TECHNICAL INFORMATION

KTS/KTX

SICK Smart Sensors / IO-Link

Device configuration – Advanced operating instructions

SICK
Sensor Intelligence.

SMART SENSORS
IO-Link

Product described

IO-Link – KTS/KTX

Manufacturer

SICK AG
Erwin-Sick-Str. 1
79183 Waldkirch
Germany

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: KTS and KTX.

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 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 (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	2.3 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 (see table 1, page 9).

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

Table 2: Process data structure

Byte offset	Byte 0								Byte 1							
Bit offset	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Measurement value of emission color										Emission color			QoR Alarm	Reserved	Q
	Value range = 0 … 1024										0 = Red 1 = Green 2 = Blue			0 = OFF 1 = ON		0 = OFF 1 = ON

NOTE

To achieve a quick response (full switching frequency) from the Q switching output: configure pin 2 to **Switching output Q** and use this as a digital switching output (**Pin 2/5 configuration** (ISDU 121)).

Pin 4 can then be used permanently for IO-Link communication.

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 all functions described in this document are available in every sensor. The complete list of the parameters available in the individual devices is contained in the document “Supplement to operating instructions”, which can be downloaded on the website: www.sick.com/[Part number] --> Downloads --> Documents.

7.1 Device identification

7.1.1 Product name and manufacturer name

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 bytes	ro [1]	SICK AG	
17	11	-	Vendor text		-	64 bytes		www.sick.com	
18	12	-	Product name		-	30 bytes			
19	13	-	Product ID		-	13 bytes		See row below ISDU 219	
219	DB	0	Product ID	Record	-	7 bytes			
		1	Product ID IO-Link device	String	-	7 bytes			

1) ro = Read only
rw = Read/write
wo = Write only

The **Product ID** is also the part number of the connected IO-Link device.
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 (e.g., a light grid).

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	“Contrast sensor”	
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 bytes	rw		
64	40	-	Device-specific name		no				

In **Application-specific tag**, you can write 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 write 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 bytes	ro	xxxx	
23	17		Firmware version			4 bytes		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 bits	rw	0	0 = Find me deactivated 1 = Find me activated 16 = Yellow LED + Q (Pin 2) flashes with 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 2/5 configuration

Table 8: General device settings – Pin 2/5 configuration

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
121	79	-	Pin2 configuration	UInt	yes	8 bits	rw	32	0 = Inactive 17 = External teach-in 18 = Light/dark 19 = Fine/coarse 20 = Blanking 32 = Switching output Q 48 = Auto [1]
122	7A		Pin5 configuration					17	0 = Inactive 17 = External teach-in 18 = Light/dark 19 = Fine/coarse 20 = Blanking 48 = Auto [1]

[1)] Auto = Referring to control panel

Assignment options for pin 2/5 of the KTS/KTX:

0 **Deactivated** Pin 2/5 in high-impedance state.

17 **External teach-in** Pin 2/5 functions as a digital input for teaching-in the sensor.

> **NOTE**
> Dependency: **Teach mode pin 2/5** decides which teach-in variant is used for external teach-in (ISDU 116).

18 **Light/dark** Pin 2/5 functions as a digital switch for changing between light switching (Q active when received signal > switching threshold) and dark switching (Q active when received signal < switching threshold) behavior (inversion) of the switching output.

> **NOTE**
> Dependency: To make it possible to use pin 2/5 with this function, **Switchpoint logic** must be set to the value 128 = **Defined by teach-in / input** (ISDU 61, sub-index 1).

19 **Fine/coarse** Pin 2/5 functions as a digital switch for changing between the **Fine** and **Coarse** sensitivity levels. The sensitivity levels are applied during **Auto mode** and **CS mode**, as well as during dynamic teach-in.

> **NOTE**
> Dependency: To make it possible to use pin 2/5 with this function, **Sensitivity** must be set to value 3 = **Auto** (ISDU 73).

20 **Blanking** Pin 2/5 functions as a digital switch to change switching output Q1 of the sensor to **deactivated** independently of the read contrast value.
Blanking active = switching output Q1 deactivated.
Blanking deactivated = switching output Q1 switches in accordance with the current read contrast value.

32 **Switching Output Q** Pin 2 functions as an additional digital switching output (Q1). There is no option to teach-in a separate switching threshold. (Function not available for 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.

48	**Auto**	The sensor automatically assigns the function of pin 2/5 depending on the last configured teach-in variant. You can find out which one this is for the device variant in question using electrical connection diagrams A to G in the Quickstart operating instructions (8020411).

7.2.2 Continuous threshold adaptation

Table 9: General device settings – Automatic drift correction

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
75	4B	-	Automatic drift correction	UInt	yes	8 bits	rw	1	0 = Inactive 1 = Active

In difficult application conditions (e.g., due to dust deposits), contamination tracking can be used to optimize the stability of detection. The sensor tracks the switching threshold automatically here. As a result, detection remains stable and secure for longer. In addition, cleaning cycles can be extended.
The original position of the switching threshold set in **Threshold settings** under **Setpoint SP1** (ISDU 60) in % changes using the current switching threshold position, which is tracked automatically. In the event of a new teach-in, the switching threshold is automatically set to 50% between the mark and the background.

NOTE
Restrictions: Automatic drift correction is only active in **KT mode**. If the switching threshold is changed manually in **Threshold settings** under **Setpoint SP1** in % after a teach-in (via display, ISDU 60), contamination tracking is deactivated until the next teach-in.

7.2.3 Sensitivity

Table 10: General device settings – Sensitivity

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
73	49	-	Sensitivity 1)	UInt	yes	8 bit	rw	3	0 = Fine 1 = Middle 2 = Coarse 3 = Auto 2)

1) Used in Auto mode, CS mode, and dynamic teach-in
2) Auto = According to pin 2/5

The sensitivity adjustment only works in **CS mode** (1-point teach-in), in **Auto mode**, and in conjunction with dynamic teach-in.
The sensitivity can be set to one of three values (**Fine / Middle / Coarse**). To switch the sensitivity via an external input (pin 2 or pin 5), this must be set to value 3 (**Auto**). Otherwise, the defined setting has priority.
If **Auto** is set, however, the sensitivity is not controlled via an input pin 2/5 (**Pin 2/5 configuration** (ISDU 121/122)), so the **Coarse** setting is used in KT mode and the **Middle** setting is used in **CS mode** and **Auto mode.**

Sensitivity in color mode / CS mode:

Coarse	The detected color can differ relatively significantly and still be recognized (high color tolerance).
Middle	Compromise between **Coarse** and **Fine** (medium color tolerance).
Fine	The detected color must be very similar to the color taught-in during teach-in to be detected (low color tolerance).

Auto mode:

Coarse	KTS/KTX switches automatically in the event of major contrast changes.
Middle	Compromise between **Coarse** and **Fine**. The KTS/KTX switches automatically in the event of medium contrast changes.
Fine	KTS/KTX switches automatically, even in the event of minor contrast changes.

Dynamic teach-in:
During dynamic teach-in, the sensor tries to compensate for the signal noise present in the material (e.g., due to printing with varying contrasts) or caused by the material guide. For this, a rough analysis of the existing material is required.

Coarse	Noise is not filtered out. The switching threshold is set to the position defined in **Threshold settings** under **Setpoint SP1** (ISDU 60) in % between the maximum and minimum value recorded during the teach-in.
Middle	Suitable for **high**-contrast marks with a fluctuating background. The fluctuations are filtered out.
Fine	Suitable for **low**-contrast marks with a fluctuating background. The print marks must be uniform. Fluctuations are filtered out.

7.2.4 Sensitivity adjustment

Table 11: General device settings – Sensitivity

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
173	AD		Sensitivity adjustment	Record	Yes	48 bits	rw	-	User-defined adjustment for the sensitivity tolerance effective for auto-mode & color sequence mode
		1	Tolerance band fine	-		16 bits		10	Adjustment in digits 0 - 400
		2	Tolerance band middle					20	Adjustment in digits 0 - 400
		3	Tolerance band coarse					50	Adjustment in digits 0 - 400

The three sensitivity levels, **fine** , **middle** and **coarse**, can be freely configured if needed. The tolerance band is set in digits. The **coarse** setting can be set to be even more tolerant, for example, by doubling preset value 50 to 100.

NOTE
This setting is only available for types with color sequence mode.

7.2.5 Key lock

Table 12: 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 bytes	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.

7.2.6 Emission color

Table 13: General device settings – Emission color

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
208	D0	-	Emission color	UInt	yes	8 bits	rw	3	0 = Red 1 = Green 2 = Blue 3 = Defined by teach-in (auto)

The KTS/KTX sensor has an RGB LED. For detection in contrast mode (**KT mode**), the best LED color for the contrast to be detected is selected automatically. This automatic selection can be deactivated and a separate emission color is specified.

The options here are red, green, blue, and automatic (determined via teach-in).

NOTE
If an emission color is specified, this also remains in place after a teach-in. This means that an emission color which is not ideal for the newly taught-in material can be set.

7.2.7 Display orientation

Table 14: 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 bits	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°.

7.2.8 Restore factory settings

Table 15: General device settings – Restore factory settings

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

Restore factory settings	The sensor is reset to factory settings.

7.2.9 Disable sender light source

Table 16: 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 bits	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.

7.2.10 Show R-G-B values

Table 17: General device settings – Show R-G-B values

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
71	47	-	Show R-G-B values	UInt	-	8 bits	rw	0	0 = R-G-B measurement mode inactive 1 = R-G-B measurement mode active

In normal contrast reading mode (**KT mode**), the sensor works with the ideal emission color for the material in question.
Sometimes it can be useful to receive measured values for all three emission colors (R-G-B mode).
With this ISDU, you can activate R-G-B measurement mode without having to change the current teach-in or change the sensor mode via teach-in.

NOTICE
When **Show R-G-B values** is active, switching output Q1 is deactivated and alternating measured values for the red, green, and blue emission colors are output.

7.2.11 (De)activate events

Table 18: General device settings – Notification handling

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
227	E3	-	Notification handling	UInt	-	8 bits	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 for KTS devices

7.3.1 Operating mode

Table 19: Teach-in / detection – Switchpoint

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
61	3D	-	Configuration Qint 1	Record	-	4 bytes	rw		
		1	Switchpoint logic / Inversion	Bit (0)		8 bits		128	0 = Fix dark switching 1 = Fix light switching 128 = Defined by teach-in / input
		2	Switchpoint mode / Operating mode 1)	Bit (8)		8 bits		1	1 = Single-point mode / KT mode (2-point and dynamic teach-in) 128 = Vendor-specific window mode / CS mode (1-point teach-in) 129 = Vendor-specific single-point mode / Auto mode (Auto-teach)
		3	Switchpoint hysteresis	Bit (16)		16 bits		0	0 = Vendor-specific default (not editable)

1) The **Operating mode** of the sensor is automatically adjusted to the type of teach-in used.
Recommendation: Use teach-in commands to change the **Operating mode**.

Switchpoint logic

The switching output (switchpoint) logic (inversion) can be defined as light switching or dark switching, or defined by the teach-in process.

Defined by teach-in means that the sensor switches to the contrast (switching output active) at which the teach-in begins during 1-point and 2-point teach-in.

In dynamic teach-in, the sensor automatically looks for the mark and switches to this mark (switching output active).

If the switching output logic is permanently set to light switching or dark switching, this can also no longer be changed via pin 2/5. To enable the changeover function via pin 2/5, the switching output logic must be set to the value 128.

By default, the switching output logic is determined by the teach-in.

Switchpoint mode

The **Switchpoint mode** specifies the current work mode of the sensor and makes it possible to change this.

KT mode and **CS mode** can only be activated via a teach-in (see **System commands**). You cannot set these modes directly via **Switchpoint** mode.

From **KT mode** and **CS mode**, you can switch directly into **Auto mode** (no teach-in is required for this) and back into the original mode again.

Detailed description of the individual modes (**Threshold settings** under **Setpoint SP1** (ISDU 60) in %).

Switchpoint Hysteresis

Switchpoint hysteresis is preset at the factory and cannot be changed.

! **NOTICE**

ISDU 61 is not part of **Data Storage** as the parameters defined here have already been saved via **Teach data** (ISDU 82).

7.3.2 Status of the switching output inversion

Table 20: Teach-in / detection – Status of output inversion

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
80	50	-	Status of output inversion 1)	UInt	yes	8 bits	ro	0	0 = Dark switching 1 = Light switching

1) Only for reading the status when **Switchpoint logic** = **Defined by teach-in / input**.

If **Defined by teach-in / input** = 128 is set under **Switchpoint / Switchpoint logic** (ISDU 61, sub-index 1), the switching logic selected automatically by the teach-in can be read out using this ISDU.
This ISDU is for information purposes only and cannot be changed.

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

Table 21: 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 bits	rw	0	0 = Inactive 1 = ON delay 2 = OFF delay 3 = ON&OFF delay 4 = One shot

The KTS/KTX has a switch-on and switch-off delay, and a pulse generator.
One shot is set at the factory.
You can individually select the different delays using this ISDU.

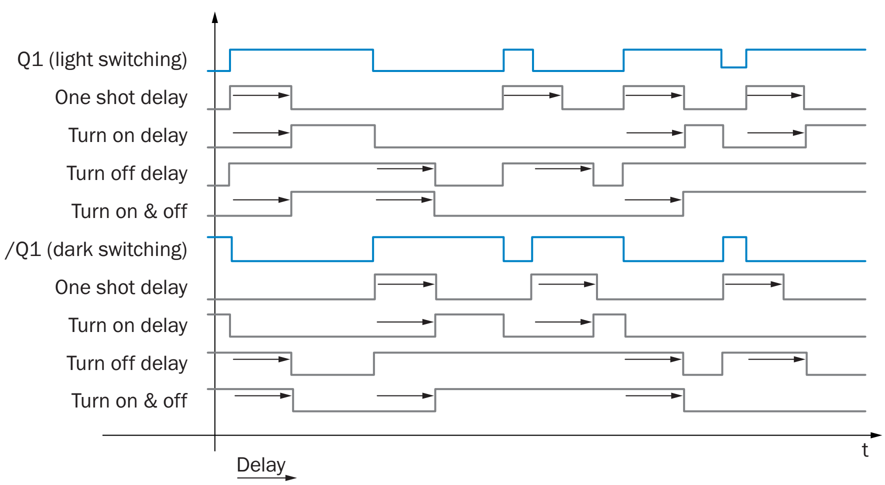


Figure 1: IO-Link delay

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 22: 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 bits	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 Teach-in

Table 23: Teach-in / detection – Teach command

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
2	02	-	Standard command – teach command	UInt	-	8 bit	ro		65 = 1-pt teach-in: teach point 1 67 = 2-pt teach-in: teach point 1 (mark) 68 = 2-pt teach-in: teach point 2 (background) 71 = Start dynamic teach-in 72 = Stop dynamic teach-in 79 = Abort teach sequence 198 = Multi value teach start 199 = Multi value teach stop 200 = Single point for multi value teach

1-point teach

Teach point 1
The 1-point teach-in function automatically activates the color mode (**CS mode**) of the KTX/KTS.
For color detection, align the light spot with the color to be detected.
Then start teaching-in the color by writing the value 65.
You can retrieve the teach result via the **Teach-in status** (ISDU 59).

2-point teach

Teach point 1 (mark)
The 2-point teach-in function automatically activates the contrast mode (**KT mode**) of the KTX/KTS.
With 2-point teach-in, the mark / object to be detected should be taught-in as the first teach point. For this, you must align the light spot with the mark / object and start the 2-point teach-in process by writing the value 67.
Then the light spot of the KTS/KTX will flash and signal that the sensor is waiting for the second teach point.

2-point teach

Teach point 2 (background)
To end the 2-point teach-in, you must position the light spot on the background to be detected and then initiate the teach-in process for the background by writing the value 68.
You can retrieve the teach result via the **Teach-in status** (ISDU 59).

Start dynamic teach

The dynamic teach-in function automatically activates the contrast mode (**KT mode**) of the KTX/KTS.
With this function, you can teach-in the contrast to be detected **dynamically** – i.e., while a process is running. For this, write the value 71 to start the teach-in process. From this time, the sensor records contrast values and interprets these.
Recommendation: Use this teach-in method, as noise (e.g., due to background printing) is also observed when contrast values are recorded dynamically.

Stop dynamic teach

Write the value 72 to end the dynamic teach-in process.
You can retrieve the teach result via the **Teach-in status** (ISDU 59).

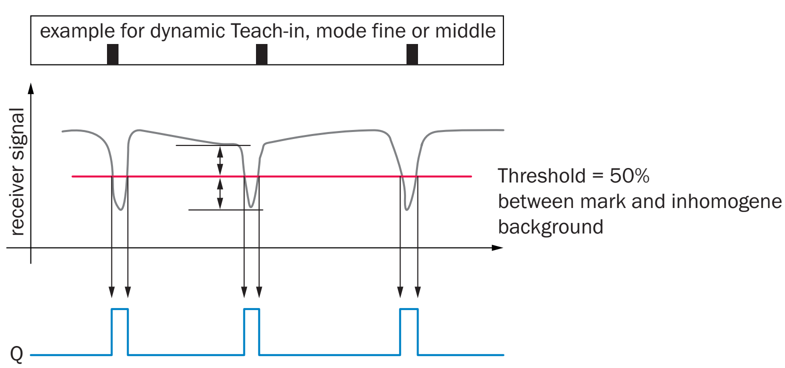


Figure 2: IO-Link teach-in status

Abort teach-in sequence

Write the value 79 to abort an ongoing teach-in process (2-point teach-in or dynamic teach-in).

Multi value teach start

Writing value 198 starts the color sequence teach-in process.

Multi value teach stop Writing value 199 stops the color sequence teach-in process.

Single point for multi value teach The value 200 must be written for every single mark of the color sequence.

7.3.5 Teach-in status

Table 24: Teach-in / detection – Teach-in status

<table>
<tr><th colspan="3">ISDU</th><th rowspan="3">Name</th><th rowspan="3">Data type</th><th rowspan="3">Data reposi-tory</th><th rowspan="3">Length</th><th rowspan="3">Access</th><th rowspan="3">Default value</th><th colspan="8" rowspan="3">Value/range</th></tr>
<tr><th colspan="2">Index</th><th rowspan="2">Sub-index</th></tr>
<tr><th>DEC</th><th>HEX</th></tr>
<tr><td rowspan="5">59</td><td rowspan="5">3B</td><td rowspan="5">-</td><td rowspan="5">Teach-in sta-tus</td><td rowspan="5">UInt</td><td rowspan="5">-</td><td>8 bits</td><td>ro</td><td>-</td><td colspan="8">Bit no.</td></tr>
<tr><td></td><td></td><td></td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td></td><td></td><td></td><td colspan="2">SP2 1)</td><td colspan="2">SP1</td><td colspan="4">Teach state</td></tr>
<tr><td></td><td></td><td></td><td>TP2</td><td>TP1</td><td>TP2</td><td>TP1</td><td colspan="4">2)</td></tr>
<tr><td></td><td></td><td></td><td colspan="4">0 = TP x failed
1 = TP x success</td><td colspan="4">0 = IDLE
1 = SP1 success
2 = SP2 success
3 = SP1+2 success
4 = Wait for command
5 = Busy
6 = Reserved
7 = Error</td></tr>
</table>

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 above.
This table can be used in a simplified manner:

0x00 hex	Ready
0x04 hex	Wait for command (dynamic teach-in running)
0x07 hex	Teach-in error
0x11 hex	Teach-in successful (with 1-point teach-in)
0x15 hex	In progress, 1st teach-in point successful
0x31 hex	Teach-in successful (with 2-point teach-in, dynamic teach-in)

7.3.6 Switching threshold position

Table 25: Teach-in / detection – Threshold settings

<table>
<tr><th colspan="3">ISDU</th><th rowspan="3">Name</th><th rowspan="3">Data type</th><th rowspan="3">Data reposi-tory</th><th rowspan="3">Length</th><th rowspan="3">Access</th><th rowspan="3">Default value</th><th rowspan="3">Value/range</th></tr>
<tr><th colspan="2">Index</th><th rowspan="2">Sub-index</th></tr>
<tr><th>DEC</th><th>HEX</th></tr>
<tr><td rowspan="3">60 1)</td><td rowspan="3">3C</td><td>-</td><td>Threshold setting Qint 1</td><td>Record</td><td rowspan="3">-</td><td>2 bytes</td><td rowspan="3">rw</td><td></td><td></td></tr>
<tr><td>1</td><td>Setpoint SP1 in % between mark and background</td><td>Bit (0)</td><td rowspan="2">8 bits</td><td>50</td><td>-3 = CS mode
-2 = Auto mode
-1 = Threshold below minimum teach con-trast
0 ... 100 = Threshold in percent between minimum and maximum teach contrast
101 = Threshold above the maximum teach contrast</td></tr>
<tr><td>2</td><td>Setpoint SP2 in %</td><td>Bit (8)</td><td></td><td>Not relevant</td></tr>
</table>

1) It is not possible to change the **Mode** in this ISDU.
Adjustment of the switching threshold only in **KT mode**. The switching threshold is reset to 50% during the next teach-in.

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

KT mode
In contrast mode (**KT mode**), the switching threshold can be in the range from 0 to 100% between the taught-in mark and background.
After a teach-in, the switching threshold is set to 50% between the mark and the background by default.

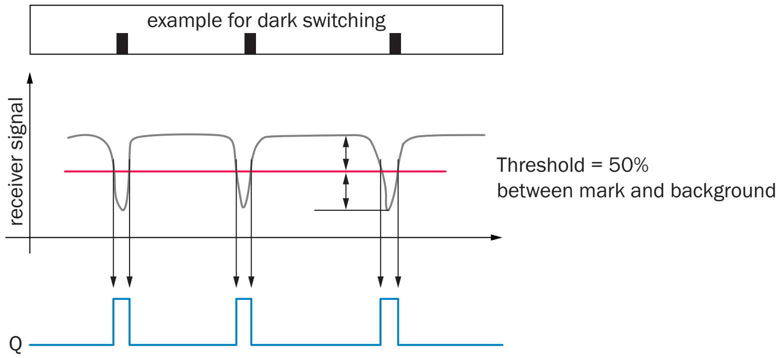


Figure 3: IO-Link KT mode

Depending on the material in question, it can be useful to place the switching threshold closer to the mark or closer to the background.
For this, the percentage value in **Setpoint** 1 can be adjusted from 0 to 100%.
If the switching threshold is readjusted by the automated contamination adjustment, this can also be read in the **Setpoint**.

NOTE
The switching threshold is reset to 50% during the next teach-in.

CS mode
In color mode (**CS mode**), a switching window is placed around the color value measured during the teach-in.
You can adjust the size of the switching window using tolerance bands.
Increments: **Fine** / **Middle** / **Coarse**.
In color mode, you cannot change the switching threshold using this ISDU.
To identify **CS mode**, -3 or 253 is output.

NOTE
Dependency: You can specify the color tolerance in **Sensitivity** (ISDU 73).

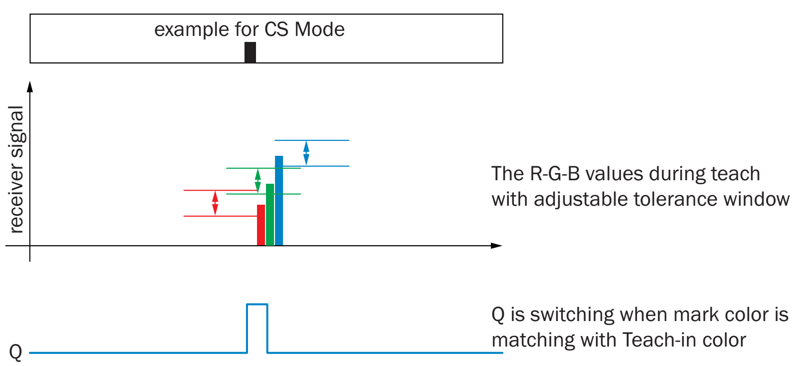


Figure 4: IO-Link CS mode

Auto mode
In **Auto mode**, the sensor switches depending on the change to the measured contrast value. In this mode, there is no switching threshold.
To identify **Auto mode**, -2 or 254 is output.

NOTE
Dependency: You can specify the degree of the contrast change necessary for switching using the **Sensitivity** in **Sensitivity** (ISDU 73).

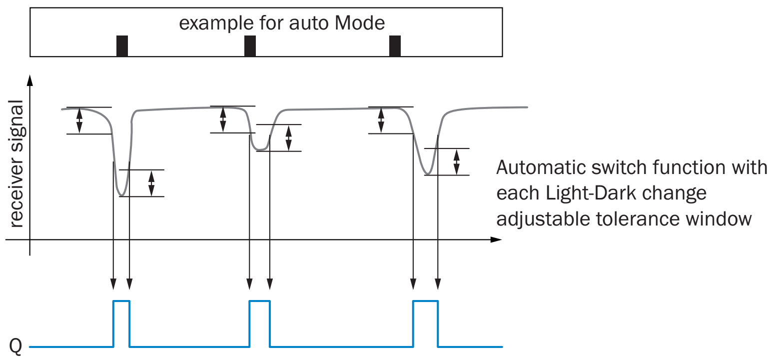


Figure 5: IO-Link Auto mode

7.3.7 Function assignment of the external inputs

Table 26: Teach-in / detection – Teach mode selection for external input

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
116	74	-	Teach mode selection for external input	Record	-	2 bytes	rw		
		1	Teach mode pin 2	Bit (0)		8 bits		1	0 = 1-point teach-in (color mode) 1 = 2-point teach-in 2 = Dynamic teach-in
		2	Teach mode pin 5	Bit (8)				1	

Selection between 1-point teach-in (**CS mode**), 2-point teach-in, and dynamic teach-in.
Prerequisite: Pin 2/5 in **Pin 2/5 configuration** (ISDU 121) receives value 17 = **External teach-in.**

7.3.8 Job assurance

Table 27: 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	Record	-	34 bytes	rw		

Parameter sets (jobs) make it possible to read out and save (in the PLC) specific application parameters (e.g., switching threshold, emission color) for certain applications, formats, recipes, or marks 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.

NOTICE
Types with color sequence mode have a job length of 128 bytes

Table 28: Job assurance teach data (ISDU 82dec)

	Job assurance byte	Value range
Version	0, 1	Version number

	Job assurance byte	Value range
Light teach value If dark switching = Background If light switching = Mark	2, 3 Red/white 4, 5 Green 6, 7 Blue	Digital values in accordance with process data/display
Dark teach value If dark switching = Mark If light switching = Background	8. 9 Red/white 10, 11 Green 12, 13 Blue	
Switching threshold	14, 15 Red/white 16, 17 Green 18, 19 Blue	
Light/dark switching	20 Red/white 21 Green 22 Blue	0 Dark switching 1 Light switching 128 Defined by teach-in
Emission color KT / Auto mode defined by teach	23	0 Red/white 1 Green 2 Blue 3 RGB
Intensification setting through the teach-in	24	
Threshold adjustment (active/ deactivated) (Applies to the current job. The threshold adjustment is, for example, deactivated if the switching threshold has been moved manually after the teach-in.)	25	0 Switched off 1 Switched on
Teach mode	26	0 1-point teach-in 1 2-point teach-in 2 Dynamic teach-in
Reserved	27	
Emission color	28	0 Red/white 1 Green 2 Blue 3 Defined by teach-in
Switchpoint logic	29	0 Dark switching 1 Light switching 128 Defined by teach-in
Switchpoint mode	30	0 Deactivated 1 KT mode 128 CS mode 129 Auto mode
Sensitivity	31	0 Fine 1 Middle 2 Coarse 3 Smart-Select
Threshold adjustment (active/deactivated) **NOTE** (Global setting of the ISDU)	32	0 Deactivated 1 Activated
Process quality alarm threshold	33	0 ... 100 percentage threshold for QoR alarm

	Job assurance byte	Value range	
Number of colors taught in	34-35	Read value +1	Only for devices with color sequence
Teach value color 1	36 ... 37 Red 38 ... 39 Green 40 ... 41 Blue	Digital values in accordance with process data/display	
Teach value color 2	42 ... 43 Red 44 ... 45 Green 46 ... 47 Blue		
Teach value color 3	48 ... 49 Red 50 ... 51 Green 52 ... 53 Blue		
Teach value color 4	54 ... 55 Red 56 ... 57 Green 58 ... 59 Blue		
Teach value color 5	60 ... 61 Red 62 ... 63 Green 64 ... 65 Blue		
Teach value color 6	66 ... 67 Red 68 ... 69 Green 70 ... 71 Blue		
Teach value color 7	72 ... 73 Red 74 ... 75 Green 76 ... 77 Blue		
Teach value color 8	78 ... 79 Red 80 ... 81 Green 82 ... 83 Blue		
Wide tolerance band in CS mode and auto mode	84 ... 85 Fine 86 ... 87 Medium 88 ... 89 Coarse		
Reserved	90 ... 127		

7.3.9 Settings for the color sequence function

NOTE
Only applies to types with color sequence mode.

Table 29: Settings for color sequence mode

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
174	AE	-	Speed adjustment	UInt	Yes	8 bits	rw	0	0 = Standard machine speed (typically 0.4 - 4 m/s) 1 = Low machine speed (typically 0.15 - 2 m/s) 2 = High machine speed (typically 2 - 12 m/s)
1178	49A		Reference pattern	Octet string		48 bits	ro		Color pattern determined by last teach-in. RGB values of each color is stored as a 16 bit integer
1179	49B		Last pattern seen	Octet string					Color pattern of last detected color sequence. RGB values of each color is stored as a 16 bit integer

174 **Speed adjustment** Optimizes the color sequence detection in relation to the material speed.
0 = For standard speed – typically 0.4 ... 4 m/s
1 = For low speed – typically 0.15 ... 2 m/s
0 = For high speed – typically 2 ... 12 m/s

1178 **Reference pattern** Contains the stored RGB values from the last color sequence teach-in.

1179 **Last pattern seen** Displays the RGB values of the last detected color sequence. This can be used for service purposes.

7.4 Installation / Diagnostics

7.4.1 Device state

Table 30: 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 bits	ro		0 = Device is OK 1 = Maintenance required 2 = Out of specification 3 = Functional check [1] 4 = Failure 5 ... 255 = Reserved
226	E2		System status						Bit 0 = Q1 [2] Bit 1 ... 7 = Reserved

1) KTS/KTX high sensitivity:
As soon as the status is set, the maximum accuracy of the sensor can no longer be ensured due to the service life of the sender LED. With measuring tasks, the measured value changes proportionally to the additional degradation of the LED from this point in time. When using with teach-in, reteaching must be done regularly from this point in time.

2) Current status of switching output Qint 1

7.4.2 Device temperature

Table 31: 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 bits	ro		Internal device temperature in °C

Read out the operating temperature of the sensor.

7.4.3 Teach-in quality

Table 32: 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 bits	ro		0 ... 100 = Quality level in %

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

- 1 ... 30: poor teach-in quality
- 31 ... 60: good teach-in quality
- 61 ... 100: excellent teach-in quality

The KTS/KTX can even reliably read contrasts with a poor teach-in quality.

NOTE
Recommendation:
In the event of poor teach-in quality, avoid external influences such as contamination or severe material fluctuations.
Teach-in the sensor again regularly.

7.4.4 Process quality and alarm threshold

Table 33: 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	-	8 bits	ro		0 ... 255 = Quality level in %

The **Quality of run** (process quality) indicates the process quality during operation.
For this, the last detected contrast is compared with the contrast during teach-in and reproduced in a range of 0 to 255%.

- If the existing contrast is exactly the same as at the teach-in time, **Quality of run** = 100%.
- If the contrast increases, the value increases to > 100%.
- If the contrast decreases (e.g., due to contamination), the value decreases to < 100%.

In the event of contamination, the **Automatic drift correction** (ISDU 75) readjusts the switching threshold.
If the contrast remains the same in the event of a simultaneous readjustment of the switching threshold, then the **Quality of run** also stays as 100%.

The readjustment of the switching threshold is displayed in **Threshold settings** (ISDU 60).

Table 34: Installation / Diagnostics – Quality of run alarm threshold

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
176	B0	-	Quality of run alarm threshold	UInt	-	8 bits	ro		0 ... 90 = Threshold level in %

In ISDU 176, you can provide the detection quality with an alarm threshold.
This threshold is designed to issue an alarm if the quality falls below a set level.
The alarm threshold is specified in percent and can be set between 0 and 90%.
The alarm is issued in bit 2 of the process data and as an IO-Link event.

7.4.5 Alignment quality

Table 35: 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	Int	-	8 bits	ro		-1 ... 100 = Quality level in %

The **Quality of alignment** tool is used to position the sensor within the nominal sensing distance to the material to be detected. The alignment quality is specified in %.

-1% Alignment aid not available
0% Poor adjustment
100% Optimum adjustment

7.5 System-specific ISDUs

7.5.1 Profile characterization

Table 36: System-specific ISDUs – Profile characteristic

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Sub-index							
DEC	HEX								
13	0D	-	Profile characteristic	Record	-	12 bytes	ro		
		1	Smart Sensor profile	Bit (0)		16 bits		1	
		2	Identification	Bit (16)				32768	
		3	BDC (binary data channel)	Bit (32)				32769	
		4	PDV (process data variable)	Bit (48)				32770	
		5	Diagnosis	Bit (64)				32771	
		6	Teach-in	Bit (80)				32772	

Profile characteristic (ISDU 13) indicates which profiles and functionalities the sensor supports.
The supported profile is displayed initially.
PID (**Profile identifier**) 1 indicates that the sensor supports the **Smart Sensor profile** defined by the IO-Link Consortium.
Values from 32768 indicate functionalities.

The KTS/KTX supports the following functionalities defined in the **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 Switchpoint, Setpoint).

32770 Process data variables.
The sensor provides the measured analog value as an item of process data.

32771 The sensor supports additional diagnostic functions, e.g., Device status, Teach-in status (see "Installation / Diagnostics", page 27).

32772 The sensor supports teach-in methods to teach-in the sensor via the IO-Link interface.

7.5.2 Process data description

Table 37: System-specific ISDUs – PD input descriptor

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range [1)]
Index		Sub-index							
DEC	HEX								
14	0E	-	PD input descriptor	Record	-	6 bytes	ro		
		1	PVinD (BDC1)	Bit (0)		24 bits		1 3 0	1 = Set of BoolT; 3 = 3-bit length; 0 = 1st bit is bit 0
		2	PVinD (PDV1)	Bit (16)		24 bits		2 13 3	2 = UIntegerT; 13 = 13-bit length; 3 = 1st bit is bit 3

1) Description of the process data

PD input descriptor (ISDU 14) provides information about the data structure of the (input) process data. The coding is described in the **Smart Sensor profile** specification.
Each part of the process data is described with 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.

7.5.3 SICK profile version

Table 38: System-specific ISDUs – SICK profile version

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Subindex							
DEC	HEX								
205	CD	-	SICK profile version	String	yes	4 bytes	ro	1.01	

SICK sensors do not just fulfil the requirements of the IO-Link specification and the IO-Link Smart Sensor profile specification, but also the requirements of SICK's in-house profiles. This means that every SICK sensor is similar in terms of operation.
This ISDU specifies the applied version of the SICK profile.

7.5.4 Teach-in channel

Table 39: System-specific ISDUs – Teach-in channel

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

With KTS/KTX, only 1 teach-in channel is available for the teach-in process. Only the preset teach-in channel can be used.

7.5.5 Teach-in data

Table 40: System-specific ISDUs – Teach data

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Subindex							
DEC	HEX								
82	52	-	Teach data [1)]	Record	-	25 bytes	rw		

1) Teach data is part of job assurance. This ISDU is only relevant to the data repository.

In this ISDU, the information collected during the teach-in (e.g., switching threshold position, mark value, and background value) is saved. This ISDU only serves the IO-Link **Data Storage mechanism**.
You can also find the same information in **Job assurance** (ISDU 222).
We recommend using ISDU 222.

7.5.6 Process data as ISDU

Table 41: System-specific ISDUs – Process data input

ISDU			Name	Data type	Data repository	Length	Access	Default value	Value/range
Index		Subindex							
DEC	HEX								
40	28	-	Process data input [1)]	PD in	yes	2 bytes	ro		

1) Refers to process data

In this ISDU, the current process data is provided as an ISDU. For more information: see "Process data", page 10.

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 42: 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 **Notification handling** (ISDU 227).

The following events are supported:

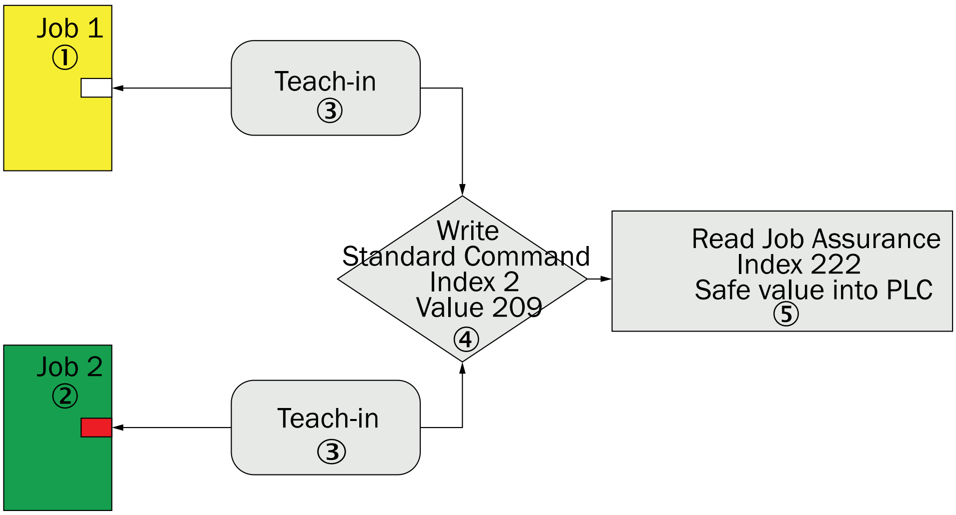
Table 43: Events

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 KTS/KTX and perform a new teach-in.
6145	1801	Teach-in 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.
36000	8CA0	Short-circuit on outputs	Warning	Triggered in the event of a short-circuit on at least one switching output. Overcurrent detection.	Check the cabling.
36004	8CA4	Quality of run alarm	Warning	Process quality alarm.	Clean sensor.

9 Use cases

9.1 Job assurance

Use case: Configuring job assurance



① Job 1 = White mark on yellow background
② Job 2 = Red mark on green background
③ Teaching in mark = Perform teach-in
④ Preparation:

Write value 209 after **standard command** index 2

⑤ Read out job and save in PLC.

Reading **Job assurance** index 222 and saving the read data string in the PLC

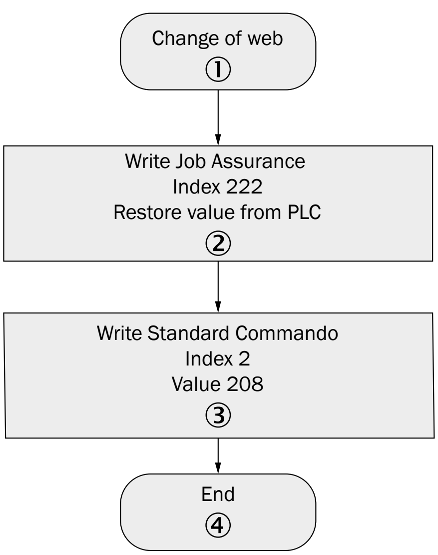


Figure 6: Use case – job assurance

① Format change in process
② Write the job matching the filed format from the stored database in the sensor:

Write the data string of the selected job after **job assurance** index 222

③ Activation:

Write value 208 after **standard command** index 2 so that job is set to active

④ End

9.2 Same mark / variable background

Use case: Configuring same mark / variable background

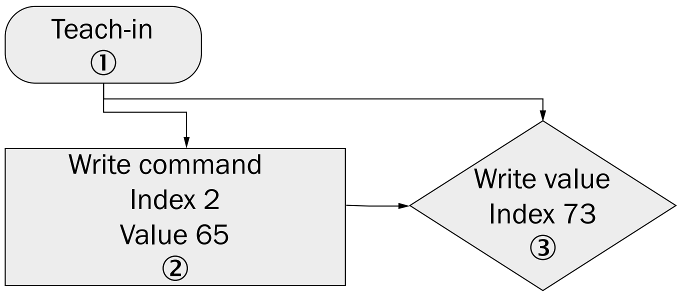


Figure 7: Use case – variable background

① 1-point teach-in command:

Write value 65 after **standard command** index 2

② Teach-in status query (optional)

Read teach-in status index 59

Expected value = 17 = Teach point 1 + switch point 1

Success = Teach-in successful

③ Sensitivity setting (if required):

Write desired value 0…2 after **sensitivity** index 73

0 = Fine

1 = Medium

2 = Coarse

1-point teach-in via IO-Link:

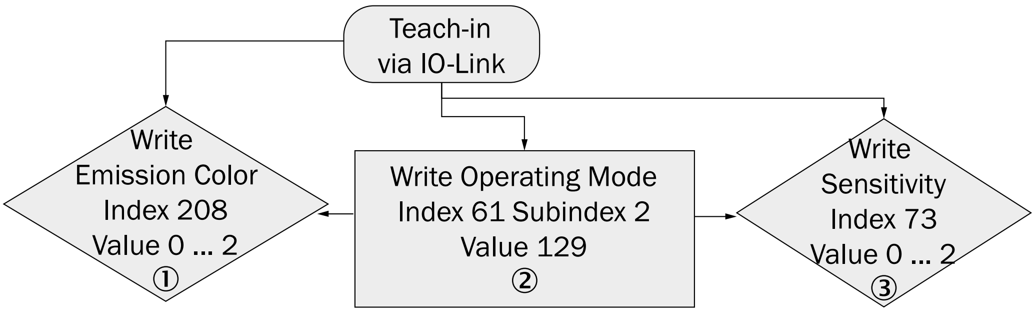
Figure 8: Red mark on a print of another color

The red mark is taught-in via 1-point teach-in.
The sensor switches into RGB mode and the light spot appears white.
The KTS then only responds to the red mark, not to the background print of another color.
As a result, the switching output only switches to the red mark and not in-between.

9.3 Coding marks

Use case: Configuring bar coding

Detecting postal code bars on envelopes: Use Auto mode.
The sensor then automatically switches to simple bar coding.



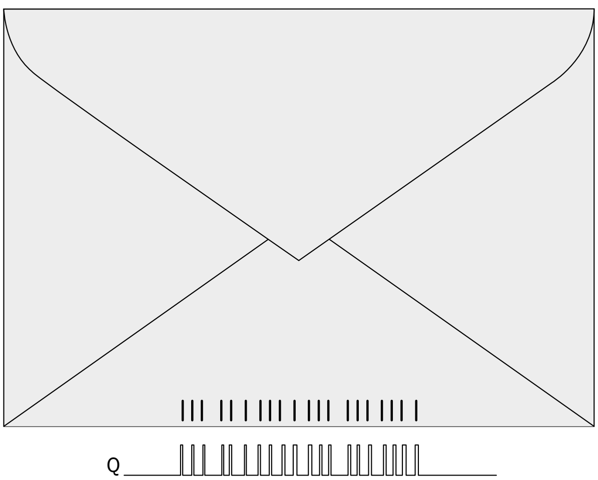


Figure 9: Use case – bar coding

① Emission color setting:

Write value 0 ... 2 after emission color index 208

0 = Red

1 = Green

2 = Blue

② Auto mode operating mode activation:

Write value 129 after operating mode index 61, subindex 2

③ Sensitivity setting (if required):

Write desired value 0 ... 2 after sensitivity index 73

0 = Fine

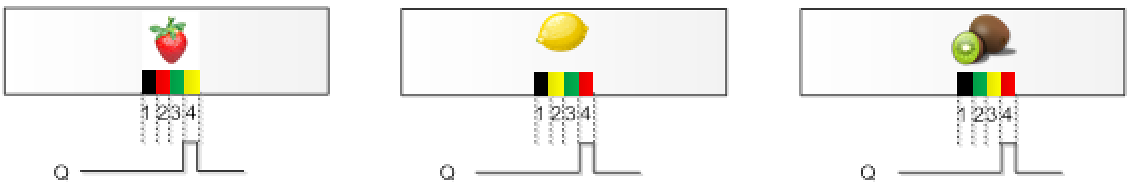
1 = Medium

2 = Coarse

9.4 Teaching in sequence

Application example: A color sequence consisting of 4 colors is taught in via IO-Link as a sorting mark.

Every color sequence is assigned to a sort.



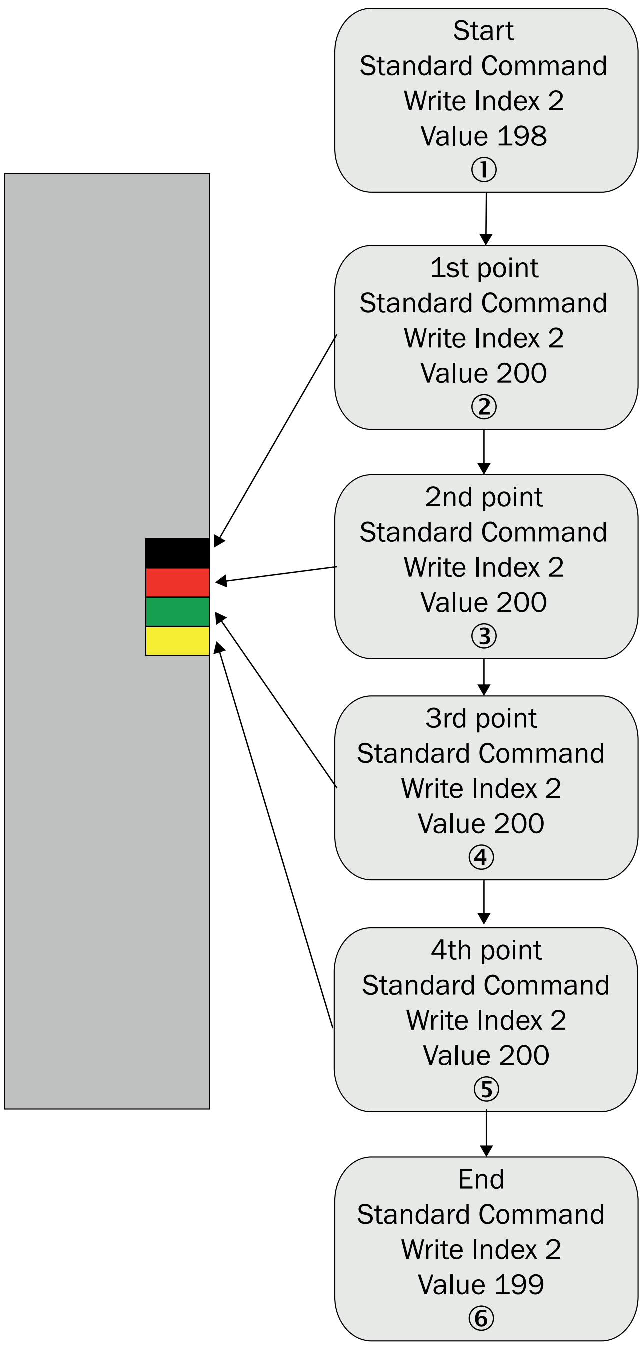


Figure 10: Application example - teaching in color sequence

① Start

Write value 198 after standard command index 2

② First point:

Light spot on the first mark

Write value 200 after standard command index 2

③ Second point:

Light spot on the second mark

Write value 200 after standard command index 2

④ Third point:

Light spot on the third mark

Write value 200 after standard command index 2

⑤ Fourth point:

Light spot on the fourth mark

Write value 200 after standard command index 2

⑥ End

Write value 199 after standard command index 2

It is possible to teach in up to 8 points. A sequence of different gray tones, for example, can be used instead of a color sequence. After successful teach-in, the color sequence can be stored or called up again via the job assurance in the control (see "Job assurance", page 32)

10 List of abbreviations

Table 44: 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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8022572.14XF/2019-08-07/en

Australia
Phone +61 (3) 9457 0600
1800 33 48 02 – tollfree
E-Mail sales@sick.com.au

Austria
Phone +43 (0) 2236 62288-0
E-Mail office@sick.at

Belgium/Luxembourg
Phone +32 (0) 2 466 55 66
E-Mail info@sick.be

Brazil
Phone +55 11 3215-4900
E-Mail comercial@sick.com.br

Canada
Phone +1 905.771.1444
E-Mail cs.canada@sick.com

Czech Republic
Phone +420 234 719 500
E-Mail sick@sick.cz

Chile
Phone +56 (2) 2274 7430
E-Mail chile@sick.com

China
Phone +86 20 2882 3600
E-Mail info.china@sick.net.cn

Denmark
Phone +45 45 82 64 00
E-Mail sick@sick.dk

Finland
Phone +358-9-25 15 800
E-Mail sick@sick.fi

France
Phone +33 1 64 62 35 00
E-Mail info@sick.fr

Germany
Phone +49 (0) 2 11 53 010
E-Mail info@sick.de

Greece
Phone +30 210 6825100
E-Mail office@sick.com.gr

Hong Kong
Phone +852 2153 6300
E-Mail ghk@sick.com.hk

Hungary
Phone +36 1 371 2680
E-Mail ertekesites@sick.hu

India
Phone +91-22-6119 8900
E-Mail info@sick-india.com

Israel
Phone +972 97110 11
E-Mail info@sick-sensors.com

Italy
Phone +39 02 27 43 41
E-Mail info@sick.it

Japan
Phone +81 3 5309 2112
E-Mail support@sick.jp

Malaysia
Phone +603-8080 7425
E-Mail enquiry.my@sick.com

Mexico
Phone +52 (472) 748 9451
E-Mail mexico@sick.com

Netherlands
Phone +31 (0) 30 229 25 44
E-Mail info@sick.nl

New Zealand
Phone +64 9 415 0459
0800 222 278 – tollfree
E-Mail sales@sick.co.nz

Norway
Phone +47 67 81 50 00
E-Mail sick@sick.no

Poland
Phone +48 22 539 41 00
E-Mail info@sick.pl

Romania
Phone +40 356-17 11 20
E-Mail office@sick.ro

Russia
Phone +7 495 283 09 90
E-Mail info@sick.ru

Singapore
Phone +65 6744 3732
E-Mail sales.gsg@sick.com

Slovakia
Phone +421 482 901 201
E-Mail mail@sick-sk.sk

Slovenia
Phone +386 591 78849
E-Mail office@sick.si

South Africa
Phone +27 10 060 0550
E-Mail info@sickautomation.co.za

South Korea
Phone +82 2 786 6321/4
E-Mail infokorea@sick.com

Spain
Phone +34 93 480 31 00
E-Mail info@sick.es

Sweden
Phone +46 10 110 10 00
E-Mail info@sick.se

Switzerland
Phone +41 41 619 29 39
E-Mail contact@sick.ch

Taiwan
Phone +886-2-2375-6288
E-Mail sales@sick.com.tw

Thailand
Phone +66 2 645 0009
E-Mail marcom.th@sick.com

Turkey
Phone +90 (216) 528 50 00
E-Mail info@sick.com.tr

United Arab Emirates
Phone +971 (0) 4 88 65 878
E-Mail contact@sick.ae

United Kingdom
Phone +44 (0)17278 31121
E-Mail info@sick.co.uk

USA
Phone +1 800.325.7425
E-Mail info@sick.com

Vietnam
Phone +65 6744 3732
E-Mail sales.gsg@sick.com

Detailed addresses and further locations at **www.sick.com**

SICK AG | Waldkirch | Germany | www.sick.com

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