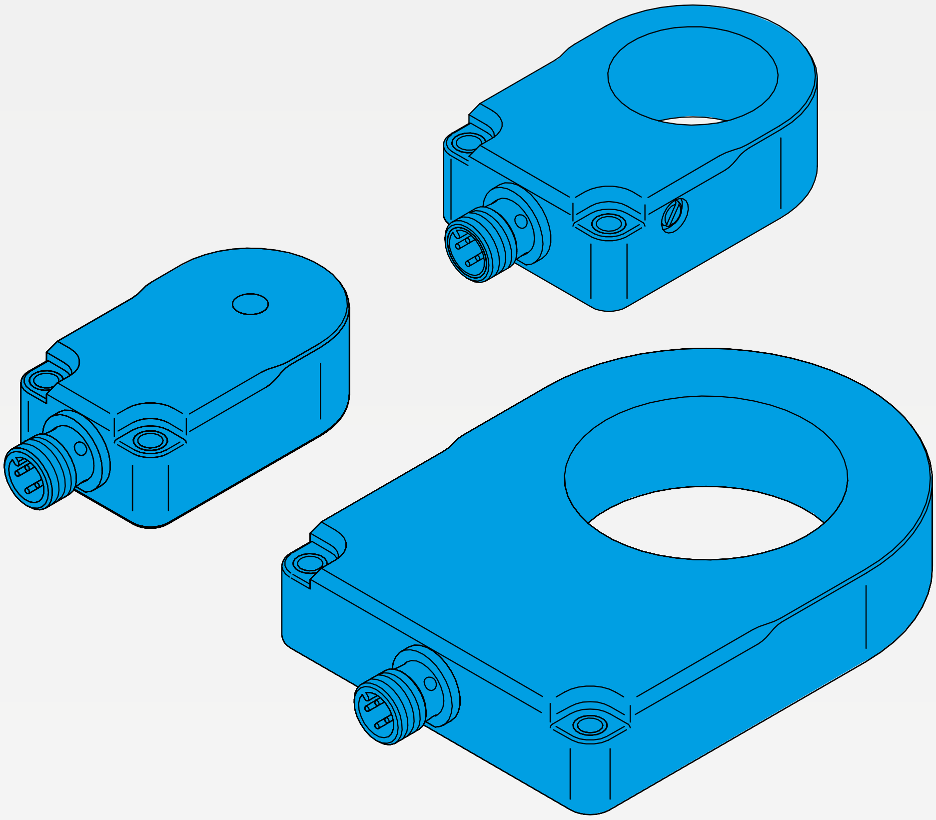
INDUCTIVE RING SENSORS IRSD



600020-0000EN · Rev 1 · 2024/03

OPERATING INSTRUCTIONS

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TABLE OF CONTENTS

1 PRELIMINARY NOTE

1.1 ABOUT THE PRODUCT

IMPORTANT! The technical data, the instructions and the instruction leaflet can be found via the QR code on the packaging or alternately via the article number at www.di-soric.com.

1.2 SYMBOLS

Warning symbol about personal harm

Note on efficient and trouble-free operation

Important! Malfunctions or faults are possible if not observed

1.3 ABBREVIATIONS, TERMS

NC opener (normally closed) (1= inverted) (1 = low-active) NO closer (normally open) (0-not inverted) (0 = high-active)

PELV Protective extra low voltage

SELV Safety extra low voltage

NEC National Electrical Code UL Underwriters Laboratories

SSC Switching signal channel

SP1 setpoint 1 (threshold value 1 / switching point 1) (setpoint 1)

SP2 setpoint 2 (threshold value 2 / switching point 2) (setpoint 2)

TP1 teachpoint 1

TP2 teachpoint 2

PNP output: Plus switching, connects load with U+

NPN output: Ground switching, connects load with ground

PP output: Push pull output (differential mode: Connects load with ground or U+)

2 SAFETY INSTRUCTIONS

WARNING! The device is not a safety component pursuant to 2006/42/EC and EN 61496-1/-2. The device may not be used for personal protection! Non-compliance can lead to death or serious injuries! The device may only be used for the intended purpose!

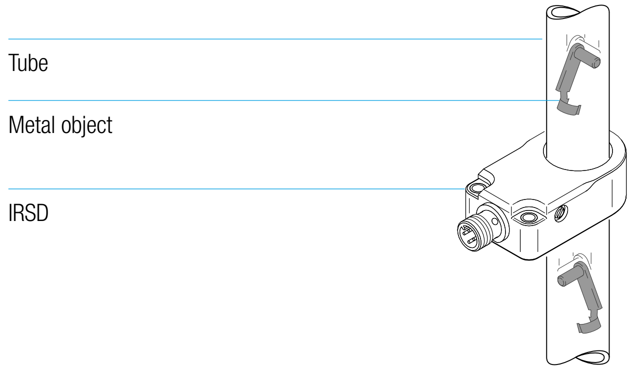
3 APPLICABILITY OF DOCUMENTATION

These instructions apply only for the inductive IO-Link IRSD ring sensors and only to the extent no new documentation has been published. These operating instructions describe the function, operation and installation of the product for proper use.

4 INTENDED USE

Description of the application: Position sensor, ring sensor for tube assembly

The IRSD is assembled on the tube through which different objects are guided in different ways.
The size of the object, for example a sphere, is almost as big as the inner diameter of the tube.



Counting of metal objects free fall

5 PRODUCT DESCRIPTION I FUNCTIONAL PRINCIPLE

5.1 FUNCTION I WORKING PRINCIPLE (DYNAMIC / STATIC), HOW DO INDUCTIVE RING SENSORS FUNCTION?

Inductive ring sensors are sensors that operate without contact and which detect (conductive) metal objects in automated production that are conveyed in supply tubes for further processing. Function: Inductive ring sensors work on the basis of a magnetic field that spreads out around an opened coil. The detection principle is based on the damping (weakening) of the magnetic field by the approaching metal object. The amplitude of the internal oscillating circuit is reduced by the dampening, until a switching threshold is reached and the sensor emits a switching signal. Using IO-Link communication, the sensors can be adapted individually to the application or to the various objects.

5.2 PRODUCT PROPERTIES (THE FUNCTIONAL PRINCIPLE STATIC/DYNAMIC)

Ring sensors with dynamic evaluation have a higher resolution than ring sensors with static resolution, so they are particularly suited for detecting very small parts with a low mass. The static functional principle is optimal for congestion control of small metal parts in supply processes. The dynamic operating principle independently compensates for contamination in the supply tube.

Static means that the output is switched on for as long the object is located in the detection range. Dynamic means that the sensor switches for a defined time as soon as a metal object is moving in the detection range, such that even tiny and very fast objects can be detected well.

NOTE: Inductive ring sensors are not suited for non-metal objects. Depending on the characteristic properties of metal objects such as electrical conductivity, temperature coefficients of electrical resistance, electromagnetic resistance and construction, smaller or larger objects can be detected accordingly.

5.3 PRODUCT OVERVIEW I PRODUCT IDENTIFICATION, VARIANTS OF PRODUCT

Inductive ring sensors from the IRSD series are available in 2 different models IRSD-X and IRSD-XP. They vary not only in size and construction, the IRSD-XP also has a potentiometer and can be adjusted to the application directly on the device.

The following product variants are offered:

Product ID	Device variant	Housing dimensions (Size)	Ø inner	Potentiometer	Remote teach	Connection	Plug outlet
213666	IRSD-6-G3-B4	20x 35±0,7x 73.5±1 mm	6.1 mm	no	Yes	Connector, M12, 4-pin	0°
213667	IRSD-10-G3-B4	20x 35±0,7x 73.5±1 mm	10.1 mm	no	Yes	Connector, M12, 4-pin	0°
213668	IRSD-15-G3-B4	20x 35±0,7x 73.5±1 mm	15.1 mm	no	Yes	Connector, M12, 4-pin	0°
213669	IRSD-20-G3-B4	20x 35±0,7x 73.5±1 mm	20.1 mm	no	Yes	Connector, M12, 4-pin	0°
213670	IRSD-25-G3-B4	20x 35±0,7x 73.5±1 mm	25.1 mm	no	Yes	Connector, M12, 4-pin	0°
213671	IRSD-30-G3-B4	20x 44±0,7x 78.5±1 mm	30.1 mm	no	Yes	Connector, M12, 4-pin	0°
213672	IRSD-35-G3-B4	20x 60±0,7x 91.5±1 mm	35.1 mm	no	Yes	Connector, M12, 4-pin	0°
213673	IRSD-50-G3-B4	20x 80±0,7x 122.5±1 mm	50.1 mm	no	Yes	Connector, M12, 4-pin	0°
213787	IRSD-6P-G3-B4	20x 35±0,7x 73.5±1 mm	6.1 mm	Yes	Yes	Connector, M12, 4-pin	0°
213788	IRSD-10P-G3-B4	20x 35±0,7x 73.5±1 mm	10.1 mm	Yes	Yes	Connector, M12, 4-pin	0°
213789	IRSD-15P-G3-B4	20x 35±0,7x 73.5±1 mm	15.1 mm	Yes	Yes	Connector, M12, 4-pin	0°
213790	IRSD-20P-G3-B4	20x 35±0,7x 73.5±1 mm	20.1 mm	Yes	Yes	Connector, M12, 4-pin	0°
213791	IRSD-25P-G3-B4	20x 35±0,7x 73.5±1 mm	25.1 mm	Yes	Yes	Connector, M12, 4-pin	0°
213792	IRSD-30P-G3-B4	20x 44±0,7x 78.5±1 mm	30.1 mm	Yes	Yes	Connector, M12, 4-pin	0°
213793	IRSD-35P-G3-B4	20x 60±0,7x 91.5±1 mm	35.1 mm	Yes	Yes	Connector, M12, 4-pin	0°
213794	IRSD-50P-G3-B4	20x 80±0,7x 122.5±1 mm	50.1 mm	Yes	Yes	Connector, M12, 4-pin	0°

6 INSTALLATION

6.1 GENERAL CONDITIONS FOR ASSEMBLY

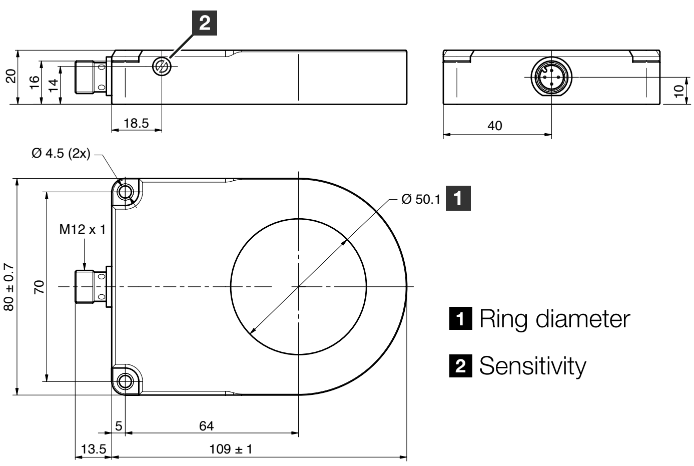
IMPORTANT! The permitted ambient conditions for operation of the device must be maintained. Technical information on this can be found on di-soric.com. The sensor is to be protected against mechanical loads, e.g. impacts and shocks. The sensor may be mounted in any position, as long as mounting is performed free of impacts and vibration.

NOTE:
DO not exert any pressure on the sensor. Following this instruction will prevent detrimental effects on the sensor function.

NOTE: Please ensure during assembly that mechanical components located nearby are connected to a continuous grounding design.

6.2 TECHNICAL DRAWING

The following technical illustration depicts a representation of an inductive ring sensor with technical specifications, using the example of the IRSD-50P-G3-B4.



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6.3 ASSEMBLY CONDITIONS (FASTENING, ORIENTATION OF THE SENSOR TOWARD THE METAL OBJECT, POTENTIALLY ALSO THE REDUCTION OF THE ASSEMBLY DISTANCE)

The sensor is fastened to the sensor fastenings. Depending on product variant, the hole distances indicated below are to be maintained. Sensor size hole distances [mm]

Sensor size	IRSD 6	IRSD 10	IRSD 15	IRSD 20	IRSD 25	IRSD 30	IRSD 35	IRSD 50
Hole distances [mm]	26	26	26	26	26	35	48	70

6.3.1 MINIMUM ASSEMBLY DISTANCE SENSOR TO SENSOR

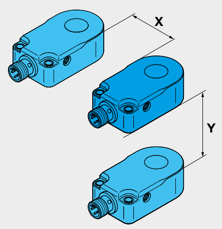
Via IO-Link it is possible to operate inductive ring sensors with two different working frequencies, A and B.
The operating channels are on index 231 with the permitted values 0 for operating channel A and 1 for operating channel B. In the factory settings, the sensor is set to the value 0 for the working channel A.

Variable "Measurement Channel" index=231 id=V_MeasurementChannel

description: Avoid interferences between sensors mounted next to each other by selecting different frequency channels
data type: 8-bit UInteger
allowed values: 0 = A, 1 = B
default value: 0
access rights: rw

octet	0
bit offset	7 - 0
element bit	7 - 0

NOTE:
If both ring sensors are assembled adjacent to one another, as shown in the following illustration, the following distances (x-axis and y-axis) must be maintained:
AA: Both sensors are operated on the same frequency.
AB: Both sensors are operated on different frequencies.



IRSD 6	Distance in mm			
	Static		Dynamic	
Channel	AA	AB	AA	AB
X	0	0	0	0
Y	0	0	0	0

IRSD 10	Distance in mm			
	Static		Dynamic	
Channel	AA	AB	AA	AB
X	0	0	0	0
Y	0	0	0	0

IRSD 15	Distance in mm			
	Static		Dynamic	
Channel	AA	AB	AA	AB
X	0	0	0	0
Y	3	0	0	0

IRSD 20	Distance in mm			
	Static		Dynamic	
Channel	AA	AB	AA	AB
X	0	0	0	0
Y	5	3	3	0

IRSD 25	Distance in mm			
	Static		Dynamic	
Channel	AA	AB	AA	AB
X	0	0	0	0
Y	10	4	7	3

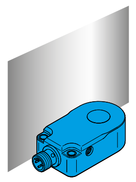
IRSD 30	Distance in mm			
	Static		Dynamic	
Channel	AA	AB	AA	AB
X	0	0	0	0
Y	13	8	12	5

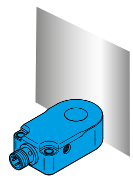
IRSD 35	Distance in mm			
	Static		Dynamic	
Channel	AA	AB	AA	AB
X	0	0	0	0
Y	18	10	14	8

IRSD 50	Distance in mm			
	Static		Dynamic	
Channel	AA	AB	AA	AB
X	0	0	0	0
Y	50	40	40	15

6.3.2 MINIMUM ASSEMBLY DISTANCE SENSOR TO METAL

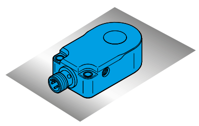
Depending on the type of assembly, the following distances between the device and metal plate are maintained.

	Sensor	Distance [mm]	
		Static	Dynamic
	IRSD 6	0	0
	IRSD 10	0	0
	IRSD 15	2	0
	IRSD 20	4	0
	IRSD 25	5	0
	IRSD 30	6	0
Sensor to metal	IRSD 35	7	0
(in X-axis)	IRSD 50	22	0

	Sensor	Distance [mm]	
		Static	Dynamic
	IRSD 6	0	0
	IRSD 10	0	0
	IRSD 15	0	0
	IRSD 20	2	0
	IRSD 25	2	0
	IRSD 30	4	0
Sensor to metal	IRSD 35	9	0
(in Y-axis)	IRSD 50	17	0

6.3.3 MIN. BORING DIAMETER D1 IN MM (WHERE Z = 0 MM)

The smallest hole D1 is the hole on which the sensor can be directly mounted. If the sensor is placed on a metal plate and the two borings are precisely over one another, the following table values are to be observed:

	Sensor	Diameter D1 [mm]	
		Static	Dynamic
	IRSD 6	6	6
	IRSD 10	10	10
	IRSD 15	18	15
	IRSD 20	27	20
	IRSD 25	34	25
	IRSD 30	40	30
Sensor to metal	IRSD 35	50	35
(in Z-axis)	IRSD 50	70	50

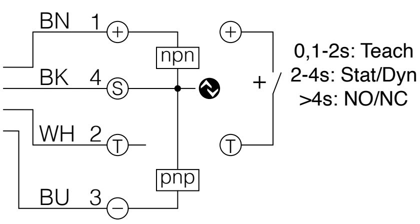
7 ELECTRICAL CONNECTION I ELECTRICAL DATA

7.1 GENERAL NOTES

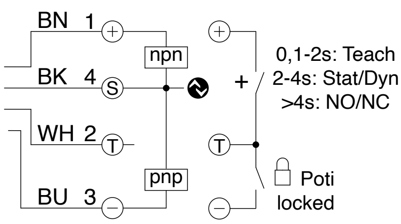
IMPORTANT! The device may only be installed by a qualified electrician. National and international regulation for setting up electrotechnical systems are to be adhered to.

7.2 PIN ASSIGNMENT I CONNECTION ASSIGNMENT

Depending on the product variant, the device has a 4-pin, metal M12 connection plug. Please observe the pin assignments below



IRSD-50-G3-B4 inductive ring sensor



IRSD-50P-G3-B4 inductive ring sensor with potentiometer

NOTE:
Via pin 2 there is the option to configure the ring sensors.

7.3 CONNECT SUPPLY VOLTAGE

NOTE: Ensure a voltage supply to SELV, PELV. Only operate power supplies with supply class 2 in the case of UL applications.
De-energize the device
connect supply voltage 10 to 30 V DC to the device

8 FIRMWARE I SWITCHING OUTPUT LOGIC: NO/NC OPERATION (SELECTABLE VIA IO-LINK)

8.1 GENERAL NOTES

By switching on the supply voltage, the device is put into operation. After the readiness delay has elapsed, the device is operational. In the delivery state, the parameters are set to the factory setting. The device can also be adjusted via appropriate IO-Link configuration software.

8.2 SWITCHING OUTPUT FUNCTION: NO/NC (CLOSER / OPENER), (NORMAL/ INVERTED), (SELECTABLE)

The "switching point logic" or switching principle determines how the switching information is transferred.

The switching output means an output with an on/off signal. With this function, the user can switch the switching output between closer operation (normally open) and opener operation (normally closed).

NO: Closer contact (normally open): If an object is in the range of the active switching zone, the output is closed.
(0 = **High-active**) (0 = **Not inverted**) (Normal operation)

NC: Opener contact (normally closed): If an object is in the range of the active switching zone, the output is open.
(1 = **low-active**) (1 = **Inverted**) (Inverted operation)

Variable "SSC1.1 Config" index=61 id=V_SSC11_Config

description: Defines the configuration parameter for switching signal channel 1.2
data type: 48-bit Record
access rights: rw
dynamic

subindex	bit offset	data type	allowed values	default value	acc. restr.	mod. other var.	excl. from DS	name	description
1	40	8-bit UInteger	0 = High Active, 1 = Low Active	0				Logic	Defines the logical representation of the switching signal in the process data
2	32	8-bit UInteger	0 = Deactivated, 1 = Single Point, 2 = Window, 3 = Two point	1				Mode	Sets the evaluation mode of the switching signal
3	0	32-bit UInteger	0..20	20				Hyst	Defines the hysteresis of the switchpoint. A higher hysteresis may help to increase stability in critical applications.

The switching logic that defines the logical representation of the switching signal in the process data is set to index 61 subindex 1. The allowed values are 0 for high-active and 1 for low-active. In the factory settings, 0 is preset for high-active.

In the factory settings, the device has a push-pull switching output at pin 4 with NO switching logic. After teaching in the device with the metal object, the following switching is done in operation:

- If a metal object is located in the detection range of the ring sensor: Switching output is active.
- If no object is located in the detection range of the ring sensor: Switching output is not active.

NOTE:
If the switching logic is set to NC, then an inverted switching behavior occurs.

9 OPERATING AND DISPLAY ELEMENTS (POTENTIOMETER, PIN 2, IO-LINK, LED) (LOCAL PARAMETERIZATION) (MECHANICAL SETTINGS)

Operation is performed intuitively and locally via potentiometer, pin 2 or via IO-Link.

Via IO-Link communication, the full functional scope of the sensor can be determined.

Information on switching state, stability, operating mode, teach mode and IO-Link communication is provided on the LED display.

10 COMMISSIONING IN LOCAL MODE (POTENTIOMETER, PIN 2)

For the operation of the sensors, there are 2 options available on index 65: Local sensor operation via potentiometer or remote via IO-Link. As values, 0 is allowed for remote and 1 for local. The factory setting is 1 for local only in the case of the variant with a potentiometer.

Variable "Switchpoint Potentiometer" index=90 id=V_SensibilityPotiSwitchpoint

description: Switchpoint Potentiometer
data type: 32-bit UInteger
allowed values: 460..4075
access rights: ro
dynamic

octet	0	1	2	3
bit offset	31 - 24	23 - 16	15 - 8	7 - 0
element bit	31 - 24	23 - 16	15 - 8	7 - 0

On index 92 the state of pin 2 is represented.

The values are 0 = inactive (pin 2 is locked), 1 = active (pin 2 is unlocked),
2 = open (pin 2 is not connected but is unlocked).
The state of pin 2 is read out via index 92.

Variable "Pin 2 Status" index=92 id=V_Pin2

description: Status of Pin 2: high, floating or low
data type: 8-bit UInteger
allowed values: 0 = Inactive (Locked), 1 = Active (Unlocked), 2 = Open (Unlocked)
access rights: ro
dynamic

octet	0
bit offset	7 - 0
element bit	7 - 0

The polarity of pin 2 as a digital input is defined on index 76.

The permissible values are 0 for high-active and 1 for low-active.
The factory setting is 0 = high-active.

Variable "Pin 2 Polarity" index=76 id=V_Pin2Polarity

description: Polarity of extern input signal on pin 2
data type: 8-bit UInteger
allowed values: 0 = High Active, 1 = Low Active
default value: 0
access rights: rw

octet	0
bit offset	7 - 0
element bit	7 - 0

The pin 2 function can be determined via index 71.

Permissible values are 0 = deactivated, 16 = activated.
The default value is 16 = activated.

Variable "Pin 2 Setting" index=71 id=V_Pin2_Setting

description: Behaviour setting of pin 2
data type: 8-bit UInteger
allowed values: 0 = Deactivated, 16 = Activated
default value: 16
access rights: rw

octet	0	
bit offset	7 - 0	
element bit	7 - 0	

11 PARAMETERIZATION ON THE DEVICE WITH OPERATING ELEMENTS (DEVICE WITH POTENTIOMETER) (LOCAL PARAMETERIZATION)

Upon delivery, the inductive ring sensor is set with potentiometer in the local device operating mode. That means that the sensor can be used with IO-Link direct after delivery.

In order to teach in the sensor, observe the respective connection diagram. Here one must observe that the potentiometer is not locked via pin 2.

Moreover, this information can also be queried via IO-Link. The default value for local parameterization is set to 0 (index 2, subindex 3). That means that the potentiometer is unlocked on the sensor in the factory settings.

3	2	Boolean	false = Unlocked, true = Locked	0				Local Parameterization	This lock prevents the device settings from being changed via local operating elements on the device.

The best way to teach in the sensor to the respective object is to use a slotted screwdriver. Hold the respective object constantly in the same position in the magnetic field. Take the slotted screwdriver and turn the potentiometer clockwise until the LED on the plug begins to illuminate. After the LED lights up, turn the potentiometer another 1 to 2 degrees clockwise. The sensor should now switch in a process-reliable manner when the object falls through the sensor.

If the potentiometer is in the max. position, the sensor can also switch permanently without object and is thus set wrong, i.e. the sensor is oversensitive.

In this case, the potentiometer must be turned counterclockwise again in order to fix the oversensitivity. This is especially the case in complex climatic conditions when a drift arises due to humidity.

The respectively set switching point can be verified via the IO-Link interface to index 90. The permissible values are between 490 and 4000.

Variable "Switchpoint Potentiometer" index=90 id=V_SensibilityPotiSwitchpoint

description: Switchpoint Potentiometer
data type: 32-bit UInteger
allowed values: 460..4075
access rights: ro
dynamic

octet	0	1	2	3	
bit offset	31 - 24	23 - 16	15 - 8	7 - 0	
element bit	31 - 24	23 - 16	15 - 8	7 - 0	

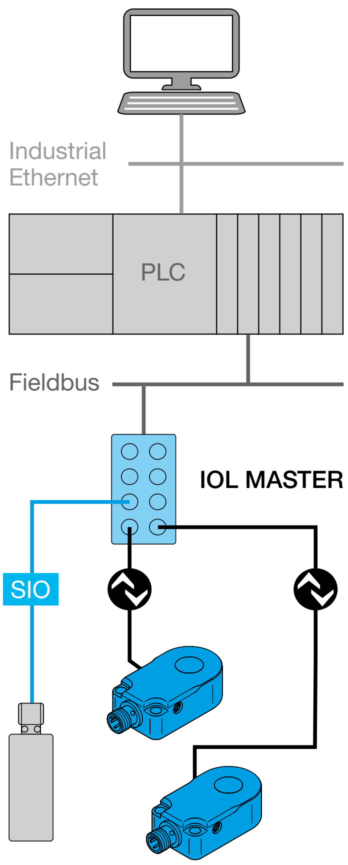
NOTE:
In comparison to the old family, the potentiometer logic is inverted with the new IRSD.

NOTE:
During commissioning of the sensor, no mechanical pressure can be exerted on the sensor.

12 COMMISSIONING IN REMOTE MODE (VIA IO-LINK)

Di-soric IRSD sensors are equipped with an IO-Link communication and can therefore be provided with additional functions. The IO-Link interface enables the best individual adjustment of the sensor to an application.

12.1 IO-LINK INTERFACE



Possible system architecture

Our inductive sensors with IO-Link can be configured and operated with an IO-Link Master. In this way, configurations such as closer / opener, PNP / NPN and much more can be set according to your needs and saved permanently. The sensor can even transmit the measured case speeds and diagnostic data via IO-Link. If you do not use IO-Link, then the sensor can be used in classic fashion as a proximity switch.

di-soric IRSD devices have the following IO-Link specification:

▪ IO-Link version V1.1.3 COM2 (38.4 kbaud), profile smart sensor 2nd edition V1.1 SSP 4.1.1

▪ The device can also be adjusted via appropriate IO-Link configuration software.

▪ The offline parameterization can be performed with the following di-soric products
– with PC IOL-Master with software version: V 5.1 and higher
– or without PC with IOL portable

The IO-Link Master establishes the connection between IO-Link devices and the automation system. An IO-Link Master may have several IO-Link ports (channels). One IO-Link device can be connected to each port (point-to-point communication). Thus, IO-Link is a point-to-point communication and not a field bus.

12.2 IODD FILE (I/O DEVICE DESCRIPTION)

In addition to an IO-Link Master with software, you also need the IODD (IO Device Description) for the device.

The IODD can be found via the QR code on the packaging or via the article number at www.di-soric.com under “Downloads”.

You can also find the IODD in the IODDfinder portal of the IO-Link Consortium: ioddfinder.io-link.com

The IODD is a zip file that consists of a main file and optional external language files (XML format) and image files (PNG format). The IODD describes IO-Link devices. It contains information to identify devices, device parameters, process and diagnostics data, communications properties, and the structure of user interfaces in engineering tools.

NOTE: Under www.di-soric.com “Downloads” there are html files that describe the contents of the XML main file in a graphic format. The following representations were taken from the English HTML file with the user role “Specialist.”

12.2.1 “DEVICE ACCESS LOCKS” I LOCAL PARAMETERIZATION.

Standard Variable "Device Access Locks" index=12 id=V_DeviceAccessLocks

description: The access to the device parameters can be restricted by setting appropriate flags within this parameter.
data type: 16-bit Record (subindex access not supported)
access rights: rw

The standard variable “Device access locks” is on index=12 id=V_DeviceAccessLocks. This lock hinders the device settings from being changed via the local operating elements on the device.

The permissible values for local parameterization are: false = unlocked, true = locked. The default value at 0 is also false = unlocked. For setup, under parameter menu, access can be restricted to the device parameters via corresponding flags in the parameter.

subindex	bit offset	data type	allowed values	default value	acc. restr.	mod. other var.	excl. from DS	name	description
1	0	Boolean	false = Unlocked, true = Locked					Parameter Write Access	This lock prevents the write access to all read/write parameters of the device except for the parameter 'Device Access Locks'.
2	1	Boolean	false = Unlocked, true = Locked					Data Storage	This lock prevents the write access to the device parameters via the data storage mechanism.
3	2	Boolean	false = Unlocked, true = Locked	0				Local Parameterization	This lock prevents the device settings from being changed via local operating elements on the device.
4	3	Boolean	false = Unlocked, true = Locked					Local User Interface	This lock prevents the access to the device settings and display via a local user interface. The user interface is disabled.

Octet 0

bit offset	15	14	13	12	11	10	9	8
subindex	//////	//////	//////	//////	//////	//////	//////	//////

Octet 1

bit offset	7	6	5	4	3	2	1	0
subindex	//////	//////	//////	//////	4	3	2	1

12.2.2 IO-LINK IDENTIFICATION

Standard Variable "System Command" index=2 id=V_SystemCommand

description: Command interface for applications. A positive acknowledge indicates the complete and correct finalization of the requested function.
data type: 8-bit UInteger

IO-Link enables the identification of sensors with a connected IO-Link Master. The following identification data for the device is located in the Identification menu:

Identification Menu
Idendification
V_VendorName
V_VendorText
V_ProductName
V_ProductID
V_ProductText
V_Lot
V_SerialNumber
V_HardwareRevision
V_FirmwareRevision
V_ApplicationSpecificTag, ro
V_CP_FunctionTag, ro
V_CP_LocationTag, ro

NOTE: The Locator function offers the option to quickly find the device in the system. The command for this function is found under “default command” or SystemCommand in index=2. With the values 126 for Locator and 127 for Locator stop, the devices can be easily visually identified.

12.2.3 IO-LINK PROCESS DATA

Standard Variable "PD Input" index=40 id=V_ProcessDataInput

description: Last valid process input data of the device.
data type: see ProcessDataIn!
access rights: ro
dynamic

The process data of the devices is transferred to the Master in a cyclical data telegram.

ProcessData id=P_ProcessData

ProcessDataIn "Process Data Input" id=PI_ProcessDataIn

bit length: 32
data type: 32-bit Record (subindex access not supported)

subindex	bit offset	data type	allowed values	default value	acc. restr.	mod. other var.	excl. from DS	name	description
1	16	16-bit Integer	0..4095		ro			Measured Value	Measured Value
2	8	8-bit Integer						Scale	Shows the multiplier for the measurement value of the sensor: 10exp(scale)
4	6	Boolean	false = OK, true = Not OK					Stability SSC1.1	Stability of switching signal channel 1.1
5	5	Boolean	false = OK, true = Not OK					Stability SSC1.2	Stability of switching signal channel 1.2
6	0	Boolean	false = Inactive, true = Active					Switch State (SSC1.1)	Switch state for SSC1.1
7	1	Boolean	false = Inactive, true = Active					Switch State (SSC1.2)	Switch state for SSC1.2

The input data PDIn has a data length of 4 bytes.

Octet 0								
bit offset	31	30	29	28	27	26	25	24
subindex	1							
element bit	15	14	13	12	11	10	9	8
Octet 1								
bit offset	23	22	21	20	19	18	17	16
subindex	1							
element bit	7	6	5	4	3	2	1	0
Octet 2								
bit offset	15	14	13	12	11	10	9	8
subindex	2							
element bit	7	6	5	4	3	2	1	0
Octet 3								
bit offset	7	6	5	4	3	2	1	0
subindex	//////	4	5	//////	//////	//////	7	6

The measured value (subindex 1) signals the damping through the metal part in the detection area of the sensor. Typically, the following measured value situation results:

- Low measured value:
  No metal part in the detection range, typically the process values here are between 480 and 500.
- High measured value:
  A metal part is located within the detection range. Observe that the sensor can be damped through the assembly of components.

NOTE:
To detect metal parts, usually the switching state of SSC1.1 (subindex 6) is used. Factory setting: 0 = no metal part detected (inactive), 1 = metal part detected (active).

With the stability of SSC1.1 (subindex 4), the functional reserve and the teaching result of the device is signaled. Value: 0 = OK, 1 = not OK, low functional reserve or teaching process not successful or teaching result unstable.

NOTE:
For fundamental device functions, the additional subindices are of subordinate importance.

12.2.4 IO-LINK BASIC FUNCTIONS (DEFAULT AND SYSTEM COMMANDS)

In the instructions, the essential basic functions are described on index 2 with the data type integer 8 bit.

Basic functions of devices are determined through IO-Link default variables and commands. The description of elementary commands is below.

- On index 2 there is the option to reset the sensor to factory settings (application reset) with the value 129.
- Resetting the device to factory settings and disconnecting IO-Link (back to box) with value 131.

NOTE:
Further basic functions can be seen in the html file of the device.

12.2.5 IO-LINK PARAMETER (OPERATION VIA IO-LINK)

IO-Link parameters enable the configuration of the sensor function. The sensor has the following important parameters.

Parameters for sensor function

With the sensor mode (index 73), the device can be optimized for specific application cases. Depending on the sensor mode, the maximum part speed and the attainable reproducibility changes. The permissible values are:
0=Standard, 1=Precision, 2=Speed The default value is 0 for Standard.

Variable "Sensor Mode" index=73 id=V_OperatingMode

description: Selected operating mode of the sensor: default, precision or speed
data type: 8-bit UInteger
allowed values: 0 = Standard, 1 = Precision, 2 = Speed
default value: 0
access rights: rw

octet	0	
bit offset	7 - 0	
element bit	7 - 0	

Working principle

The switching of the working principle is defined on index 230. The permissible value are 0 = static, 1 = dynamic. The factory setting is the default value 0 = static.

The static working principle is exceptionally well suited for example for part recognition, part counting and congestion control, while the dynamic working principle can detect the smallest and very fast parts with its very high resolution. Moreover, based on the switching principle, it has contamination compensation.

Variable "Operating Principle" index=230 id=V_OperatingPrinciple

description: Change operating principle
data type: 8-bit UInteger
allowed values: 0 = Static, 1 = Dynamic
default value: 0
access rights: rw
dynamic

octet	0	
bit offset	7 - 0	
element bit	7 - 0	

13 OPERATING MODES OF THE SENSOR: PARAMETERS FOR SWITCHING OUTPUT (DEACTIVATED, INDIVIDUAL VALUE, WINDOW, TWO VALUES)

The IRSD di-soric ring sensor has 4 operating modes: Deactivated, individual value, window, two values.

The switching logic of the sensor output is parameterized in index 61, subindex 1 with IO-Link. The following values are permissible: 0 for high active and 1 for low active. The factory setting is 0 for high-active.

The measured value difference between the switch-on and switch-off points is determined by hysteresis. It is required for stable switching behavior when the measured values fluctuate by the set switching point. A higher hysteresis can help to increase the stability in critical applications.

The hysteresis at the switching point can also be set via index 61 and subindex 3: The following values are allowed: 0 to 20%

The default value is: 5% for variants between 6 and 30 mm inner diameter and 3% for variants between 35 and 50 mm inner diameter.

The sensor mode can also be set in index 61 and in subindex 2 with permissible values: 0 for deactivated, 1 for individual value, 2 for window, and 3 for two values. The factory setting is 1 for individual value.

Variable "SSC1.1 Config" index=61 id=V_SSC11_Config

description: Defines the configuration parameter for switching signal channel 1.2
data type: 48-bit Record
access rights: rw
dynamic

subindex	bit offset	data type	allowed values	default value	acc. restr.	mod. other var.	excl. from DS	name	description
1	40	8-bit UInteger	0 = High Active, 1 = Low Active	0				Logic	Defines the logical representation of the switching signal in the process data
2	32	8-bit UInteger	0 = Deactivated, 1 = Single Point, 2 = Window, 3 = Two point	1				Mode	Sets the evaluation mode of the switching signal
3	0	32-bit UInteger	0..20	20				Hyst	Defines the hysteresis of the switchpoint. A higher hysteresis may help to increase stability in critical applications.

13.1 DEACTIVATED:

If the switching output SSC1.1 or SSC1.2 is deactivated on index 61, subindex 2, then the switching state remains subindex 6 inactive in the IO-Link communication of the process data.

ProcessData id=P_ProcessData

ProcessDataIn "Process Data Input" id=PI_ProcessDataIn

bit length: 32
data type: 32-bit Record (subindex access not supported)

subindex	bit offset	data type	allowed values	default value	acc. restr.	mod. other var.	excl. from DS	name	description
6	0	Boolean	false = Inactive, true = Active					Switch State (SSC1.1)	Switch state for SSC1.1
7	1	Boolean	false = Inactive, true = Active					Switch State (SSC1.2)	Switch state for SSC1.2

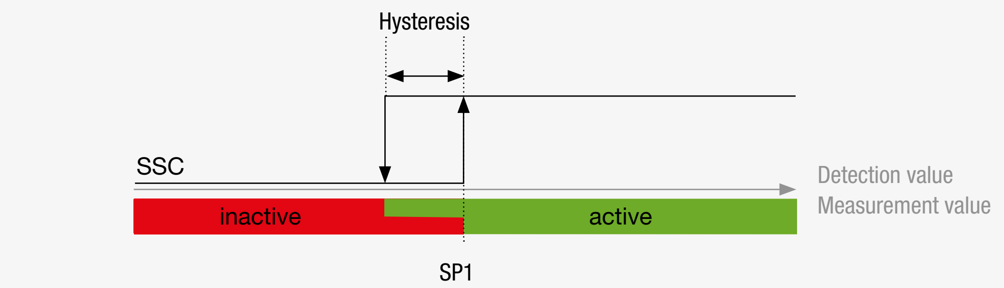
13.2 INDIVIDUAL VALUE MODE:

The single-point mode according to SSP "Quantity detection: Single Point Mode" (B.8.3 IO-Link Profile Smart Sensors 2nd Edition V.1.1) is implemented.

The switching state changes under consideration of the hysteresis when the measured value exceeds or drops below the limit value set in the switching point SP1.

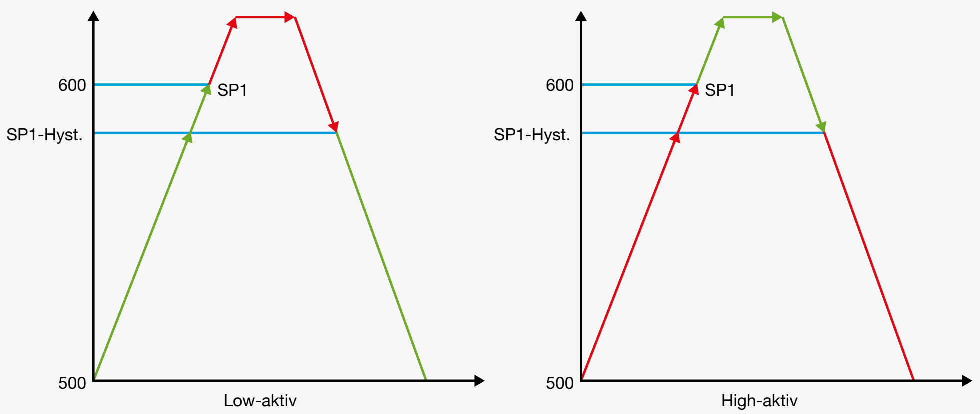
If the switching logic is set to low active, the sensor switches off when the set switching point SP1 is exceeded. The switching output is in the switched-off state as long as the measuring signal of the sensor falls below the switching point plus hysteresis. The sensor behaves inversely when the switching logic is set to high active.

The switching point logic (high-active / low-active) is defined through the application. The switching point 2 SP2 is not considered in this configuration mode.

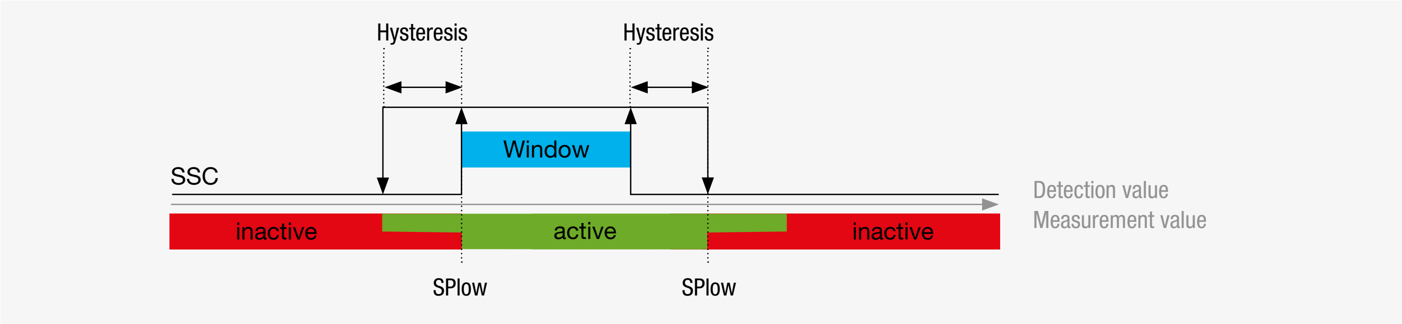


Quantity detection in individual value mode

The behavior of the SSC switching signal channel in the detection of quantities in the individual value mode with switching logic low-active and high-active is shown below.



13.3 WINDOW OPERATION



Quantity detection in window mode

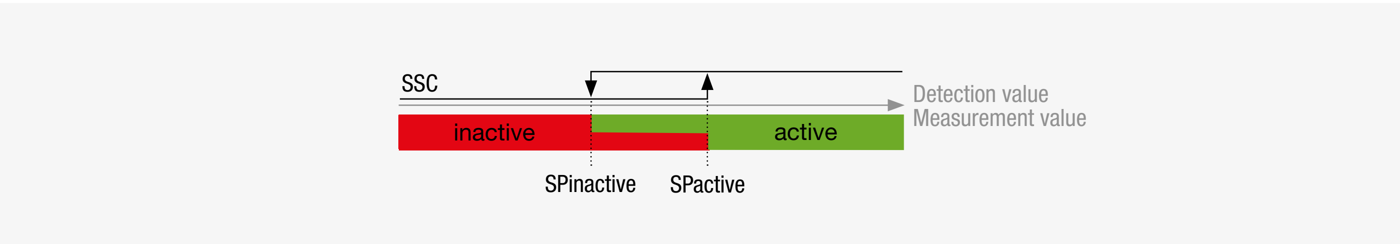
The hysteresis is established to be tube-shaped around the defined window. The window size is defined with the respective switching points SP1 and SP2. Since the hysteresis is indicated as a percentage, the size of the hysteresis loop for both switching points (SP1, SP2) varies.

This is an advanced feature of the ring sensor. In the case of this function, the switching output is only set when the object is located within a window that is defined through two window limits. Metal objects in supply tubes, for example, can therefore be monitored for correct size. Metal parts that are too large and too small are separated out.

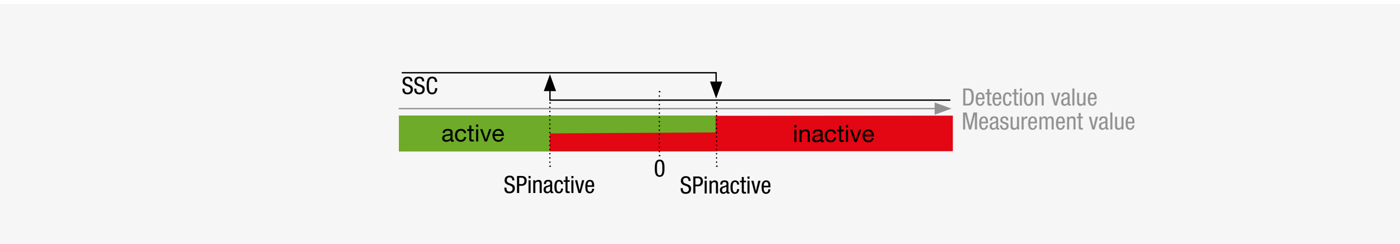
13.4 TWO VALUES

The two-point mode according to SSP "Quantity detection: Two Point Mode" (B.8.3.3 IO-Link Profile Smart Sensors 2nd Edition V.1.1) is implemented.

The behavior of the SSC in the determination of quantities in the two-point mode is shown in the illustration. In this configuration mode, the parameter hysteresis is not relevant.



Quantity detection in two value mode, positive activity



Quantity detection in two value mode, negative activity

13.5 POLARITY OF THE SWITCHING OUTPUT

The polarity of the switched output is determined by the index 70.

Values: 0=Differential mode output (PP outputs), 1=NPN output, 2=PNP output, the default value or factory setting is 0-PP (push-pull) differential mode.

Variable "Switching Output" index=70 id=V_MultiIO1

description: Polarity of the switching output
data type: 8-bit UInteger
allowed values: 0 = PP, 1 = NPN, 2 = PNP
default value: 0
access rights: rw

octet	0	
bit offset	7 - 0	
element bit	7 - 0	

The switch-on delay for the switching output is defined with index 66. Value range: 0 to 60,000 ms

Variable "SSC1.1 Switch-On Delay" index=66 id=V_SSC11_DS

description: Defines the switch-on delay for the switching signal of signal channel 1.1
data type: 16-bit UInteger
allowed values: 0..60000
default value: 0
access rights: rw

octet	0	1	
bit offset	15 - 8	7 - 0	
element bit	15 - 8	7 - 0	

The switch-off delay for the switching output is defined with index 67.

Value range: 0 to 60,000 ms

Variable "SSC1.1 Switch-Off Delay" index=67 id=V_SSC11_DR

description: Defines the switch-off delay for the switching signal of signal channel 1.1
data type: 16-bit UInteger
allowed values: 0..60000
default value: 20
access rights: rw

octet	0	1	
bit offset	15 - 8	7 - 0	
element bit	15 - 8	7 - 0	

14 PARAMETERIZATION WITH IO-LINK V1.1.3 (TEACHING BEHAVIOR)

14.1 TEACHING PROCESS:

The process in a device to determine teaching points and nominal values for a certain switching function.

Before the actual object can be taught in, it must be ensured that the correct switching signal channel (SSC) is selected.

The switching signal (SSC) can be selected with IO-Link communication under the index 58 with the permissible values 1 for SSC1.1 and 2 for SSC1.2. The default value is 1 for SSC1.1.

Variable "Teach Select" index=58 id=V_TeachSelect

description: Selection of the switching signal channel for which a teach procedure will be applied
data type: 8-bit UInteger
allowed values: 1 = SSC1.1, 2 = SSC1.2
default value: 1
access rights: rw

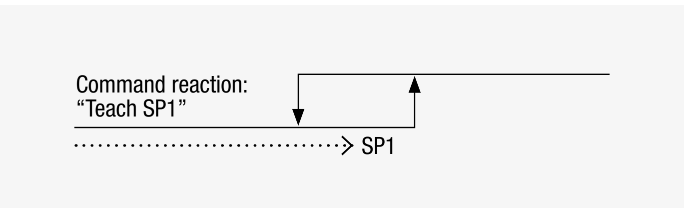
octet	0	
bit offset	7 - 0	
element bit	7 - 0	

IMPORTANT! The selection of the switching signal channel with the index 58 is used both for the static and the dynamic teaching method.

14.2 STATIC SINGLE POINT TEACH-IN TO METAL OBJECT

Teach-in of an individual value is only possible when the static working principle has been set. This is how the switching point 1 SP1 is set. The switching point 1 SP1 is set when a metal object in located in the magnetic field. To trigger the teach-in process, the sensor must be written to with a system command on index 2 with the value 65 for teach SP1.

IMPORTANT! With a device tool, the teach method is applied in a different way. The same command is executed.



Individual value teach-in (individual value mode)

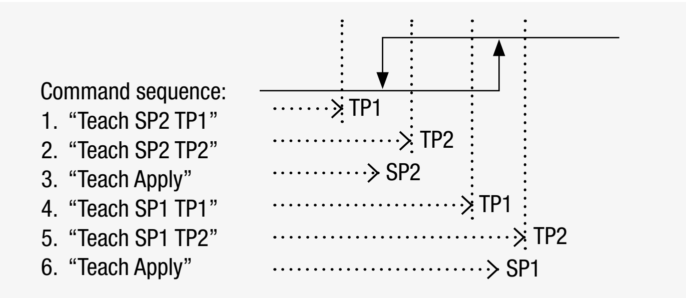
Procedure:

- Switching channel selection SSC1.1 or SSC1.2
- One point teach-in static to metal parts
- Position the metal part statically in the detection range.
- Index 2, value 65 = teaching object SP1

NOTE: The following notes should be observed: Teaching to the metal part is only effective with low measured value fluctuations on the tube.

14.3 STATIC TWO POINT TEACH-IN TO METAL OBJECT

In this teaching process, two teaching points (SP1, TP1 and SP2, TP2) are set in order to determine a threshold value.



Individual value (two value mode)

Procedure:

- Switching channel selection SSC1.1 or SSC1.2
- One point teach-in static to metal parts
- Position the metal parts statically in the detection range.
- Apply Index 2 value 64 teach-in

NOTE:
Teaching to the metal part is only effective with low measured value fluctuations on the tube.

14.4 MANUAL ADJUSTMENT OF SWITCHING POINT

The switching point SP1 for the switching output is defined with index 60 subindex 1. Permitted values: [450 to 4000]. The factory setting is 500.

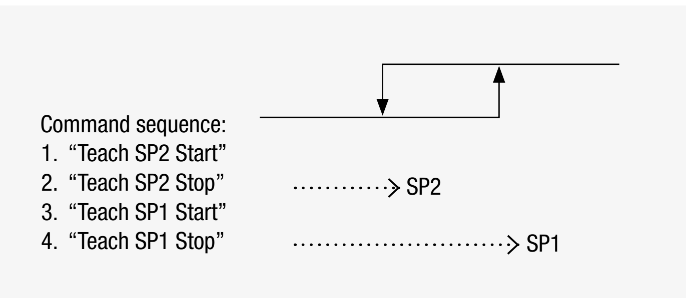
Variable "SSC1.1 Param" index=60 id=V_SSC11_Param

description: Defines the setpoint values for switching signal channel 1.1
data type: 64-bit Record
access rights: rw
dynamic

subindex	bit offset	data type	allowed values	default value	acc. restr.	mod. other var.	excl. from DS	name	description
1	32	32-bit UInteger	450..4000	500				SP1	Defines the setpoint 1 value for the switching signal channel
2	0	32-bit UInteger	450..4000	500				SP2	Defines the setpoint 2 value for the switching signal channel

14.5 DYNAMIC TEACH-IN TO MOVING METAL OBJECT

In a dynamic teach-in, the median value of several consecutively falling metal objects is determined. For example, the switching point 1 SP1 is taught in with the system command to index 2 with the following values: 71 = Teach SP1 Start, 72 = Teach SP1 Stop, 73 = Teach SP2 Start, 74 = Teach SP2 Stop.



Dynamic teach-in method (window mode and two value mode)

Procedure:

- Switching channel selection SSC1.1 or SSC1.2
- Command Start Index 2 value 71 teach SP1 Start
- Move moving metal parts through the detection range
- Command Index 2 value 72 teach SP1 Stop
- Repeat same procedure with other references metal objects for SP2

NOTE:
As opposed to intelli-teach, the dynamic teach-in must be ended with a command.

14.6 TEACH VERIFICATION

The teaching values for detecting the switching point of the switching output SSC1.1 SP1 can be found under index 59 subindex 3, permitted values: 1 = switching point is set, value 2 = switching point 2 is set, value 3 = switching points 1 and 2 are set.

Variable "Teach Result" index=59 id=V_TeachResult

description: Result of teach procedure
data type: 8-bit Record (subindex access not supported)
access rights: ro
dynamic

subindex	bit offset	data type	allowed values	default value	acc. restr.	mod. other var.	excl. from DS	name	description
3	0	4-bit UInteger	0 = Idle, 1 = Switchpoint 1 Set, 2 = Switchpoint 2 Set, 3 = Switchpoints 1 and 2 Set, 4 = Wait for Command, 5 = Busy, 6 = Reserved, 7 = Error	0				State	Indication of the current state of the teach-in procedure

Octet 0

bit offset	7	6	5	4	3	2	1	0
subindex	//////	//////	//////	//////	3			
element bit					3	2	1	0

14.7 IO-LINK DIAGNOSIS

IO-Link diagnosis enables the efficient maintenance of the device.

The following illustration shows the menu for diagnosis of a ring sensor that is activated via the IO-Link Master.

Diagnosis Menu
Diagnosis
General
V_DeviceStatus
V_Temperature * 0.1 °C, Dec.1
V_Temperature_Max * 0.1 °C, Dec.1
V_OperatingTime h
V_StartUps
Detailed Device Status
V_DetailedDeviceStatus
Resettable
V_SSC11_Switchcounter
V_SSC12_Switchcounter
V_ProcessDataLimits.Min
V_ProcessDataLimits.Max
V_SystemCommand, Button:=163

14.8 STANDARD DIAGNOSIS

The current status of the device is displayed by the device status with index 36.

Values: 0 = Device is OK, 1 = Maintenance required, 2 = Outside specification, 3 = Function test, 4 = Error

Further information can be found in the detailed device status with index 37.

Standard Variable "Device Status" index=36 id=V_DeviceStatus

description: Indicator for the current device condition and diagnosis state.
data type: 8-bit UInteger
allowed values: 0 = Device is OK, 1 = Maintenance required, 2 = Out of specification, 3 = Functional check, 4 = Failure
access rights: ro
dynamic

octet	0	
bit offset	7 - 0	
element bit	7 - 0	

14.8.1 DEVICE-SPECIFIC DIAGNOSIS

Non-resettable diagnosis:

Diagnosis Menu
Diagnosis
General
V_DeviceStatus
V_Temperature * 0.1 °C, Dec.1
V_Temperature_Max * 0.1 °C, Dec.1
V_OperatingTime h
V_StartUps

Index 36: Display of the current device and diagnostic state.

Standard Variable "Device Status" index=36 id=V_DeviceStatus

description: Indicator for the current device condition and diagnosis state.
data type: 8-bit UInteger
allowed values: 0 = Device is OK, 1 = Maintenance required, 2 = Out of specification, 3 = Functional check, 4 = Failure
access rights: ro
dynamic

octet	0	
bit offset	7 - 0	
element bit	7 - 0	

Index 86: current internal temperature in device in °C

Variable "Temperature" index=86 id=V_Temperature

description: Temperature of the sensor in °C
data type: 16-bit Integer
allowed values: -400..1200
access rights: ro
dynamic

octet	0	1	
bit offset	15 - 8	7 - 0	
element bit	15 - 8	7 - 0	

Index 96: maximum temperature since commissioning in °C

Variable "Maximum Temperature" index=96 id=V_Temperature_Max

description: Maximum operating temperature reached by sensor
data type: 16-bit Integer
allowed values: -400..1200
access rights: ro
dynamic

octet	0	1
bit offset	15 - 8	7 - 0
element bit	15 - 8	7 - 0

Index 93: Number of operating hours of the device

Variable "Operating Hours" index=93 id=V_OperatingTime

description: Number of hours the system was powered on
data type: 32-bit UInteger
allowed values: 0..4294967295
access rights: ro
dynamic

octet	0	1	2	3
bit offset	31 - 24	23 - 16	15 - 8	7 - 0
element bit	31 - 24	23 - 16	15 - 8	7 - 0

Index 94: Number of switch-on processes

Variable "Count of System Start-ups" index=94 id=V_StartUps

description: Number of times the system was started
data type: 32-bit UInteger
allowed values: 0..4294967295
access rights: ro
dynamic

octet	0	1	2	3
bit offset	31 - 24	23 - 16	15 - 8	7 - 0
element bit	31 - 24	23 - 16	15 - 8	7 - 0

Resettable diagnosis:

Resettable
V_SSC11_Switchcounter
V_SSC12_Switchcounter
V_ProcessDataLimits.Min
V_ProcessDataLimits.Max
V_SystemCommand, Button:=163

Resettable diagnostic values are reset after switching on or with a standard command.

The standard command under index 2 with a value of 163 resets the following diagnostic functions:

Index 85: Number of switching operations since start of device or reset for the switching channel SSC1.1

Variable "Switching Count SSC1.1" index=85 id=V_SSC11_Switchcounter

description: Switching count since power-up or reset for SSC1.1
data type: 32-bit UInteger
allowed values: 0..4294967295
access rights: ro
dynamic

octet	0	1	2	3
bit offset	31 - 24	23 - 16	15 - 8	7 - 0
element bit	31 - 24	23 - 16	15 - 8	7 - 0

Index 102: Number of switching operations since start of device or reset for the switching channel SSC1.2

Variable "Switching Count SSC1.2" index=102 id=V_SSC12_Switchcounter

description: Switching count since power-up or reset for SSC1.2
data type: 32-bit UInteger
allowed values: 0..4294967295
access rights: ro
dynamic

octet	0	1	2	3
bit offset	31 - 24	23 - 16	15 - 8	7 - 0
element bit	31 - 24	23 - 16	15 - 8	7 - 0

Index 84, subindex 1: Minimum measured value after switching on or reset

Index 84, subindex 2: Maximum measured value after switching on or reset

Variable "Measurement Value" index=84 id=V_ProcessDataLimits

description: Min and max value of the measurement value since power-up or reset
data type: 64-bit Record
access rights: ro
dynamic

subindex	bit offset	data type	allowed values	default value	acc. restr.	mod. other var.	excl. from DS	name	description
1	32	32-bit UInteger						Min	Minimum measurement value since power-up or reset
2	0	32-bit UInteger						Max	Maximum measurement value since power-up or reset

octet	0	1	2	3	4	5	6	7
bit offset	63 - 56	55 - 48	47 - 40	39 - 32	31 - 24	23 - 16	15 - 8	7 - 0
subindex	1	1	1	1	2	2	2	2
element bit	31 - 24	23 - 16	15 - 8	7 - 0	31 - 24	23 - 16	15 - 8	7 - 0

NOTE: The minimum and maximum measured values enable an evaluation of the dependent variation of the measured values and are suited for evaluating the application.

14.9 PARAMETERIZATION WITH PIN 2

14.9.1 PARAMETERIZATION WITH INPUT FUNCTION ON PIN 2

The polarity of the external input signal to pin 2 is determined by the index 76. The permissible values are 0 for high-active and 1 for low-active.

In the factory settings, the input signal is set at pin 2 to 0 = high-active.

Variable "Pin 2 Polarity" index=76 id=V_Pin2Polarity

description: Polarity of extern input signal on pin 2
data type: 8-bit UInteger
allowed values: 0 = High Active, 1 = Low Active
default value: 0
access rights: rw

octet	0	
bit offset	7 - 0	
element bit	7 - 0	

The behavior of the input signal pin 2 can be switched between deactivated and activated with index 71. The permissible values are: 0 = deactivated, 16 = activated.

In the factory settings, pin 2 is set to setting 16 = activated.

Variable "Pin 2 Setting" index=71 id=V_Pin2_Setting

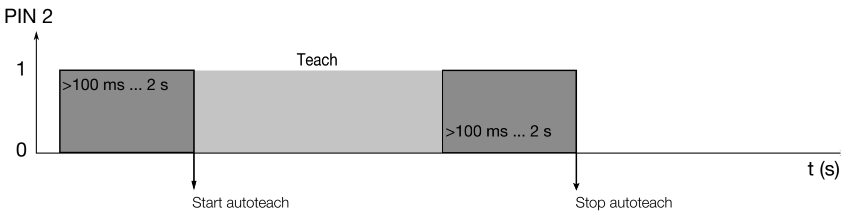
description: Behaviour setting of pin 2
data type: 8-bit UInteger
allowed values: 0 = Deactivated, 16 = Activated
default value: 16
access rights: rw

octet	0	
bit offset	7 - 0	
element bit	7 - 0	

NOTE: Alternatively, pin 2 can also be assigned other functions when the device is configured for operation with IO-Link. (e.g. pin 2 is a digital input).

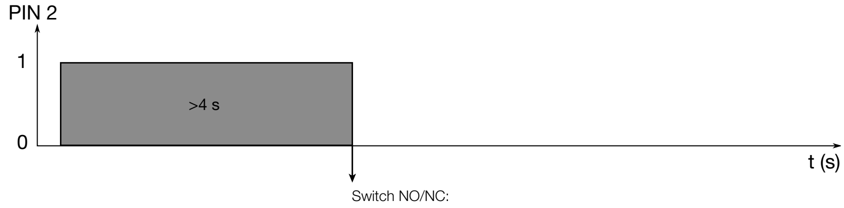
The following settings options for pin 2 are to be observed:

- If pin 2 is set to operating voltage (10 to 30 VDC):
  – for 0.1-2 s: the teaching function is executed



  – for 2-4 s: the functional principle can be switched between dynamic/static

– for >4 s: the switching output NO/NC can be switched.



- If pin 2 is connected to ground:
  – the potentiometer is locked

15 TROUBLESHOOTING

In the following, the most commonly occurring IO-Link specific parameter error types and function error types and warnings are listed.

15.1 ERROR TYPES (PARAMETERS AND FUNCTIONS)

In the following, the most common error types are described:

Code	Additional code	Name	Description
128 (0x80)	0 (0x00)	Device application error - no details	Service was denied by the technology-specific application. No detailed root-cause information is available.
128 (0x80)	17 (0x11)	Index not available	Read or write access attempt to a non-existing index.
128 (0x80)	18 (0x12)	Subindex not available	Read or write access attempt to a non-existing subindex of an existing index.
128 (0x80)	32 (0x20)	Service temporarily not available	Parameter not accessible due to the current state of the technology-specific application.
128 (0x80)	35 (0x23)	Access denied	Write access to a read-only parameter or read access to write-only parameter.
128 (0x80)	48 (0x30)	Parameter value out of range	Written parameter value is outside of the permitted value range.
128 (0x80)	49 (0x31)	Parameter value above limit	Written parameter value is above its specified value range.
128 (0x80)	50 (0x32)	Parameter value below limit	Written parameter value is below its specified value range.
128 (0x80)	51 (0x33)	Parameter length overrun	Written parameter is longer than specified.
128 (0x80)	52 (0x34)	Parameter length underrun	Written parameter is shorter than specified.
128 (0x80)	53 (0x35)	Function unavailable	Written command is not supported by the technology-specific application.
128 (0x80)	54 (0x36)	Function temporarily unavailable	Written command is unavailable due to the current state of the technology-specific application.
128 (0x80)	64 (0x40)	Invalid parameter set	Written single parameter value collides with other existing parameter settings.
128 (0x80)	65 (0x41)	Inconsistent parameter set	Parameter set inconsistencies at the end of block parameter transfer. Device plausibility check failed.

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15.2 WARNINGS

In the following the warning notices are listed:

Code	Type	Name	Description
36350 (0x8dfe)	Warning	Test Event 1	Event appears by setting index 2 to value 240. Event disappears by setting index 2 to value 241
36351 (0x8dff)	Warning	Test Event 2	Event appears by setting index 2 to value 242. Event disappears by setting index 2 to value 243

NOTE: In case of faulty device behavior:
Disconnect power from device and restore factory settings.

Should problems continue, contact di-soric technical support.

For contact with technical support, please have the following information handy:

- Customer number
- Article designation or article number
- Serial or batch number
- Description of support request (explanation of problem)

16 MAINTENANCE, REPAIRS, DISPOSAL

16.1 MAINTENANCE

Abrasive materials can cause contamination on the inner wall of the tube. Indications of this are an inconstant switching signal or an interconnection of the sensor.

If a repeated teach-in (new switching point(s)) does not have a positive effect, please check the tube length at the respective sensor position for contamination and clean the tube or change it.

NOTE: Tighten screws evenly in order to avoid mechanical stresses. The maximum torque for the fastening screws is to be observed. (M3 max. 0.5 Nm, M4 max. 1.4 Nm)

IMPORTANT! After cleaning and re-assembly of the ring sensor on the tube, the sensor must be taught in again.

16.2 REPAIR

Repair of defective devices may only be performed by the manufacturer.

16.3 DISPOSAL

The device is to be disposed of in an environmentally appropriate manner according to the respectively applicable waste removal regulations.

SOLUTIONS. CLEVER. PRACTICAL.

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