TECHNICAL INFORMATION

PSS

SICK Smart Sensors/IO-Link

Device configuration – Advanced operating instructions

SICK
Sensor Intelligence.

SMART SENSORS
IO-Link

Product described

PSS

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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 principle of operation: PSS.

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 5).
The specific functional scope of an individual sensor is described in full in the **Supplement 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 SICK's YouTube channel, you can find some 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 (see table below). 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.

Table 1: Physical layer – System data

SIO mode	Yes
Min. cycle time	4.3 ms
Baud rate	COM 2 (38.4 kbit/s)
Process data length PD in (from device to master)	2 bytes
IODD version	V1.1
Supported IO-Link version	V1.1
Supports block-parametrization	Yes

6 Process data

Process data is transmitted cyclically. There is no confirmation of receipt.
The master determines the cycle time; however, this must not be less than the minimum cycle time of the sensor ("figure X").

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

Table 2: Process data structure

Byte offset	Byte 1								Byte 0							
Bit offset	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Quality of print										Reserved			Q_1 valid	Reserved	Q_1
	Value range = 0 … 100													0 = OFF 1 = ON		0 = OFF 1 = ON

6.1 Quality of print

After each reading taken by the PSS sensor, the quality of print is calculated and output. This quality indicator reflects the degree of detection of the taught-in pattern.

100% Read pattern is identical to the taught-in pattern
50% Only half of the read pattern reflects the taught-in pattern
0% No overlap detected between taught-in and read pattern

6.2 Q1 valid

The bit indicates whether the current quality of print and Q1 are valid.

0 During pattern reading and while the quality calculation is being executed, the switching output is invalid
1 When the quality calculation is complete, the output values are valid

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 service data is designated as ISDUs. Using an ISDU, you can change the configuration or read out information about the status of the sensor.

The respective counterpart confirms receipt of the data.

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

7.1 Device identification

7.1.1 Device identification

Table 3: Device identification

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
16	10	-	Vendor name	String	-	7 byte	ro	SICK AG	
17	11		Vendor text			64 byte		www.sick.com	
18	12		Product name			30 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** is also 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.

To make it possible to provide a family IODD for a device family, the Product ID can be found under Device identification (ISDU 219) for SICK IO-Link devices.

Furthermore, the part numbers for the components associated with the system are filed in sub-index 2...x for sensors.

7.1.2 Product text and serial number

Table 4: Device identification – Product text/serial number

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
20	14	-	Product text	String	-	64 bytes	ro	“PSS”	
21	15		Serial number			8 bytes			

Format of the serial number:
YYWWnnnn (Y = year, W = week, n = sequential numbering)

7.1.3 Definable names

Table 5: Device identification – Specific tag / name

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
24	18	-	Application-specific tag	String	yes	32 byte	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.

7.1.4 Hardware and firmware version

Table 6: Device identification – Version

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

This ISDU indicates the hardware and software versions.

7.1.5 Find me

Table 7: Device identification – Find me

ISDU			Name	Data type	Data repository	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 1 = Find me activated, yellow LED flashes at 1 Hz 16 = Find me activated, yellow LED + Q_1 (pin 2) flashes at 1 Hz

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.

To identify the switching output (pin 2) in the control cabinet, you can also activate or deactivate the digital output at pin 2 by writing the value 16.

! **NOTICE**
Observe the effect of the output activation and deactivation on the connected system.

7.2 General device settings

7.2.1 Pin 2 configuration

Table 8: General device settings – Pin 2 configuration

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
121	79	-	Pin2 configuration	UInt	yes	1 byte	rw	32	0 = Deactivated 17 = External teach-in 32 = Switching output Q

Assignment options for pin 2 of the PSS:

0	**Deactivated**	Pin 2 in high-impedance state.
17	**External teach-in**	Pin 2 functions as a digital input for teaching-in the sensor.
32	**Switching output Q**	Pin 2 functions as an additional digital switching output (Q_1). There is no option to teach-in a separate switching threshold. (Function not available or pin 5) Particularly with constant IO-Link communication via pin 4, it is advisable to configure the quick switching output (50 kHz) to pin 2 in order to continue to benefit from the quick switching frequency.

7.2.2 Key lock

Table 9: General device settings – Device access locks

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range	
Index		Sub-index								
DEC	HEX									
12	0C	-	Device access locks (key lock)	Record	yes	2 byte	rw	-	Bit no.	
									0	Not available
									1	0 = Data Storage released 1 = Data Storage locked
									2	0 = Keys released 1 = Key lock (can only be reset via IO-Link)
									3	0 = Keys released 1 = Key lock (can be reset via display keys)
									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**	You can lock the Data Storage functionality using bit 1. When the bit is set, the sensor rejects **Data Storage** write requests from the IO-Link master with an error message.
Bit 2	Key lock Local parameterization	You can completely lock the controls on the sensor using bit 2 (key lock). When the bit is set, all keys are locked. The lock can **only** be reset via IO-Link.
Bit 3	Key lock Local user interface	You can completely lock the controls on the sensor using bit 3 (key lock). When the bit is set, all keys are locked. In this case, you can deactivate the lock by pressing the ± key for 10 seconds.

7.2.3 Display orientation

Table 10: General device settings – Display orientation

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
117	75	-	Display orientation	UInt	yes	8 bit	rw	0	0 = Standard 1 = Upside down

If the installation position of the device makes it difficult to read from the segment display, the display can be rotated by 180°.

7.2.4 Disable sender light source

Table 11: General device settings – Sender light source

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
97	61	-	Disable sender light source	UInt	-	8 bit	rw	0	0 = Sender active 1 = Sender inactive

The sender LED can be switched off using this ISDU.

! **NOTICE**
When the sender LED is switched off, the process data and switching output will not function.

7.2.5 Restore factory settings/reset

Table 12: General device settings – Restore factory settings

ISDU Index DEC	ISDU Index HEX	Sub-index	Name	Data type	Data repository	Length	Access	Default value	Value/range
2	02	-	Standard command	UInt	-	8 bit	ro		128 = Device reset 130 = Restore factory settings

Device reset The sensor performs a restart.
Restore factory settings The sensor is reset to factory settings.

7.2.6 (De)activate events

Table 13: General device settings – Notification handling

ISDU Index DEC	ISDU Index HEX	Sub-index	Name	Data type	Data repository	Length	Access	Default value	Value/range
227	E3	-	Notification handling	UInt	-	8 bit	rw	0	0 = All enabled 1 = All disabled

With this ISDU, you can switch off the generation of sensor IO-Link events.

7.3 Teach-in / detection settings

7.3.1 Configuration Q_1 / inversion

Table 14: Teach-in/detection – Switchpoint

ISDU Index DEC	ISDU Index HEX	Sub-index	Name	Data type	Data repository	Length	Access	Default value	Value/range
61	3D	-	Configuration Qint 1	Record	yes	4 bytes	rw		
		1	Switchpoint logic/inversion	Bit (0)		8 bit		128	0 = Q_1 active on match 1 = Q_1 active on mismatch
		2	Switchpoint mode	Bit (8)		8 bit		1	1 = single point mode
		3	Switchpoint hysteresis	Bit (16)		16 bit		0	0 = Vendor-specific default (not editable)

Switchpoint logic The switching output logic (inversion) can be configured so that the switching output is activated following successful detection of the pattern (positive detection) or so that it is activated when the pattern is not detected (negative detection). This inversion of the switching logic takes place upstream of the integrated timer module.
Switchpoint mode The switchpoint mode indicates the current work mode of the sensor. There is no option to edit this information.
Switchpoint hysteresis Switchpoint hysteresis is preset at the factory and cannot be changed.

7.3.2 Switching output inversion

Table 15: Smart Tasks – Inverter

ISDU Index DEC	ISDU Index HEX	Sub-index	Name	Data type	Data repository	Length	Access	Default value	Value/range
1089	441	-	Inverter Q_1	UInt	yes	8 bytes	rw	0	0 = Not inverted 1 = Inverted

Inverter for digital switching output. This inverter is positioned downstream of the timer.

7.3.3 Switch-on and switch-off delay/impulse generator

Table 16: Teach-in/detection – Timer 1 mode

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
1085	43D	-	Timer 1 mode	UInt	yes	8 bit	rw	0	0 = Inactive 1 = ON delay 2 = OFF delay 3 = ON&OFF delay 4 = Impulse

The PSS has a switch-on and switch-off delay (Delay) and an impulse generator.
Impulse is set by default.
You can individually select the different delays using this ISDU.

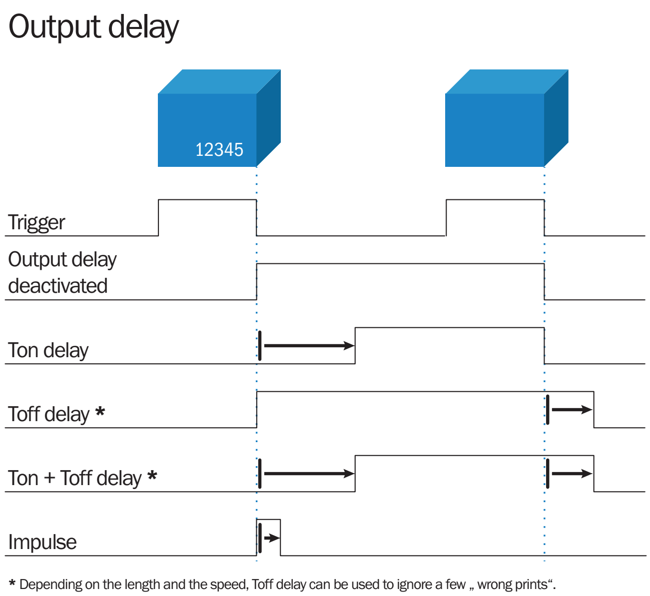


Figure 1: Ein- und Ausschaltverzögerung

NOTE
The selected delay affects the Q1 bit in the IO-Link process data.

NOTE
Dependency: You must set the duration of the selected delay in **Timer 1 setup** (ISDU 1087).

Table 17: Teach-in / detection – Timer 1 setup

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
1087	43F	-	Timer 1 setup	UInt	yes	16 bit	rw	10	1 ... 30000

The duration of the delay function defined in **Timer 1 mode** (ISDU 1085) is specified here in ms (milliseconds).

7.3.4 Trigger input delay

Table 18: Trigger input teach-in/delay

ISDU Index DEC	ISDU Index HEX	ISDU Sub-index	Name	Data type	Data repository	Length	Access	Default value	Value/range
161		-	Ton timer mode	UInt	yes	8 bit	rw	0	0 = deactivated 1 = Ton delay 2 = Toff delay 3 = Ton + Toff delay 4 = Ton delay + impulse
162			Ton input delay	UInt	yes	16 bit	rw	1	1...30,000 [ms]
163			Toff input delay/impulse length	UInt	yes	16 bit	rw	1	1...30,000 [ms]

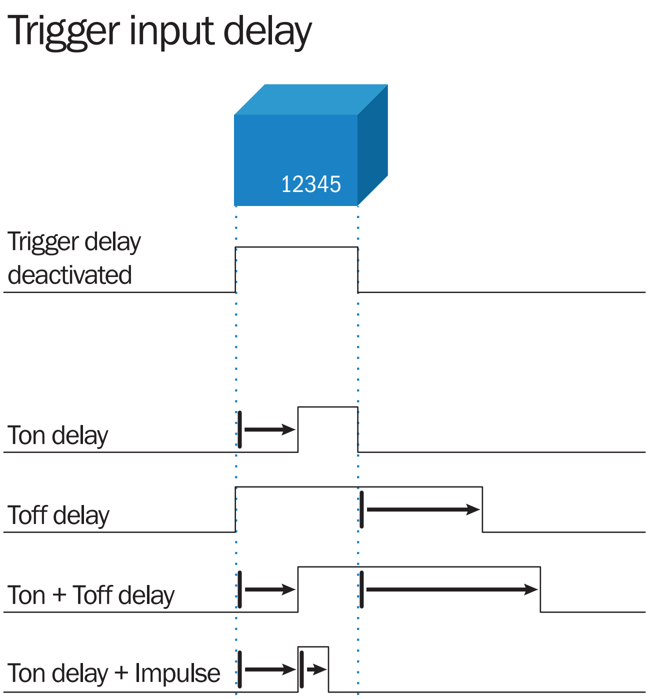


Figure 2: Ein- und Ausschaltverzögerung

The trigger input delay option allows you to delay (Ton delay) or extend (Toff delay) the digital input signal, or to generate a specific length (impulse) from this signal. The switch-on delay delays the incoming trigger signal by the duration indicated in index 162 in milliseconds (trigger is delayed). The switch-off delay extends the trigger impulse by the duration indicated in index 163 in milliseconds. The combination of switch-on delay and impulse generator can be used to delay a trigger signal (duration in index 162 – can also be set to 0 ms) and to assign a defined length to the signal (duration in index 163).

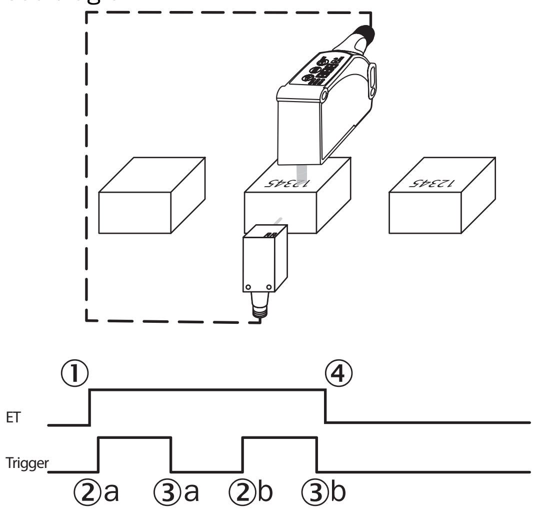
7.3.5 Teach-in

Table 19: Teach-in/detection – Teach command

ISDU Index DEC	ISDU Index HEX	ISDU Sub-index	Name	Data type	Data repository	Length	Access	Default value	Value/range
2	02	-	Standard command – Teach command	UInt	-	8 bit	ro		71 = Start teach-in (background + print) 73 = Start teach (print only) 79 = Abort teach sequence 226 = Trigger window start 227 = Trigger window stop

Start teach-in (background + print)

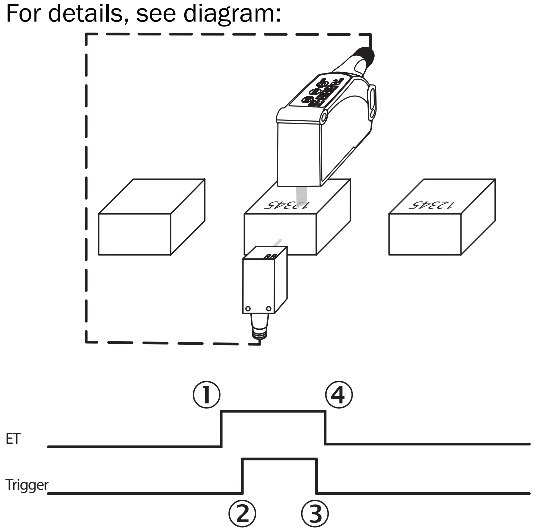
When the value 71 is written to index 2, the teach-in process for the pattern to be detected begins. In this case, the background must be taught-in first, followed by the pattern to be detected. For teach-in to begin, the PSS sensor must be triggered via the trigger input (pin 5) or by writing the system commands “Trigger window start” and “Trigger window stop”. For details, see diagram:



① Start teach (background + print) with standard command 71.
② Trigger window start with standard command 226 or trigger signal via pin 5.
③ Trigger window stop with standard command 227 or trigger signal via pin 5.
④ Teach-in ends automatically at the end of the second trigger window

Start teach (print only)

When the value 73 is written to index 2, the teach-in process for the pattern to be detected begins. This teach-in process is only suitable for patterns with a homogeneous background, as this process only teaches in the pattern and not the background. For teach-in to begin, the PSS sensor must be triggered via the trigger input (pin 5) or by writing the system commands “Trigger window start” and “Trigger window stop”.
For details, see diagram:



① Start teach (print only) with standard command 73.
② Trigger window start with standard command 226 or trigger signal via pin 5.
③ Trigger window stop with standard command 227 or trigger signal via pin 5.
④ Teach-in ends automatically at the end of the trigger window.

Abort teach-in sequence

Writing the value 79 aborts the ongoing teach-in process.

7.3.6 Teach-in status

Table 20: Teach-in/detection – Teach-in status

ISDU Index DEC	ISDU Index HEX	ISDU Sub-index	Name	Data type	Data repository	Length	Access	Default value	Value/range							
59	3B	-	Teach-in status	UInt	-	8 bit	ro	-	Bit no.							
									7	6	5	4	3	2	1	0
									SP2 [1]		SP1		Teach state			
									TP2	TP1	TP2	TP1	[2]			
									0 = TP x failed 1 = TP x success				4 = Device is waiting for background trigger window 5 = Device is recording background 7 = Teach error 52 = Device is waiting for reference pattern window 53 = Device is recording reference pattern 240 = Device is in run mode			

1) SP = Switchpoint
2) TP = Teach point

You can retrieve the current status of the teach-in process at any time via the teach-in status. The interpretation of the status bytes can be taken from the table.

7.3.7 Switching threshold position

Table 21: Teach-in/detection – Threshold settings

ISDU Index DEC	ISDU Index HEX	ISDU Sub-index	Name	Data type	Data repository	Length	Access	Default value	Value/range
60	3C	-	Threshold setting Qint 1	Record	-	2 bytes	rw		
		1	Setpoint SP1 in % between mark and background	Bit (0)		8 bit		50	10 ... 90
		2	Setpoint SP2 in %	Bit (8)					not editable

In this ISDU, the switching threshold is described depending on the selected sensor mode.

The switching threshold of the PSS is indicated as a quality of print percentage (see "Q1 valid", page 10). If the calculated quality of print exceeds the threshold, the output Q_1 is activated.

If the ambient conditions are not ideal, e.g., in the event of:

- Material variations
- Variations in the exact pattern printing location on the background
- Variations in printing intensity
- Where changes to the pattern to be detected are not taught-in separately, we recommend setting the switching threshold significantly below 90%.

If the sensor is used for quality control, the interference factors listed above must be eliminated.

7.3.8 Background evaluation

Table 22: Configuring the outputs

ISDU Index DEC	ISDU Index HEX	ISDU Sub-index	Name	Data type	Data repository	Length	Access	Default value	Value/range
164	A4		Background teach evaluation	UInt	yes	16 bit	rw	0	0 = Background teach disabled 1 = Background teach enabled

This ISDU can be used to switch background evaluation on or off.

External teach-in	Background teach enabled	Two trigger windows for (1.) Background and (2.) Patterns are necessary.
	Background teach disabled	Only one trigger window is necessary for the pattern.
Display	Background teach enabled	Teach-in of background and pattern possible via display.
	Background teach disabled	Only pattern teach-in possible.
Assessment	Background teach enabled	The available background pattern is evaluated (even if only one pattern without a background has been taught-in previously. In such cases, the most recently taught-in background pattern is used).
	Background teach disabled	Only the taught-in pattern is evaluated (any previously taught-in background pattern is ignored).

7.3.9 Job assurance

Table 23: Teach-in/detection – Job assurance

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
222	EN	-	Job assurance Part 1	Array	no	232 bytes	rw		Unsigned Integer8 [232]
223	DF		Job assurance Part 2						
224	E0		Job assurance Part 3						
225	E1		Job assurance Part 4						

Parameter sets (jobs) make it possible to read out and save (in the PLC) specific application parameters (e.g., switching threshold) for certain applications, formats, or patterns so that you can use them flexibly later.
Compared to IO-Link Data Storage, only the application-specific data is saved.
In other words, a job can be duplicated from one sensor to another easily without the need to overwrite the local sensor-related settings (e.g., configuration of the pins).
This means that you can quickly change the sensor parameters in the event of a format change or quickly install the saved job data on a new device.
Furthermore, the teach-in values (such as measured value on mark, measured value on background) saved in the job assurance can be used for visualization.

NOTE
To load and write job data, two standard commands (**Execute Job Assurance (Restore), value 208 and Show Present Job (Read Job), value 209)**) must be used.

Table 24: Job assurance teach data (ISDU 82dec)

	Byte offset	Length	Part	ISDU	Value range
Version	0	2 bytes	1	222	
Background teach data	4	12 bytes	1	222	
Teach pattern	16	216 bytes	1	222	
	0	232 bytes	2	223	Teach pattern consists of 696 bytes in total
	0	232 bytes	3	224	
	0	16 bytes	4	225	
Ton input delay	20	2 bytes	4	225	1 to 30,000 ms
Toff input delay/impulse	22	2 bytes	4	225	1 to 30,000 ms
Input timer mode	24	1 byte	4	225	0 = deactivated 1 = Ton delay 2 = Toff delay 3 = Ton + Toff delay 4 = Ton delay + impulse

	Byte offset	Length	Part	ISDU	Value range
Q_1 setpoint SP1: sensitivity	25	1 byte	4	225	10 to 90: Steps of 10 percent
Q_1 configuration: switchpoint logic	26	1 byte	4	225	0 = Q1 active on match 1 = Q1 active on mismatch
Q1 configuration: switchpoint mode	27	1 byte	4	225	1 = single point mode
Background teach enabled	28	1 byte	4	225	0 = background teach disabled 1 = background teach enabled

Table 25: Teach-in/detection – Job assurance

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
2	02	-	Standard command – Job assurance	UInt	-	8 bit	ro		208 = Execute job assurance (restore) 209 = Show present job (read out)

Execute job assurance After a new job is written to **job assurance** (ISDUs 222 to 225 – a job is always comprised of all four ISDUs), it must be activated via the system command **Execute job assurance.** Without activation, the loaded job will not be adopted.

Show present job (read job) To ensure that the job data in **Job assurance** (ISDUs 222 to 225) contains up-to-date, consistent values, this system command must be executed before reading the job data. The sensor then provides the data in ISDU 222-225. To read out an entire PSS job, all four ISDUs 222 to 225 must be read out and saved.

7.3.10 Reference pattern

Table 26: System-specific ISDUs – Reference pattern

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
82	52	-	Reference pattern – Part 1	Array	yes	232 bytes	rw		Unsigned Integer32 [58]
83	53		Reference pattern – Part 2						
84	54		Reference pattern – Part 3						
85	55		Background pattern and teach meta data						

In these ISDUs, the information collected during the teach-in (e.g., the recorded contrast pattern) is saved. These ISDUs exist solely for the purposes of the IO-Link data storage mechanism. It can also be used to visualize the reference pattern. You can also find the same information in job assurance (ISDUs 222 to 225). For recipe management, we recommend using ISDUs 222 to 225.

NOTE
The reference pattern is part of Job assurance. This ISDU is only relevant for data maintenance and visualization. The exact breakdown of the arrays can be found in the Job assurance chapter.

7.3.11 Last read pattern

Table 27: System-specific ISDUs – Reference pattern

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
165	A5	-	Last print pattern – Part 1	Array	yes	232 bytes	ro	0	Unsigned Integer32 [58]
166	A6	-	Last print pattern – Part 2						
167	A7	-	Last print pattern – Part 3						

ISDUs 165 to 167 can be used to read out the last patten read by the sensor. This is particularly helpful for visualization and diagnostics purposes. As the process, and therefore the reading sequence of the sensor, is often faster than the read-out process via IO-Link, the pattern must always be read out following the ascending sequence of the ISDUs (165 before 166 and then 167). If the pattern is read out in this sequence, the PSS ensures that the data is consistent and that it comes from the same reading sequence.

7.4 Installation / Diagnostics

7.4.1 Device state

Table 28: Installation/diagnostics – Device status

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
36	24	-	Device status	UInt	-	8 bit	ro	-	0 = Device is OK 1 = Maintenance required 2 = Out of specification 3 = Functional check 4 = Failure 5 to 255 = Reserved

7.4.2 Device temperature

Table 29: Installation / Diagnostics – Temperature

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
153	99	-	Temperature	Int	-	16 bit	ro		Internal device temperature in °

Read out the operating temperature of the sensor.

7.4.3 Teach-in quality

Table 30: Installation/diagnostics – Quality of teach-in

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
114	72	-	Quality of teach-in	UInt	-	8 bit	ro		0 ... 100 = Quality level in %

Quality of teach-in contains the teach-in quality of the taught-in material.
Values:

- ERR < 10: low information content in printed image
- 50: adequate information content for printed image
- 100: optimum information content for printed image

The PSS also reliably detects printed images with sufficient information content.

NOTE
Recommendation:

In the event of poor teach-in quality, avoid external influences such as contamination or significant material variation. In such cases, we also recommend that the system is used only for presence monitoring and not for quality tests.

7.5 System-specific ISDUs

7.5.1 Teach-in channel

Table 31: System-specific ISDUs – Teach-in channel

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
58	3A	-	Teach-in channel	UInt	yes	8 bit	rw	0	0 = Qint 1

The PSS only has one teach-in channel for the teach-in process. Only the preset teach-in channel can be used.

7.5.2 Process data as ISDU

Table 32: 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 [1)]	PD in	yes	2 byte	ro		

1) Refers to process data

In this ISDU, the current process data is provided as an ISDU. For more information: see "Process data".

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 33: 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 ISDU 227 Notification handling.

The following events are supported:

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

Table 34: Events

Code		Name	Type	Comment	Action
Dec	Hex				
6144	1800	Teach-in failure	Error	Triggered after a failed teach-in. The contrast was too low during teach-in.	Realign the PSS and perform a new teach-in.
6145	1801	Teach-in background successful	Notification	Triggered after a successful teach-in.	No action required.
6146	1802	Teach-in print successful	Notification	Triggered after a successful teach-in.	No action required.
6147	1803	Hardware error	Error	Sensor is defective.	Replace the sensor.
16912	4210	Device temperature over-run	Warning	Triggered if the critical temperature is exceeded in the device.	Check the sensor environment and remove the heat source.
3600	8CA0	Output is shortcircuited	Warning	Triggered in the event of a short-circuit on at least one switching output. Overcurrent detection.	Check the cabling.

9 Use cases

9.1 Configuring job assurance

Store a job from sensor in PLC

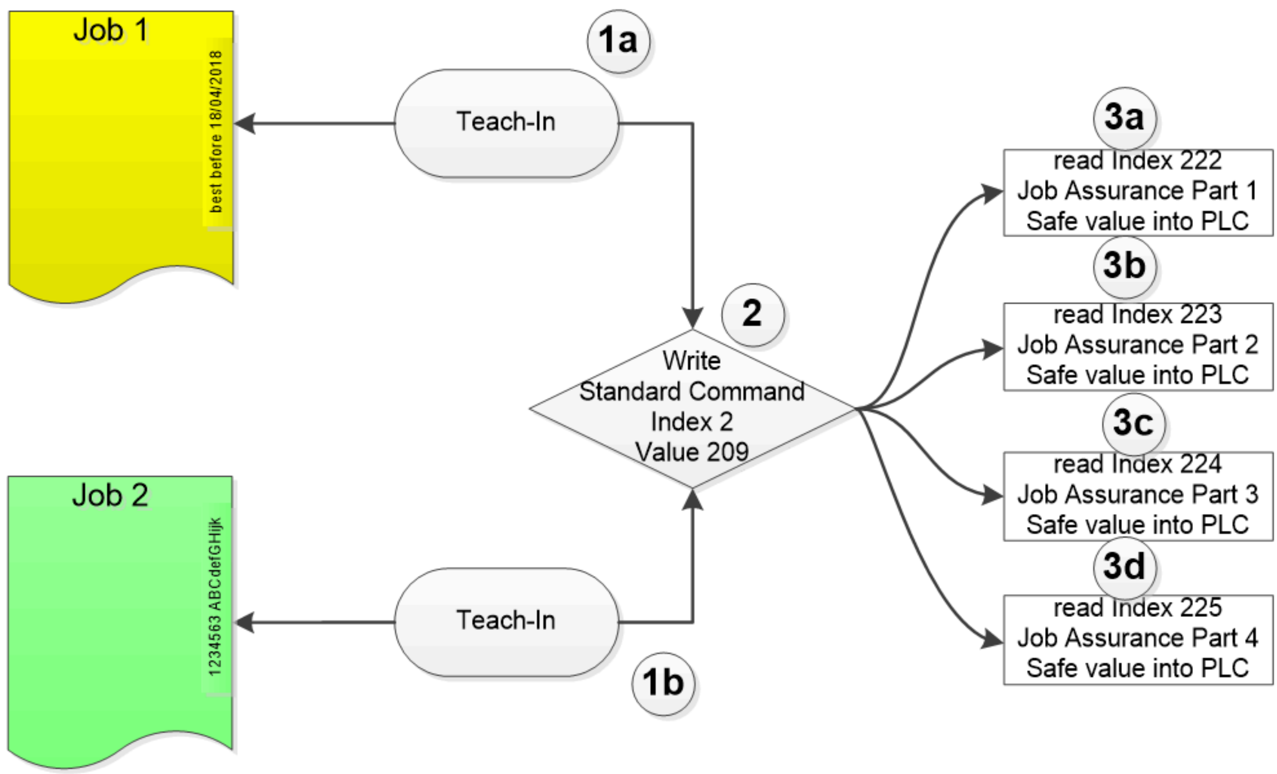


Figure 3: Store a job from sensor in PLC

Job 1 = Text field on yellow background

Job 2 = Text field on green background

①a and ①b text field teach-in = Perform teach-in as described in operating instructions

② Preparation: Write value 209 to index 2

③ Read out job and save in PLC, read indexes 222 to 225 and save in PLC

Write job to sensor

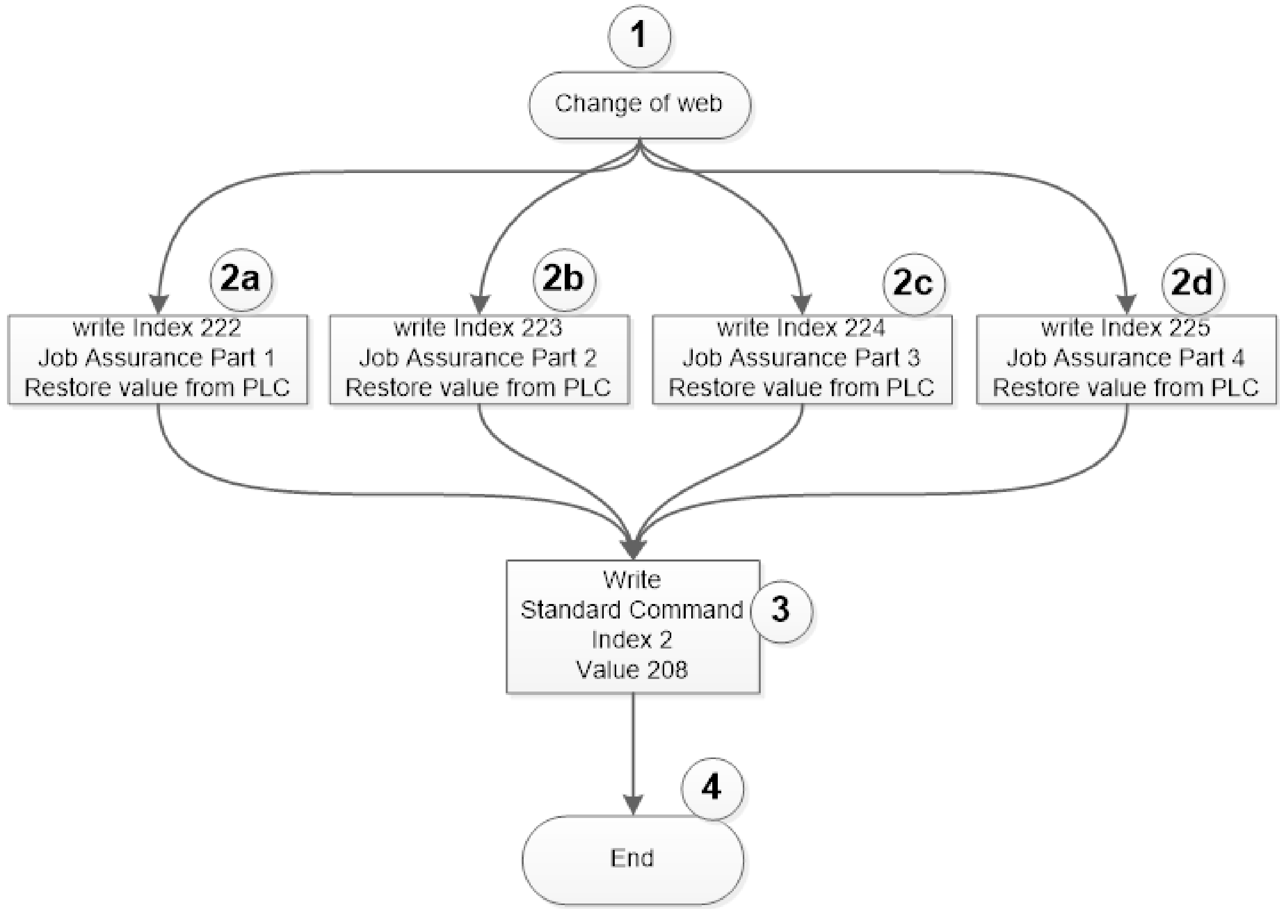


Figure 4: Write job to sensor

① Format change

② Write new job from database to sensor: Write the selected job to indexes 222 to 225

③ Activation: Write value 208 to index 2 to activate the job.

④ End

9.2 Teach-in via IO-Link

Teach-in – Teach-in background & printed image

For a non-homogeneous background, we recommend teaching in the background during the teach-in process to improve the detection results.

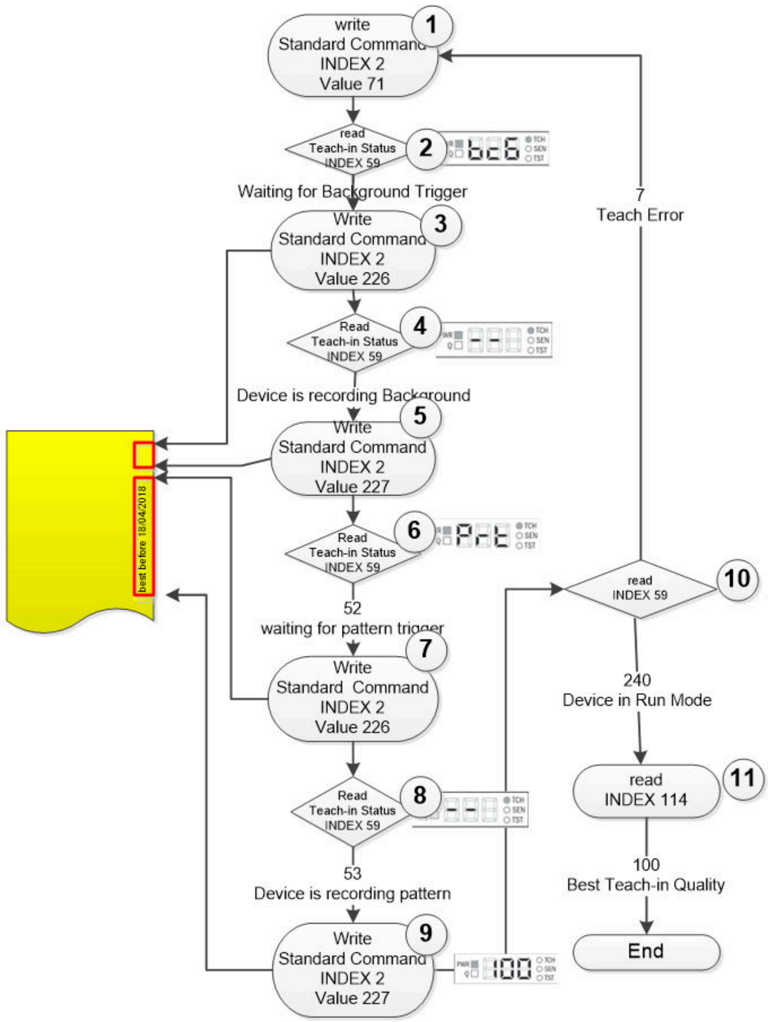


Figure 5: Application example – Teach-in – Background & printed image

① Start teach-in process. Write 71 to index 2

② Query teach-in status. Read index 59 4 = wait for background teach-in

③ Start background teach-in. Write 226 to index 2

④ Query teach-in status. Read index 59 5 = teach-in background

⑤ End teach-in background. Write 227 to index 2

⑥ Query teach-in status. Read index 59 52 = wait for text field

⑦ Start text field teach-in. Write 79 to index 2

⑧ Query teach-in status. Read index 59 53 = teach-in text field

⑨ Complete teach-in. Write 227 to index 2

⑩ Query teach-in status. Read index 59 240 = in run mode

⑪ Query teach quality. Read index 114 100 = best teach-in quality

End

9.3 Teach-in via IO-Link

Teach-in – Teach-in printed image only without background

For a consistent, homogeneous background, the background does not need to be included in the teach-in process. A shortened form of the teach-in process can be executed.

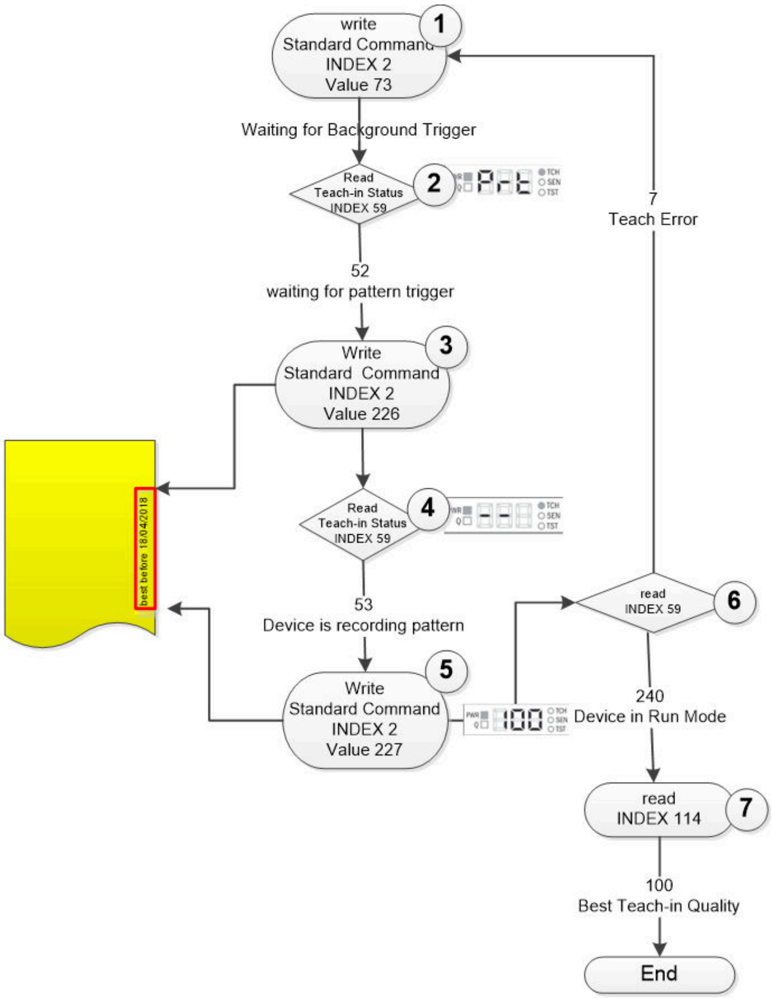


Figure 6: Anwendungsbeispiel – Teach-in – nur Druckbild

① Start teach-in process. Write 73 to index 2

② Query teach-in status. Read index 59 52 = wait for text field

③ Start text field teach-in. Write 79 to index 2

④ Query teach-in status. Read index 59 53 = teach-in text field

⑤ Complete teach-in. Write 227 to index 2

⑥ Query teach-in status. Read index 59 240 = in run mode

⑦ Query teach quality. Read index 114 100 = best teach-in quality

End

9.4 Control reading window via IO-Link

Control the reading window via the IO-Link rather than the trigger input

The PSS must be controlled via a reading window when detecting the printed image. This can be executed using the trigger input or via IO-Link commands.

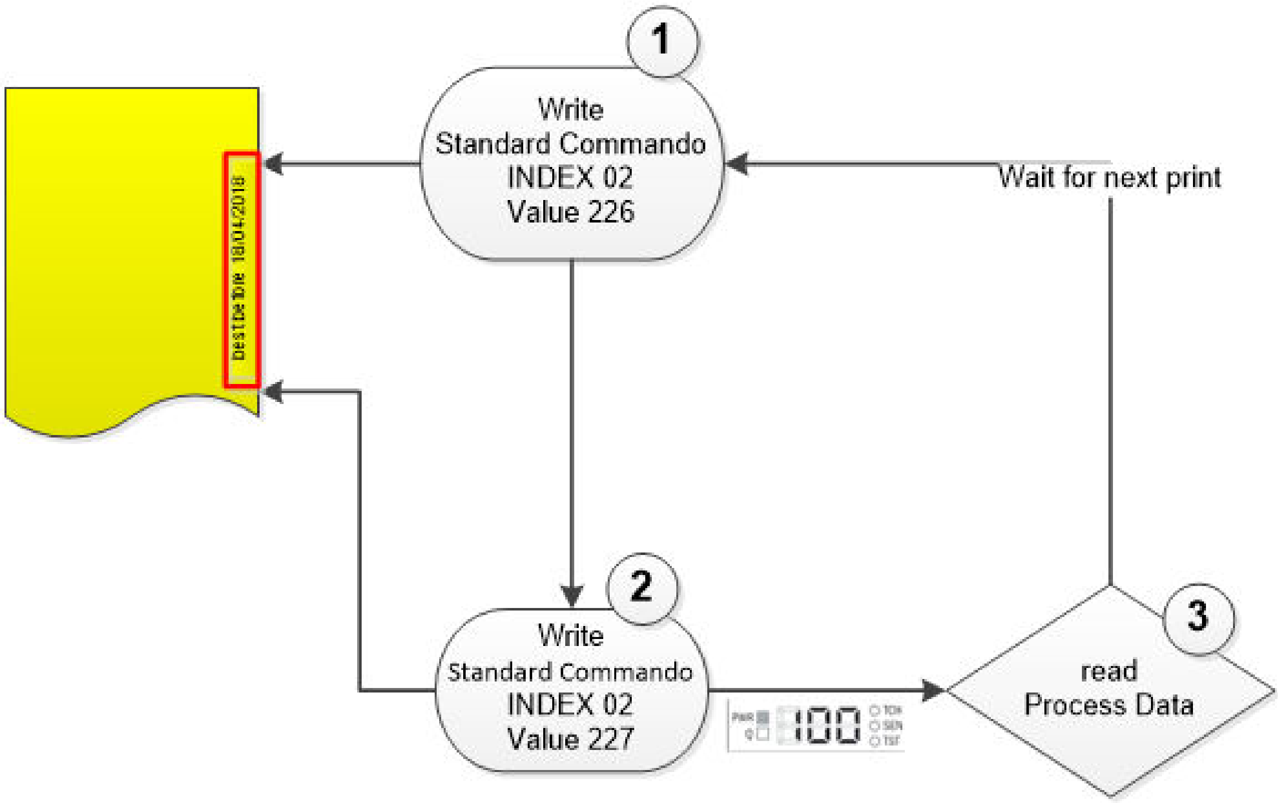


Figure 7: Application example – Reading window via IO-Link

① Start trigger window

② End trigger window

③ Read out process data

10 List of abbreviations

Table 35: 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
COM 1 – 3	SDCI communication mode	1 = 4.8 kbit/s 2 = 38.4 kbit/s 3 = 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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