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## IO-Link

This document reflects the Novotechnik sensor protocol implementation of the standard IO-Link protocol. A basic knowledge of the IO-link interface is required for a proper understanding of this document. Most of the definitions made are according to the IO-Link Standard specifications. For making use of all the features that these specifications offer, a knowledge about them is absolutely necessary. The linear sensors supports the IO-Link Smart Sensor Profile specifications (Edition 2019) according IEC 61131-9.

The IO-Link interface is a point-to-point connection based on a UART protocol with 24 V pulse modulation. Data is exchanged cyclically between the IO-Link Master and the IO-Link device using the IO-Link protocol. The protocol contains process data and also requested additional data for state determination or configuration.

### 1 IODD Files

For integration in a common IO-Link projecting tool, IO Device Description (\*.IODD) files are provided. These files can be downloaded from the Novotechnik Web Site, see Downloads/Operating manuals where also this document can be found.

⇒ IODD see file *Product series\_IODD\_model.zip*

### 2 Support

If you have any questions, please contact our product support at support@novotechnik.de. Electronic data sheets or user manuals for previous software versions are available on request.

### 3 Device specification

Specification	IO-Link Description	Value
Transfer rate	COM3	230.4 kBaud
Minimum cycle time of device	Min cycle time	0x0A (1 ms)
Frame specification - Number of preoperate data required - Number of operate data required - Enhanced parameters	M-sequence capability: - Preoperate M-sequence type - Operate M-sequence type - ISDU supported	0x2B Type_1_V Type_2_V Supported
IO-Link protocol version	Revision ID	0x11 (Version 1.1)
IO-Link Profile + Profile type	Profile + Profile Type	____-____-____-A10-____ (Code A10): Smart Sensor Profile Ed.2 (Digital Measuring Sensor), SSP 4.2.1 ____-____-____-A11/A12-____ (Code A11/A12): Common Profile V1.1
Number of process data (PD) from device to master	ProcessDataIn	See chapt. 4
Number of process data (PD) from master to device	ProcessDataOut	0x00 (0 bit)
Manufacturer ID	Vendor ID	0x030B (779)
Device identification	Device ID	____-____-____-A10-____: 0x1006 (004102) ____-____-____-A11-____: 0x1007 (004103) ____-____-____-A12-____: 0x1011 (004113)

Transfer times	
Process data cycle with master V1.1	Master cycle time = 1 ms

### 4 Process Data (PD)

The process data are transmitted cyclically.

Process data "Position":

This value is the absolute angle related to the factory default null point including the number of turns. The sensor outputs a 32-bit integer value via the IO-Link interface.

Process data "Velocity":

This value is the calculated speed from the position change per time. The sensor outputs a 16-bit integer value via the IO-Link interface.

**4.1 Common Profile V1.1**

Code/Model	Byte			
	3	2	1	0
Code A11: ___ - ___ - ___ -A11-___ 1x Position	Position			

Code/Model	Byte					
	5	4	3	2	1	0
Code A12: ___ - ___ - ___ -A12-___ 1x Position + Velocity	Position				Velocity	

**4.2 Smart Sensor Profile Ed.2 (Digital Measuring Sensor) SSP 4.2.1**

The sensor cyclically outputs a measurement value and additional status and switching point information.

Code/Model	Byte					
	5	4	3	2	1	0
Code A10 : ___ - ___ - ___ -A10-___ 1x Position SSP Ed.2	Measurement value (position)				Scaling factor	Status and SSC

The **measurement value** corresponds to the absolute angle including the number of turns in 0,01°/bit and is related to the factory default null point. It must be multiplied by the scaling factor to obtain a value in the SI unit. The **scaling factor** for this multi-turn sensor is -2.  
 Measurement value x 10<sup>-2</sup> = Position [°]

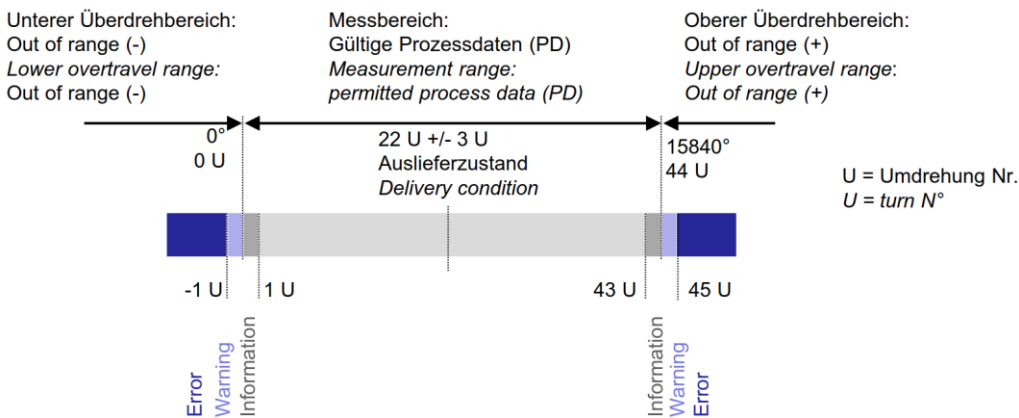
Bit	Name	Function
7	System Error	General system error, hardware or memory
6	No measurement data	Position marker missing
5	Out of Range (+)	Outside of measurement range, in upper overtravel range
4	Out of Range (-)	Outside of measurement range, in lower overtravel range
3	Velocity overrange	Velocity out of range
2	Empty	-
1	SSC2	Switching information of the second switching signal channel
0	SSC1	Switching information of the first switching signal channel

**4.3 Validity of Process Data**

**4.3.1 Validity of the process data during Parameterization**

While the sensor is parameterized and changed parameters are written to persistent memory, process data is labeled as invalid (PD Invalid Bit).

**4.3.2 Validity of Process Data "Position"**



If the output signal is out of measurement range, the values Out of Range (-) 0x80000008 (lower overtravel range) or Out of Range (+) 0x7FFFFFF8 (upper overtravel range) are put out. The values Out of Range (+) and Out of Range (-) are independent of the direction of rotation (cw or ccw).

**Warning range:**

If overtravelling > -1 turn or < 45 turns (i.e. maximally one turn outside of the measurement range), the sensor outputs an additional warning. After turning back into the measurement range, the position signal still corresponds to the position signal before leaving the measurement range.

**Error range:**

If overtravelling < -1 turn or > 45 turns, the sensor outputs an additional error message. It must be deleted after reversing into the measurement range using the "Position error reset" command or power off/on. To return into the measurement range, the sensor shaft has to be turned back at least 3 turns in the opposite direction. In case of an error, the error value 0x7FFFFFFC is put out and data is labeled as invalid (PD Invalid Bit).

**4.3.3 Validity of Process Data “Velocity”**

Only Code A10 (SSP Ed.2): If velocity is out of range, status bit 3 is set.

**5 Parameter Data**

Device parameters are exchanged non-cyclically and on request of the IO-Link master. Parameter values can be written into the sensor (Write) or device states can be read out of the sensor (Read) by means of the "On-Request Data Objects".

**5.1 Identification data**

Index	Sub-index	Parameter	Access	Default value
0x0010	0	Vendor name	Read only	Novotechnik Messwertaufnehmer OHG
0x0011	0	Vendor Text	Read only	www.novotechnik.de
Index	Sub-index	Parameter	Access	Default value
0x0012	0	Product name	Read only	e.g. MC1-2802-214-A11-551
0x0013	0	Product ID	Read only	Multiturn series MC1-2800, MZ1-2200: M_1-SSP-K 1x position Edition 2, with cable Code A10 M_1-SSP-ST 1x position Edition 2, with plug Code A10 M_1-P-K 1x position, with cable Code A11 M_1-P-ST 1x position, with plug Code A11 M_1-PV-K 1x position + velocity, with cable Code A12 M_1-PV-ST 1x position + velocity, with plug Code A12
0x0014	0	Product text	Read only	Magnetic Multiturn Sensor
0x0015	0	Serial number	Read only	see product label B/N xxxxxx or S/N xxxxxxxx
0x0016	0	Hardware revision	Read only	HW xx.xx
0x0017	0	Firmware revision	Read only	FW xx.xx

**5.2 System Commands**

Command	Name	Description
0x80	Device Reset	This feature enables a device to perform a "warm start" to an initial state such as power-on
0x82	Restore Factory Settings	This feature enables a device to restore parameters to the original delivery status
0x83	Back-to Box	This feature enables a device to restore parameters to the original delivery values without any interaction with upper level mechanisms such as Data Storage or PLC based parameterization
0xA8	Position Error Reset	Precondition: The sensor is turned back into the measurement range. The front end of the device is reset to delete the errors 0x8CB3 Out of Range (+) and Out of 0x8CB7 Range (-). No communication stop or restart.
0xAF	Powermanagement	The front end of a device is switched off to eliminate disruptive influences on the environment or to reduce power consumption. Switch on must be done via Power-on or by Device Reset.

**5.3 Device parameter Data**

Index	Sub-index	Parameter	Access	Default value	Value Range	Parameter managem.
<b>System Parameters</b>						
0x000C	0	Device Access Locks (see 5.3.2)	Read/Write	0 (not locked)	-	Yes*
0x000D	0	Profile Characteristics (see 5.3.3)	Read only	0x00 01 80 00 80 02 80 03	-	No
0x000E	0	PD Input Descriptor (see 5.3.4)	Read only	See 5.3.4	-	No
0x0018	0	Application Specific Tag (see 5.3.5)	Read/Write	***	-	Yes*
0x0019	0	Function Specific Tag (see 5.3.5)	Read/Write	***	-	Yes*
0x001A	0	Location Specific Tag (see 5.3.5)	Read/Write	***	-	Yes*

\*) changeable during operation

Index	Sub-index	Parameter	Access	Default value	Value Range	Parameter managem.
<b>Measurement Data Channel</b>						
0x0040	0	Null Point Offset (see 5.3.6)	Read/Write	0	0 ... max. measurement range	Yes*
0x0041	1	Averaging Position (see 5.3.7)	Read/Write	0 (not activated)	0 ... 7 = filter 0 (noise 0,03°) ... filter 7 (noise 0,0026°)	Yes*
0x0041	2	Averaging Velocity (see 5.3.7)	Read/Write	5 (noise 0,83°/s)	0 ... 8 = filter 0 (noise 26,51°/s) ... filter 8 (noise 0,1°/s)	Yes*
0x0042	0	Direction Setting (see 5.3.8)	Read/Write	0	0 = rising cw 1 = rising ccw	Yes*
0x0044	0	Mode (see 5.3.9)	Read/Write	(configuration, default see ordering code)	mode 0 = Code A10: 1x position + switches SSP Ed. 2  mode 1 = Code A11: 1x position  mode 2 = Code A12: 1x position + 1x velocity	Yes**
0x0050	0	Position	Read only	(actual position value, 32 bits)	-	No
0x0051	0	Velocity	Read only	(actual velocity value, 16 bits)	-	No
0x0054	0	Temperature	Read only	(actual temperature value, 16 bits)	-	No
0x4080	1	MDC Describer Lower Limit	Read only	0	-	No
0x4080	2	MDC Describer Upper Limit	Read only	Code A10: 44x360/0.01°  Code A11/A12: 44x2^16 inc	-	No
0x4080	3	MDC Describer Unit Code	Read only	Code A10: 1005 Code A11/12: 1997	-	No
0x4080	4	MDC Describer Scale	Read only	Code A10: 0xFE (-2) Code A11/12: 0	-	No

\*) changeable during operation. Process data are invalid until renewed output of valid process data after 10 ms

\*\*) changeable during operation but only effective after Power Off / Power On

**Switching Signal Channels (see 5.3.10)**

0x003C	1	SSC1 Parameter: Setpoint 1 (SP1)	Read/Write	0	0...max. measurement range	Yes*
0x003C	2	SSC1 Parameter: Setpoint 2 (SP2)	Read/Write	0	0...max. measurement range	Yes*
0x003D	1	SSC1 Configuration: Logic	Read/Write	0 = High-active	0 = High-active 1 = Low-active	Yes*
0x003D	2	SSC1 Configuration: Mode	Read/Write	0 = deactivated	0 = deactivated 1 = Single Point Mode 2 = Window mode 3 = Two Point Mode	Yes*
0x003D	3	SSC1 Configuration: Hysteresis	Read/Write	0	0 ... 32.767 (symmetric)	Yes*
0x003E	1	SSC2 Parameter: Setpoint 1 (SP1)	Read/Write	0	0...max. measurement range	Yes*
0x003E	2	SSC2 Parameter: Setpoint 2 (SP2)	Read/Write	0	0...max. measurement range	Yes*
0x003F	1	SSC2 Configuration: Logic	Read/Write	0 = High-active	0 = High-active 1 = Low-active	Yes*
0x003F	2	SSC2 Configuration: Mode	Read/Write	0 = deactivated	0 = deactivated 1 = Single Point Mode 2 = Window mode 3 = Two Point Mode	Yes*
0x003F	3	SSC2 Configuration: Hysteresis	Read/Write	0	0 ... 32.767 (symmetric)	Yes*

\*) changeable during operation

**Work Area (see 5.3.11)**

0x0048	1	Work Area Min.	Read/Write	0	0 ... max. measurement range	Yes*
0x0048	2	Work Area Max.	Read/Write	Max. measurement range	0 ... max. measurement range	Yes*

\*) changeable during operation

Index	Sub-index	Parameter	Access	Default value	Value Range	Parameter managem.
<b>Device Configuration</b>						
0x0045	1	Diagnosis Suppression Configuration (see 5.3.12): Suppression Level	Read/Write	0 = all events active	0 = all events active 1 = info and warnings suppressed	No
0x0045	2	Diagnosis Suppression Configuration: PD Invalid Suppression	Read/Write	0 = PD Invalid active	0x00 (0) = PD Invalid active 0xFF (255) = PD Invalid suppressed, invalid process data (error values) are output	No
<b>Condition Monitoring – Commands/Settings</b>						
0x0300	0	Reset Maintenance	Write	-	„reset“	No
0x030A	0	Time between Maintenance	Read/Write	0 (deactivated)	32 bits value in [h]	Yes*
0x0301	0	Reset Lot Size	Write	-	„reset“	No
0x0302	0	Reset Temperature Min.	Write	-	„reset“	No
0x0303	0	Reset Temperature Max.	Write	-	„reset“	No
0x0304	0	Reset Voltage Min.	Write	-	„reset“	No
0x0305	0	Reset Voltage Max.	Write	-	„reset“	No
*) changeable during operation						
<b>Condition Monitoring – Temperature (see 5.3.13)</b>						
0x0350	0	Temperature live	Read only	-	-	No
Index	Sub-index	Parameter	Access	Default value	Value Range	Parameter managem.
0x0351	1	Temp. Power-on Min.	Read only	-	-	No
0x0351	2	Temp. Power-on Max.	Read only	-	-	No
0x0352	1	Temp. since Reset Min.	Read only	-	-	No
0x0352	2	Temp. since Reset Max.	Read only	-	-	No
0x0353	1	Temp. s. Maintenance Min.	Read only	-	-	No
0x0353	2	Temp. s. Maintenance Max.	Read only	-	-	No
0x0354	1	Temperature Min. Total	Read only	-	-	No
0x0354	2	Temperature Max. Total	Read only	-	-	No
0x035A	1	Temperature Warning Min.	Read/Write	Min. operating temperature (see data sheet)	Min. up to max. operating temperature (see data sheet). Generates info when exceeded	Yes*
0x035A	2	Temperature Warning Max.	Read/Write	Max. operating temperature (see data sheet)	Min. up to max. operating temperature (see data sheet). Generates info when exceeded	Yes*
0x035B	1	Temp. Threshold Min.	Read only	Min. operating temperature (see data sheet)	Min. up to max. operating temperature (see data sheet). Generates info when exceeded	No
0x035B	2	Temp. Threshold Max.	Read only	Max. operating temperature (see data sheet)	Min. up to max. operating temperature (see data sheet). Generates info when exceeded	No
*) changeable during operation						
<b>Condition Monitoring – Supply Voltage (see 5.3.14)</b>						
0x0360	0	Voltage live	Read only	-	-	No
0x0361	1	Voltage Power-on Min.	Read only	-	-	No
0x0361	2	Voltage Power-on Max.	Read only	-	-	No
0x0362	1	Voltage since Reset Min.	Read only	-	-	No
0x0362	2	Voltage since Reset Max.	Read only	-	-	No
0x0363	1	Voltage s. Maintenance Min.	Read only	-	-	No
0x0363	2	Voltage s. Maintenance Max.	Read only	-	-	No
0x0364	1	Voltage Total Min.	Read only	-	-	No
0x0364	2	Voltage Total Max.	Read only	-	-	No
0x036A	1	Voltage Warning Min.	Read/Write	Min. supply voltage (see data sheet)	Min. up to max. supply voltage (see data sheet). Generates info when exceeded	Yes*
0x036A	2	Voltage Warning Max.	Read/Write	Max. supply voltage (see data sheet)	Min. up to max. supply voltage (see data sheet). Generates info when exceeded	Yes*
0x036B	1	Voltage Threshold Min.	Read only	Min. supply voltage (see data sheet)	Min. up to max. supply voltage (see data sheet). Generates info when exceeded	No

Index	Sub-index	Parameter	Access	Default value	Value Range	Parameter managem.
0x036B	2	Voltage Threshold Max.	Read only	Max. supply voltage (see data sheet)	Min. up to max. supply voltage (see data sheet). Generates info when exceeded	No
*) changeable during operation						
<b>Condition Monitoring – Operating Time Counter (see 5.3.15)</b>						
0x0321	0	Time Power-on	Read only	-	-	No
0x0322	0	Time since Maintenance	Read only	-	-	No
0x0323	0	Time Total	Read only	-	-	No
0x032A	0	Time Unit	Read only	1 h	-	No
<b>Condition Monitoring – Boot Cycle Counter (see 5.3.16)</b>						
0x0312	0	Boot cycles s. Maintenance	Read only	-	-	No
0x0313	0	Boot cycles Total	Read only	-	-	No
<b>Condition Monitoring – Lot Size Counter (see 5.3.17)</b>						
0x0331	0	Lot Size Power-on	Read only	-	-	No
0x0332	1	Lot Size since Reset	Read only	-	-	No
0x0333	2	Lot Size since Maintenance	Read only	-	-	No
0x0334	3	Lot size Total	Read only	-	-	No
0x0339	0	Lot Configuration	Read/Write	0	0 ... 4 = off ... SSC2 falling	No
<b>Condition Monitoring – Odometer (see 5.3.18)</b>						
0x0341	0	Odometer Power-on	Read only	-	-	No
0x0342	0	Odometer s. Maintenance	Read only	-	-	No
0x0343	0	Odometer Total	Read only	-	-	No
0x034A	0	Odometer Unit	Read only	turns	-	No

### 5.3.1 Condition Monitoring Data

The statistics data for temperature, supply voltage, operating time, boot cycle, lot size and odometer ("history recorder") are not cleared by any system command according to chapter 5.2 .

Exceptions are all condition monitoring data with the suffix "Power-on" that have been recorded since switching on. These are set to "0" by power-cycle (power off/on).

### 5.3.2 Device Access Locks

With this parameter, it is possible to active or deactivate the function of the parameter manager.

In order to lock the parameter manager, bit #1 of the 2 byte value must be set to "1" (locked), to unlock bit #1 is set to "0".

### 5.3.3 Profile Characteristics

This parameter indicates which profile is supported by the IO-Link device.

The sensor supports the Smart Sensor Profile:

Profile Identifier (Code A11/A12)	DeviceProfileID	0x0001	Smart Sensor Profile Ed. 1
Profile Identifier (Code A10)	DeviceProfileID	0x000E	Smart Sensor Profile Ed. 2
	FunctionClassID	0x800B	Measurement Data Channel (high resolution)
	FunctionClassID	0x800D	Multiple Adjustable Switching Signal Channel)
Profile Identifier (all Codes Axx)	DeviceProfileID	0x4000	Identification and Diagnosis
	FunctionClassID	0x8000	Device Identification
	FunctionClassID	0x8002	ProcessDataVariable
	FunctionClassID	0x8003	Sensor Diagnosis
	FunctionClassID	0x8100	Extended Identification

**5.3.4 PD Input Descriptor**

This parameter describes the composition of the process data variables used. The sensor processes the process data variable as follows. Using subindex 0, the complete process data description can be read out.

Code A10: SSP Ed. 2

Subindex	Value	Description
1	0x01	Set of Boolean (Status Bits)
	0x08	8 bits
	0x00	0 bits offset
2	0x03	Signed Integer
	0x08	8 bits
	0x08	8 bits offset
3	0x03	Signed integer
	0x20	32 bits
	0x10	16 bits offset

Code A11: Position

Subindex	Value	Description
1	0x03	Signed integer
	0x20	32 bits
	0x00	0 bits offset

Code A12: Position + Velocity

Subindex	Value	Description
1	0x03	Signed integer
	0x10	16 bits
	0x00	0 bits offset
2	0x03	Signed Integer
	0x20	32 bits
	0x10	16 bits offset

**5.3.5 Application / Function / Location Specific Tag**

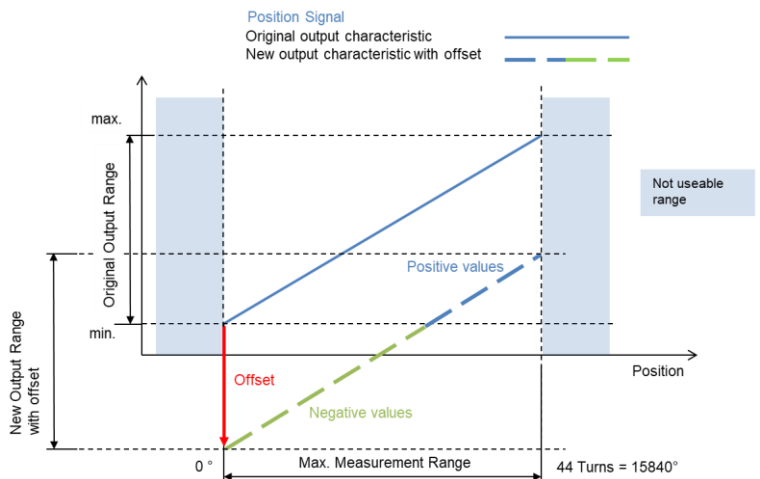
This parameter makes it possible to assign the IO-Link device an arbitrary, 32-byte string. This can only be used by the customer for specific identification and applied in the parameter manager. The entire objects are accessed via subindex 0.

**5.3.6 Null point offset**

Same as process data value, this parameter is a signed 32 bits decimal value.

The null point offset can be done without magnet or position marker. The value is subtracted from the factory default null point as a simple offset. The range of the null point offset is 0 to max. measurement range.

Access takes place via subindex 0.



**5.3.7 Averaging**

The behavior of the output filter can be adjusted for smoothing the signal noise of the output signal. This allows to achieve a better repeatability. Filtering can be carried out separately for both position signal and velocity signal.

**5.3.7.1 Position Filter**

Filter	Noise [°]	Cutoff frequency [Hz]
0 (default)	0,03	-
1	0,02	5000
2	0,015	2500
3	0,01	1250
4	0,0075	625
5	0,005	312,5
6	0,00375	156,25
7	0,02	78,125

**5.3.7.2 Velocity Filter**

Filter	Noise [°/s]	Cutoff frequency [Hz]	Max. rotation speed [U/s]
0	26,51	62,5	1250
1	13,26	52,1	625
2	6,63	39,1	312,5
3	3,31	26,0	156,3
4	1,66	15,1	78,1
5 (default)	0,83	8,7	39,1
6	0,41	4,6	19,5
7	0,21	2,4	9,8
8	0,10	1,2	4,9



**5.3.8 Direction setting**

With this parameter the direction of rotation can be set.

- 0: rising cw with view on sensor shaft
- 1: rising ccw with view on sensor shaft

**5.3.9 Mode**

The ordered product model can be configured regarding measured variables:

Mode	Output	Device ID	Product ID	Product Name
0	Code A10: 1x position + switches SSP Ed. 2	04102	M_1-SSP-K M_1-SSP-ST	1x position Edition 2, with cable 1x position Edition 2, with plug
1	Code A11: 1x position	04103	M_1-P-K M_1-P-ST	1x position, with cable 1x position, with plug
2	Code A12: 1x position + 1x velocity	04113	M_1-PV-K M_1-PV-ST	1x position + velocity, with cable 1x position + velocity, with plug

**5.3.10 Configuration of Switching Signal Channels SSC**

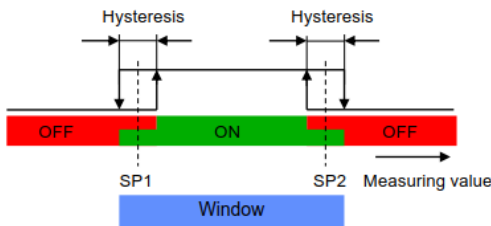
The sensor offers 2 Switching Signal Channels (SSC) each with 2 setpoints (SP) according to Smart Sensor Profile Edition 2 V1.0. Each switching signal channel is described by the two characteristics (Parameter and Configuration). The distance between 2 set points SP1 and SP2 must be at least 2x hysteresis.

SSC Parameter: Setpoint 1 und 2 (SP1 und SP2)  
 SSC Configuration: Logic, Mode und Hysteresis

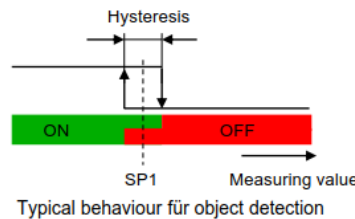
There are 4 different modes for switching signal channels available:

- Deactivated (default)
- Single Point Mode
- Window Mode
- Two Point Mode

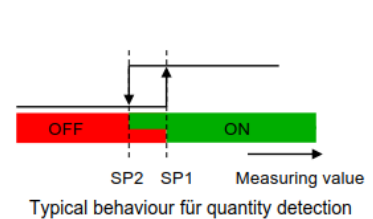
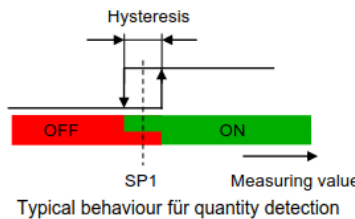
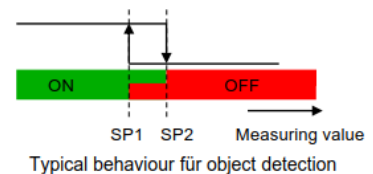
Window Mode



Single Point Mode



Two Point Mode



**5.3.11 Work Area**

It is possible for encoders to define a so-called user defined working area.

The main purpose for a work area is to get an information (via Warning) when the transducer's position leaves its pre-defined working area.

The actual work area information with work area low limit (min.) and work area high limit (max.) may be stored in index 0x0048.

**5.3.12 Diagnosis Suppression**

If diagnostic functions in the application cause problems, messages like information and warnings can be suppressed. This does not apply to error messages.

Index 0x0045 subindex 1: 0 = all events active  
 1 = warnings suppressed

If invalid process data (error values e.g. if out of range) are to be output, setting of PD Invalid can be suppressed.

Index 0x0045 subindex 2: 0 = PD Invalid active  
 255 = PD Invalid suppressed

**5.3.13 Condition Monitoring - Temperature**

The sensor records the sensor-internal temperature, which is always higher than the actual ambient temperature.

#### Statistics Data

Temperature values are stored statistically as minimum or maximum values in a defined interval depending on time events (over total operating time, since last maintenance, since last reset, since last power-on...).

#### Temperature Thresholds

The sensor offers the possibility of setting temperature thresholds (definable within the operating temperature range according to the data sheet):

Falling below threshold: Temperature Warning Min.

Exceeded threshold: Temperature Warning Max.

Exceeding or falling below these thresholds triggers a warning message.

Exceeding factory-set thresholds for the minimum and maximum temperature according to data sheet triggers a warning, too.

#### Reset to Zero

Stored minimum and maximum temperature values are reset to zero with 0xFF (255) via Reset Temperature Min. 0x0302 subindex 1 and Reset Temperature Max. 0x0302 subindex 2.

#### Reset after Maintenance

Reset of stored minimum and maximum temperature values to zero after maintenance is carried out via Reset Maintenance 0x0300.

#### 5.3.14 Condition Monitoring - Voltage

The sensor records the supply voltage during operation.

#### Statistics Data

Supply voltage values are stored statistically as minimum or maximum values in a defined interval depending on time events (over total operating time, since last maintenance, since last reset, since last power-on...).

#### Thresholds Supply Voltage

The sensor offers the possibility of setting supply voltage thresholds (definable within the voltage range according to the data sheet):

Falling below threshold: Voltage Warning Min.

Exceeded threshold: Voltage Warning Max.

Exceeding or falling below these thresholds triggers a warning message.

Exceeding factory-set thresholds for the minimum and maximum supply voltage according to data sheet triggers a warning, too.

#### Reset to Zero

Stored minimum and maximum voltage values are reset to zero with 0xFF (255) via Reset Voltage Min. 0x0302 subindex 3 and Reset Voltage Max. 0x0302 subindex 4.

#### Reset after Maintenance

Reset of stored minimum and maximum voltage values to zero after maintenance is carried out via Reset Maintenance 0x0300.

#### 5.3.15 Condition Monitoring - Operating Time Counter

Operating time is stored in a defined interval depending on time events (over total operating time, since last maintenance, since last power-on...).

#### Reset after Maintenance

Reset of stored operating time to zero after maintenance is carried out via Reset Maintenance 0x0300.

#### 5.3.16 Condition Monitoring - Boot cycles

Each restart of the sensor increases the permanently stored boot cycle counter. Restart can be done either via hardware restart (power-on) or via system command Device Reset (see 5.2).

#### Reset after Maintenance

Reset of boot cycle counter to zero after maintenance is carried out via Reset Maintenance 0x0300.

#### 5.3.17 Condition Monitoring - Lot Size Counter

The number of switching operations via 1 definable switching point is permanently stored as a lot size counter depending on time events (total operating time, since last maintenance, since last reset, since last power-on...). The switching point is same as SSC1 or SSC2, see chapter 5.3.10.

The lot size counter is incremented as soon as a status change of the switching point occurs according to the parameterization (lotConfig) of the selected switching point (rising: off => on, falling: on => off).

Switching point	Status change	Parameterization 0x0339
off	-	0
SSC1	Rising	1
SSC1	Falling	2
SSC2	Rising	3
SSC2	Falling	4

**Reset to Zero**

The lot size counter is reset to zero with 0xFF (255) via Reset Lot Size 0x0302 subindex 0.

**Reset after Maintenance**

Reset of lot size counter to zero after maintenance is carried out via Reset Maintenance 0x0300.

**5.3.18 Condition Monitoring - Odometer**

Cumulative position changes (from a position change of at least 180°) are rounded up to whole revolutions and permanently stored as an odometer depending on time events (total operating time, since last maintenance, since last reset, since last power-on...). Changes in position below the defined minimum speed (0,055°/s) and in non-powered state are not recorded.

**Reset after Maintenance**

Reset of odometer to zero after maintenance is carried out via Reset Maintenance 0x0300.

**6 Events: Warnings and Errors**

If diagnostic functions in the application lead to problems, information and warnings can be suppressed (see 5.3.12).

Code	Charact.	Device Status	Description
0x1000	Error	Failure	Unknown error, process data 0x7FFFFFFC
0x1820	Info	Operating-Properly	Temperature overrun, Temperature Warning Max. exceeded (custom threshold)
0x1821	Info	Operating-Properly	Temperature underrun, Temperature Warning Min. exceeded (custom threshold)
0x1830	Info	Operating-Properly	Supply Voltage overrun, Voltage Warning Max. exceeded (custom threshold)
0x1831	Info	Operating-Properly	Supply Voltage underrun, Voltage Warning Min. exceeded (custom threshold)
0x4210	Warning	Out-of-Specification	Temperature overrun, Temperature Threshold Max. exceeded (threshold is factory-set)
0x4220	Warning	Out-of-Specification	Temperature underrun, Temperature Threshold Min. exceeded (threshold is factory-set)
0x5000	Error	Failure	Device Hardware Fault, process data 0x7FFFFFFC
0x5011	Error	Failure	Memory lost
0x5100	Error	Out-of-Specification	Supply Voltage failure
0x5110	Warning	Out-of-Specification	Supply Voltage overrun, Voltage Threshold Max. exceeded (threshold is factory-set)
0x5111	Warning	Out-of-Specification	Supply Voltage underrun, Voltage Threshold Min. exceeded (threshold is factory-set)
0x6000	Error	Failure	Device Software Fault, process data 0x7FFFFFFC
0x8C40	Info	Maintenance_Required	Maintenance required
0x8CB1	Info	Operating-Properly	Position overflow info (Issued in the last revolution before the upper limit)
0x8CB9	Info	Operating-Properly	Position underflow info (Issued in the last revolution before the lower limit)
0x8CB2	Warning	Functional-Check	Out of Range (+): no measurement data, process data 0x7FFFFFF8 (Zero offset)
0x8CB8	Warning	Functional-Check	Out of Range (-): no measurement data, process data 0x80000008 (Zero offset)
0x8CB3	Error	Functional-Check	Out of Range (+): no measurement data, process data 0x7FFFFFF8 (Return offset). Reset via Position Error Reset (see 5.2)
0x8CB7	Error	Functional-Check	Out of Range (-): no measurement data, process data 0x80000008 (Return offset). Reset via Position Error Reset (see 5.2)
0x8CB5	Error	Failure	Measurement range exceeded, magnet or position marker is missing, process data 0x7FFFFFFC
0x8D10	Warning	Operating-Properly	Workarea overflow
0x8D11	Warning	Operating-Properly	Workarea underflow

The following IO-Link error messages are stored if parametrization fails:

Error code	Error Message
0x8011	Index not available
0x8012	Subindex not available
0x8020	Service temporarily not available
0x8023	Index not writable (Access denied)
0x8030	Parameter value out of range
0x8035	Function not available

## 7 Storage of Parameter Data

The device parameters that have been set by the configuration tool and IODD are stored non-volatile. They can be changed and stored again in the sensor any time via the configuration tool or by the PLC. The device acknowledges any change of the parameters to the master.

## 8 Document Changes

Revision	Changes	Date	Who
V00	First edition	24.04.24	VM/mm