated from a certain number of measured values. The number of measured values used for the **Measurement averaging** is set under this ISDU.

*Table 54: Teach-in/Detection – Teach-in offset*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| Dec | Hex | | | | | | | | |
| 90 | 5A | - | Teach-in offset | Int | yes | 2 byte | rw | 0 | -200 ... +200 |

When this function is in use, when triggering a teach-in command (via the teach-in button on the sensor housing or via the **Single value teach SP1** / **SP2** system command (ISDU 2, value 65)), the detected detection point is corrected by the set value.

This function makes it possible to increase detection reliability, especially for teach-in ongoing processes, by moving the detection point with the **Teach-in offset** e.g. “into the object”.

**NOTE**

Dependency:

**Single value teach SP1** / **SP2** system command (ISDU 2, value 65/66)

**NOTE**

The **Teach-in offset** does not work if a sensing range is set directly via **Qint.x SP1** / **SP2** (ISDU 60/62/16384/16386/16388/16390/16390/16392/16394).

*Table 55: Teach-in/Detection - Distance to object*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 229 | E5 | 0 | Distance to object | Record | - | 3 byte | ro | - | |
| | | 1 | Distance | UInt | | 16 bit (offset 8) | | | 0 ... 30000 |
| | | 2 | Distance qualifier | UInt | | 2 bit (offset 0) | | | 0 = Distance in range/valid<br>3 = No distance information/distance invalid |

This parameter can be used to output the measured distance to the object or the background (if available and in sensing range) as a **Distance** in mm or 1/10 mm (depending on the device – see IODD of the respective device for details). If no measured value can be detected (e.g. because the sensor is facing empty space) or if the measured value is outside of the specified sensing range, the sensor delivers output value “30,000”, which is to be interpreted as an invalid measurement.

Each measured value must be linked with the **Distance qualifier.** This value specifies whether the current output measured value is valid or not.

**NOTE**

Separate access to sub-index 1 or 2 is not possible.

## 7.8 Installation / Diagnostics

*Table 56: Teach-in/Detection – Standard command*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 2 | 02 | - | Standard command | UInt | - | 1 byte | wo | - | 228 = Reset diagnostic parameter |

The **Reset diagnostic parameter** system command sets all resettable diagnostic parameters in the device back to the original value or zero.

**NOTE**
Dependency:

- **Operating hours since last reset** (ISDU 190, sub-index 2)

*Table 57: Installation/diagnostics – Device status*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 36 | 24 | - | Device Status | UInt | - | 8 bits | ro | - | 0 = Device is OK<br>1 = Maintenance required<br>2 = Out of specification<br>3 = Functional check<br>4 = Failure<br>5 to 255 = Reserved |

*Table 58: Installation / Diagnostics – Quality of teach*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 114 | 72 | - | Quality of teach | UInt | - | 1 byte | ro | - | 0 to 100% |

*Table 59: Installation/Diagnostics – Quality of teach*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 114 | 72 | - | Quality of teach | UInt | - | 1 byte | ro | - | 0 ... 100 % |
| | | 0 | Quality of teach | RecordT | | [sum of subindices] | | | 0 ... 100 % |
| | | 1 | Quality of teach Qint.1 SP1 | UIntegerT | | 8 bit (offset: see IODD) | | | 0 ... 100 % |
| | | 2 | Quality of teach Qint.1 SP2 | UIntegerT | | 8 bit (offset: see IODD) | | | 0 ... 100 % |
| | | 3 | Quality of teach Qint.2 SP1 | UIntegerT | | 8 bit (offset: see IODD) | | | 0 ... 100 % |
| | | 4 | Quality of teach Qint.2 SP2 | UIntegerT | | 8 bit (offset: see IODD) | | | 0 ... 100 % |
| | | 5 | Quality of teach Qint.3 SP1 | UIntegerT | | 8 bit (offset: see IODD) | | | 0 ... 100 % |
| | | 6 | Quality of teach Qint.3 SP2 | UIntegerT | | 8 bit (offset: see IODD) | | | 0 ... 100 % |
| | | | ... | ... | | | | | 0 ... 100 % |
| | | x | Quality of teach Qint.n SP1 | UIntegerT | | 8 bit (offset: see IODD) | | | 0 ... 100 % |
| | | x+1 | Quality of teach Qint.n SP2 | UIntegerT | | 8 bit (offset: see IODD) | | | 0 ... 100 % |

**Quality of teach** provides feedback regarding the quality of the last teach-in process performed. The **Quality of teach** value is updated after each teach-in process.

For devices with several active setpoints, one **Quality of teach** value is output per setpoint. The number of sub-indices, the data length as well as the offset of the individual sub-indices are device specific and can be taken from the respective IODD.

*Table 60: Definition of Quality of teach for WTB, WTS, and WTL devices*

| | | | | | | |
|---|---|---|---|---|---|---|
| Min. sensing range | ≤ | Taught-in sensing range | ≤ | Max. sensing range on black [1] | ➜ | Quality of teach = 100% |

| | | | | | | |
|---|---|---|---|---|---|---|
| Max. sensing range on black [1] | < | Taught-in sensing range | ≤ | Max. sensing range on white [2] | ➜ | Quality of teach = 100 to 10% |
| | | | | Teach error | ➜ | Quality of teach = 0% |

1) 6% remission
2) 90% remission

*Table 61: Definition of Quality of teach for WL, WLA, WLG, WE, and WEO devices with teach-in*

| | | |
|---|---|---|
| Operating reserve after teach-in ≥ 3.75 | ➜ | Quality of teach = 100% |
| 3.75 > Operating reserve after teach-in > 1.0 | ➜ | Quality of teach = 99% to 1% |
| Operating reserve after teach-in ≤ 1.0 | ➜ | Quality of teach = 0% |

**NOTE**
Dependency:

- Standard command **Single value teach** (ISDU 2, value 65)

*Table 62: Installation/Diagnostics – Temperature*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 153 | 99 | 0 | Temperature | Record | - | 5 byte | ro | | |
| | | 1 | Current temperature | | | 8 bit (offset 32 bit) | | | -127 ... 127 °C |
| | | 2 | Max. temperature all time | | | 8 bit (offset 24 bit) | | | -127 ... 127 °C |
| | | 3 | Min. temperature all time | | | 8 bit (offset 16 bit) | | | -127 ... 127 °C |
| | | 4 | Max. temperature since last reset | | | 8 bit (offset 8 bit) | | | -127 ... 127 °C |
| | | 5 | Min. temperature since last reset | | | 8 bits (offset: 0 bits) | | | -127 ... 127 °C |

Read out the operating temperature of the sensor. The **Reset diagnostic parameters** (ISDU 2, value 228) standard command can be used to delete the **Max. temperature since last reset** and **Min. temperature since last reset** values.

*Table 63: Installation/Diagnostics – Temperature zone*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 154 | 9A | - | Temperature zone | UInt | yes | 1 byte | ro | - | 0 = very cold<br>1 = cold<br>2 = ideal<br>3 = warm<br>4 = above specified limit |

The **Temperature zone** parameter reports the interior device temperature.

*Table 64: Installation/Diagnostics - Remaining sender lifetime*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 155 | 9B | 0 | Remaining sender lifetime | UInt | - | 2 byte | ro | | 0 ... 5000<br>65535 |

Shows the expected number of days until the sender unit will reach the end of its life cycle (the performance specified in the data sheet can no longer be guaranteed).

65535 = calculation not possible (e.g. because history is not available).

*Table 65: Installation / Diagnostics – Quality of run*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 175 | AF | - | Quality of run | UInt | - | 1 byte | ro | - | 0 to 255% |
| | | | Function reserve | | | | | | 0 to 99% [1] |

1) Only for WE / WEO devices without teach-in

**Quality of run** provides ongoing feedback regarding the current energy-related robustness of object detection.

Whenever a teach-in command is issued, the receiver's current light receiver level is set as the reference value and the **Quality of run** value is set to 100%. The 0% threshold is automatically determined by the sensor. Should the energy at the receiver increase or decrease (e.g., due to contamination of the sensor's front screen or the reflector, or due to these elements being cleaned; excluding object detection), the **Quality of run** will change accordingly.

**Function reserve** (for WE- / WEO devices without teach-in) shows the current operating reserve of the WE / WEO device in absolute terms.
The light receiver level that reaches the limit between "Object detected" and "Object not detected" is defined as **Function reserve** = 1. If, for example, the amount of light energy received doubles, the **Function reserve** value increases to 2.

**NOTE**
Dependency:

- Standard Command **Single value teach** (ISDU 2 , value 65)

*Table 66: Installation/Diagnostics – Quality of run alarm threshold*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 176 | B0 | - | Quality of run alarm threshold | UInt | yes | 1 byte | rw | 50 | 0 ... 90% |
| | | | Function reserve alarm threshold | | | | | 4 | 0 ... 99% [1] |

1) Only for WE/WEO devices without teach-in

**Quality of run alarm threshold** or **Function reserve alarm threshold** can be used to define an alarm switching threshold for **Quality of run** or **Function reserve.**
If the value recorded falls below the alarm switching threshold, the **Quality of run alarm output** (ISDU 226, sub-index 1) is activated. If the **Quality of run** or **Function reserve** value begins to climb again, the alarm is deactivated as soon as the selected alarm switching threshold is exceeded by five percentage points (= hysteresis).
The alarm signal can also be emitted as a physical signal via pin 2 (**Pin 2 configuration** (ISDU 121)).

**NOTE**
Dependency:

- **Pin 2 configuration** (ISDU 121)
- **Quality of run alarm output** (ISDU 226 , sub-index 1)

*Table 67: Installation / Diagnostics – Quality of alignment*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 177 | B1 | - | Quality of alignment | UInt | yes | 1 byte | ro | - | 0 to 100% |

**Quality of alignment** shows the current energy level received by the sensor, regardless of the reference signal or teach-in command.
**Quality of alignment** is used to align the sensor with the reflector as accurately as possible (for WL, WLA, and WLG devices) or to align the sender with the receiver (for WE / WEO devices).
In some devices, this information is also displayed on the alignment aid display (blue LEDs on top of the sensor).

*Table 68: Installation/Diagnostics - Maintenance prediction*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 178 | B2 | 0 | Maintenance prediction | UInt | - | 2 byte | ro | | 0 ... 5000<br>65535 |

Shows the expected number of days until maintenance is required. The maintenance prediction is calculated using the long-term trend of the **Quality of run** value. Suitable maintenance measures depend on the ambient conditions; typical are, for example, readjustment of the sensor to the object or cleaning of the sensor front screen.

65535 = calculation not possible (e.g. because history is not available).

*Table 69: Installation/Diagnostics - Alarm thresholds for diagnostic parameters*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 179 | B3 | - | Alarm thresholds for diagnostic parameters | Record | yes | 9 byte | rw | | |
| | | 1 | Temperature threshold [1] | Sint | | 8 bit (offset 64 bit) | | 80 | -127 ... 127 |
| | | 2 | Remaining sender lifetime threshold [2] | UInt | | 16 bit (offset 48 bit) | | 30 | 0 ... 5000 |
| | | 3 | Maintenance prediction threshold [3] | UInt | | 16 (Offset 32 bit) | | 30 | 0 ... 5000 |
| | | 4 | Operating hours threshold [4] | UInt | | 32 (Offset 0 bit) | | 40000 | 0 ... 1000000 |

1) In relation to index 153 dec, sub-index 1 [° C]
2) In relation to index 155 dec [d]
3) In relation to index 178 dec [d]
4) In relation to index 190 dec, sub-index 2 [h]

The **Alarm threshold for diagnostic parameters** parameter provides the option of defining alarm thresholds for certain diagnostic functions which the device offers. A corresponding event is generated when these alarm thresholds are exceeded or undercut.

Future expansion to include additional sub-indices is possible.

**NOTE**
Dependency:

- **Current temperature** (ISDU 153, sub-index 1)
- **Remaining sender lifetime** (ISDU 155)
- **Maintenance prediction** (ISDU 178)
- **Operating hours since last reset** (ISDU 190, sub-index 2)

*Table 70: Installation/Diagnostics – Operating hours*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 190 | BE | 0 | Operating hours | Record | yes | 8 byte | ro | - | |
| | | 1 | Total operating hours | UInt | | 32 bit (offset 32 bit) | | | 0 ... 1000000 |
| | | 2 | Operating hours since last reset | UInt | | 32 bit (offset: 0 bits) | | | 0 ... 1000000 |

The **Total operating hours** parameter displays how many total hours (h) the device has already been in operation. This value cannot be reset.

The **Operating hours since last reset** parameter displays how many hours (h) the device has been in operation since the last reset of the diagnostic parameters. The diagnostics parameters are reset using the **Reset diagnostic parameter** standard command (ISDU 2, value 228).

**NOTE**
Dependency:

- **Reset diagnostics parameter** system command (ISDU 2, value 228)
- **Operating hours threshold** (ISDU 179)

*Table 71: Installation / Diagnostics – Quality of run alarm output*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 226 | E2 | 0 | System state | Record | - | 1 byte | ro | - | |
| | | 1 | Quality of run alarm output [1] | | | 1 bit (Offset 1 bit) | | | 0 = Alarm not active<br>1 = Alarm active |
| | | 2 | Detection output Qint. | | | 1 bit (Offset 0 bit) | | | 0 = No object detected<br>1 = Object detected |

1) Not available for WTx devices.

**System state** can be used to request certain device statuses related to the current detection signal **Qint.1** and the **Quality of run alarm output.**

Dependency on or interaction with:

- **Quality of run alarm threshold / Function reserve alarm threshold** (ISDU 176)

## 7.9 Smart Tasks

Smart Tasks process the various Smart Sensor signals for detection and measurement, linking them to binary switching signals from an external sensor if necessary. These signals can be imported via pin 2 (see Pin 2 configuration, ISDU 121). The Smart Task uses this data to generate the requisite process information – tailored to the task at hand in the plant. This saves time during data evaluation in the control, accelerates machine processes, and makes high-performance, cost-intensive additional hardware unnecessary.

- Decentralized signal analysis directly at the sensor
- Faster signal capture and processing
- Through Smart Tasks, Smart Sensors deliver the information that the plant process actually requires – no separate data preparation necessary in the control

### 7.9.1 Smart Tasks “Basic logic” (A00)

Logical principle of operation:

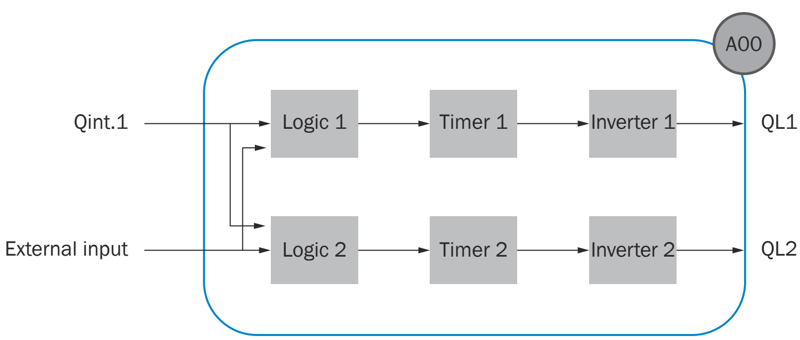


*Figure 1: Logical principle of operation A00*

*Table 72: Smart Tasks - SLTI Version*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1080 | 438 | - | SLTI Version | String | - | 8 bytes | ro | - | - |

The **SLTI version** contains the version number for the Smart Task **Basic logic.**

*Table 73: Smart Tasks – Logic*

| ISDU | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | Name | Data type | Data reposi-tory | Length | Access | Default value | Value/range |
| DEC | HEX | | | | | | | | |
| 1083 | 43B | - | Logic 1 | UInt | yes | 1 byte | rw | 0 | 0 = DIRECT<br>1 = AND<br>2 = OR<br>3 = Window Mode<br>4 = Hysteresis |
| 1084 | 43C | - | Logic 2 | | | 1 byte | | | |

The settings for **Logic 1** and **Logic 2** can be used to logically link the sensor's internal detection signal **Qint.1** to another sensor's switching signal imported via pin 2.
To do this, **Pin 2 configuration** (ISDU 121) must be set to **External input** .

| | |
|---|---|
| Direct | For **Logic 1**:<br>**Qint.1** signal is transferred without changes and without taking the external signal into account.<br>For **Logic 2**:<br>The external input signal is transferred without changes and without taking the **Qint.1** signal into account. |
| AND | Logical AND link between **Qint.1** and the external input. |
| OR | Logical OR link between **Qint.1** and the external input. |
| WINDOW MODE | See the following diagram |
| HYSTERESIS MODE | See the following diagram |

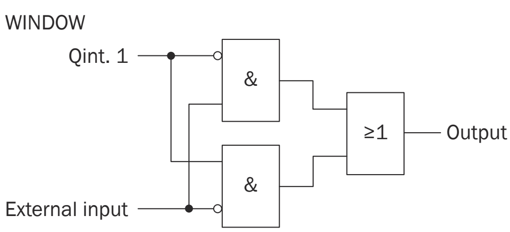


*Figure 2: Window Mode*

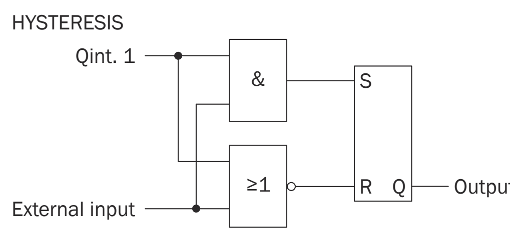


*Figure 3: Hysteresis Mode*

**NOTE**
If no physical signal is applied to the external input or if another function is selected for **Pin 2 configuration** (ISDU 121), the status of the external input is interpreted as logical 0.

**NOTE**
Dependency:

- **Pin 2 configuration** (ISDU 121)

*Table 74: Smart Tasks – Timer*

| ISDU | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | Name | Data type | Data reposi-tory | Length | Access | Default value | Value/range |
| DEC | HEX | | | | | | | | |
| 1085 | 43D | - | Timer 1 mode | UInt | yes | 1 byte | rw | 0 | 0 = Deactivated<br>1 = T-on delay<br>2 = T-off delay<br>3 = T-on/T-off<br>4 = Impulse (one shot) |
| 1086 | 43E | - | Timer 2 mode | | | 1 byte | | | |
| 1087 | 43F | - | Timer 1 setup | | | 2 bytes | | 1 | 1 to 30,000 ms |
| 1088 | 440 | - | Time 2 setup | | | 2 bytes | | | |

**Timer 1/2 mode** can be used to select various delay modes.
The relevant delay time is selected under **Time 1/2 setup.**
See the graph below for details on how the various modes work.

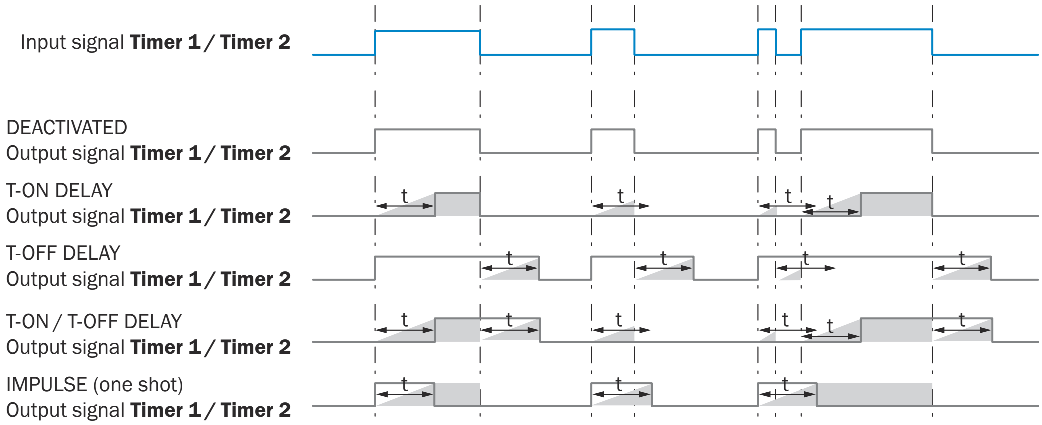


*Figure 4: Timer 1 / Timer 2*

*Table 75: Smart Tasks – Inverter*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Subindex | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1089 | 441 | - | Inverter 1 | UInt | yes | 1 byte | rw | 0 1) | 0 = Not inverted<br>1 = Inverted |
| 1090 | 442 | - | Inverter 2 | | | 1 byte | | | |

1) Presetting for WL, WLA, WLG, WE, and WEO devices: 1 = Inverted

**Inverter 1/2** inverts the logical status of the timer 1/2 output signal.

**NOTE**
Inverting the **Timer 1/2** output signal does not affect how the delay models work.
Please note that inverting the **Timer 1/2** output signal could, for example, affect a selected switch-on delay or switch-off delay.

### 7.9.2 Smart Tasks “Time measurement and debouncing” (A70)

Logical principle of operation:

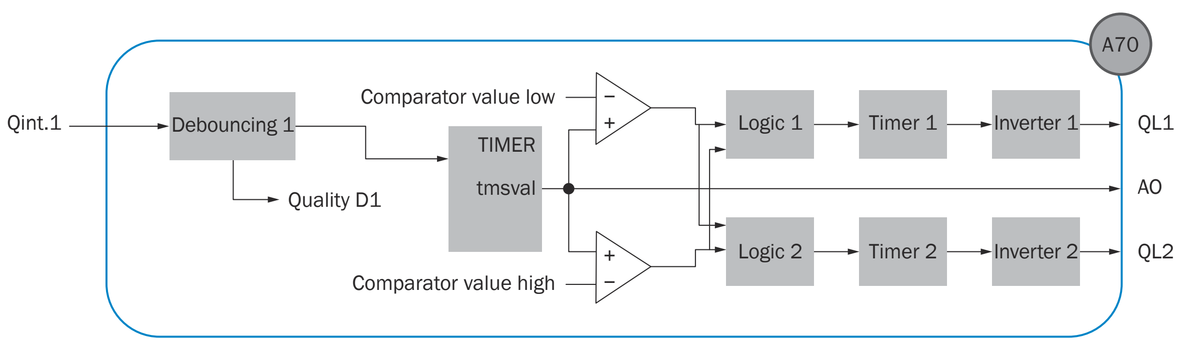


*Figure 5: Logical principle of operation A70*

*Table 76: Smart Tasks – Time measurement version*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Subindex | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1016 | 3F8 | - | Time measurement version | String | - | 8 bytes | ro | - | - |

The **SLTI version** contains the version number for the Smart Task sub-function **Time measurement.**

*Table 77: Smart Tasks – Time base*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1017 | 3F9 | - | Time base | UInt | yes | 1 byte | rw | 3 | 3= 1 ms<br>4= 10ms<br>5= 100ms |

The time value **tmsval** is a 14-bit value and can therefore assume a value between 0 and 16383 (dec).

**Time base** is a factor by which the time measurement result is multiplied. This allows longer times to be measured. The resolution and measurement accuracy decrease accordingly.

*Table 78: Smart Tasks – Measuring mode*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1018 | 3FA | - | Measuring mode | UInt | yes | 1 byte | rw | 0 | 0 = target<br>1 = gap<br>2 = target, target + gap |

**Measuring mode** determines which time measurement values are measured.

**Target** Time-length measurement of the object passing the sensor.

**Gap** Time-length measurement of the gap between two objects passing the sensor.

**Target, Target + Gap** The next time value emitted corresponds to the length of the object expressed as time. The next time value emitted then corresponds to the sum of the time-length measurement of the object and the subsequent gap to the next object.

*Table 79: Smart Tasks – Comparator value*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1019 | 3FB | - | Comparator value low | UInt | yes | 2 bytes | rw | 50 | 0 to 16383 |
| 1020 | 3FC | - | Comparator value high | | | 2 bytes | | 100 | |

1) Time in ms, 10 ms, 100 ms – depending on the Measuring mode setup, ISDU 1018 (see above)

**Comparator value low** and **Comparator value high** are two independent switching thresholds, which are related to the measured time value.
If the measured time value exceeds the selected switching threshold, a logical 1 signal is applied to the output for the comparator in question.
If the measured time value matches or is lower than the selected switching threshold, a logical 0 signal is applied to the output for the comparator in question.
These signals are transferred to the Logic 1 or Logic 2 module.

*Table 80: Smart Tasks – Debounce Version*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1032 | 408 | - | Debounce version | String | - | 8 bytes | ro | - | |

**Debounce version** contains the version number for the Smart Task sub-function **Debouncing**.

*Table 81: Smart Tasks – Debouncing*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1033 | 409 | - | Debounce time 1 | UInt | yes | 2 bytes | rw | 0 | 0 to 30,000 ms |
| 1034 | 40A | - | Quality D1 | | - | 2 bytes | ro | - | 0 to 100% |

**Debounce time 1** can be used to suppress (debounce) short, interfering signals at the Smart Task's input. The selected debounce time has the same effect as a switch-on or switch-off delay.
The measured time value **tmsval** is not affected when debouncing is active. **Quality D1** indicates the extent to which active debouncing is used. The higher the value, the more level changes that took place within the selected **Debounce time 1**.

Explanations for ISDUs 1080, 1083, 1084, 1085, 1086, 1087, 1088, 1089, 1090: see "Smart Tasks “Basic logic” (A00)", page 36.

### 7.9.3 Smart Tasks “Counter and debouncing” (A71)

Logical principle of operation:

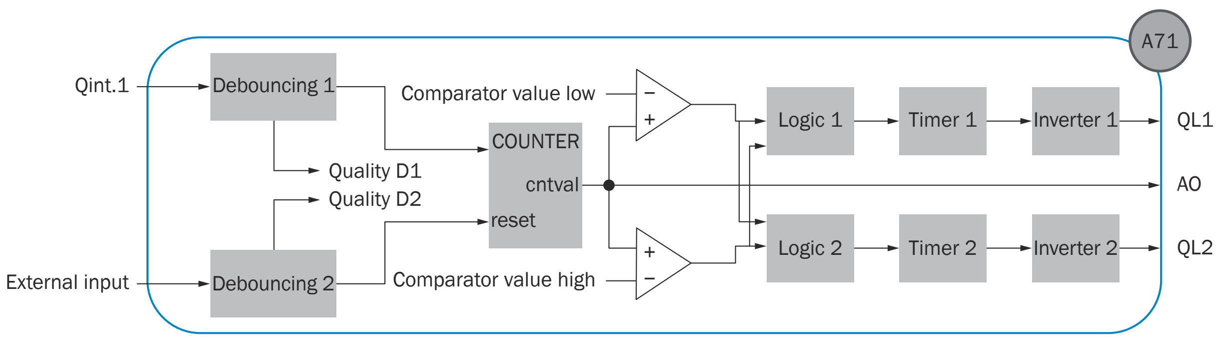


*Figure 6: Logical principle of operation A71*

*Table 82: Smart Tasks – Standard command*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 2 | 2 | - | Standard command | UInt | - | 1 byte | wo | - | 192 = Reset counter<br>193 = Preset counter |

**Reset counter** resets the counter value **cntval** to 0.
The counter value can also be reset to 0 using a HIGH signal at the Smart Task's external input. To do so, the **Pin 2 configuration** (ISDU 121) must be set to **External input**.
The **Preset counter** standard command is used to set the current **cntval** counter value to the set **Preset value** (ISDU 1003).

**NOTE**
Dependency:

- **Pin 2 configuration** (ISDU 121)
- **Preset value** (ISDU 1003)

*Table 83: Smart Tasks – Counter Version*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1000 | 3E8 | - | Counter version | String | - | 8 bytes | ro | - | - |

**Counter version** contains the version number for the Smart Task sub-function **Counter**.

*Table 84: Smart Tasks – Counter mode*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1001 | 3E9 | - | Counter mode | UInt | yes | 1 byte | ro | 0 | 0 = Up<br>1 = Down |

**Counter mode** defines whether the counter value **cntval** is increased or decreased by an interval of one with each rising signal edge from the **Debouncing 1 module.**
The counter value **cntval** is a 14-bit value and can therefore assume a value between 0 and 16383 (dec). Time pulses beyond these thresholds are ignored.

*Table 85: Smart Tasks – Preset*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1002 | 3EA | - | Preset mode | UInt | yes | 1 byte | rw | 0 | 0 = Preset internal disabled<br>1 = Preset internal enabled |
| 1003 | 3EB | - | Preset value | | | 2 bytes | | | 0 to 16383 |

If **Preset mode** is activated, the counter value **cntval** is set to the **Preset value** (ISDU 1003) if either the current counter value **cntval** exceeds the **Comparator value high** (ISDU 1005) or if the standard command **Preset counter** (ISDU 2, value 193) is issued.
**Preset mode** is activated, for example, if the counter value **cntval** should be automatically reset to a predefined value **Preset value** (ISDU 1003) (normally “1”) when a certain counter value is reached. This allows the Smart Task to be used as a buffer.

**NOTE**
Dependency:

- **Preset value** (ISDU 1003)
- **Comparator value high** (ISDU 1005)
- **Standard command Preset counter** (ISDU 2, value 193)

*Table 86: Smart Tasks – Comparator value*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1004 | 3EC | - | Comparator value low | UInt | yes | 2 bytes | rw | 50 | 0 to 16383 |
| 1005 | 3ED | - | Comparator value high | | | 2 bytes | | 100 | |

**Comparator value low** and **Comparator value high** are two independent switching thresholds, which are related to the counter value.
If the counter value exceeds the selected switching threshold, a logical 1 signal is applied to the output for the comparator in question.
If the counter value matches or is lower than the selected switching threshold, a logical 0 signal is applied to the output for the comparator in question.
These signals are transferred to the **Logic 1** or **Logic 2** module.

**NOTE**
Dependency:

- **Preset mode** (ISDU 1002)
- **Preset value** (ISDU 1003)

*Table 87: Smart Tasks – Debounce Version*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1032 | 408 | - | Debounce version | String | - | 8 bytes | ro | - | |

The **Debounce version** contains the version number for the Smart Task sub-function **Debouncing**.

*Table 88: Smart Tasks – Debouncing*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1033 | 409 | - | Debounce time 1 | UInt | yes | 2 bytes | rw | 0 | 0 to 30,000 ms |
| 1034 | 40A | | Quality D1 | | - | | ro | - | 0 to 100% |
| 1035 | 40B | | Debounce time 2 | | yes | | rw | 0 | 0 to 30,000 ms |
| 1036 | 40C | | Quality D2 | | - | | ro | - | 0 to 100% |

**Debounce time 1/2** can be used to suppress (debounce) short, interfering signals at the Qint.1 input or the Smart Task's external input.
The selected debounce time has the same effect as a switch-on or switch-off delay.
**Quality D1/D2** indicates the extent to which debouncing is used. The higher the value, the more level changes that took place within the selected **Debounce time 1/2**.

Explanations for ISDUs 1080, 1083, 1084, 1085, 1086, 1087, 1088, 1089, 1090: see "Smart Tasks “Basic logic” (A00)", page 36

### 7.9.4 Smart Task “Speed and length measurement” (A72)

Logical principle of operation:

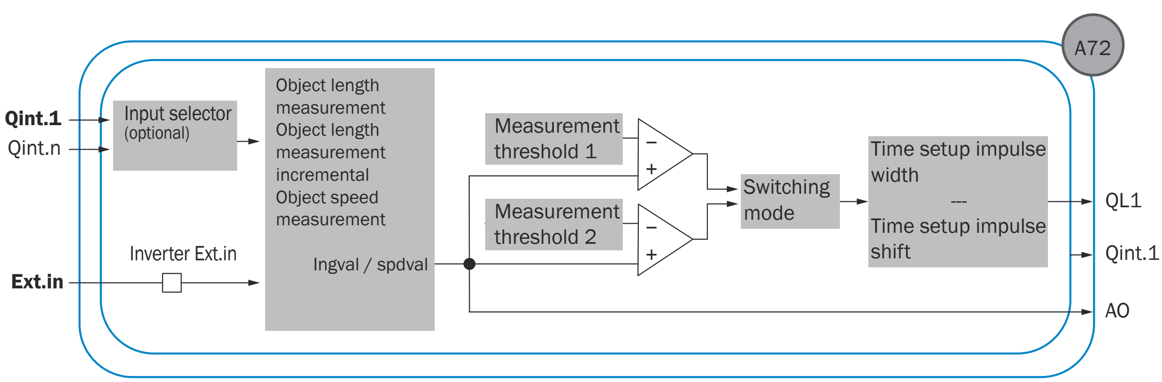


*Figure 7: Logical principle of operation A72*

The Smart Task “Speed and length measurement” (A72) can measure the length and speed of objects that move past the sensor, e.g. on a conveyor belt, and can also determine their direction of travel. The Smart Task has three measurement modes for this purpose:

1 Measurement of the object length (“Length”)
2 Incremental measurement of the object length (“Length incremental”)
3 Measurement of the object speed (“Speed”)

The Smart Task A72 “Speed and length measurement” requires an additional external signal in each of the three measurement modes. This is supplied to the Smart Sensor via its Pin 2 / white wire.

An additional binary-switching sensor is required in “Length” and “Speed” modes. This detects the same measuring object shortly before or after the A72 Smart Sensor, see figure 8, page 44. In order to guarantee the measurement accuracy specified in the sensor data sheet, it is recommended that the additional sensor has the same optical and detection characteristics as the A72 Smart Sensor used. In addition, the light beams of both sensors must be aligned exactly parallel.

In order to ensure correct length and speed measurement, it is essential that the travel speed of the measuring object is constant. If the movement is accelerated, for example, the sensor will determine the average speed between the two measurement points and the measured object length will be too short as a result.

The “Length incremental” measurement mode must be used in order to also obtain a correct length measurement for accelerated or decelerated movements.

---

**NOTE**
The distance between the Smart Sensor and the additional sensor must be smaller than the smallest object to be measured. This means that the smallest object to be measured must be detected by both sensors simultaneously for a short moment.

---

**NOTE**
For easy connection of the additional sensor to the Smart Sensor, Y-distributor SYL-1204-G0M11-X1 (6055011) or SYL-8204-G0M11-X2 (6055012) can be used (see **www.sick.com/6055011** or **www.sick.com/6055012**).

---

In the “Length incremental” measuring mode, the A72 Smart Sensor requires the HTL signal of a connected incremental encoder (e.g. SICK DBS36, **www.sick.com/dbs36**), see see figure 9, page 44.

This measurement mode is particularly recommended if the object movement can be accelerated or decelerated during the measurement or if the object can come to a standstill during the measurement.

In order to ensure correct length measurement, the encoder must always rotate only in one direction during measurement. Detection of the movement direction of the object is not possible in this measurement mode.

---

**NOTE**
The A72 Smart Sensor can process a maximum of 1,000 encoder pulses per second.

---

**NOTE**
The Smart Sensor and the additional sensor or additional encoder must be connected to the same electrical potential with their supply voltage.

---

The measured speed or length value and the direction of movement are made available via the process data element, see see "Process data", page 9. Either a length or a speed signal is output depending on the set measurement mode. The direction of movement is indicated by the sign of the measured value (only in “Speed” and “Length” measurement modes, not for “Length incremental”):

- • Positive sign: object travels into the measuring distance via the Smart Sensor
- • Negative sign: object travels into the measuring distance via the additional sensor

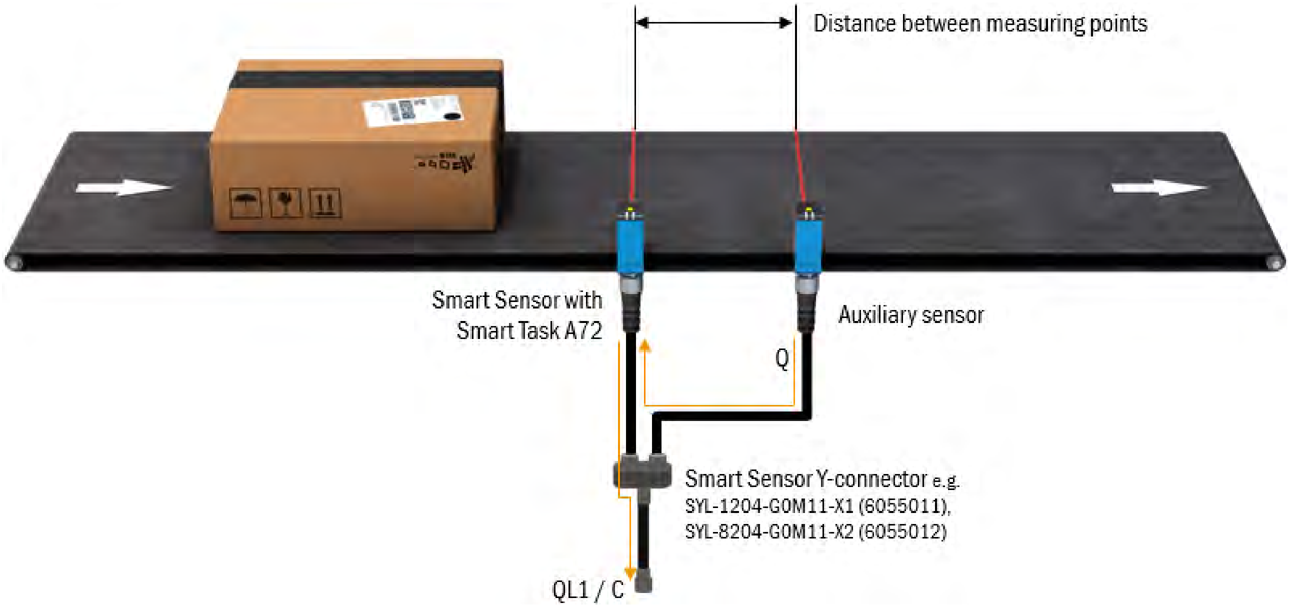


*Figure 8: Wiring example for “Length” and “Speed” measurement modes*

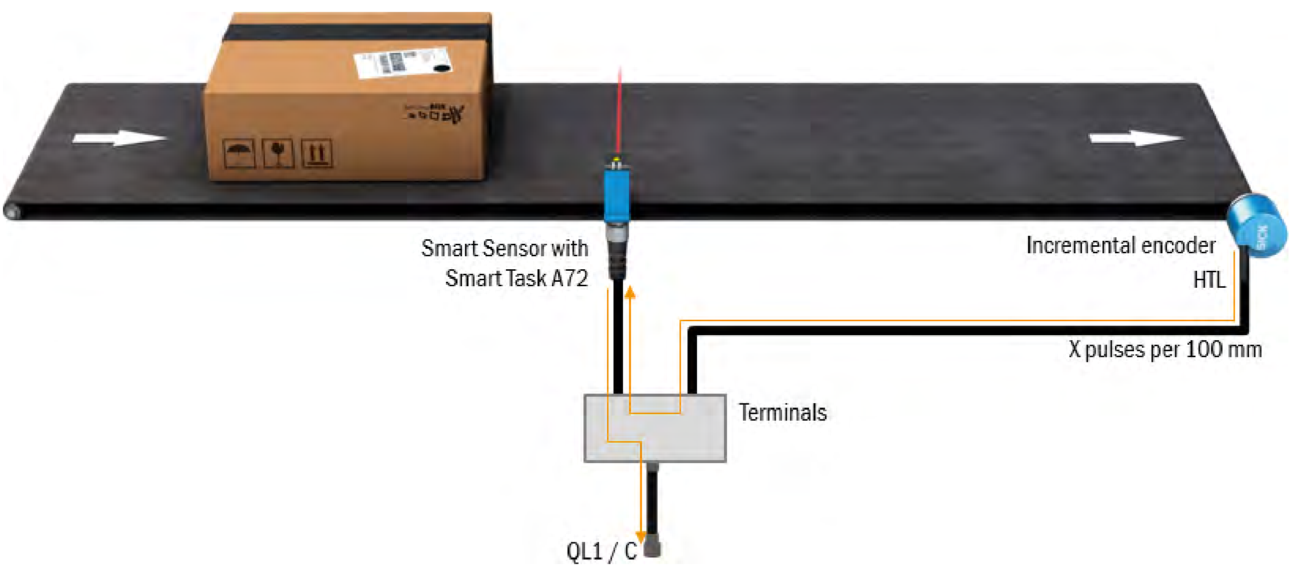


*Figure 9: Wiring example for “Length incremental” measurement mode*

*Table 89: Smart Task – Standard command*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 2 | 02 | - | Standard command | UInt | - | 1 byte | ro | - | 201 = Start and stop reference run<br>202 = Zero setting for incremental length measurement value |

Alternatively to direct input of the distance between the two measuring points (via ISDU 1098 **Distance between measuring points**), this distance value can also be determined automatically: the command **Start and stop reference run** starts a recording function with which the parameter **Distance between measuring points** (ISDU 1098) is set automatically by an object being moved through the detection zone of the Smart Sensor and additional sensor at a defined and constant speed. Process:

- Input of a constant object speed during the reference run via **Object speed for reference run** (ISDU 1105).
- Reference run start via the command **Start and stop reference run** (ISDU2, value 201). **Smart Task operating state** (ISDU 1109) changes from **Operate** to **Reference run.**

- Within the next 20 seconds, an object must be moved through the detection zone of the Smart Sensor and the additional sensor with precisely the previously entered and constant speed.
- The parameter **Distance between measuring points** (ISDU 1098) is overwritten with the new value as soon as the object has entered the detection zone of the second sensor. The status changes back to **Operate** (ISDU 1109).
- The reference run is aborted if no object is moved through the detection zones of the sensors within 20 seconds after activation of the reference run. The sensor returns to the status **Operate** (ISDU 1109), and the previous value for the **Distance between measuring points** (ISDU 1098) remains unchanged. The same happens if the command **Start and stop reference run** (ISDU2, value 201) is issued again within 20 seconds.

The command **Start and stop reference run** is executed by the sensor only if the **Measurement Mode** (ISDU 1097) is set to **Speed** or **Length**.

**NOTE**

Dependency:
- **Measurement mode** (IDSU 1097)
- **Distance between measuring points** (ISDU 1098)
- **Object speed for reference run** (ISDU 1105)
- **Smart Task operating state** (ISDU 1109)

The command **Zero setting for incremental length measurement value** resets to zero the current measured value of the Smart Task, which is output via the process data element or the parameter **Length measurement value** (ISDU 1106). This is necessary, for example, if a measurement is to start only after the measuring object has already entered the detection zone of the A72 Smart Sensor.

The command **Zero setting for incremental length measurement value** is executed by the sensor only if the **Measurement Mode** (ISDU 1097) is set to **Length incremental.**

*Table 90: Smart Task – Speed and Length Measurement version*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1096 | 448 | - | Speed and Length Measurement version | String | - | 8 bytes | ro | - | - |

**Speed and Length Measurement version** specifies the version of the Smart Task “Speed and length measurement”.

*Table 91: Smart Tasks - Input selector*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1081 | 439 | - | Input selector | UInt | yes | 1 byte | rw | 0 | 0 = Qint.1<br>1 = Qint.2<br>2 = Qint.3<br>3 = Qint.4<br>4 = Qint.5<br>5 = Qint.6<br>6 = ... |

The **Input selector** defines which Qint.x detection signal is used for speed and length measurement.

**NOTE**

This function is only available if the Smart Sensor has more than one Qint.x. The actual scope of the value range is device specific. For details, see the respective device IODD.

*Table 92: Smart Task - Inverter external input*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1093 | 445 | - | Inverter Ext.input | UInt | yes | 1 byte | rw | 0 | 0 = Not inverted<br>1 = Inverted |

The Smart Task A72 Speed and length measurement always expects a HIGH signal at the external input (Pin 2 or white wire) when the additional sensor detects an object. If the connected additional sensor supplies a LOW signal when an object is detected (typical for retro-reflective or through-beam photoelectric sensors), the **Inverter Ext. input** must be set to **1 = inverted.** The measurement will not function is the inverter is incorrectly set.

**NOTE**
This function is relevant only in the “Speed” and “Length” measurement modes of the **Measurement mode** parameter (ISDU 1097).

*Table 93: Smart Task - Measurement mode*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1097 | 449 | - | Measurement mode | UInt | yes | 1 byte | rw | 0 | 0 = Length [mm]<br>1 = Length incremental [mm]<br>2 = Speed [mm/s] |

**Measurement mode** defines which primary measuring task is performed by the Smart Task:

**Length**
The length of the objects traveling past the Smart Sensor and additional sensor is measured. The measured result is output in the process data element as a millimeter value. The sign of the measured value indicates the direction of movement of the object:

- Positive sign: object travels into the measuring distance via the Smart Sensor
- Negative sign: object travels into the measuring distance via the additional sensor

The measurement provides correct values only if the parameter **Distance between measuring points** (ISDU 1098) is set correctly.

**Length incremental**
The length of the objects traveling past the Smart Sensor is measured. The measured result is output in the process data element as a millimeter value. The sign of the measured value is always positive. It is not possible to make a statement about the movement direction of the object in this mode. The measurement provides correct values only if the parameter **Pulses per 100 millimeter** (ISDU 1099) is set correctly.

**Speed**
The speed of the objects traveling past the Smart Sensor and additional sensor is measured. The measured result is output in the process data element as a millimeter per second value. The sign of the measured value indicates the direction of movement of the object:

- Positive sign: object travels into the measuring distance via the Smart Sensor
- Negative sign: object travels into the measuring distance via the additional sensor

The measurement provides correct values only if the parameter **Distance between measuring points** (ISDU 1098) is set correctly.

The lengths and speeds measured by the sensor are also additionally output via the parameters **Length measurement value** (ISDU 1106) and **Speed measurement value** (ISDU 1107).

**NOTE**
Dependency:

- **Distance between measuring points** (ISDU 1098)
- **Pulses per 100 millimeter** (ISDU 1099)

*Table 94: Smart Task – Distance between measuring points*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1098 | 44A | - | Distance between measuring points [in 100 µm] | UInt | yes | 2 bytes | rw | 1000 | 1 ... 65535 [x 100 µm] |

In order for the length or speed measurement (**Measurement mode** “Length” or “Speed”, ISDU 1097) to be performed correctly, the parameter **Distance between measuring points** must be set as exactly as possible. This is the physical distance between the detection point of the A72 Smart Sensors and the detection point of the additional sensor. The distance is specified in 100 µm (corresponds to 1/10 mm) in order to increase the measurement accuracy of the Smart Task.

Example: The value “1500” must be entered for a measured distance between the detection points of 150.0 mm.

**NOTE**
Dependency:

- **Measurement mode** (ISDU 1097)

*Table 95: Smart Task – Pulses per 100 millimeter*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1099 | 44B | - | Pulses per 100 millimeter | UInt | yes | 2 bytes | rw | 100 | 1 ... 1000 |

In order for the incremental length measurement (**Measurement mode** “Length incremental”, ISDU 1097) to be performed correctly, the parameter **Pulses per 100 millimeter** must be set as exactly as possible. This is the number of HTL signal pulses that the incremental encoder sends to the Smart Sensor while the conveyor belt on which the measuring object is transported and to which the encoder is coupled covers a distance of 100 mm. The value depends on the number of pulses per revolution of the encoder, the diameter of the measuring wheel or conveyor roller and, where applicable, the thickness of the conveyor belt.

The parameter is included in the Smart Task calculations only in the **Measurement mode** “Length incremental” (ISDU 1097).

**NOTE**
Dependency:

- **Measurement mode** (ISDU 1097)

*Table 96: Smart Tasks - Measurement threshold*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1100 | 44C | - | Measurement threshold 1 | Int | yes | 2 bytes | rw | 100 | - 8191 ... +8191 |
| 1101 | 44D | - | Measurement threshold 2 | Int | yes | 2 bytes | rw | 50 | - 8191 ... +8191 |
| 1102 | 44E | - | Switching mode | UInt | yes | 1 byte | rw | 0 | 0 = Within time window<br>1 = Out of time window |
| 1103 | 44F | - | Time setup impulse width | UInt | yes | 2 bytes | rw | 500 | 1 ... 30,000 ms |
| 1104 | 450 | - | Time setup impulse shift | UInt | yes | 2 bytes | rw | 0 | 0 ... 30,000 ms |

The **Measurement threshold 1** and **Measurement threshold 2** are switching thresholds based on the measured length or measured speed. The two switching thresholds form a switching window, whereby the larger value is the upper switching threshold and the smaller value is the lower switching threshold. A logical HIGH signal is generated depending on the setting for **Switching mode**:

- **Within time window:**
  HIGH signal when the lower switching threshold < measured value ≤ upper switching threshold
- **Out of time window:**
  HIGH signal when measured value ≤ lower switching threshold; or when the measured value > upper switching threshold

The HIGH signal is output as switching pulse **QL1**. The width of the switching pulse can be adjusted via **Time setup impulse width**. Output of the switching pulse can be delayed via **Time setup impulse shift.**

**NOTE**
The set pulse width (**Time setup impulse width**) must always be smaller than the time gap to the next measuring object.

**NOTE**
Dependency:

- **Impulse buffer state** (ISDU 1123)

*Table 97: Smart Task - Object speed for reference run*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1105 | 451 | - | Object speed for reference run | UInt | yes | 2 bytes | rw | 100 | 10 ... 500 mm/s |

Alternatively to direct input of the distance between the two measuring points (via ISDU 1098 **Distance between measuring points**), this distance value can also be determined automatically: the command **Start and stop reference run** starts a recording function with which the parameter **Distance between measuring points** (ISDU 1098) is set automatically by an object being moved through the detection zone of the Smart Sensor and additional sensor at a defined and constant speed. Process:

- Input of a constant object speed during the reference run via **Object speed for reference run** (ISDU 1105).
- Reference run start via the command **Start and stop reference run** (ISDU2, value 201). **Smart Task operating state** (ISDU 1109) changes from **Operate** to **Reference run.**
- Within the next 20 seconds, an object must be moved through the detection zone of the Smart Sensor and the additional sensor with precisely the previously entered and constant speed.
- The parameter **Distance between measuring points** (ISDU 1098) is overwritten with the new value as soon as the object has entered the detection zone of the second sensor. The status changes back to **Operate** (ISDU 1109).
- The reference run is aborted if no object is moved through the detection zones of the sensors within 20 seconds after activation of the reference run. The sensor returns to the status **Operate** (ISDU 1109), and the previous value for the **Distance between measuring points** (ISDU 1098) remains unchanged. The same happens if the command **Start and stop reference run** (ISDU2, value 201) is issued again within 20 seconds.

The command **Start and stop reference run** is executed by the sensor only if the **Measurement Mode** (ISDU 1097) is set to **Speed** or **Length.**

**NOTE**
Dependency:
- **Measurement mode** (IDSU 1097)
- **Distance between measuring points** (ISDU 1098)
- **Object speed for reference run** (ISDU 1105)
- **Smart Task operating state** (ISDU 1109)

The command **Zero setting for incremental length measurement value** resets to zero the current measured value of the Smart Task, which is output via the process data element or the parameter **Length measurement value** (ISDU 1106). This is necessary, for example, if a measurement is to start only after the measuring object has already entered the detection zone of the A72 Smart Sensor.

The command **Zero setting for incremental length measurement value** is executed by the sensor only if the **Measurement Mode** (ISDU 1097) is set to **Length incremental.**

**NOTE**
Dependency:

- **Standard command Start and stop reference run** (ISDU 2, value 201)

*Table 98: Smart Tasks - Length measurement value*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1106 | 452 | - | Length measurement value | Int | - | 2 bytes | ro | - | - 8,191 ... +8,191 mm |

Provision of the last measured length measurement value.

*Table 99: Smart Tasks - Speed measurement value*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1107 | 453 | - | Speed measurement value | Int | - | 2 bytes | ro | - | - 8,191 ... +8,191 mm/s |

Provision of the last measured speed measurement value.

*Table 100: Smart Tasks - Smart Task operating state*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1109 | 455 | - | Smart Task operating state | UInt | - | 1 byte | ro | - | 0 = Operate<br>1 = Reference run |

Alternatively to direct input of the distance between the two measuring points (via ISDU 1098 **Distance between measuring points**), this distance value can also be determined automatically: the command **Start and stop reference run** starts a recording function with which the parameter **Distance between measuring points** (ISDU 1098) is set automatically by an object being moved through the detection zone of the Smart Sensor and additional sensor at a defined and constant speed. Process:

- Input of a constant object speed during the reference run via **Object speed for reference run** (ISDU 1105).
- Reference run start via the command **Start and stop reference run** (ISDU2, value 201). **Smart Task operating state** (ISDU 1109) changes from **Operate** to **Reference run.**
- Within the next 20 seconds, an object must be moved through the detection zone of the Smart Sensor and the additional sensor with precisely the previously entered and constant speed.
- The parameter **Distance between measuring points** (ISDU 1098) is overwritten with the new value as soon as the object has entered the detection zone of the second sensor. The status changes back to **Operate** (ISDU 1109).
- The reference run is aborted if no object is moved through the detection zones of the sensors within 20 seconds after activation of the reference run. The sensor returns to the status **Operate** (ISDU 1109), and the previous value for the **Distance between measuring points** (ISDU 1098) remains unchanged. The same happens if the command **Start and stop reference run** (ISDU2, value 201) is issued again within 20 seconds.

The command **Start and stop reference run** is executed by the sensor only if the **Measurement Mode** (ISDU 1097) is set to **Speed** or **Length.**

**NOTE**

Dependency:

- **Measurement mode** (IDSU 1097)
- **Distance between measuring points** (ISDU 1098)
- **Object speed for reference run** (ISDU 1105)
- **Smart Task operating state** (ISDU 1109)

The command **Zero setting for incremental length measurement value** resets to zero the current measured value of the Smart Task, which is output via the process data element or the parameter **Length measurement value** (ISDU 1106). This is necessary, for example, if a measurement is to start only after the measuring object has already entered the detection zone of the A72 Smart Sensor.

The command **Zero setting for incremental length measurement value** is executed by the sensor only if the **Measurement Mode** (ISDU 1097) is set to **Length incremental.**

**NOTE**

Dependency:

- **Standard command Start and stop reference run** (ISDU 2, value 201)

*Table 101: Smart Task - Impulse buffer state*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1123 | 463 | - | Impulse buffer state | UInt | - | 1 byte | ro | - | 0 = Green: Buffer OK<br>1 = Yellow: Buffer almost full<br>2 = Red: Buffer overflow |

If a pulse delay is set via **Time setup impulse shift object** (ISDU 1104), further switching pulses may still be generated during the delay time of a preceding switching pulse. In this case, up to 16 switching pulses are temporarily stored and output in succession via **QL1**.

Impulse buffer state indicates how full the buffer is:

| | | |
|---|---|---|
| **Green:** | **Buffer OK:** | 0 ... 12 QL1 pulses in the buffer |
| **Yellow:** | **Buffer almost full:** | 13 ... 16 QL1 pulses in the buffer |
| **Red:** | **Buffer overflow:** | Buffer is full. New QL1 pulses will be discarded. |

**NOTE**

Dependency:

- **Time setup impulse shift** (ISDU 1104)

### 7.9.5 Smart Tasks “Object and gap monitor” (A73)

Logical principle of operation:

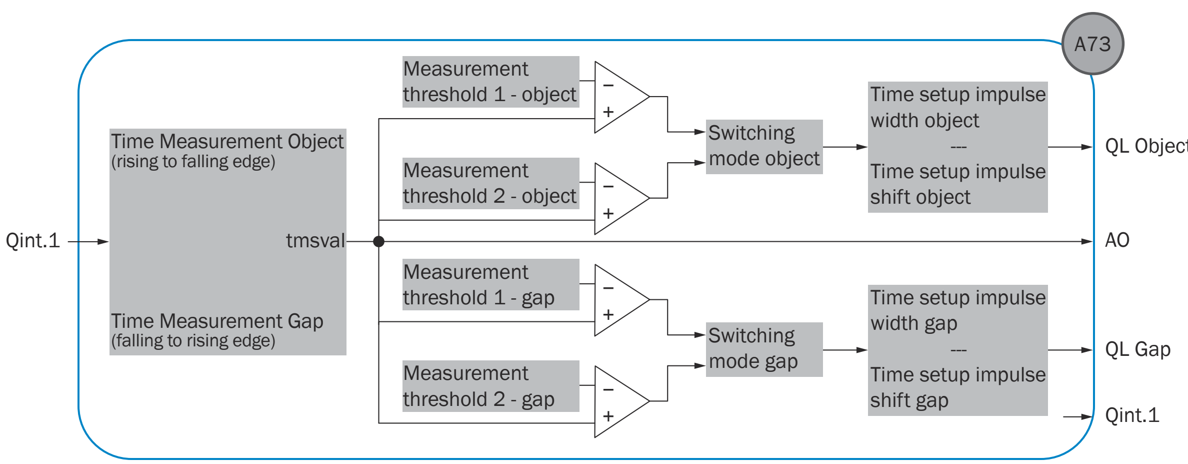


*Figure 10: Logical principle of operation A73*

The Smart Task “Object and gap monitor” measures the length of the objects that pass the sensor followed by the gap to the next detection object. In this case, the time between the rising signal edge and the falling signal edge of the Qint.1 detection signal corresponds to the object length and the time between the falling signal edge and the rising signal edge of the Qint.1 detection signal corresponds to the length of the gap. The measured time value for objects and gaps is always output in the sensor’s process data element. The measurement is recorded in milliseconds (see "Process data", page 9).

**NOTE**

The measured length value depends on the object’s speed of transportation. If the speed of transportation increases, the measured time value decreases and vice versa.

*Table 102: Smart Tasks – Object + Gap Monitor version*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1112 | 458 | - | Object + Gap Monitor version | String | - | 8 bytes | ro | - | - |

**Object + Gap Monitor version** specifies the version present in the Smart Task sub-function “Object and gap monitor”.

*Table 103: Smart Tasks – Measurement threshold – object*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1113 | 459 | - | Measurement threshold 1 - object | UInt | yes | 2 bytes | rw | 200 | 1 to 8,190 ms |
| 1114 | 45A | - | Measurement threshold 2 - object | UInt | yes | 2 bytes | rw | 150 | 1 to 8,189 ms |
| 1115 | 45B | - | Switching mode object | UInt | yes | 1 byte | rw | 0 | 0 = Object within time window<br>1 = Object out of time window |
| 1116 | 45C | - | Time setup impulse width object | UInt | yes | 2 bytes | rw | 50 | 1 to 30,000 ms |
| 1117 | 45D | - | Time setup impulse shift object | UInt | yes | 2 bytes | rw | 0 | 0 to 30,000 ms |

**Measurement threshold 1 – object** and **Measurement threshold 2 – object** are thresholds that are placed on the measured time between the rising signal edge and falling signal edge of the detection signal **Qint.1**(= Object detection). Together, the two thresholds form a time window, whereby the larger value is the upper threshold and the smaller value is the lower threshold. A HIGH signal is generated depending on the settings for **Switching mode object:**

- **Object within time window:**
  HIGH signal, when the lower switching threshold < Object time value ≤ Upper switching threshold
- **Object out of time window:**
  HIGH signal, when the object time value ≤ Lower switching threshold; or when the object time value > Upper switching threshold

The HIGH signal can be emitted as a switching pulse: **QL Object**. The width of the switching pulse can be adjusted under **Time setup impulse width object. Time setup impulse shift object** can be used to delay the output of the switching pulse.

**NOTE**
The selected pulse width (**Time setup impulse width object**) must always be smaller than the smallest time gap to the next object.

*Table 104: Smart Tasks – Measurement threshold – gap*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1118 | 45E | - | Measurement threshold 1 - gap | UInt | yes | 2 bytes | rw | 200 | 1 to 8,190 ms |
| 1119 | 45F | - | Measurement threshold 2 - gap | UInt | yes | 2 bytes | rw | 150 | 1 to 8,189 ms |
| 1120 | 460 | - | Switching mode gap | UInt | yes | 1 byte | rw | 0 | 0 = Gap within time window<br>1 = Gap out of time window |
| 1121 | 461 | - | Time setup impulse width gap | Unnt | yes | 2 bytes | rw | 50 | 1 to 30,000 ms |
| 1122 | 462 | - | Time setup impulse shift gap | UInt | yes | 2 bytes | rw | 0 | 0 to 30,000 ms |

**Measurement threshold 1 – gap** and **Measurement threshold 2 – gap** are thresholds that are placed on the measured time between the falling signal edge and rising signal edge of the detection signal **Qint.1**(= Gap detection). Together, the two thresholds form a time window, whereby the larger value is the upper threshold and the smaller value is the lower threshold. A HIGH signal is generated depending on the settings for **Switching mode gap:**

- **Gap within time window:**
  HIGH signal, when the lower switching threshold < Gap time value ≤ Upper switching threshold
- **Gap out of time window:**
  HIGH signal, when the gap time value ≤ Lower switching threshold; or when the gap time value > Upper switching threshold

The HIGH signal can be emitted as a switching pulse: **QL Gap**. The width of the switching pulse can be adjusted under **Time setup impulse width gap. Time setup impulse shift gap** can be used to delay the output of the switching pulse.

**NOTE**
The selected pulse width (**Time setup impulse width gap**) must always be smaller than the smallest time to the next gap.

*Table 105: Smart Tasks – Impulse buffer state*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1123 | 463 | - | Impulse buffer state | UInt | - | 1 byte | ro | - | 0 = Green: Buffer OK<br>1 = Yellow: Buffer almost full<br>2 = Red: Buffer overflow |

If a pulse delay is selected using **Time setup impulse shift object** (ISDU 1117) and / or **Time setup impulse shift gap** (ISDU 1122), further switching pulses may still be generated during the delay time of a preceding switching pulse. In this case, up to 16 switching pulses are temporarily stored and output in succession via **QL Object** or **QL Gap**.

**Impulse buffer state** indicates how full the buffer is:

| | | |
|---|---|---|
| **Green:** | **Buffer OK:** | 0 to 12 **QL Object**- / **QL Gap** pulses in the buffer |
| **Yellow:** | **Buffer almost full:** | 13 to 16 **QL Object**- / **QL Gap** pulses in the buffer |
| **Red:** | **Buffer overflow:** | Buffer is full. New **QL Object**- / **QL Gap** pulses will be discarded |

### 7.9.6 "Load mapping" Smart Task (A75)

**Logical principle of operation:**

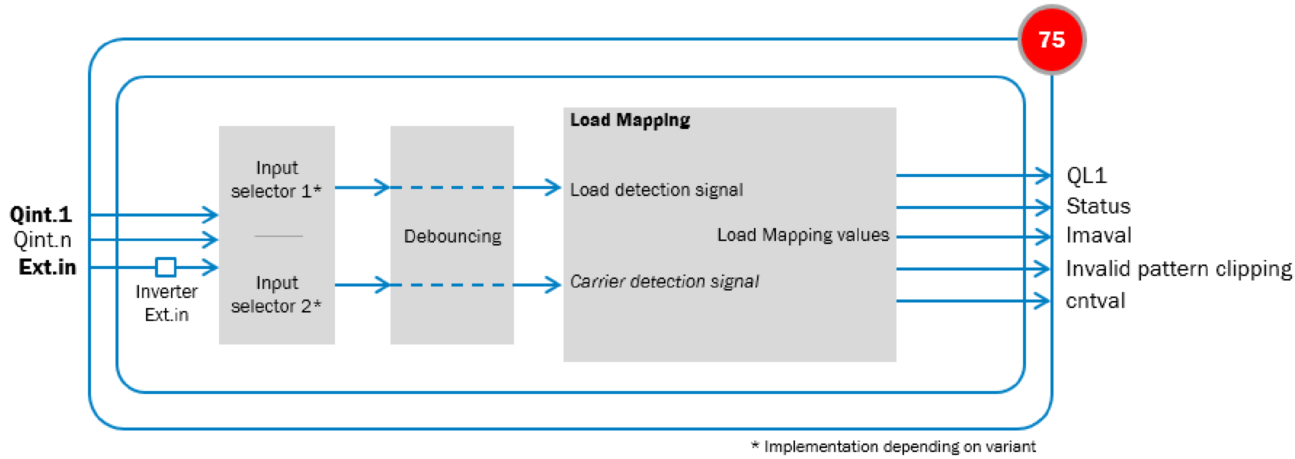


*Figure 11: Logical principle of operation A75*

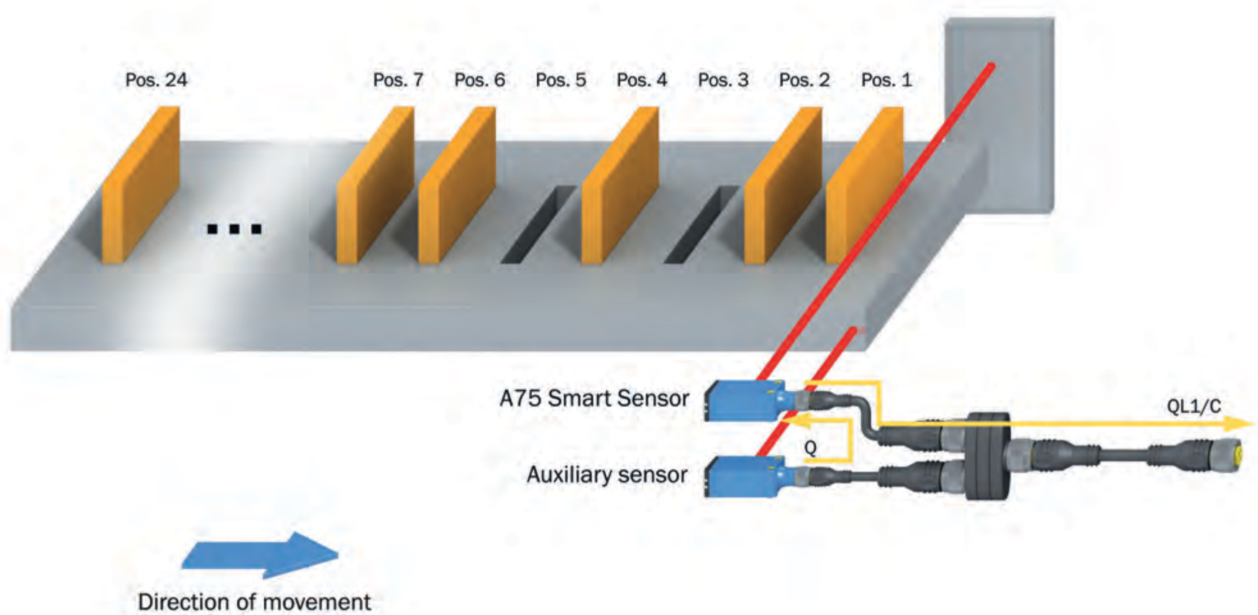


*Figure 12: Application principle*

A Smart Sensor with the **Load mapping** Smart Task (A75) can very easily, quickly and efficiently report to a gripper robot in a pick-and-place application at which position in the workpiece carrier an object is located as well as where it is not located. Access to empty positions or timely, non-value-adding searches for objects in the workpiece carrier are avoided, increasing system efficiency (OEE). In addition to the loading information of the workpiece carrier, the Smart Task also transmits the number of objects in the workpiece carrier or in the respective row of workpiece carriers which are detected by the respective sensor.

In addition to pick-and-place applications with workpiece carriers, load mapping can be used in other applications, for example object identification, quality control in mounting processes or completeness detection in filling processes.

Up to 24 object positions can be monitored with the A75 Smart Sensor and evaluated regarding assignment. Each (potential) object position corresponds to a bit: Object position assigned --> bit = 1, object position not assigned --> bit = 0. This load mapping is output as a double word (byte 0 to 3) in the process data, whereby only bit 32 (position 1) up to max. bit 55 (position 24) actually contain loading information.

**NOTE**
The following explanations on the exact function of the **Load mapping** Smart Task is based on the example of the pick-and-place application with a workpiece carrier. The descriptions can be applied to other applications.

### Functionality

One A75 Smart Sensor must be used per object row of the workpiece carrier to detect the loading of a workpiece carrier when it moves by. In addition, a auxiliary sensor is usually required, which continually detects the workpiece carrier.

The A75 Load mapping Smart Task requires two binary input signals (see figure 11):

- **Load detection signal**
- **Carrier detection signal**

The **Load detection signal** is provided by the Smart Sensor itself, typically the Qint.1 detection signal of the Smart Sensor. This binary detection signal is aligned to detection of objects in the workpiece carrier or the detection of empty object positions, depending on the selected **operating mode** of the Smart Task (see ISDU 1145 for details).

The **Carrier detection signal** delivers the information on the presence of the workpiece carrier and is used as a start and stop signal for the Smart Task. This signal is typically provided by a second binary switching sensor (→ auxiliary sensor) via the external input of the Smart Sensor (pin 2 / white wire).

**NOTE**
If the A75 Smart Sensor has more than one detection channel, the **Carrier detection signal** can also be provided by the Smart Sensor, for example via Qint.2, if the application conditions allow this. The auxiliary sensor would then be omitted. However, since in many cases you must assume that the requirements for omitting the auxiliary sensor will not exist, the following descriptions assume the use of the A75 Smart Sensor with auxiliary sensor.

Workpiece carrier loading is detected by the A75 Smart Sensor by comparing the associated detection pattern with a previously-recorded reference pattern. In order to record the reference pattern – depending on the operating mode (**Operating mode**, ISDU 1145) – a completely loaded or completely empty workpiece carrier must move past the A75 Smart Sensor and the auxiliary sensor. All following read workpiece carriers are compared to this reference pattern. If the last read switching pattern matches the structure of the reference pattern, the Smart Task specifies which placement position of the workpiece carrier is assigned an object and which is free (**Reading successful** status). If the pattern structures do not match, the sensor delivers the **Reading failed** status.

*Table 106: Smart Tasks – Standard command*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 2 | 2 | - | Standard command | UInt | - | 1 byte | ro | - | 194 = Record reference pattern<br>195 = Delete reference pattern |

After the **Record reference pattern** command, the sensor changes to recording mode for a maximum of 120 seconds. The next workpiece carrier detected within this time triggers the actual recording. Recording ends as soon as the auxiliary sensor no longer detects the workpiece carrier.

If recording is successful, the previous reference pattern is replaced by the new reference pattern. In addition, the sensor displays the **Recording successful** status. If recording fails, the previous reference pattern is maintained and the sensor displays the **Recording failed** status.

The **Delete reference pattern** command deletes the current reference pattern in the sensor. The **Pattern deleted** status is displayed.

*Table 107: Smart Tasks - Load Mapping version*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1144 | 478 | - | Load Mapping version | String | - | 8 byte | ro | - | - |

**Load Mapping version** names the version present in the “Load mapping” Smart Task.

*Table 108: Smart Tasks - Input selector*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1081 | 439 | - | Input selector 1 | UInt | yes | 1 byte | rw | 0 | 0 = Qint.1<br>1 = Qint.2<br>2 = Qint.3<br>3 = Qint.4<br>4 = Qint.5<br>5 = Qint.6<br>6 = ... |
| 1082 | 43A | - | Input selector 2 | UInt | | 1 byte | | 64 | 0 = Qint.1<br>1 = Qint.2<br>2 = Qint.3<br>3 = Qint.4<br>4 = Qint.5<br>5 = Qint.6<br>...<br>64 = Ext.input 1<br>65 = Ext.input 2 |

Selection via **Input selector 1** defines which Qint.x detection signal is used for detection of objects in the workpiece carrier.

Selection via **Input selector 2** defines which Qint.x detection signal or which external input signal is used for detection of the workpiece carrier.

**NOTE**
These functions are only available if the A75 Smart Sensor has more than one Qint.x. The actual scope of the value range is device specific. For details, see the IODD of the respective sensor.

*Table 109: Smart Tasks – Debouncing*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1033 | 409 | - | Debounce time | UInt | yes | 2 byte | rw | 0 | 0 ... 30000 ms |

The **Debounce time** can be used to suppress (debounce) short, interfering signals at the Smart Task’s input. The selected debounce time has the same effect as a switch-on delay in parallel on both input variables. Time unit: Milliseconds [ms]

*Table 110: Smart Tasks - Inverter external input*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1039 | 445 | - | Inverter Ext.input | UInt | yes | 1 byte | rw | 0 | 0 = Not inverted<br>1 = Inverted |

The A75 **Load mapping** Smart Task always expects a HIGH signal on the external input (pin 2 or white wire) if the auxiliary sensor detects the workpiece carrier. If the connected auxiliary sensor delivers a LOW signal when the workpiece carrier is detected (typical for photoelectric retro-reflective or through-beam photoelectric sensors), **Inverter Ext.input** must be set to **1 = Inverted**. If the inverter is incorrectly set, load mapping does not work.

*Table 111: Smart Tasks - Operating mode*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1145 | 479 | - | Operating mode | UInt | yes | 1 byte | rw | 0 | 0 = Direct object detection, midpoint<br>1 = Direct object detection, width<br>3 = Inverse object detection, width |

The **operating mode** must be set depending on the workpiece carrier type and the desired manner of workpiece evaluation. The following handles the difference between **Direct object detection** and **Inverse object detection** as well as the difference between **midpoint** and **width** evaluation.

**Direct object detection:**

- This mode is used when the A75 Smart Sensor, due to its detection principle, is able to detect the objects in the workpiece carrier individually and directly (i.e. the Smart Sensor can differentiate them from the workpiece carrier), see figure 13, page 56. In this operating mode, Qint.1 of the A75 Smart Sensor must deliver a HIGH signal when an object is detected in the workpiece carrier. The A75 Smart Sensor must deliver a LOW signal on Qint.1 between two objects.
- If the A75 Smart Sensor is operated in this mode, a fully-loaded workpiece carrier must be taught in as a reference pattern (see **Record reference pattern** standard command, ISDU 2, value 194).

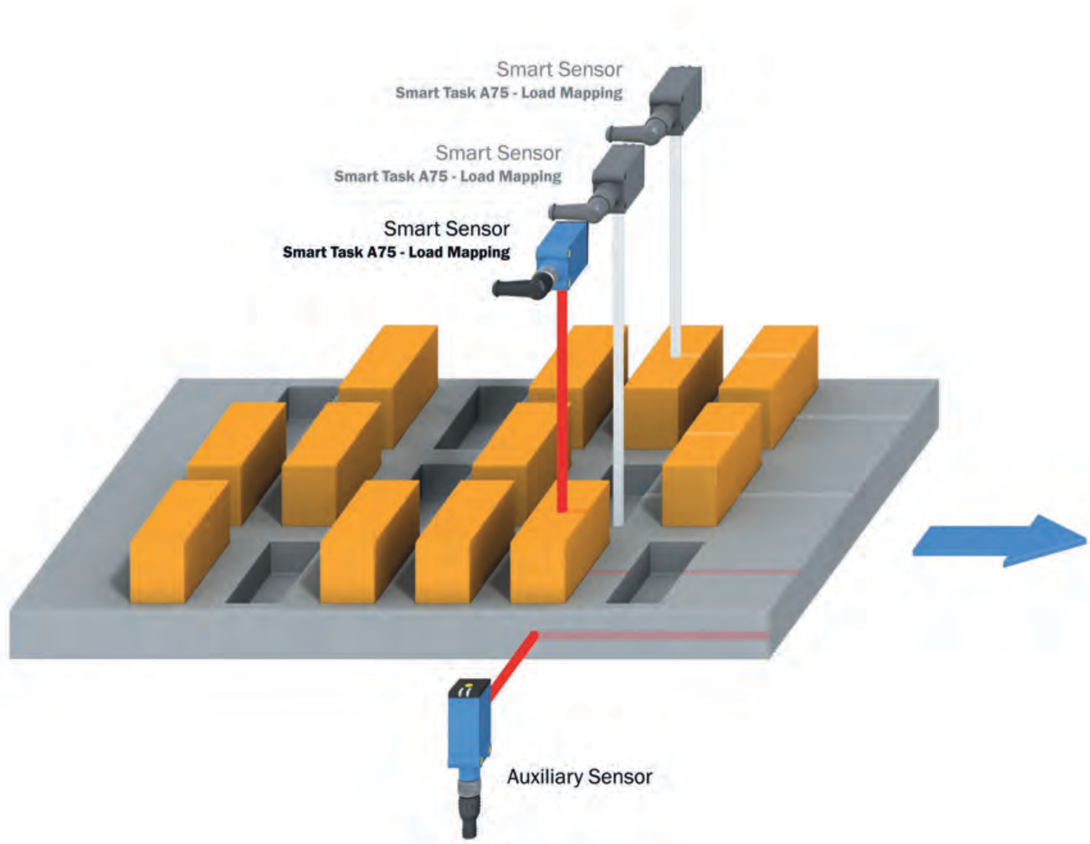


*Figure 13: Workpiece carrier for Direct object detection, midpoint/width mode*

**Inverse object detection:**

- If the A75 Smart Sensor, due to its detection principle, is NOT able to differentiate between the objects in the workpiece carrier from the workpiece itself, for example because they are sunk into the surface of the work-piece carrier, the **Inverse object detection** mode must be applied. The prerequisite for this is that, with the absence of each individual object in the workpiece carrier, a single gap is created which the A75 Smart Sensor can differentiate from the workpiece carrier, see figure 14, page 57. In this operating mode, Qint.1 must deliver a HIGH signal when the workpiece carrier or an object is detected. For an empty object position, the A75 Smart Sensor must be LOW on Qint.1.
- If the A75 Smart Sensor is operated in this mode, a completely empty workpiece carrier must be taught in as a reference pattern (see **Record reference pattern** standard command, ISDU 2, value 194).

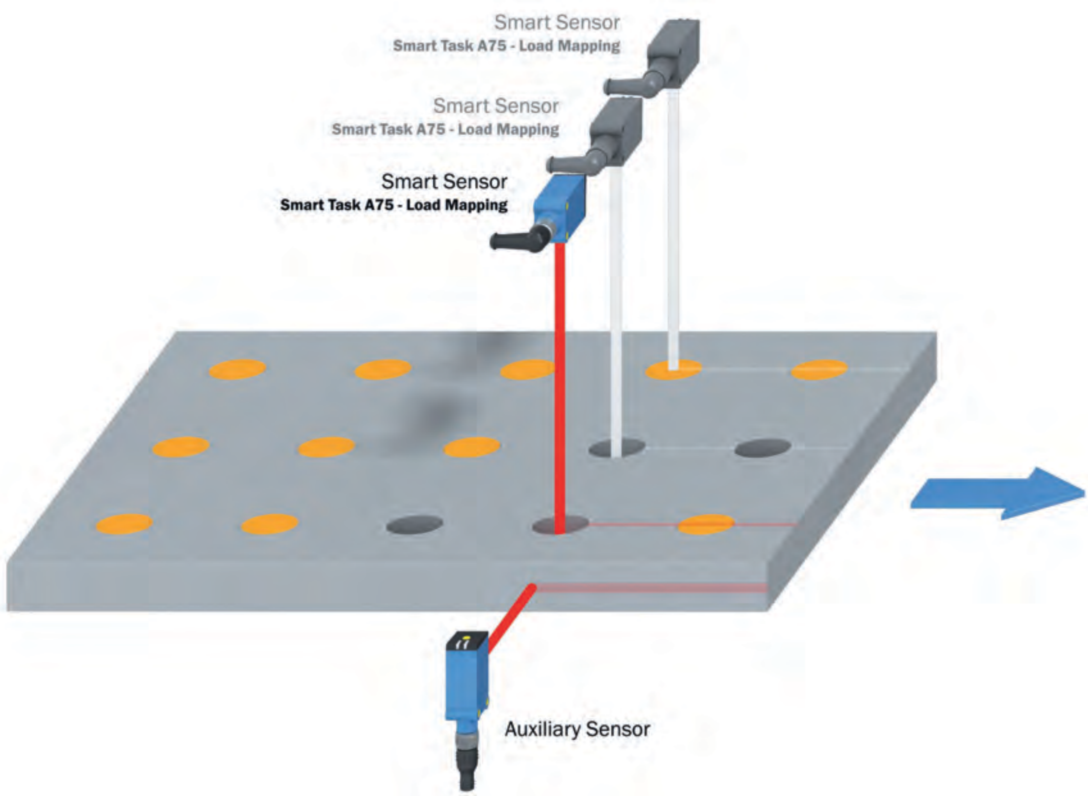


*Figure 14: Workpiece carrier for Inverse object detection, width*

**Midpoint** evaluation:

- In this mode, the center position of each object in the last read-in workpiece carrier is compared to the center positions of objects in the reference pattern.
- Wider or thinner objects (referring to their "detection width") whose center position match a center point position in the reference pattern are evaluated as present, valid objects at the respective positions.
- If the center position of one or several objects does not match the center positions in the reference pattern, this is interpreted as a false reading by the A75 Smart Sensor (**Reading failed** status).
- In comparison to the **Width** evaluation mode, the **Midpoint** evaluation mode offers higher read durability and therefore a lower risk of faulty reading.
- figure 15 Shows an example of how read-in signals are evaluated regarding the reference pattern in **Midpoint** evaluation mode:

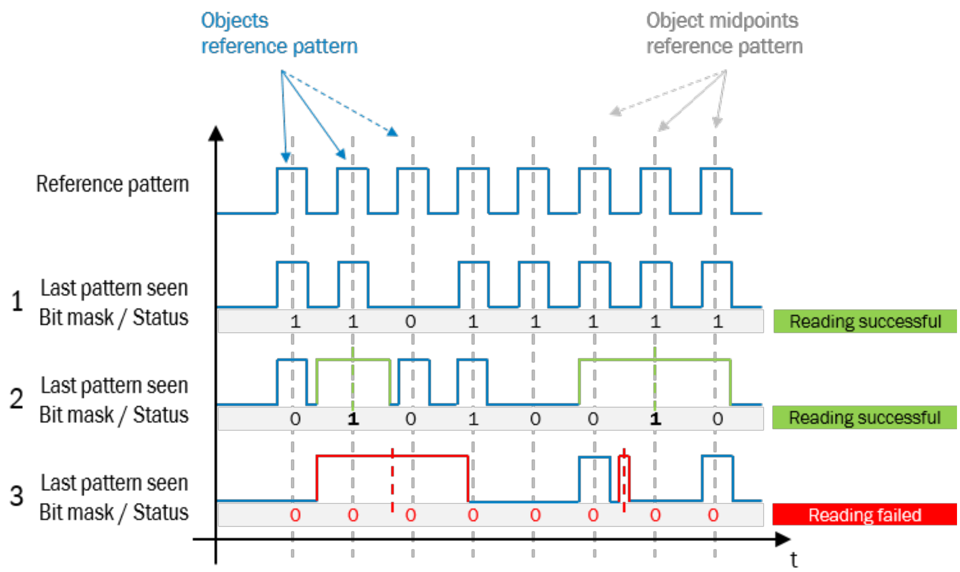


*Figure 15: Midpoint evaluation (Direct object detection) signal schema*

**Width** evaluation:

- In this mode, the width and position of each object in the last read-in workpiece carrier is compared to the width and position of objects in the reference pattern.
- Objects whose detection signal edges match the detection signal edges of the reference pattern concerning the width and position are evaluated as present, valid objects at the respective positions.
- If the detection signal edges do not match the reference pattern regarding the width and/or position, this is interpreted as a false reading by the A75 Smart Sensor (**Reading failed** status).
- Compared to the **Midpoint** evaluation mode, the **Width** evaluation mode is better at detecting incorrect loading in the workpiece carrier and outputting this as an error.
- figure 16 Shows an example of how read-in signals are evaluated in reference to the reference pattern in **Width** evaluation mode:

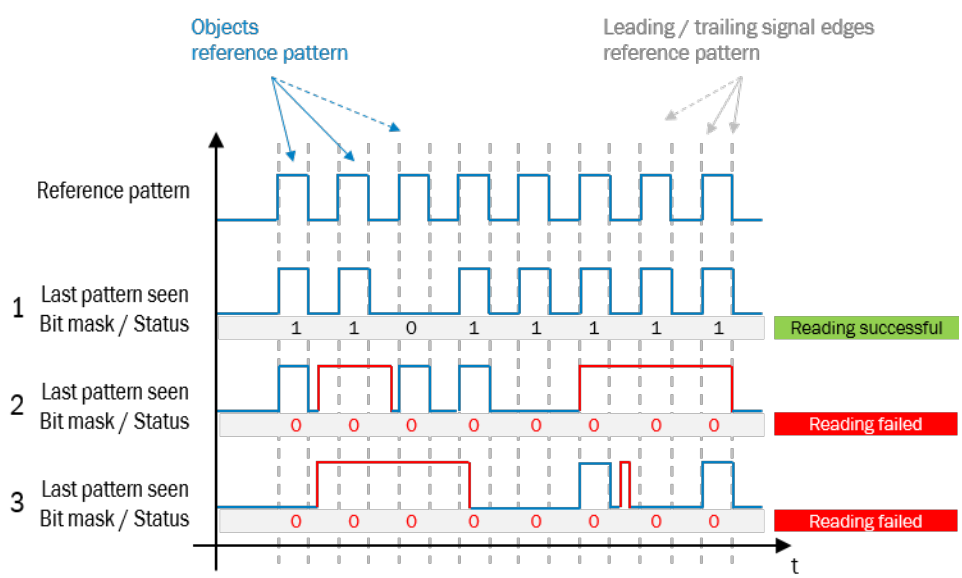


*Figure 16: Width evaluation (direct object detection) signal schema*

*Table 112: Smart Tasks - Pattern clipping*

| ISDU | | | Name | Data storage | Data type | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1147 | 47B | 0 | Pattern clipping | Record | yes | 2 byte | rw | - | |
| | | 1 | Number of clipped signal edges at pattern start | UInt | | 8 bits<br>(Offset 8 bit) | | 0 | 0<br>2<br>4<br>6<br>8 |
| | | 2 | Number of clipped signal edges at pattern end | UInt | | 8 bits<br>(Offset 0 bit) | | 0 | 0<br>2<br>4<br>6<br>8 |

The **Number of clipped signal edges at pattern start** or **Number of clipped signal edges at pattern end** parameters can be used to exclude from the evaluation up to eight detection signal edges (corresponds up to four objects) independently of each other at the beginning or end of the read-in pattern. **Pattern clipping** affects both the last read pattern as well as the reference pattern.

If in total more signal edges are cut off than the reference pattern shows, the **Invalid pattern clipping** (bit 8) status bit is set in the process data (logic 1). This is also the case when **Pattern clipping** is set, but there is no reference pattern. As long as the status bit is set, each workpiece carrier reading is rejected with the **Reading rejected** status message.

For example, **Pattern clipping** is necessary if the workpiece carrier is shaped so that the edge of the workpiece carrier is detected by the A75 Smart Sensor although the edge is not part of workpiece carrier loading. Example: see figure 17.

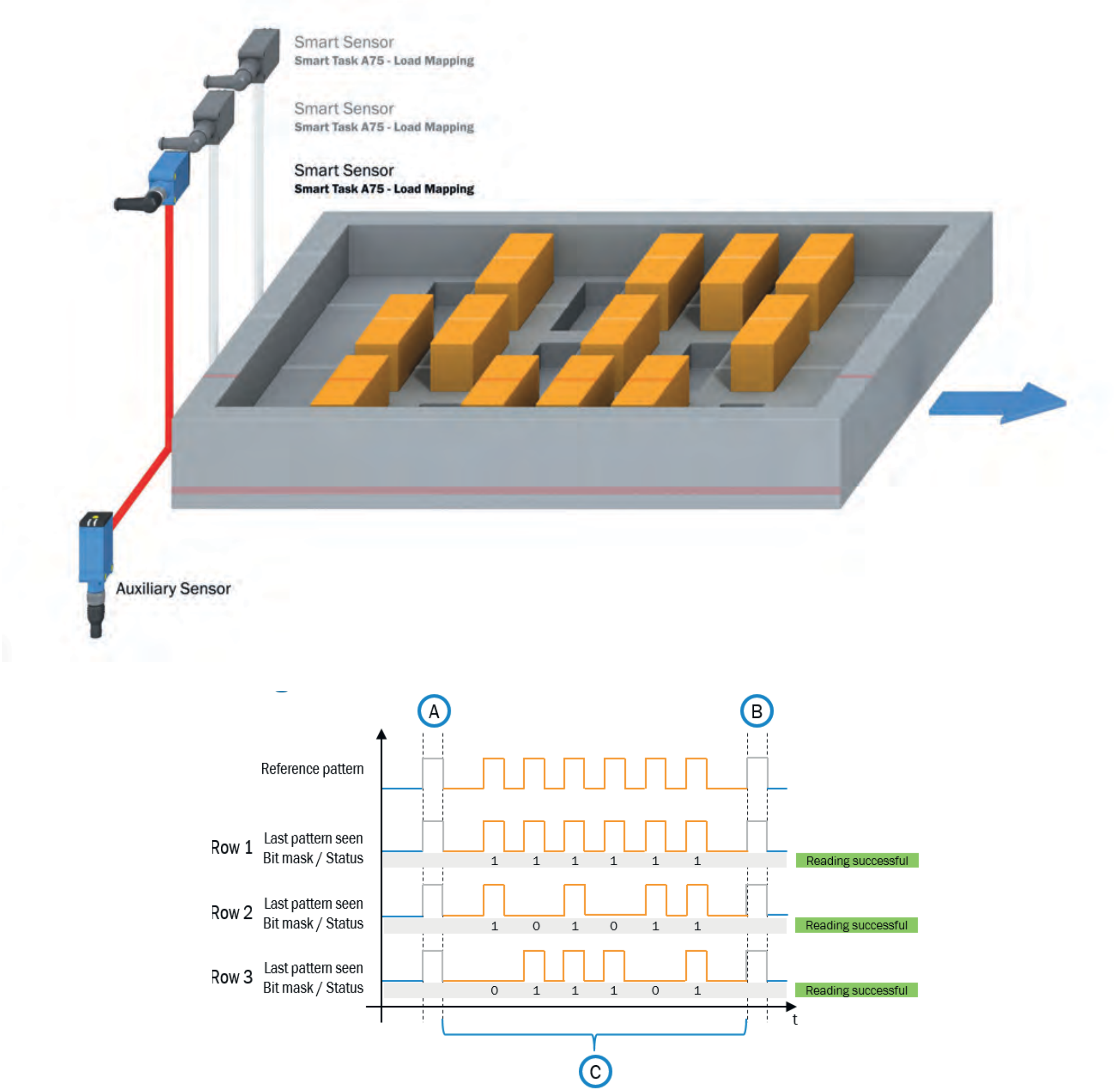


*Figure 17: Workpiece carrier and the associated signal schema with pattern clipping: Two signal edges each at the beginning and end of the pattern are cut off and are not included in signal evaluation*

*Table 113: Smart Tasks - Pattern tolerance*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1148 | 47C | - | Pattern tolerance | UInt | yes | 1 byte | rw | 1 | 0 = Fine<br>1 = Middle<br>2 = Coarse |

**Pattern tolerance** can be used to set how much deviation between the objects in the last read-in reference pattern compared to the reference pattern are still permitted before an error (**Reading failed**/**Recording failed** status) is output.

- Fine = Low error tolerance
- Middle = Medium error tolerance
- Coarse = High error tolerance

*Table 114: Smart Tasks - Measurement expiration time*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1149 | 47D | - | Measurement expiration time | UInt | yes | 2 byte | rw | 5000 | 500 ... 30000 ms |

The **Measurement expiration time** defines after which time the A75 Smart Sensor interrupts an ongoing load mapping reading. This is required if, for example, the workpiece carrier comes to a standstill during an ongoing reading. The time can be set so that the longest workpiece carrier moves past the sensors within the **Measurement expiration time** at the slowest feed speed. Time unit: Milliseconds [ms]

*Table 115: Smart Tasks - Status expiration time*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1150 | 47E | - | Status expiration time | UInt | yes | 2 byte | rw | 2000 | 0 ... 10000 ms |

The **Status expiration time** defines how long the measurement results are displayed after completion of workpiece carrier reading in the process data. After this time expires, the entire process data is reset to 0 (with the exception of bit 8: **Invalid pattern clipping**). Time unit: Milliseconds [ms]

*Table 116: Smart Tasks - Number of objects*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1151 | 47F | - | Number of objects in reference pattern | UInt | - | 1 byte | ro | - | 0 ... 32<br>255 |
| 1152 | 480 | - | Number of objects in last pattern seen | UInt | | 1 byte | | | 0 ... 32<br>255 |

These parameters specify the number of objects which are contained in the reference pattern and in the last seen pattern after **Pattern clipping**. If no number can be determined, value 255 is displayed.

**NOTE**

Dependency:

- **Pattern clipping** (ISDU 1147)
- **Reference pattern** (ISDU 1153)
- **Last pattern seen** (ISDU 1154)

*Table 117: Smart Tasks - Pattern*

| ISDU | | | Name | Data type | Data storage | Length | Access | Default value | Value/Range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 1153 | 481 | - | Reference pattern | Array | yes | 136 byte | rw | -0 | [full data range] |
| 1154 | 482 | - | Last pattern seen | Array | - | 136 byte | ro | - | [full data range] |

The **Reference pattern** describes the recorded reference pattern against which the last pattern seen is compared.

**Last pattern seen** describes the last read pattern of the workpiece carrier which last moved past the A75 Smart Sensor and the auxiliary sensor.

#### 7.9.6.1 Process data structure

*Table 118: Load mapping process data structure*

| Bit | Name | Description |
|---|---|---|
| Bit 0 | QL1 reference pattern identified | Bit switches to "1" if the **Last pattern seen** exactly matches the **Reference pattern**. |
| Bit 1 ... 7 | Qint.1 ... Qint.7 | Display of the current detection statuses of the A75 Smart Sensors on detection channels Qint.1 to Qint.7, if supported by the A75 Smart Sensor. |
| Bit 8 | Invalid pattern clipping | Bit switches to 1 if the current **Pattern clipping** is invalid in relation to the reference pattern. See ISDU 1147 for more details. |
| Bit 9 ... 12 | Status | Display of the current device status:<br>0 = Ready<br>1 = Recording<br>2 = Recording successful<br>3 = Recording failed<br>4 = Reading<br>5 = Reading successful<br>6 = Reading failed<br>7 = Empty carrier<br>8 = Reading rejected<br>9 = Pattern deleted |
| Bit 13 ... 23 | Reserved | --- |
| Bit 24 ... 31 | Number of objects in last pattern seen | See ISDU 1152. |
| Bit 32 ... 63 | Load mapping | Up to 24 objects positions can be monitored with the A75 Smart Sensor. Each bit corresponds to a (potential) loading position in the workpiece carrier: Bit 32 = position 1 ... bit 55 = position 24.<br>Bit value = 1 → object present<br>Bit value = 0 → no object present |

#### 7.9.6.2 Mounting and detection instructions

In the **Direct object detection, midpoint/widthoperating mode** (ISDU 1145), the A75 Smart Sensor and the auxiliary help sensor are aligned so that the detection signal of the auxiliary sensor switches to HIGH (= workpiece carrier detected/reading start) before the A75 Smart Sensor detects the first object on the workpiece carrier (rising signal edge). In addition, the detection signal of the auxiliary sensor must not switch to LOW (= workpiece carrier not detected/reading stop) until after the A75 Smart Sensor detects the last object on the workpiece carrier (falling signal edge). see figure 18.

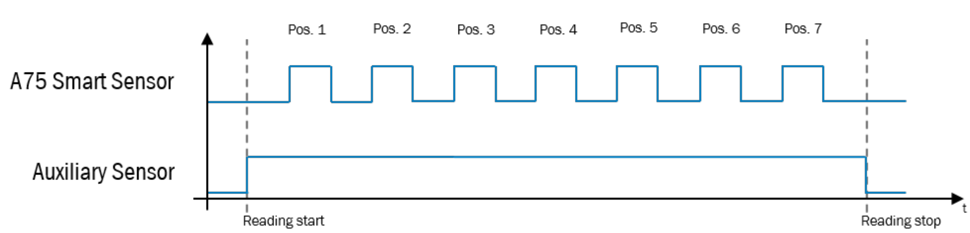


*Figure 18: Signal position of A75 Smart Sensor to auxiliary sensor (**Direct object detection, midpoint/ width** mode)*

In the **Inverse object detection, width** operating mode (ISDU 1145), the A75 Smart Sensor and the auxiliary sensor must be aligned so that the detection signals of both sensors switch to HIGH and LOW as simultaneously as possible when the workpiece carrier is extended or retracted. Slight shifts of the two signals of up to 500 ms can be balanced out by the A75 Smart Sensor. see figure 19.

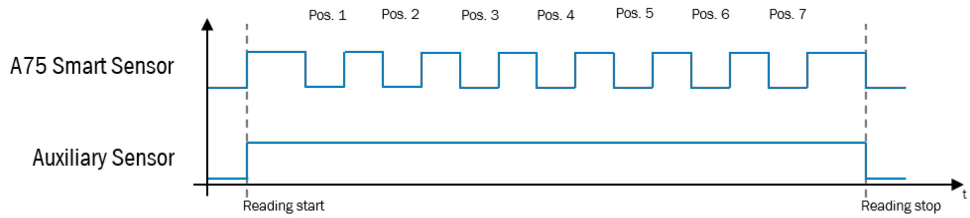


*Figure 19: Signal position of A75 Smart Sensor to auxiliary sensor (**Inverse object detection, width** mode)*

## 7.10 System-specific ISDUs

*Table 119: System-specific ISDUs – Profile characteristic*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 13 | D | - | Profile characteristic | String | - | 4 byte | ro | - | - |

**Profile characteristic** indicates which standardized profiles and functionalities the sensor supports.
The values are emitted in five 16-bit blocks.
At most, the following profiles / functionalities are supported:

1 PID (Profile Identifier) “Smart Sensor Profile”.
32768 Device Identification
The sensor supports enhanced identification options, see Identification chapter.
32769 Binary Data Channel
Using measured analog values, the sensor generates a switching signal and provides this in a specified manner (see ISDU 60/61 or 62/63).
32770 Process data variables
The sensor provides the measured analog value as an item of process data.
32772 The sensor supports teach-in methods to teach-in the sensor via the IO-Link interface.

*Table 120: System-specific ISDUs – PD descriptor*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/Range [1] |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 14 | 0E | - | PDInput Descriptor | Array | - | 10 byte | Read only | - | Octet String [2] |
| 15 | 0F | - | PDOutput Descriptor | Array | - | 5 byte | Read only | - | Octet String [1] |

1) Description of the process data

The **PDInput Descriptor** (ISDU 14) and the **PDOutput Descriptor** (ISDU 15) provide information about the data structure of the process data (input and output). The coding is described in the **Smart Sensor profile** specification.
Each part of the process data is described using 3 bytes.

Byte 1 Data type:
0: OctetStringT
1: Set of BoolT
2: UIntegerT
3: IntegerT
4: Float32T.
Byte 2 Length of the data in bits.
Byte 3 Bit offset of the corresponding process data variables in the process data.

*Table 121: System-specific ISDUs – SICK profile version*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 205 | 0E | - | SICK profile version | String | - | 4 byte | ro | - | - |

SICK sensors do not just fulfill the requirements of the IO-Link specification and the IO-Link Smart Sensor profile specification, but also the requirements of in-house profiles so as to ensure that all sensors of SICK can be operated in a similar manner. This ISDU specifies the applied version of the SICK profile.

*Table 122: System-specific ISDUs – Process data input*

| ISDU | | | Name | Data type | Data repository | Length | Access | Default value | Value/range |
|---|---|---|---|---|---|---|---|---|---|
| Index | | Sub-index | | | | | | | |
| DEC | HEX | | | | | | | | |
| 40 | 28 | - | Process data input | PD in | - | 2 byte | ro | - | - |

In this ISDU, the current process data is provided as an ISDU.
For further information see "Process data", page 9.

# 8 Events

IO-Link communication is a master-slave communication system.
With “Events”, an IO-Link device reports events to the master (without being prompted by the master). Device-specific events are classified as follows:

*Table 123: Device-specific events*

| | |
|---|---|
| Notification | For information purposes only; system is not restricted. |
| Warning | System is still functional, but is impaired in some way. You must rectify this with suitable measures as soon as possible. |
| Error | System is no longer functional. Depending on the cause of the error, it may be possible to restore functionality. |

An event issues an event code, which contains the cause of the occurrence of the event.

**NOTE**
Not all IO-Link masters support the event mechanism.
You can deactivate the generation of events on the device side in **Notification handling** (ISDU 227).

The following events are supported:

*Table 124: Events*

| Code | | Name | Type | Comment | Action |
|---|---|---|---|---|---|
| Dec | Hex | | | | |
| 36000 | 0x8CA0 | Short circuit on Qx | Warning | Triggered in the event of a short-circuit on at least one switching output.<br>Overcurrent detection. | Check device connection. |
| 36001 | 0x8CA1 | New parameters | Notification | Parameters have been amended (only when changing the sensing range using controls on the sensor housing or using the external teach-in via pin 2). | None |
| 36004 | 0x8CA4 | Quality of run alarm | Warning | Operational safety alarm | Clean the optical surfaces (sensor and reflector). |
| 36005 | 0x8CA5 | Teach/value out of specified range | Notification | Teach / distance value outside the specified range (too close, too far, no signal). | Readjust sensor or detection object and reteach. |
| 36006 | 0x8CA6 | Value out of specified range | Notification | Set value is outside the permissible range. | Correct adjustment value. |
| 36007 | 0x8CA7 | Teach-in necessary or teach-in error | Warning | Teach-in required<br>Teach-in error | Reteach. |
| 36008 | 0x8CA8 | Alarm upper temperature threshold | Warning | Upper temperature threshold exceeded. | Cool down sensor. |
| 36009 | 0x8CA9 | Alarm sender lifetime threshold | Warning | Alarm threshold for sender LED monitoring reached. | Prepare device exchange. |
| 36010 | 0x8CAA | Alarm maintenance prediction | Warning | Alarm threshold for maintenance request reached. | Prepare on-site service. |
| 36011 | 0x8CAB | Alarm operating hours | Warning | Alarm threshold for operating hours reached | Prepare on-site service or device exchange. |
| 36015 | 0x8CAF | Alarm lower temperature threshold | Warning | Lower temperature threshold exceeded. | Warm up sensor. |

# 9 List of abbreviations

*Table 125: List of abbreviations*

| | | |
|---|---|---|
| IODD | IO Device Description | Device description file of an IO-Link device |
| ISDU | Indexed Service Data Unit | Service data object in IO-Link |
| COM1<br>COM2<br>COM3 | SDCI communication mode | COM1 = 4.8 kbit/s<br>COM2 = 38.4 kbit/s<br>COM3 = 230.4 kbit/s |
| SDCI | Single-drop digital interface | Official (specification) name for IO-Link technology |
| SDD | SOPAS ET Device Description | Device description file / driver for SICK SOPAS ET software |

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## I

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