

Instruction Manual for ORQ8 / OTQ8 Sensors with IO-Link



Instruction Manual

ORQ8 / OTQ8 Sensors with IO-Link



Content

| | | |
|----------|--|-----------|
| 1 | Sensors covered by this manual | 3 |
| 2 | IO-Link Introduction | 3 |
| 2.1 | SIO / DI Mode Mode | 3 |
| 2.2 | IO-Link Communication Mode | 4 |
| 2.2.1 | Cyclic data | 4 |
| 2.2.2 | Acyclic data..... | 4 |
| 2.3 | IO-Link Device Description (IODD)..... | 5 |
| 2.4 | Off-Line Parametrization..... | 5 |
| 2.5 | Adjustable switching sensor (AdSS) | 5 |
| 3 | Sensor in the IO-Link Communication Mode..... | 6 |
| 3.1 | Signal Path | 6 |
| 3.2 | Process Data | 7 |
| 3.2.1 | Process Data-In | 7 |
| 3.2.2 | Process Data-Out | 8 |
| 4 | Parameter | 9 |
| 4.1 | System Commands | 9 |
| 4.2 | Measurement Data Channel (MDC) | 9 |
| 4.2.1 | Measurement Values | 9 |
| 4.2.2 | Switch Counts | 10 |
| 4.2.3 | MDC Source | 10 |
| 4.2.4 | MDC Descriptor | 10 |
| 4.3 | Configuration - Switching Signal Channel (SSC) | 11 |
| 4.3.1 | Setpoints SP | 11 |
| 4.3.2 | SSC Configuration | 12 |
| 4.3.3 | Timefilter | 15 |
| 4.3.4 | Counter / SSC4..... | 18 |
| 4.4 | Signal Processing | 20 |
| 4.4.1 | Measurement Mode (Only OTQ8)..... | 20 |
| 4.5 | Input/Output Settings..... | 20 |
| 4.5.1 | Switching Output..... | 20 |
| 4.6 | Local User Interface | 21 |
| 4.6.1 | Local Teach Settings..... | 21 |
| 4.6.2 | Indication LEDs..... | 24 |
| 4.7 | Quality Parameters | 25 |
| 4.8 | Device Access Locks | 25 |
| 5 | Teach Commands | 26 |
| 5.1 | Teach Channel Selection, TPO & Teach Status | 26 |
| 5.2 | Static..... | 27 |
| 5.2.1 | Single Point Mode: 1-Point Teach | 29 |
| 5.2.2 | Single Point Mode: 2-Point Teach | 30 |
| 5.2.3 | Window Mode: Window Teach | 30 |
| 5.3 | Dynamic | 31 |
| 5.3.1 | Dynamic in Single Point Mode..... | 31 |
| 5.3.2 | Dynamic in Window Mode | 32 |
| 6 | Diagnosis..... | 32 |
| 6.1 | Device Status..... | 32 |
| 6.2 | Device Temperature..... | 32 |
| 7 | Glossar | 33 |

1 Sensors covered by this manual

These instruction applies to all ORQ8 / OTQ8 sensors with IO-Link interface

2 IO-Link Introduction

IO-Link is an IO technology standardized worldwide according to IEC 61131-9. It permits manufacturer-independent digital, bidirectional point-to-point communication. For this purpose, sensors are connected to the IO-Link master via standardized 3-wire plug-in cables. IO-Link is available for various sensor technologies and can also be integrated into small miniature sensors.

With the IO-Link master, which bundles several sensors, the connection to the controller is made via the respective fieldbus system. In addition, an Ethernet-based connection (with OPC UA) from the master allows direct communication from the sensor to IT systems. IO-Link masters are available as field devices for decentralized mounting or as versions for mounting in control cabinets. Many control suppliers also offer IO-Link input terminals and thus an IO-Link master implemented directly on the control. The maximum cable length between sensor and master is 20 m. However, significantly longer connections from the sensor to the controller can be realized by connecting a field master to a field bus system. This gives them maximum flexibility in the connection solution.

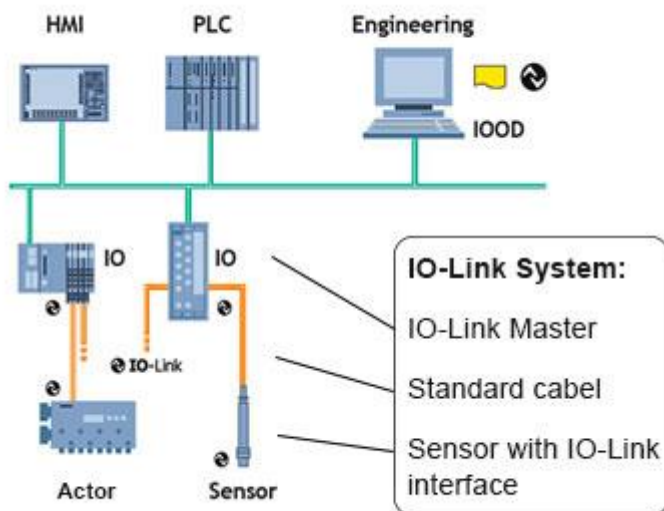


Figure 1 Example of a system architecture using IO-Link

2.1 SIO / DI Mode Mode

Each port of the IO-Link master can be operated either in SIO mode (standard in-out mode: according to the latest specification DI mode for sensors and DQ mode for actuators) or in IO-Link mode and thus process the information of all sensors. In SIO mode, the binary switching output (NPN, PNP or push-pull) of the sensor is used. In IO-Link mode, the output of the sensor (pin 4) is used as a bidirectional, digital interface to exchange measurement and diagnostic information.

2.2 IO-Link Communication Mode

The IO link communication mode is initiated by the master (PLC) with a standardized command sequence, this sequence is called “wake-up”. After successful completion of the wake-up sequence the IO link communication starts.

Data is the most important basis for process and product optimization. With the help of IO-Link, valuable additional data can be made accessible. Sensor and Master can exchange two different types of data (cyclic and acyclic data).

2.2.1 Cyclic data

Transmitted in real time. They are used for process control in the automation system. These can also be transferred to other IT systems via IO-Link.

2.2.2 Acyclic data

Through this data stream, sensors (IO devices) can be parameterized. Additionally this data stream also allows to transmit data for identification and analyzation. The figure below shows the different types of data and their value for the application.



Figure 2 Different IO Link data streams

2.3 IO-Link Device Description (IODD)

Each IO-Link Device has a device description file, the so-called IODD (IO Device Description). This contains data about the manufacturer, article number, functionality, software version etc., which can be easily read out and further processed by the automation system. Each device, i.e. each sensor, can be uniquely identified both via the IODD and via an internal device ID. The identification data of the sensor also includes device or application descriptions that can be freely assigned by the user. The IODD consists of several files: a main file and optional external language files (both in XML format), as well as image files (in PNG format).

2.4 Off-Line Parametrization

Off-line sensor parameter adjustment via convenient user interfaces in the PC (via USB Master) or via Wireless App (via Wireless Master). Sensors can be conveniently configured at the desk and installed without further teach-in.

Even if IO-Link is not implemented in the machine control, sensors can be operated in SIO mode and use this advantage

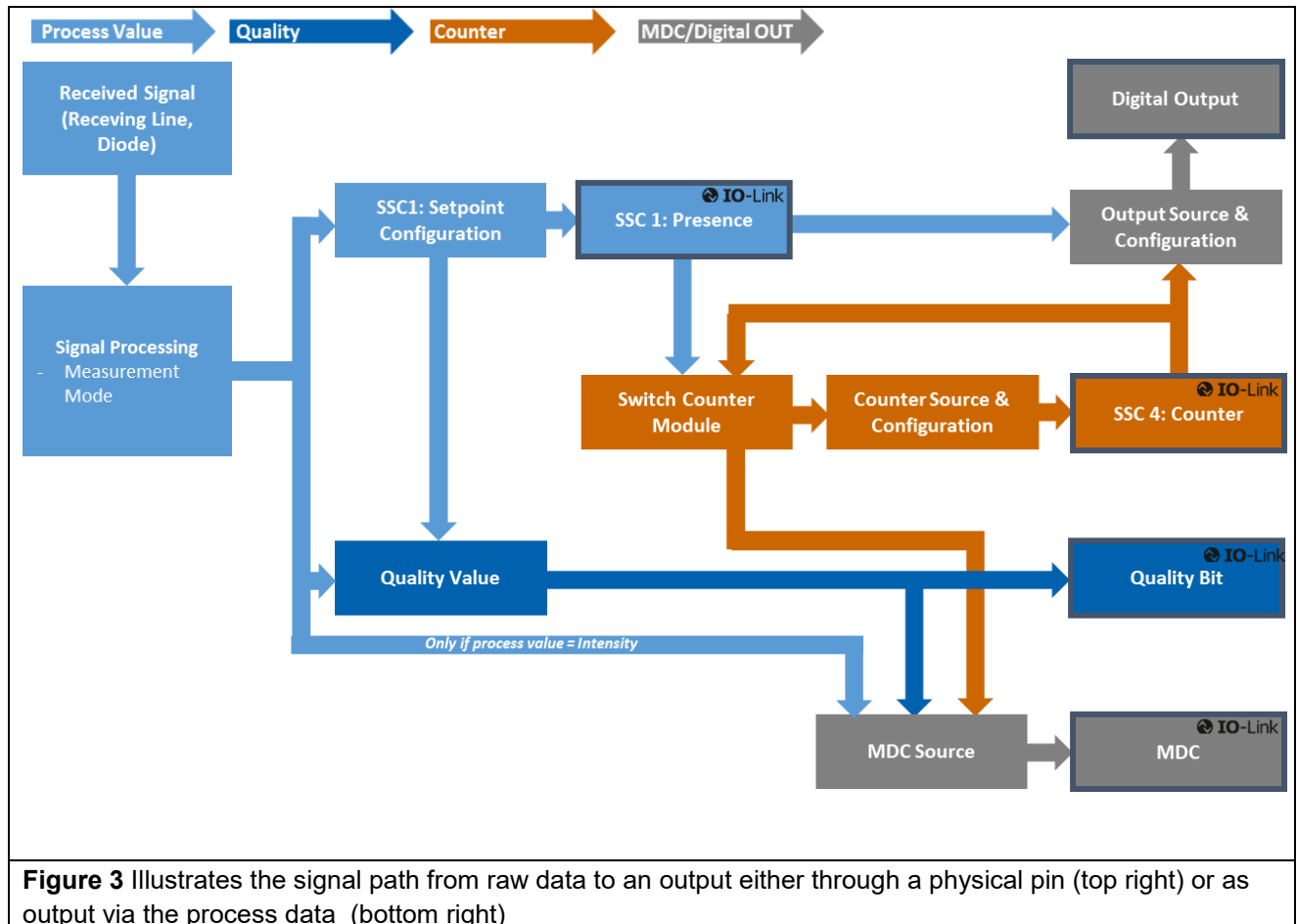
2.5 Adjustable switching sensor (AdSS)

Additionally, the sensors described in this manual can be operated as “adjustable switching sensors (AdSS)” according to the Smart Sensor Profile. When treated as AdSS the sensors-Master communications happens via a fully standardized command set. Thus operation without IODD file is possible.

3 Sensor in the IO-Link Communication Mode

3.1 Signal Path

The signal path describes the rough position of a parameter in the signal processing chain. The path starts with the measuring value in the top left corner and finishes either with a physical pin (top right) or as output via the process data (bottom right).



3.2 Process Data

With the sensor in the IO-Link communication mode, process data is cyclically exchanged between the IO-Link master and the device. Process data is exchanged to and from the sensor (Sensor \leftrightarrow Master). The master does not need to explicitly request these process data.

3.2.1 Process Data-In

Process Data-In is sent from the sensor to the master (Sensor \rightarrow Master).

| IO-Link Process Data Input | | | | | | | |
|--------------------------------|---|---------|-------|---|------|---|---|
| Bit: | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| SSC1 | | Quality | Alarm | | SSC4 | | |
| | | | | | | | |
| Bit: | | | | | | | |
| 16...31 | | | | | | | |
| Measurement Data Channel (MDC) | | | | | | | |

The Process Data Input is an 32bit string and structured according to the Smart Sensor Profile definition PDI32.INT16_INT8.

Bit 0: SSC1 (Switching Signal Channel 1)

This bit is the digital representation of a switching output.

Bit 0 = 0 \rightarrow No object is being detected (Logic: Normal)

Bit 0 = 1 \rightarrow An object is being detected (Logic: Normal)

See section 4.3 to learn how to configure this bit

Bit 2: Quality

The quality bit signals that the signal quality has fallen below the configured threshold.

It is directly connected to the weak signal indication LED (section 4.6.2)

See section 4.7 to learn how to configure this bit

Bit 3: Alarm

The alarm bit indicates that there is a detectable problem with the configuration or function of the sensor.

Bit 3 = 0 \rightarrow Sensor operates properly.

Bit 3 = 1 \rightarrow A problem with either the sensor configuration or function was detected.

Bit 5: Switching Signal Channel 4 (SSC4), Switch Counter Function

By configuring SSC4, it is possible to set up a binary signal related to the number of switchcounts of SSC1.

An auto-reset and timefilters are included, to be able to create a full-featured counter being able to count lot sizes without any need to code software on the PLC.

See section 4.3.4 to learn how to configure this bit.

Bit 8 to 15: Scale

Value is the exponent to the power of ten, applicable to the value of the Measurement Data Channel (MDC)

Example:

- Value of MDC 1000
- Unit m
- Scale -6
- Means $1000 \cdot 10^{-6} \text{ m}$ or $1000 \text{ } \mu\text{m}$

As ORQ8 / OTQ8 sensors only provide measuring values where no scale factor is required, the scale factor is set fixed to 0 (zero).

Bit 16 to 31: MDC / Measurement Value

MDC stands for measurement data channel. Via this channel the distance value or the switch counts of SSC1 or 4 can be read out as 16 bit integer value. See section 4.2 to learn how to configure the MDC.

3.2.2 Process Data-Out

This data is cyclically sent from the master to the sensor (Master→Sensor).

| IO-Link Process Data Output | | | | | | | |
|-----------------------------|---|---|---|---|---|---------------------------------------|----------------------|
| Bit: | | | | | | | |
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | | | | | | Find Me (Localization: LEDs flashing) | Disable Transmit LED |

Bit 0: Disable Transmit LED

If set to true, the transmission LED is deactivated. The sensor will not deliver a measurement or switching value. This can be useful to measure neighbouring sensors sequentially or to perform functional tests.

Bit 1: Find Me Function

Signalling e.g. by flashing LEDs on the sensor to locate and physically identify a sensor in a machine or system. The signalling can be triggered, for example, from the engineering tool of the controller.

4 Parameter

4.1 System Commands

A factory reset of the sensor activates the default parameters as programmed in the factory. All parameters changed by the user will be lost.

| Parameter name | Short Description | Rights | Unit / Allowed values |
|------------------|--------------------------|--------|-----------------------|
| Standard command | Restore Factory Settings | wo | |

4.2 Measurement Data Channel (MDC)

4.2.1 Measurement Values

| Parameter name | Short Description | Rights | Unit / Allowed values |
|---------------------------------|--|--------|-----------------------|
| Measurement Value.Intensity | Intensity measuring value (Only available for ORQ8) | ro | 0 ... 32000 |
| Measurement Value.Quality Value | The quality value represents the excess gain ration in % 100 = Exactly the amount of light needed for a switching operation 200 = Twice the amount of light needed OTQ8: Quality = Strength of received light / Strength required ORQ8: Quality = Intensity value / SSC1 SP1 | ro | 0 ... 32000 |

4.2.2 Switch Counts

For each individual SSC a switching counter is implemented, which can be used as diagnosis data or also as measurement value. The number of counts of each channel can also be mapped to the measurement data channel MDC by adjusting the MDC source. Trigger of counter is on positive slope of related SSC.

Note:

Each power up, the switch counts are being reset/start from 0.

| Parameter name | Short Description | Rights | Unit / Allowed values |
|--|--|--------|-----------------------|
| - SSC1 Switch Counts Reset - SSC4 Switch Counts Reset | Command to set the counter value of SSCn to zero. Available for SSC1 and 4. | wo | 32 Bit value |
| - Switch Counts.SSC1 Resettable - Switch Counts.SSC4 Resettable | Number of switching operations. Available for SSC1 and 4. | ro | 32 Bit value |

4.2.3 MDC Source

Selects which measuring value is mapped to the MDC channel and is then available via the process data-IN path. When SSC1, SSC2 or SSC4 is selected the number of switches detected by the channel is shown.

| Parameter name | Short Description | Rights | Unit / Allowed values |
|----------------------|---|--------|--|
| MDC Selection.Source | Defines the measuring value which is mapped to the MDC channel for availability via the process data-IN path. | ro | - Intensity (Only ORQ8) - Quality Value - Switch Counter SSC1 - Switch Counter SSC4 |

4.2.4 MDC Descriptor

This parameter allows to read out the limits of the measuring range of the sensor and unit. When the sensor detects values outside of this range, it will report an out of range value (32760).

| Parameter name | Short Description | Rights | Unit / Allowed values |
|----------------------------|---|--------|-----------------------|
| MDC Descriptor.Unit Code | Shows the unit of the selected MDC source | ro | |
| MDC Descriptor.Lower Limit | lower limit of the measuring range | ro | |
| MDC Descriptor.Upper Limit | upper limit of the measuring range | ro | |

4.3 Configuration - Switching Signal Channel (SSC)

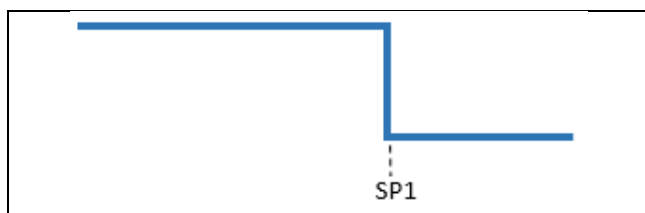
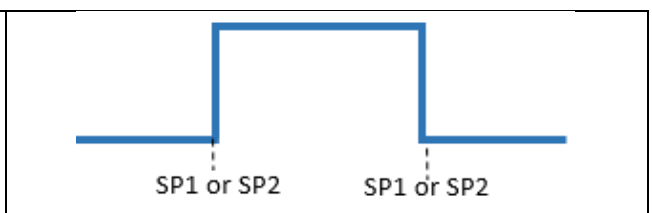
The sensor features two different switching channels. Switching Signal Channel SSC1 is reserved for object detection.

Switching Channel 4 includes a counter function with an auto-reset. All switching channels can be adjusted individually via IO-Link. All switching channels can be mapped to the MDC as well. Then they will show the counts detected by the channel.

For more information about how to set-up the Counter/SSC4 channel and its behavior, please see section 4.3.4.

4.3.1 Setpoints SP

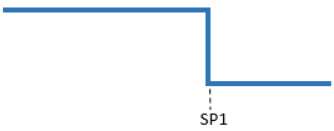
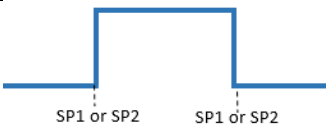
Using this parameter the user can modify the switchpoint of the sensor by enter the intensity (ORQ8) or distance value (OTQ8) at which the sensor should switch (teach-by-value function). **Figure 4** shows the illustration of the switching behavior. Regarding Single point mode only SP1 is relevant, SP2 is not active. For the Window mode SP1 & SP2 are active. The switching modes are explained in section Window mode is only available for the SSC1 of OTQ8 and for the SSC4/Counter.

| | |
|--|--|
|  |  |
| <p>Figure 4 Single Point Mode (OR / OTQ8) SP1: Switch point 1 SP2: Not active</p> | <p>Figure 5 Window Mode (Only OTQ8 or SSC4) SP1: Switch point 1 SP2: Switch point 2</p> |
| | |
| | |

| Parameter name | Short Description | Rights | Unit / Allowed values |
|----------------------------|---|--------|-----------------------|
| SSC1 Param.SP1 | Defines the value at which the related SSC is set to active (or inactive if inverted) | rw | |
| SSC1 Param.SP2 (Only OTQ8) | Defines the value at which the related SSC is set to inactive (or active if inverted) - only active if SSC is set to window mode | rw | |
| | | | |

4.3.2 SSC Configuration


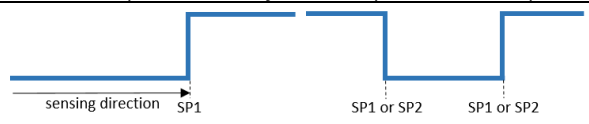
4.3.2.1 Switching Mode

| | |
|--|--|
|  |  |
| <p>Figure 7 Single Point Mode (OR / OTQ8)</p> <p>A single setpoint (SP1) is defined at which the sensor switches.</p> | <p>Figure 8 Window Mode (Only OTQ8)</p> <p>The sensor switches withing a range defined by two different setpoints (SP1 and SP2)</p> |
| | |
| | |

| Parameter name | Short Description | Rights | Unit / Allowed values |
|------------------|---------------------------------|--------|--|
| SSC1 Config.Mode | Selection of the switching mode | rw | <ul style="list-style-type: none"> - Disabled - Single Point - Window (Only OTQ8) |

4.3.2.2 Channel Logic

Allows to change the output logic from Normally Open (NO, Normal) to Normally closed (NC, Inverted).

| | |
|--|---|
|  <p>Single Point Mode Window Mode</p> |  <p>Single Point Mode Window Mode</p> |
| <p>Figure 10 «Normal» or NO setting</p> <ul style="list-style-type: none"> - The output is high, when the object is within the range defined by the setpoints. - The output is low when the object is not present outside of the range defined by the setpoints | <p>Figure 11 «Inverted» or NC setting</p> <ul style="list-style-type: none"> - The output is high when the object is not present outside of the range defined by the setpoints - the output is low, when the object is within the range defined by the setpoints |

| Parameter name | Short Description | Rights | Unit / Allowed values |
|-------------------|---------------------------------|--------|--|
| SSC1 Config.Logic | Changes the Logic from NO to NC | rw | <ul style="list-style-type: none"> - Normal (NO) - Inverted (NC) |

4.3.2.3 Hysteresis Alignment Mode (Only OTQ8)

In case of axial detection tasks like stop trigger or level detection, an accurate switching distance is required. To adapt the switching behavior and the hysteresis to the movement direction of the object, the alignment of the hysteresis can be changed.

Only available for O200.G sensors.

| Parameter name | Short Description | Rights | Unit / Allowed values |
|------------------------------|---|--------|---|
| Hysteresis.SSC1 Alignment | Selection of the alignment modes Available for SSC1. Default: Right aligned | rw | <ul style="list-style-type: none"> - Left Aligned - Center Aligned - Right Aligned |

4.3.2.3.1 Left Aligned

Left Aligned defines the hysteresis to be aligned towards the sensor / against the sensing direction.

When to apply?

- For an accurate switching distance in case the object is moving away from the sensor

| | |
|--|--|
| | |
| Figure 12 Left Aligned, Single Point Mode | Figure 13 Left Aligned, Window Mode |

4.3.2.3.2 Right Aligned

Right Aligned defines the hysteresis to be aligned away from the sensor / in sensing direction.

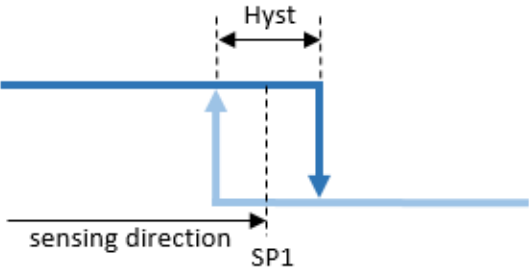
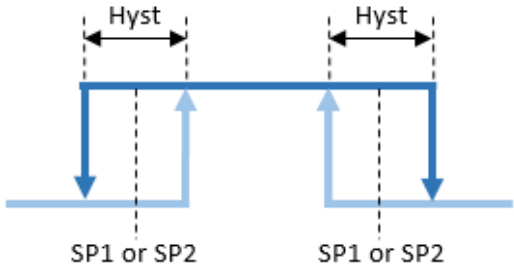
When to apply?

- For an accurate switching distance in case the object is moving towards the sensor.
 - o Example: Stop trigger application, usual detection tasks.

| | |
|---|---|
| | |
| Figure 14 Right Aligned, Single Point Mode | Figure 15 Right Aligned, Window Mode |

4.3.2.3.3 Center Aligned

A compromise between left and right aligned. The hysteresis is aligned symmetrical around the individual setpoints.

| | |
|---|--|
|  |  |
| Figure 16 Center Aligned, Single Point Mode | Figure 17 Center Aligned, Window Mode |

4.3.3 Timefilter

This changes the timing of the switching signals, for example to avoid bouncing/suppress false switching operation. The ability to directly parametrize and configure the timing on the sensor itself, removes the need to have additional coding on the PLC or to use pulse stretching adapters.

The described time filters can be configured and applied to each SSC individually.

4.3.3.1 Response Delay Time

The response delay time defines the time, the measurement value needs to be above (single point mode) or inside (window mode) the switchpoints of the related SSC until its status changes to active (or inactive, if the logic is inverted as described in section 4.3.2.1)

When to apply?

- To avoid the detection of small peaks/false switching operations due to structure changes of the background or similar.
- To avoid wrong switching of known disturbances such as the wheel of a mixer
- To avoid bouncing.
- To optimize the timing of the execution of a subsequent actor triggered by the output of the sensor.

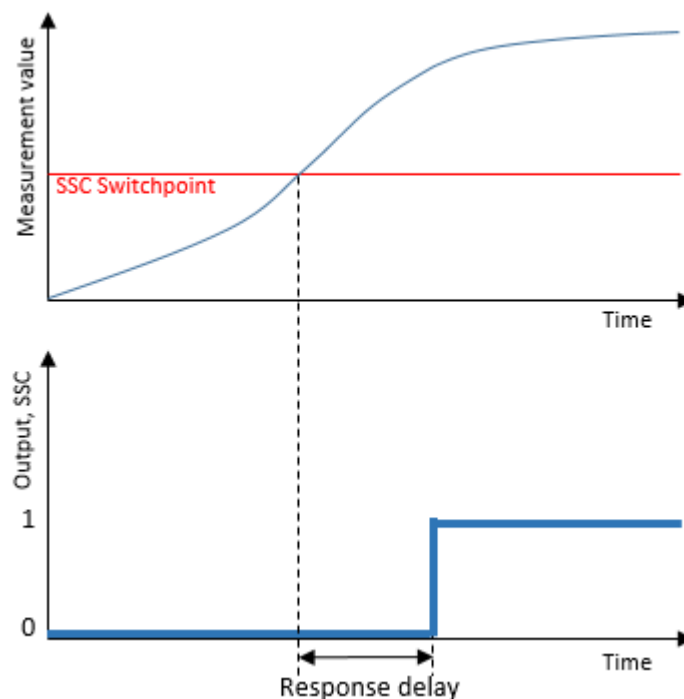


Figure 18: Response Delay

| Parameter name | Short Description | Rights | Unit / Allowed values |
|--------------------------|---|--------|-----------------------|
| Response Delay.SSC1 Time | Sets the response delay time, Available for SSC1 and SSC4 | rw | 0 to 60.000 ms |

4.3.3.2 Release Delay Time

The release delay time defines the time, where the measurement value needs to be below (single point) or outside (window mode) of the switchpoints of the related SSC, until its status is changed to inactive (or active, if the logic is inverted as described in section 4.3.2.1)

When to apply?

- To avoid false switching operations in case of an object which is not 100% stable to detect over the whole length
- To suppress short losses of a proper signal due to known disturbances such as the wheel of a mixer.
- To avoid bouncing.
- To optimize the timing of the execution of a subsequent actor triggered by the output of the sensor.
- To detect a unwanted gap size within a continuous flow of products.

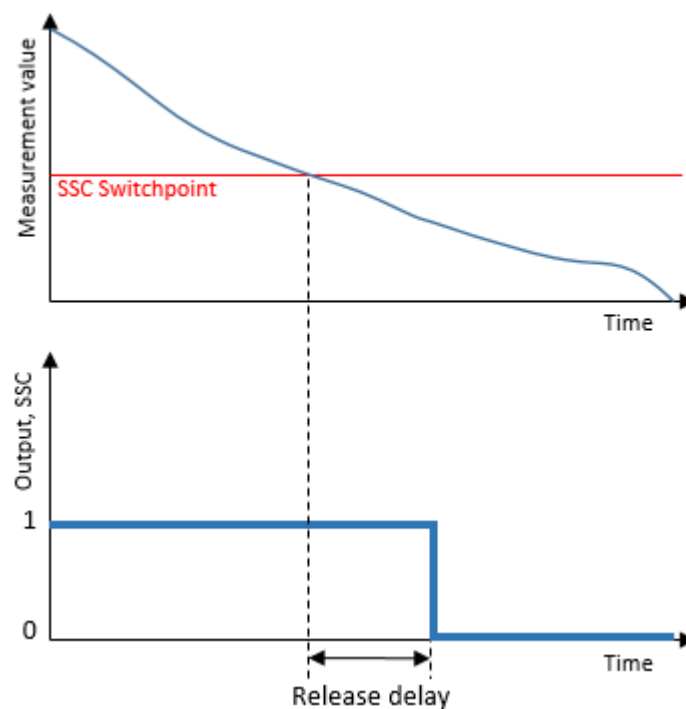


Figure 19: Release Delay

| Parameter name | Short Description | Rights | Unit / Allowed values |
|-------------------------|---|--------|-----------------------|
| Release Delay.SSC1 Time | Sets the release delay time, Available for SSC1 and SSC4 | rw | 0 to 60.000 ms |

4.3.3.3 Minimum Pulse Duration

The minimum pulse duration defines the minimum time, the switching signal of the related SSC stays active or inactive after the change of its status.

When to apply?

- To align the timing of the sensor to a slower PLC.
- To avoid bouncing.
- To avoid false pulses due to short losses of a proper signal.
- To straighten the clock / pace

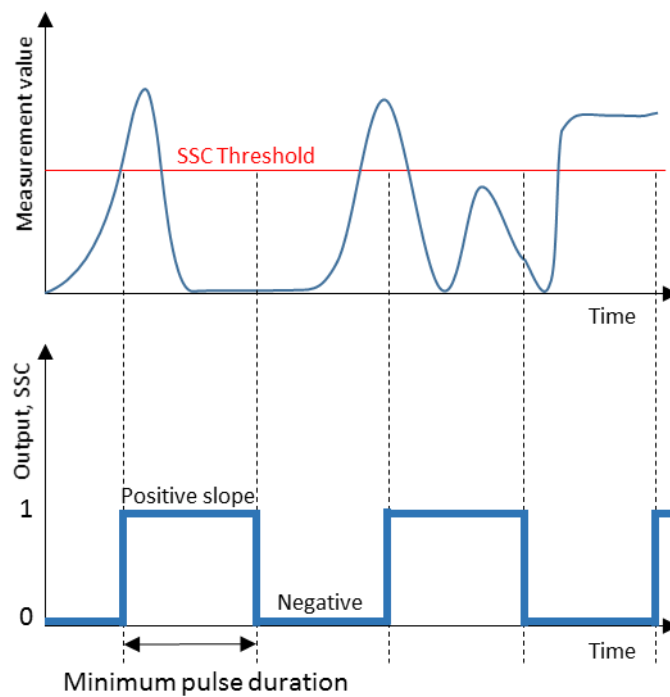


Figure 20 Minimum Pulse Duration

| Parameter name | Short Description | Rights | Unit / Allowed values |
|----------------------------------|--|--------|-----------------------|
| Minimum Pulse Duration.SSC1 Time | Sets the response delay time, Available for SSC1 and SSC4 | rw | 0 to 60.000 ms |

4.3.4 Counter / SSC4

For each individual SSC a switching counter is implemented, which can be used as diagnosis data or also as measurement value. The number of counts of each channel can also be mapped to the measurement data channel MDC by adjusting the MDC source (See section 4.2.3).

Trigger of counter is on positive slope of related SSC.

By configuring SSC4, it is also possible to set up a binary signal related to the number of switchcounts of SSC1. An auto-reset and timefilters are included, to be able to create a full-featured counter being able to count lot sizes without any need to code software on the PLC.

As all SSCs, SSC4 can also be mapped to the digital output giving the possibility to create a stand-alone lot-size counter.

In section 3.1, the signal path is described more detailed, to illustrate how the counter module is implemented. In section 4.3.4.2 the behavior depending on the configuration is explained.

4.3.4.1 SSC4 Configuration

In general the SSC4 offers the same features as the SSC1 and SSC2 based on distance (See 4.3.2), including also timefilters.

Exceptions:

- No hysteresis settings as there are only incremental counts.
- Additional parameters to adjust like *SSC4 Source* and *SSC4 Auto-Reset*.

| Parameter name | Short Description | Rights | Unit / Allowed values |
|--------------------|--|--------|-----------------------|
| SSC4 Setpoints.SP1 | Set the number of counts at which the SSC is set to active (or inactive if inverted) | rw | Counts / 0 to 32759 |
| SSC4 Setpoints.SP2 | Set the number of counts at at which the SSC is set to inactive (or active if inverted) <ul style="list-style-type: none">- only active if SSC is set to window mode | rw | Counts / 0 to 32759 |

| Parameter name | Short Description | Rights | Unit / Allowed values |
|------------------------|--|--------|---|
| SSC4 Config.Logic | Changes the Logic from NO to NC | rw | <ul style="list-style-type: none">- Normal- Inverted |
| SSC4 Config.Mode | Selection of the switching mode | rw | <ul style="list-style-type: none">- Single Point- Window |
| SSC4 Config.Source | Selection of source for counter function | rw | <ul style="list-style-type: none">- SSC1 Switch Counter |
| SSC4 Config.Auto Reset | Autoreset of switch counter if given switch counts are reached. If autoreset is switched from disabled to enabled, the selected switch counter-source is automatically being reset to zero. | rw | <ul style="list-style-type: none">- Enabled- Disabled |

| Parameter name | Short Description | Rights | Unit / Allowed values |
|----------------------------------|--|--------|-----------------------|
| Response Delay.SSC4 Time | Sets the response delay time, Available for SSC1, SSC2, SSC3 and SSC4 | rw | 0 to 60'000 ms |
| Release Delay.SSC4 Time | Sets the release delay time, Available for SSC1, SSC2, SSC3 and SSC4 | rw | 0 to 60'000 ms |
| Minimum Pulse Duration.SSC4 Time | Sets the response delay time, Available for SSC1, SSC2 , SSC3 and SSC4 | rw | 0 to 60'000 ms |

4.3.4.2 SSC4 Behavior

By enabling autoreset, a full-featured counter being able to count lot sizes can be created without any need of a manual reset.

Timefilters like *Response Delay* can help to optimize the timing of the execution of a subsequent actor.

Figure 21 illustrates the behavior of SSC4 using different setting. SSC4 source is hereby the switchcounter of SSC1.

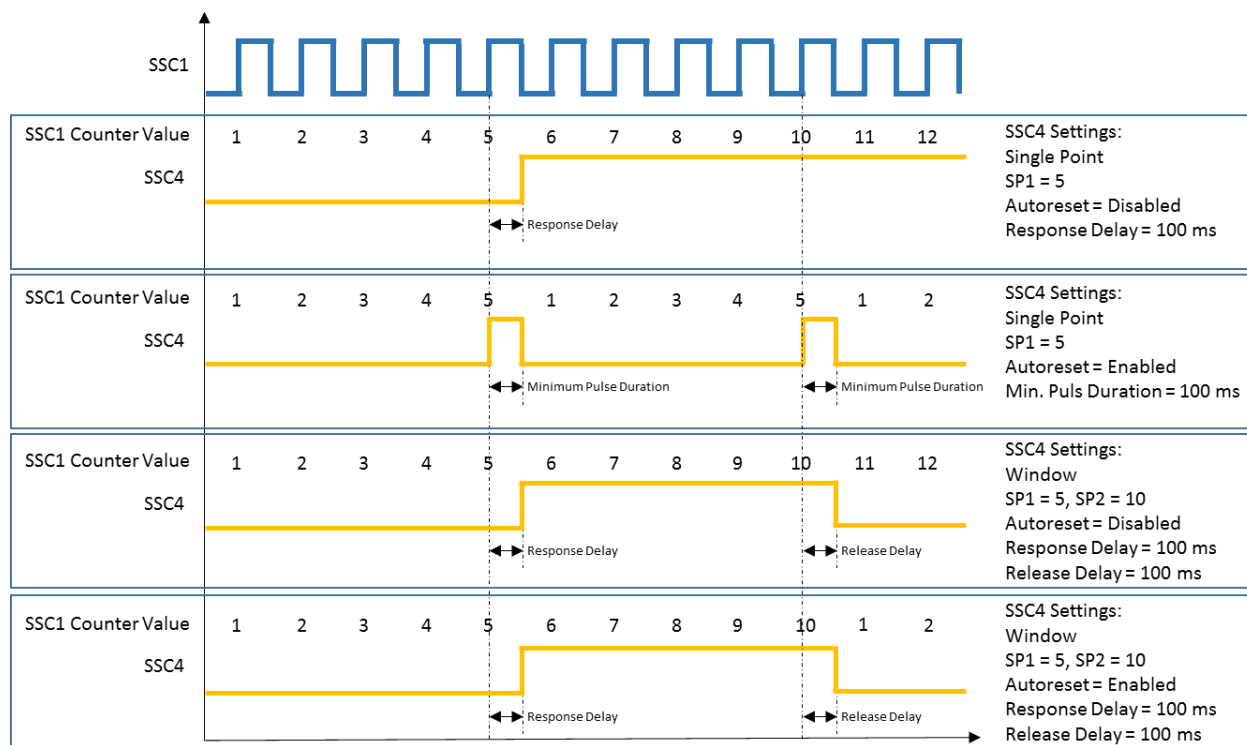


Figure 21 Behavior SSC4/Counter: Single-Point or Window, Autoreset enabled or disabled

4.4 Signal Processing

4.4.1 Measurement Mode (Only OTQ8)

With this parameter pre-defined modes can be selected to achieve optimal results without much trial and error.

| Parameter name | Short Description | Rights | Unit / Allowed values |
|------------------|--|--------|--|
| Measurement Mode | Choose measurement mode for different applications | rw | - High Speed - Standard - High Power |

High Speed:

Ideal for fast moving objects. Sensors is adjusted for fastest response time. Detection ability identical to Standard-Mode but with reduced ambient light immunity

Standard:

Standard setting with outstanding performance with the highest ambient light immunity.

High Power:

Twice the excess gain compared to Standard mode but with slower response time.
Reduced hysteresis due to better signal/noise ratio.

4.5 Input/Output Settings

4.5.1 Switching Output

| Parameter name | Short Description | Rights | Unit / Allowed values |
|-----------------------------|--|--------|--|
| DI/DO Settings.OUT1 Circuit | Selection of circuit type | rw | - PushPull (default) |
| DI/DO Settings.OUT1 Mode | Selection of output source (Default: SSC1) | rw | - None (SIO deactivated) - SSC1 (default) - SSC4 |

4.6 Local User Interface

Different parameters are available to configure the local user interface which means the indication LED and the qTeach availability or qTeach mode (Xpress vs Xpert, static vs dynamic)

4.6.1 Local Teach Settings

| Parameter name | Short Description | Rights | Unit / Allowed values |
|--|--|--------|--|
| Teach Lock Settings.Teach Lock Time This parameter is only applicable for the qTeach – the teach-in by wire is not affected / locked at any time. | Defines the time between power up and qTeach deactivation. 0: qTeach never locked 1 – 120 min: Accepted range 0xFF: qTeach always locked Default: 5 min | rw | 0 ... 120 min 0xFF |
| Teach Mode Settings.Teach Mode | Defines the teach mode for the qTeach and teach by wire. | rw | Xpert Static Xpress Static Xpert Dynamic Xpress Dynamic |

4.6.1.1 Local Teach: Teach Modes

Applicable for qTeach and for teach-in by wire

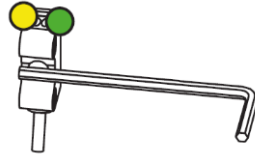


Figure 22: Teach-in activation by qTeach

The switching behavior depends if the switching mode is set to single point or window (only available for OTQ8).

For the behavior resulting based on the teach-in, please check section 5 and the following sub-chapters or section 4.3.2 how to adjust the switching mode or relevant parameters. (TPO, hysteresis, ...)

If the teach-in was not successful, is indicated by the LED flashing 8 Hz for 2 sec. Previous settings are restored.

If the teach-in was successful, the sensor turns in to operation mode.

| Mode | Level 1 | Level 2 |
|--|--|--|
| Xpert Static | 1 Point Teach Enter teach level by activating qTeach-in >2 .. <4 sec (Green LED flashes with 2 Hz) Tap qTeach to teach-in the position | 2-Point Teach Enter teach level by activating qTeach >4 ... <6 sec. (Yellow LED flashes with 2 Hz) Tap qTeach to teach the position of TP1 Tap qTeach again to teach the position of TP2 |
| Xpert Dynamic | Start: Enter teach Level by activating qTeach >2 .. <4 sec. (Green LED flashes with 2 Hz) Data acquisition starts after releasing teach-in Stop: Tap qTeach Accepted duration: 2 ... 15 sec | N/A |
| Xpress Static One Step Teach | Activate qTeach for >2 sec to teach-in the position (Green LED flashes with 2 Hz) | N/A |
| Xpress Dynamic One Step Teach | Start: Activate qTeach Stop: Release qTeach (Green LED flashes with 2 Hz) Accepted duration: 2 ... 15 sec | N/A |

| Mode | Level 3: Output Logic | Level 4: Factory Reset |
|--|---|--|
| Xpert Static | <p>Enter teach Level by activating qTeach >6 .. <8 sec. (Green & yellow LED flash with 2 Hz)</p> <p>Tap qTeach to change the logic indicated by the LEDs Green LED: Normal Yellow LED: Inverted</p> | <p>Enter teach level by activating qTeach >8 ... <12 sec.</p> <p>No further actions required</p> |
| Xpert Dynamic | <p>Enter teach Level by activating qTeach >6 .. <8 sec. (Green & yellow LED flash with 2 Hz)</p> <p>Tap qTeach to change the logic indicated by the LEDs Green LED: Normal Yellow LED: Inverted</p> | <p>Enter teach level by activating qTeach >8 ... <12 sec.</p> <p>No further actions required</p> |
| Xpress Static One Step Teach | N/A | N/A |
| Xpress Dynamic One Step Teach | N/A | N/A |

4.6.2 Indication LEDs

While the underlying functionality of the LEDs is in general well defined, it is possible to deactivate or to invert those.


| LED Indication | Legend | Operating Mode | EN |
|---|---------------------|------------------------------------|--------------------------|
|  | ● LED on | LED Indicators | Green |
| | ① LED flashing 1 Hz | Power on | ● |
| | ② LED flashing 2 Hz | Short circuit | ① |
| | ⑧ LED flashing 8 Hz | Output 1 active | ● |
| | | Output 1 signal close to threshold | ⑧ |
| | | Teach-in mode | see Teach-in Instruction |

Figure 23 LED Indication - Standard-behavior in operating mode

| Parameter name | Short Description | Rights | Unit / Allowed values |
|--------------------------|--|--------|-----------------------|
| LED Settings.Green Mode | Power on/short circuit | rw | On Off |
| LED Settings.Yellow Mode | Connected to output 1 - State - Signal close to threshold/weak signal The weak signal can be configured by using the quality bit (section4.7) Default: LED on if output is active | rw | On Off Inverted |

If the LED mode is set

- *On*, the behaviour of the related LED is as described in Figure 23.
- *Off*, the LED is deactivated except if the function Find Me is activated. (See section 3.2.2)
- *Inverted*, the LED behaviour is inverted to the definition in Figure 23.

4.7 Quality Parameters

The ORQ8 / OTQ8 sensors offers quality values to give an idea about the reliability or trend of the process based on the ratio of the current signal and the threshold or minimum required signal.

- Contamination indicaton
- Alignment indication
- Evaluation of process reliability

| Parameter name | Short Description | Rights | Unit / Allowed values |
|-----------------------|---|--------|-----------------------|
| Quality Value | Same value as described in section 4.2.1. The quality value represents the excess gain ration in % 100 = Exactly the amount of light needed for a switching operation 200 = Twice the amount of light needed OTQ8: Quality = Strength of received light / Strength required ORQ8: Quality = Intensity value / SSC1 SP1 | ro | |
| Quality Bit Threshold | Sets the threshold for the quality bit value in % which is mapped to the process data in (section 3.2.1) The quality bit is directly connected to the weak signal indication LED (section 4.6.2) Default: 150 | rw | |

4.8 Device Access Locks

| Parameter name | Short Description | Rights | Unit / Allowed values |
|-------------------------------|---|--------|-----------------------|
| Parameter (write) Access Lock | n/a | rw | True/False |
| Data Storage Lock | Deactivates the parameter server functionality / does not overtake values | rw | True/False |
| Parametrization Lock | n/a | rw | True/False |
| Local User Interface Lock | n/a | rw | True/False |

5 Teach Commands

By using teach commands, the setpoints of the switching signal channel SSC1 can be defined by teach-in the position of the object or reference.

Next to teach-by-value which can be applied as described in section 4.3.1, using teach commands makes it easy to compensate individual variations such as mechanical and mounting tolerances.

There are two different procedures available – static or dynamic – which can be individually chosen independent of the switching mode of the selected SSC

- Static: Defines the setpoints by teach-in the positions of non-moving objects
- Dynamic: For moving and small objects. Analyzes the minimum and maximum distances within a time frame to define the setpoints.

The teach-in procedures are described more detailed in section 5.2 (Static) and 5.3 (Dynamic).

The switching behavior of each switching signal channel depends on the configuration (Switching Mode, Channel Logic, ...) described in section 4.3.2.

5.1 Teach Channel Selection, TPO & Teach Status

The described teach commands can be applied to individual switching signal channels. Before proceeding with the teach-in procedure, make sure to select the SSC that should be addressed.

Furthermore different information are available to indicate the current mode and teach-in state of the selected switching signal channel to help to execute the right commands described in section 5.2 and 5.3.

| Parameter name | Short Description | Rights | Unit / Allowed values |
|---------------------------------|---|--------|---|
| TI.Select | Selects the SSC to which the teach-in will be applied | rw | SSC1 |
| Teach Point Offset.TPO [%] | Defines the offset used for the calculation of the setpoints. Affects the teach-in by IO-Link or qTeach/bywire. See the following chapters regarding the behaviour depending on the teach-modes | | % |
| Teach Status.Teach Flag SP1 TP1 | If Teach SP1 or Teach SP1 TP1 was performed, this flag is set to Taught | ro | Not Taught / Taught |
| Teach Status.Teach Flag SP1 TP2 | If Teach SP1 or Teach SP1 TP2 was performed, this flag is set to Taught | ro | Not Taught / Taught |
| Teach Status.Teach Flag SP2 TP1 | Only available for OTQ8 | ro | Not Taught / Taught |
| Teach Status.Teach State | Default: Idle | ro | 0 = Idle 1 = SP1 Success 2 = SP2 Success 3 = SP1&2 Success 4 = Waiting for Command 6 = Busy 7 = Error |

5.2 Static

By using teach commands, setpoint 1 and setpoint 2 (SP1 and SP2) can be set by placing the object at the desired position and triggering the command. Which command is used in which order varies depending on the active switching mode (Single-Point or Window) of the selected-teach channel and is explained in the following sections.

| Switching Mode | Teach Mode | Applicable for | Result |
|----------------|---------------|----------------|---|
| Single Point | 1-Point Teach | All | <p>Defines SP1 by teach-in only one position and adding a configurable offset to this position/value.</p> <p>OTQ8: Teaches the position of the object $SP1 = TP + TPO$</p> <p>ORQ8: Teaches the sensor hitting the reflector without any object in between. $SP1 = TP * TPO$</p> |
| Single Point | 2-Point Teach | OTQ8 ORQ8 | <p>Defines SP1 based on TP1 and TP2 for an optimized switching behaviour.</p> <p>OTQ8: Teaches the position of the object and of the background. $SP1 = (TP1 + TP2) / 2$</p> <p>ORQ8: Teaches the sensor hitting the reflector with and without an object in between $SP1 = \sqrt{TP1 * TP2}$</p> |
| Window | Window Teach | OTQ8 | Defines a window based on two positions |

| Parameter name | Short Description | Rights | Unit / Allowed values |
|----------------|---|--------|-----------------------|
| Teach SP1 | Sets SP1 at the current position of the object which is within the allowed range. In singlepoint mode, the teachpoint offset TPO needs to be considered. | wo | |
| Teach SP2 | Sets SP2 at the current position of the object which is within the allowed range. In singlepoint mode, the teachpoint offset TPO needs to be considered. | wo | |
| Teach SP1 TP1 | Command can be used to define SP1 based on TP1 and TP2 | wo | |
| Teach SP1 TP2 | Command can be used to define SP1 based on TP1 and TP2 | wo | |
| Teach Apply | Stores the teach in SP and sets the Teach State to idle | wo | |
| Teach Cancel | Aborts the on-going teach-in process | wo | |

5.2.1 Single Point Mode: 1-Point Teach

If the selected SSC is configured as Single Point mode (Section 4.3.2.1), following command sequence is required to teach-in SP1:

Command sequence:

- Place object (OTQ8), reflector (ORQ8) at desired position
- Execute *Teach SP1* to teach-in the position
- Execute *Teach Apply* to store the resulting setpoint

By executing *Teach Cancel* the teach-in procedure can be canceled at any state, as long *Teach Apply* has not been used before.

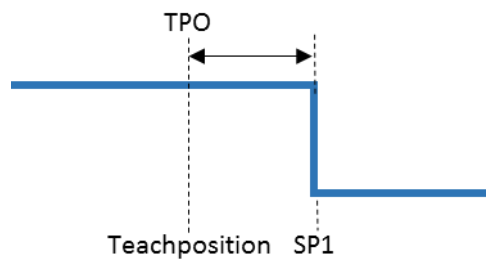


Figure 24: Single Point Teach, switching behavior

Figure 24 shows the switching behavior of the selected SSC if the teach-in was successful. In single point mode, the TPO/Teach Point Offset will be added on the teach-in value to define the setpoint.

OTQ8: $SP1 = TP + TPO$
ORQ8: $SP1 = TP * TPO$

5.2.2 Single Point Mode: 2-Point Teach

Defines SP1 based on TP1 and TP2 for an optimized switching behaviour.

OTQ8: Teaches the position of the object and of the background.

ORQ8:

Teaches the sensor hitting the reflector with and without an object in between

Command sequence:

- Place object at desired switching distance
- Execute *Teach SP1 TP1* to teach TP1
- Execute *Teach SP2 TP2* to teach TP2
- Execute *Teach Apply* to store the setpoint

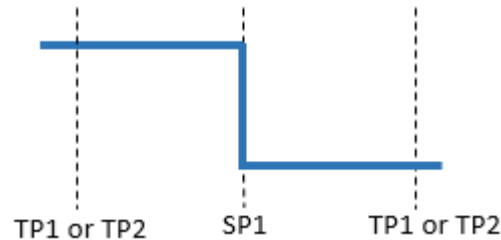


Figure 26: 2-Point Teach, switching behavior

OTQ8: $SP1 = (TP1 + TP2) / 2$

ORQ8: $SP1 = \sqrt{TP1 * TP2}$

5.2.3 Window Mode: Window Teach (Only OTQ8)

If the selected SSC is configured to Window mode (Section 4.3.2.1), following command sequence can be applied to teach-in SP1 and SP2:

Command sequence:

- Place object at desired switching distance
- Execute *Teach SP1* to teach-in the distance related to SP1
- Execute *Teach SP2* to teach-in the distance related to SP2
- Execute *Teach Apply* to store the setpoint

By executing *Teach Cancel* the teach-in procedure can be canceled at any state as long *Teach Apply* has not been used before.

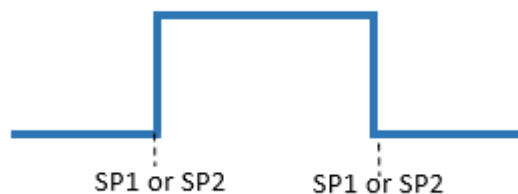


Figure 27: Window Teach, switching behavior

Which SP was taught at a higher distance does not have any influence on the switching behavior ($SP1 < SP2$, $SP1 > SP2$).

5.3 Dynamic

By using the dynamic teach-in commands, it is possible to define the setpoints by evaluating the minimum and maximum measurement values within a time frame. Accepted duration: 2 ... 15 sec.

When to apply?

- For moving and/or small objects

The command sequence to perform a dynamic teach-in is the same for all switching modes.

Command sequence:

- Execute *Dynamic Teach Start* to start the data acquisition
- Execute *Dynamic Teach Stop* to stop the data acquisition
- Execute *Teach Apply* to store the setpoint

By executing *Teach Cancel* the teach-in procedure can be canceled at any state as long *Teach Apply* has not been used.

| Parameter name | Short Description | Rights | Unit / Allowed values |
|------------------------|------------------------------|--------|-----------------------|
| Dynamic Teach SP Start | Starts the data acquisition. | wo | |
| Dynamic Teach SP Stop | Stops the data acquisition | wo | |
| Teach Apply | | wo | |
| Teach Cancel | | wo | |

5.3.1 Dynamic in Single Point Mode

If the selected SSC is configured to Single Point mode (Section 4.3.2.1), during the dynamic teach-in the minimum and maximum values are evaluated and the setpoint SP1 set to the middle

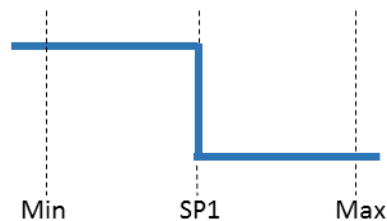


Figure 28: Dynamic Single Point Teach, switching behavior

OTQ8: $SP1 = (Min + Max) / 2$

ORQ8: $SP1 = \sqrt{Min * Max}$

5.3.2 Dynamic in Window Mode (Only OTQ8)

If the selected SSC is configured to Window mode (Section 4.3.2.1) during the dynamic teach-in the minimum and maximum values are evaluated. Setpoint SP1 is set to Min, SP2 is set to Max.

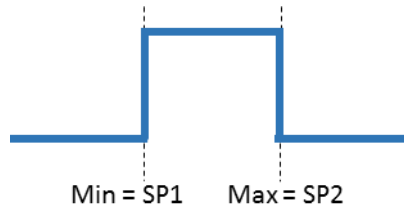


Figure 29: Dynamic Window Teach, switching behavior

6 Diagnosis

In addition to solving the primary application, the simple evaluation of secondary data, such as temperature, supply voltage or operating time, allows for predictive maintenance and thus optimum machine availability.

6.1 Device Status

| Parameter name | Short Description | Rights | Unit / Allowed values |
|------------------------|---|--------|---|
| Device Status | Indicates if the sensor is working properly | ro | 0=Device is OK 2=Out of Specification 4=Failure |
| Detailed Device Status | | ro | |

6.2 Device Temperature

An integrated temperature sensor allows to track the internal temperature of the sensor.

Please be aware that compared to the ambient temperature the indicated values are higher due to the internal heating of the sensor.

The temperature may also vary due to mounting conditions and due to the electric load connected to the output.

| Parameter name | Short Description | Rights | Unit / Allowed values |
|----------------------------|--|--------|-----------------------|
| Device Temperature.Current | | ro | |
| Unit Selection.Temperature | Choice of temperature unit (Default: °C) | rw | °C, °F, K |

7 Glossar

| | |
|------|-----------------------------|
| wo | Write only access |
| rw | Read and write access |
| ro | Read only access |
| SSC | Switching Signal Channel |
| MDC | Measurement Data Channel |
| SP | Switching Point |
| AdSS | Adjustable switching sensor |
| | |
| | |

