Gebrauchsanleitung IO-Link für Rotative Multiturn Sensoren
User manual IO-Link for Rotary Multi-turn Sensors

novotechnik
Siedle Gruppe

Content

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.
In order to make use of all the features that this specification offers, knowledge about the IO-Link Standard is absolutely necessary.
The rotary sensors supports the IO-Link Smart Sensor Profile specifications (Edition 2019) according IEC 61131-9.
For all functions not mentioned in this document (such as input circuit), the IO-Link Interface and System specification (Edition 2019) must be observed.
The IO-Link interface features point-to-point communication based on a half-duplex serial protocol with 24 V levels.
Data is exchanged cyclically between the IO-Link Master and the IO-Link device mostly using Process Data-messages as defined by the IO-Link standard. The protocol also offers Service Data-messages to exchange additional data, e.g. for status updates 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. 0
Number of process data (PD) from master to device	ProcessDataOut	0x00 (0 bit)
Manufacturer ID	Vendor ID	0x030B (779)
Device identification	Device ID	___-____-___-A10-___: MC1-2800: 0x1006 (004102) MB1-3600: 0x62A86 (404102) MZ1-2200: 0x68C2E (429102) ___-____-___-A11-___: MC1-2800: 0x1007 (004103) MB1-3600: 0x62A87 (404103) MZ1-2200: 0x68C2F (429103) ___-____-___-A12-___: MC1-2800: 0x1011 (004113) MB1-3600: 0x62A91 (404113) MZ1-2200: 0x68C39 (429113)
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 over 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 switch-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^{-2} = 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 lower overtravel range
4	Out of range (+)	Outside of measurement range, in upper 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 is set).

4.3.2 Validity of Process Data "Position"
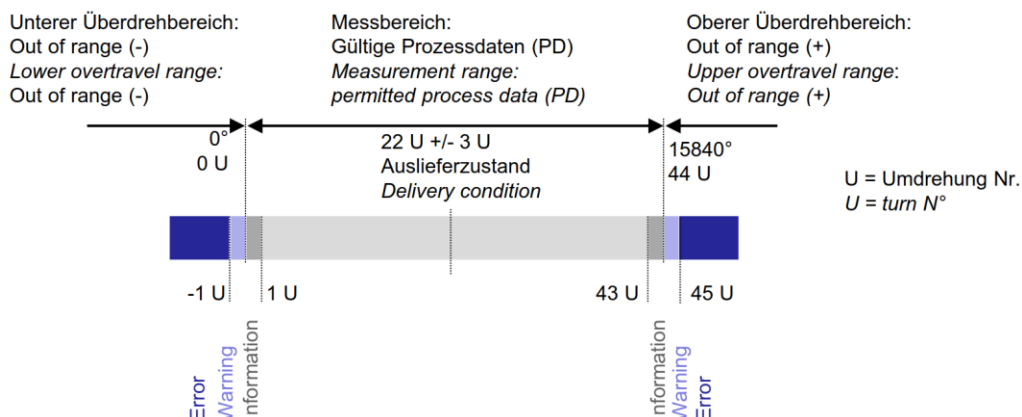
If the output signal is out of measurement range, the values "Out of range (-)" 0x80000008 (lower overtravel range) or "Out of range (+)" 0x7FFFFFF8 (upper overtravel range) are sent. The values Out of range (+) and Out of range (-) are independent of the configured direction of rotation (cw or ccw).

Warning ranges:
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 ranges:
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 other errors, the error value 0x7FFFFFFC is transmitted and data is labeled as invalid (PD invalid Bit is set).

4.3.3 Validity of Process Data "Velocity"

Only applicable to 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	Description
0x0010	0	Vendor Name	Read only	Novotechnik Messwertaufnehmer OHG
0x0011	0	Vendor Text	Read only	www.novotechnik.de
0x0012	0	Product Name	Read only	e.g. MC1-2802-214-A11-551
0x0013	0	Product ID	Read only	Multiturn series M__-__00: M__-SS**P-K** 1x position Edition 2, with cable Code A10 M__-SS**P-ST** 1x position Edition 2, with plug Code A10 M__-**P-K** 1x position, with cable Code A11 M__-**P-ST** 1x position, with plug Code A11 M__-**PV-K** 1x position + velocity, with cable Code A12 M__-**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 123456 or S/N 123456/000
0x0016	0	Hardware Revision	Read only	400000000.00
0x0017	0	Firmware Revision	Read only	xx.yy.zz_iolink

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 0x8CB7 Out of 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.
System Parameters						
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.
Measurement Data Channel						
0x0040	0	Null Point Offset (see 5.3.6)	Read/Write	0	MDC Describer Lower Limit … MDC Describer Upper Limit	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: 44x(100x360)-1 Code A11/A12: 44x2^16-1	-	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
**) Triggers automatic soft reset/warm start to ensure correct value scaling

Index	Sub-index	Parameter	Access	Default value	Value Range	Parameter managem.
Switching Signal Channels (see 5.3.10)						
0x003C	1	SSC1 Parameter: Setpoint 1 (SP1)	Read/Write	0	(MDC Describer Lower Limit - max. Offset) … (MDC Describer Upper Limit)	Yes*
0x003C	2	SSC1 Parameter: Setpoint 2 (SP2)	Read/Write	0	(MDC Describer Lower Limit - max. Offset) … MDC Describer Upper Limit	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	100 (P-/PV-Mode) 1 (SSP-Mode)	100 … 16384 (P-/PV-Mode) 1…16.384 (SSP-Mode)	Yes*
0x003E	1	SSC2 Parameter: Setpoint 1 (SP1)	Read/Write	0	(MDC Describer Lower Limit - max. Offset) … MDC Describer Upper Limit	Yes*
0x003E	2	SSC2 Parameter: Setpoint 2 (SP2)	Read/Write	0	(MDC Describer Lower Limit - max. Offset) … MDC Describer Upper Limit	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	100 (P-/PV-Mode) 1 (SSP-Mode)	100 … 16384 (P-/PV-Mode) 1…16.384 (SSP-Mode)	Yes*

*) Changeable during operation

Index	Sub-index	Parameter	Access	Default value	Value Range	Parameter managem.
Work Area (see 5.3.11)						
0x0048	1	Work Area Min.	Read/Write	0	(MDC Describer Lower Limit - max. Offset) … MDC Describer Upper Limit	Yes*
0x0048	2	Work Area Max.	Read/Write	MDC Describer Upper Limit	(MDC Describer Lower Limit - max. Offset) … MDC Describer Upper Limit	Yes*

*) Changeable during operation

Index	Sub-index	Parameter	Access	Default value	Value Range	Parameter managem.
Device Configuration						
0x0045	1	Diagnosis Suppression Configuration (see 5.3.12): Suppression Level	Read/Write	0 = all events active	0 = all events active 1 = info suppressed 2 = info and warnings suppressed	Yes*
0x0045	2	Diagnosis Suppression Configuration: PD invalid Bit Suppression	Read/Write	0 = PD invalid Bit active	0 = PD invalid Bit active 1 = PD invalid Bit suppressed, process data still contain error values	Yes*
Condition Monitoring – Commands/Settings						
0x0300	0	Reset Maintenance	Write	-	1=„reset"	Yes*
0x030A	0	Time between Maintenance	Read/Write	0 (deactivated)	32 bits value in [h]	Yes*
0x0301	0	Reset Lot Size	Write	-	1=„reset"	Yes*
0x0302	0	Reset Temperature Min.	Write	-	1= „reset"	Yes*
0x0303	0	Reset Temperature Max.	Write	-	1= „reset"	Yes*
0x0304	0	Reset Voltage Min.	Write	-	1= „reset"	Yes*
0x0305	0	Reset Voltage Max.	Write	-	1= „reset"	Yes*
*) Changeable during operation						
Condition Monitoring – Temperature (see 5.3.13)						
0x0350	0	Temperature live	Read only	-	-	No
0x0351	1	Temp. since Power-on Min.	Read only	-	-	No
0x0351	2	Temp. since 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	Temp. Min. Total	Read only	-	-	No
0x0354	2	Temp. Max. Total	Read only	-	-	No
0x035A	1	Temp. 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	Temp. 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						
Condition Monitoring – Supply Voltage (see 5.3.14)						
0x0360	0	Voltage live	Read only	-	-	No
0x0361	1	Voltage since Power-on Min.	Read only	-	-	No
0x0361	2	Voltage since 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 since Maintenance Min.	Read only	-	-	No
0x0363	2	Voltage since 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

Condition Monitoring – Operating Time Counter (see 5.3.15)

Index	Sub-index	Parameter	Access	Default value	Value Range	Parameter managem.
0x0321	0	Time since 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

Condition Monitoring – Boot Cycle Counter (see 5.3.16)

Index	Sub-index	Parameter	Access	Default value	Value Range	Parameter managem.
0x0312	0	Boot cycles s. Maintenance	Read only	-	-	No
0x0313	0	Boot cycles Total	Read only	-	-	No

Condition Monitoring – Lot Size Counter (see 5.3.17)

Index	Sub-index	Parameter	Access	Default value	Value Range	Parameter managem.
0x0331	0	Lot Size since 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

Condition Monitoring – Odometer (see 5.3.18)

Index	Sub-index	Parameter	Access	Default value	Value Range	Parameter managem.
0x0341	0	Odometer since 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 each 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 FunctionClassID FunctionClassID	0x000E 0x800B 0x800D	Smart Sensor Profile Ed. 2 Measurement Data Channel (high resolution) Multiple Adjustable Switching Signal Channel)
Profile Identifier (all Codes Axx)	DeviceProfileID FunctionClassID FunctionClassID FunctionClassID FunctionClassID	0x4000 0x8000 0x8002 0x8003 0x8100	Identification and Diagnosis Device Identification ProcessDataVariable Sensor Diagnosis 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 sub-index 0.

5.3.6 Null point offset

This parameter is a signed 32 bit integer value with the same scaling as process data.

The null point offset can be done without magnet or position marker present. The value is substracted from the factory default null point as a simple offset. The range of the null point offset is "MDC Describer Lower Limit" to "MDC Describer Upper Limit".

Access takes place via subindex 0.
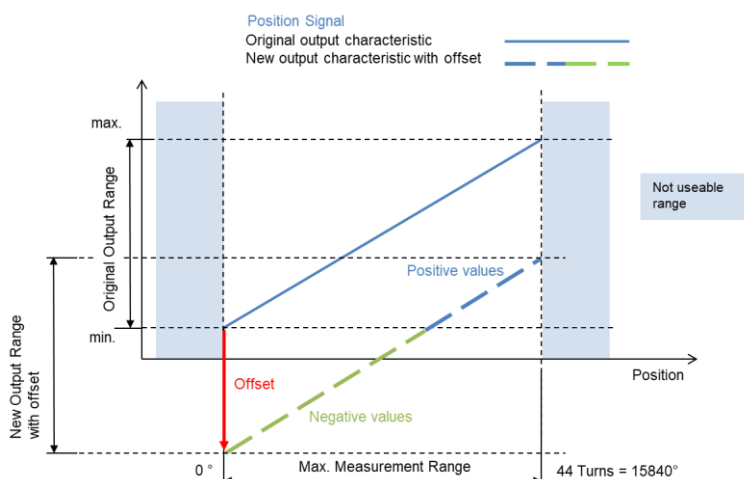
5.3.7 Averaging

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- 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	0,0026	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 measurement 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	Product ID		Product Name	Unit of position
0	Code A10: 1x position + switches SSP Ed. 2	M__-SSP-K M__-SSP-ST	1x position Edition 2, with cable 1x position Edition 2, with plug	M__-____-___-A10-___	0,01°/LSB
1	Code A11: 1x position	M__-P-K M__-P-ST	1x position, with cable 1x position, with plug	M__-____-___-A11-___	360°/2^16/LSB
2	Code A12: 1x position + 1x velocity	M__-PV-K M__-PV-ST	1x position + velocity, with cable 1x position + velocity, with plug	M__-____-___-A12-___	360°/2^16/LSB

ℹ When changing the mode, an automatic Device Reset is performed and some parameters are adjusted to stay plausible in regard to process data scaling. Already set values for switching signal channels SSC (parameters and hysteresis), null point offset and work area must be adjusted to the position unit of the new mode to keep their intended use.

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).
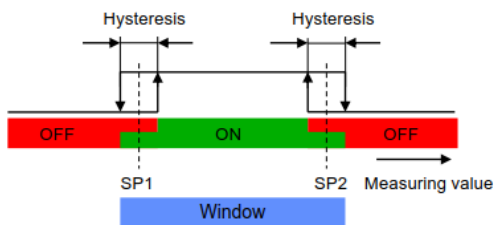The distance between 2 set points SP1 and SP2 must be at least 2x hysteresis.
SSC Parameter: Setpoint 1 und 2 (SP1 und SP2)
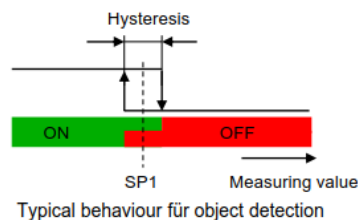SSC Configuration: Logic, Mode und Hysteresis

There are 4 different modes for switching signal channels available:
• Deactivated (default)
• Single Point Mode
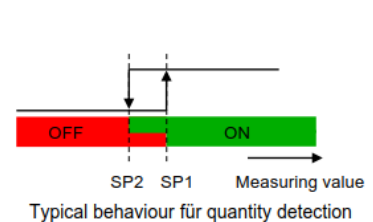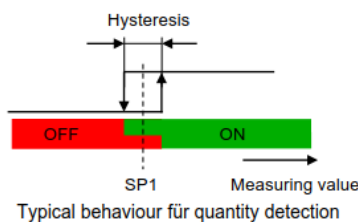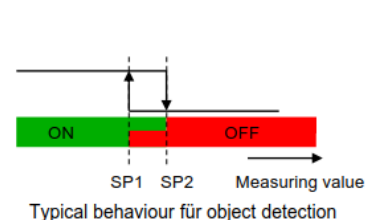• Window Mode
• Two Point Mode

5.3.11 Work Area

It is possible for the user to define a so-called working area.
The main purpose for a work area is to get an information (via Warning) when the transducer's position leaves its predefined 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 = info suppressed
                           2 = info and warnings suppressed

ℹ After changing from a higher value back to a lower value, a power off/on must be performed before future events (info or warnings) are shown.
If invalid process data (error values e.g. if out of range) are to be output, the setting of the PD invalid-bit can be suppressed.

Index 0x0045 subindex 2:   0   = PD Invalid active
                            1   = PD Invaild suppressed

5.3.13 Condition Monitoring - Temperature

The sensor records the sensor-internal temperature, which is usually 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, see data sheet, also triggers a warning.

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 0.
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 turns 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)
0x1880	Error	Failure	Frontend failure or frontend deactivated, process data 0x7FFFFFFC
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	Operating-Properly	Maintenance required
0x8CB1	Info	Operating-Properly	Position overflow info (Issued in the last turn before the upper limit)
0x8CB2	Warning	Functional-Check	Out of Range (+): no measurement data, process data 0x7FFFFFF8 (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)
0x8CB5	Error	Failure	Magnet or position marker is missing, process data 0x7FFFFFFC
0x8CB7	Error	Functional-Check	Out of Range (-): no measurement data, process data 0x80000008 (Return offset) Reset via Position Error Reset (see 5.2)
0x8CB8	Warning	Functional-Check	Out of Range (-): no measurement data, process data 0x80000008 (Zero offset)
0x8CB9	Info	Operating-Properly	Position underflow info (Issued in the last turn before the lower limit)
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 in non-volatile memory.
They can be changed and stored again in the sensor any time via a configuration tool or by a PLC.
The device acknowledges any change of the parameters to the IO-Link master.

8   Document Changes

Revision	Changes	Date	Who
V00	First edition	24.04.24	VM/mm
V01	3 Device-ID MB1-3600 added. 5.3.9 Need to change units of SSC/work area when changing mode (A10/A11/A12)	03.05.24	VM/mm
V02	5.3.9 When changing the mode, all parameterizations are reset to default, 6 0x1880 frontend failure added	13.01.25	VM/mm
V03	3 Device identification: MZ1-2200 added 4.2 Process Data Smart Sensor Profile Ed.2: Bit 5 Out of range (-) instead of (+), Bit 4 Out of range (+) instead of (-) 5.3 Object 0x0045 Diagnosis Suppression: subindex 1: 0/1/2 instead of 0/1, subindex 2: 0/1 instead of 0x00/0xFF, "1 = PD invalid Bit suppressed, process data still contain error values" instead of "1 = PD invalid Bit suppressed, invalid process data (still contain error values) are output" 5.3 Condition Monitoring-Commands/Settings: 1 = "reset" instead of "reset" 5.3 Device Data: "**) Triggers automatic soft reset/warm start to ensure correct value scaling" instead of "**) changeable during operation but only effective after Power Off/Power on" 5.3 Switching signals: object 0x003C/0x003E: MDC Describer Lower Limit - max. Offset) instead of MDC Describer Lower Limit. Object 0x003D/0x003F: default 100 (P-/PV-Mode), 1 (SSP-Mode) instead of 0, range: 100 … 16384 (P-/PV-Mode), 1…16.384 (SSP-Mode) instead of 0...32.767 (symmetric) 5.3 Work Area: object 0x0048: (MDC Describer Lower Limit - max. Offset) instead of MDC Describer Lower Limit 5.3 0x0045...0x0305: Parameter management "Yes*" instead of "No" (Write, Read/Write) 5.3.7.1 Position filter: Noise 0,026° instead of 0,02° 5.3.9 Changing of the mode: hint added: Device Reset is performed 5.3.12 Object 0x0045 Diagnosis Suppression: 0/1/2 instead of 0/1, hint added: reset via Power off/on necessary after changing from higher to lower	14.03.25	VM/mm