

**TURCK**

Industrial  
Automation

**INCLINOMETERS  
WITH IO-LINK  
TECHNOLOGY**

 **IO-Link**



**PARAMETRIZATION**

***Sense it! Connect it! Bus it! Solve it!***

# Inclinometers with IO-Link technology – General information

## 1 General information

Please read this section carefully. Safety aspects cannot be left to chance when dealing with electrical equipment.

These instructions contain the necessary information for the commissioning and parametrization of the inclinometer series B2N360 from TURCK. It specifically addresses trained and qualified personnel disposing of the appropriate technical knowledge.

### Prescribed use

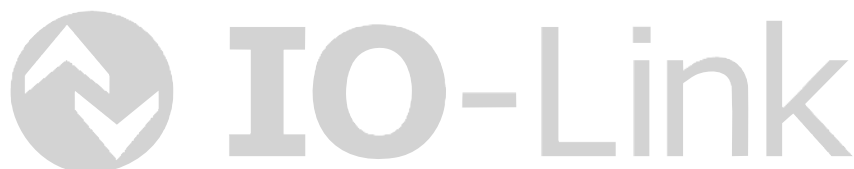
The devices described in this manual must only be used in the prescribed way and only with certified components and devices from third party manufacturers.

Appropriate transport, storage, deployment and mounting as well as careful operating and thorough maintenance guarantee the troublefree and safe operation of these devices.



## Inclinometers B2N360 – with IO-Link technology

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# Inclinometers with IO-Link technology – Description of the IO-Link technology

## 2 IO-Link technology

An IO-Link system consists of IO-Link devices (sensors or actuators), a standard sensor/actuator cable and an IO-Link master. An IO-Link master can feature one or several ports. Only one IO-Link device can be connected at each port. IO-Link is therefore a point-to-point communication and not a fieldbus.

### 2.1 Operating modes

TURCK inclinometers can be operated in SIO mode (standard I/O mode) or in IO-Link communication mode. After power up the device is always in SIO mode.

#### 2.1.1 SIO mode

If the sensor operates in SIO mode it can be run via a standard input module, for which an IO-Link master is not required. Thereby Pin 2 can be used as a switching output, Pin 5 and Pin 6 as analog outputs. Pin 4 is configured as a switching output and can also be used for IO-Link communication.

#### 2.1.2 IO-Link communication mode

In order to run the sensor in IO-Link mode, the sensor must be connected to an IO-Link capable module (master). The sensor operates in COM2 mode at 38.4 Kbaud. The IO-Link communication between the sensor and the master is implemented via Pin 4. The output on pin 2 retains its functionality. Process data (cyclic), service data (acyclic) and events are transferred in communication mode. Furthermore, the sensor can be parameterized in communication mode via the master.

For detailed information on the sensor parameters see the parameter lists.

# Inclinometers with IO-Link technology – Commissioning

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## 3 Commissioning

For the connection of the inclinometer to the IO-Link master, use the adapter cable RKC 8.4T-1.5-RSC4T/TX320, ident no. 6625002 (sensor side M12, 8-pin, IO-Link master side M12, 4-pin).

The ports of the IO-Link master can be configured differently. If a port is set to SIO mode, the master at this port behaves like a normal digital input. If the port is set to communication mode, it tries to find the connected sensor. This process is called the wake up process. For this read also the manual for your IO-Link master.

If the sensor is in IO-Link mode, it can be parameterized via the master. For this read chapter 7

### Parametrization using PACTware™ and IODD

PACTware™ is an open platform in which any fieldbus device manufacturer can integrate the operation of their devices.

PACTware™ uses a standard interface between the frame program and the individual software modules for operating devices. Only in this way can modern user-friendly operating concepts be implemented.

The connection between the sensor and PC is established via the USB-IO-Link master. In order to operate the Turck inclinometer via PACTware™, you also need the IODD interpreter and sensor-specific IODD in addition to the PACTware™ software. These tools can be obtained from the TURCK website. The standard display of PACTware™ enables the sensor to be read and set easily.

For more details and specific parameter information see the parameter lists. More information about the PACTware™ software is provided at [www.turck.com](http://www.turck.com).

### Parametrization using the teach function

The inclinometer can be set via the teach function. Pin 8 is used as teach input, whereby the inclinometer is parametrized by bridging Pin 8 and Pin 3 (GND) or Pin 8 and Pin 1 ( $U_B$ ). For simple teaching use the optionally available teach adapter TX3-Q20L60 with the ident no. 6967118. With the switches you can activate the teach inputs.

# Inclinometers with IO-Link technology – Parametrization via teach function

## 4 Parametrization via teach function

Parameters	Teach input	LED
To adjust the zero point offset and the measuring range, position the sensor accordingly.		
Zero point offset (see notes on p. 7)	bridge Pin 3 (GND) and Pin 8 for 5 s	yellow LED flashes – after 1 s steady – after 3 s flashes – after 5 s steady
Measuring range start, x-axis (see notes on page 7)	bridge Pin 1 (U <sub>B</sub> ) and Pin 8 for 1 s	green LED flashes – after 1 s steady
Measuring range end, x-axis (see notes on page 7)	bridge Pin 1 (U <sub>B</sub> ) and Pin 8 for 3 s	green LED flashes – after 1 s steady – after 3 s flashes
Measuring range start, y-axis (see notes on page 7)	bridge Pin 3 (GND) and Pin 8 for 1 s	yellow LED flashes – after 1 s steady – after 3 s flashes
Measuring range end, y-axis (see notes on page 7)	bridge Pin 3 (GND) and Pin 8 for 3 s	yellow LED flashes – after 1 s steady – after 3 s flashes
Preset mode	bridge Pin 1 (U <sub>B</sub> ) and Pin 8 for 10 s	green LED flashes – after 10 s steady
Preset angular ranges	bridge or press the button within 10 s or the device exits this mode automatically	
-10°...+10°	bridge Pin 3 (GND) and Pin 8 once briefly	yellow LED flashes once
-45°...+45°	bridge Pin 3 (GND) and Pin 8 twice briefly	yellow LED flashes twice
-60°...+60°	bridge Pin 3 (GND) and Pin 8 three times briefly	yellow LED flashes three times
-85°... +85°	bridge Pin 3 (GND) and Pin 8 four times briefly	yellow LED flashes four times
Preset mode Functions	bridge Pin 1 (U <sub>B</sub> ) and Pin 8 for 10 s bridge or press the button within 10 s or the device exits this mode automatically	green LED steady – after 10 s flashes
Mode 1 "upper hemisphere" ± 90°, default setting	bridge Pin 1 (U <sub>B</sub> ) and Pin 8 once briefly	green LED flashes once
Mode 2 "lower hemisphere" ± 90°	bridge Pin 1 (U <sub>B</sub> ) and Pin 8 twice briefly	green LED flashes twice
Mode 3, 2 × 360°	bridge Pin 1 (U <sub>B</sub> ) and Pin 8 three times briefly	green LED flashes three times
Mode 4, X: 0...360°, Y: off	bridge Pin 1 (U <sub>B</sub> ) and Pin 8 four times briefly	green LED flashes four times
Mode 5, Y: 0...360°, X: off	bridge Pin 1 (U <sub>B</sub> ) and Pin 8 five times briefly	green LED flashes five times
Filter setting mode	bridge Pin 3 (GND) and Pin 8 for 10 s bridge or press the button within 10 s or the device exits this mode automatically	yellow LED steady – after 10 s flashes
Filter A, 24 Hz (for programming adapter Q20L60), default setting	bridge Pin 3 (GND) and Pin 8 once briefly	yellow LED flashes once
Filter B, 15 Hz	bridge Pin 3 (GND) and Pin 8 twice briefly	yellow LED flashes twice
Filter C, slower but less susceptible Filter	bridge Pin 3 (GND) and Pin 8 three times briefly	yellow LED flashes three times
Default setting	bridge Pin 3 (GND) or Pin 1 (U <sub>B</sub> ) and Pin 8 for 15 s	after 15 s yellow and green LED alternate fast

**i NOTE**

Please note that with changing the zero point you also change the start and end point of the measuring range accordingly. In the "upper hemisphere" and "lower hemisphere" mode the zero-point can only be offset if the measuring range stays within the defined spreads of 0°...90°, 0°...270°, 180°...90° or rather 180°...270° (see Fig. 2, on page 8).

## 5 Parametrization via PACTware™ and IODD

You can download PACTware™, the IODD-interpreter and the inclinometer IODD-file from [www.turck.com](http://www.turck.com).

Once you have installed PACTware™, activate the "IODD\_IOL\_B2N360-Q42.zip" file with the IODD-interpreter and update the device catalog in PACTware™.

You need the following hardware components:

- B2N360-Q42... (the sensor to be parametrized)
- IO-Link master
- Adapter cable RKC8.4T-1,5-RSC4T/TX320; Ident no.: 6625002

### 5.1 Configure system

Name	Value	Default value
<b>System configuration</b>		
Operation mode	1 (Inclination)	1 (Inclination)
Lowpass filter A	24 (Cut-off frequency 24Hz)	24 (Cut-off frequency 24Hz)
Lowpass filter B	15 (Cut-off frequency 15Hz)	15 (Cut-off frequency 15Hz)
Lowpass filter C	0 (Cut-off frequency lowest)	0 (Cut-off frequency lowest)
Active filter	1 (Filter A)	1 (Filter A)

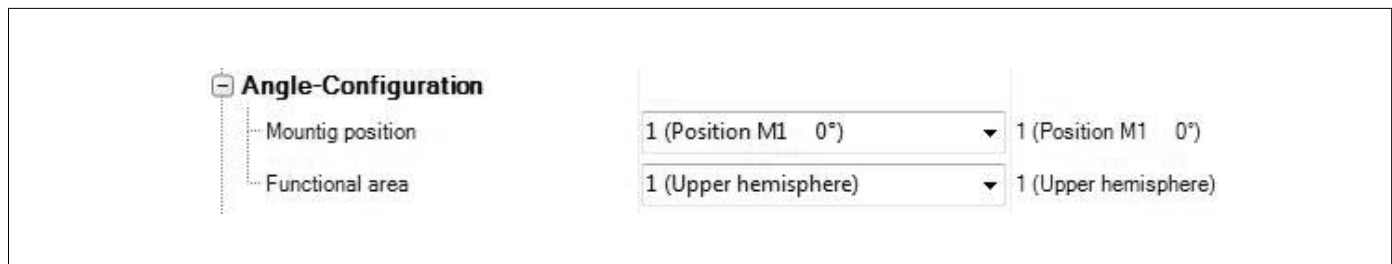
Under the menu item "Operation Mode" you can either configure the sensor as an inclinometer or as accelerometer (see also page 11). You can set different lowpass filters. Faults of different frequency ranges can thus be suppressed.

Depending on the application requirements, you should parametrize and test the appropriate filter setting using PACTware™. Three filter settings can be specified (Filter A, B, C). For each of these settings you can choose from over 30 different filter values.

Under the menu item "Active filter" you can finally select the active filter setting. These three filter settings (Filter A, B, C) can also be set via teach function (see previous page 6) without IO-Link communication.

# Inclinometers with IO-Link technology – Parametrization via PACTware™ and IODD

## 5.2 Configure angle



Under the menu item "Mounting position" you can adapt the sensor to the respective application. In default status (upper hemisphere) the sensor provides output values in the tilt position of 5 V or 12 mA as the zero point for the X and the Y axis. All six possible mounting positions can be configured with this output behaviour. For example, if the connector should face upwards, this can be set under this menu item.

The factory default assignment of the axes is shown in the following figure:

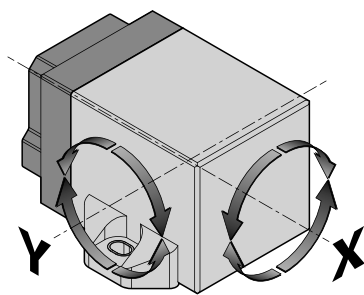


Fig. 1: Assignment of axes

The menu item "Functional area" provides five possible functions (see also programming via teach function, page 6):

- 1 Upper hemisphere (see fig. 2)**
- 2 Lower hemisphere (see fig. 2)**
- 3 (2 × 360°)**
- 4 (360° X)**
- 5 (360° Y)**

Upper and lower hemisphere are defined as follows

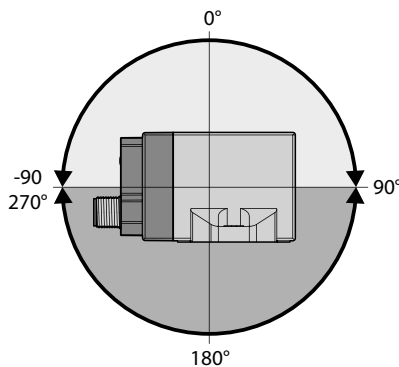


Fig. 2: Definition of the upper and lower hemisphere

### 1 Upper hemisphere

This function is the default setting. The sensor provides the possibility to capture all angles from 0°...±90° via the X and the Y-axis.

**NOTE:** In PACTware™, angles are specified as absolute values between 0°...359.99°. Entering negative areas is therefore not possible. The following are the standard measuring ranges:

- ±45° = 315°...45°
- ±60° = 300°...60°
- ±30° = 330°...30°
- ±10° = 350°...10°

### 2 Lower hemisphere

The sensor provides the possibility to capture all angles from 180°...90° or rather 180°...270° via the X and the Y-axis.

### 3 (2 × 360°)

The sensor captures the entire angular range of 0°...360° via the X and the Y-axis. Please observe, however, that owing to the principle involved, the analog output signals may mutually influence each other.

### 4 (360° X)

The X-axis is output over the entire range (0°...360°). The Y-axis is turned off.

### 5 (360° Y)

The Y-axis is output over the entire range (0°...360°). The X-axis is turned off.



## 5.3 Configure analog outputs

Parameter	Value	Value
Analog output function	1 (Current)	1 (Current)
Start value of analog output	0 mA	0 mA
End value of analog output	0 mA	0 mA
Overrange behavior	1 (Keep limiting value)	1 (Keep limiting value)
Direction of rotation	1 (Clockwise)	1 (Clockwise)
Start position of measuring range	0 °	0 °
Teach start position of measuring range...	1 (Teach)	
End position of measuring range	0 °	0 °
Teach end position of measuring range...	1 (Teach)	
Zero point offset	0 °	0 °
Zero point offset teach	1 (Teach)	

Use the menu item "Output type" to define the analog output either as current or voltage output.

"Start value" or "End value" are the limit values of the analog output. These can be chosen freely between 0 mA and 20 mA or 0 V and 10 V. It is also possible for example to select an output range of 0...10 mA.

In the menu item "Overrange behaviour" you determine how the sensor behaves in case of exceeding the set measuring range. You can adjust that the limiting value is either held or that an error beep is issued.

In the menu item "Direction of rotation" you can select between "clockwise CW" and "counterclockwise CCW" rotation.

The "Lower limit" and "Upper limit" of the measuring range define the active area of the sensor. For instance, if you want to parameterize a detection range of  $\pm 30^\circ$ , here you can set  $330^\circ$  (lower limit) and  $30^\circ$  (upper limit) in "clockwise direction of rotation".

You can also use the current tilt position of the sensor for the upper and lower limit. You can make these settings in the menu item "Teach start position of measuring range" resp. "Teach end position of measuring range" (see also teach function on page 6).

If the sensor is mounted on a flat surface where the slope is used as the zero point (5 V or 12 mA), this can be done by selecting the menu item "Zero point offset teach".

To enter values for movement of the zero point select the menu item "Zero point offset" (see also teach function page 6).

# Inclinometers with IO-Link technology – Parametrization via PACTware™ and IODD

## 5.4 Configure digital outputs

Referring axis	1 (X)	1 (X)
Output type	1 (PNP)	1 (PNP)
Switch point ON	0 °	0 °
Teach switch point ON	1 (Teach)	
Switch point OFF	0 °	0 °
Teach switch point OFF	1 (Teach)	
Switch point hysteresis	0 °	0 °
Inverting	0 (Normally open)	0 (Normally open)

Pin 2 and pin 4 of the inclinometer can be used as a switching output.

The switchpoint and the hysteresis are defined as follows under "Digital Outputs" as output 1 (Pin 2) and output 2 (Pin 4).

In "Referring axis" you specify which axis (X or Y) is used for the determination of the switchpoint.

In "Output type" you can select between PNP and NPN switching function.

In "Teach switchpoint ON" and "Teach switchpoint OFF", the current inclined positions are taken to define the hysteresis.

In "Switchpoint ON" or rather "Switchpoint OFF" you enter the angular range for the hysteresis in plain text.

In addition, you can parametrize a "hysteresis" (0.01° or greater) for the switchpoints or select the switching behaviour in the menu item "Inverting".

# Inclinometers with IO-Link technology – Parametrization via PACTware™ and IODD

## 5.5 Configure "acceleration"

System configuration		
Operation mode	3 (Acceleration X/Y linear)	1 (Inclination)
Lowpass filter A	24 (Cut-off frequency 24Hz)	24 (Cut-off frequency 24Hz)
Lowpass filter B	15 (Cut-off frequency 15Hz)	15 (Cut-off frequency 15Hz)
Lowpass filter C	0 (Cut-off frequency lowest)	0 (Cut-off frequency lowest)
Active filter	1 (Filter A)	1 (Filter A)

The operating modes "Inclination" and "Acceleration" are selected in the system configuration (see also page 7).

In the selection "Acceleration X/Y linear" the acceleration is output as an analog signal separately in the X and Y-direction. The detectable acceleration values are  $\pm 2$  g, with the initial value being 0 V or rather 0 mA with -2 g, 5 V or rather 10 mA, with 0 g and 10 V or rather 20 mA with 2 g.

The following top view Fig. 3 shows the corresponding acceleration:

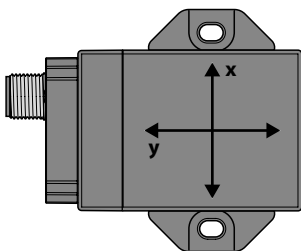


Fig. 3: Directions of acceleration X/Y linear (top view)

In the operating mode "Acceleration 2D" or "Acceleration 3D" the sensor uses the analog output (Pin 5). The direction of the acceleration is not taken into account, only the value is issued. Fig. 4 shows the corresponding acceleration "2D"; Fig. 5 for "3D". The following values can be determined 0 g = 0 V or rather 0 mA to 2 g = 10 V or rather 20 mA.

In addition, a switching output can be defined as threshold logic, i.e. if the freely selectable threshold value is exceeded, the output switches through for at least 1 second.

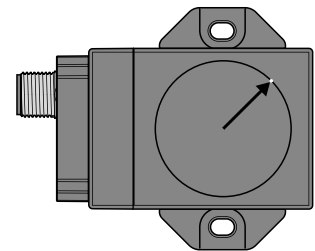


Fig. 4: Directions of acceleration 2D (top view)

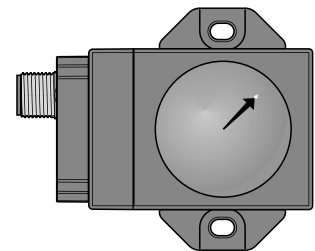
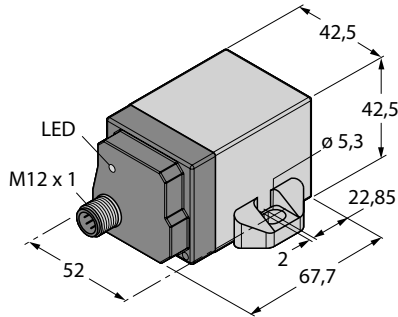


Fig. 5: Directions of acceleration 3D (top view)

# Inclinometers with IO-Link technology – Technical data

## 6 Technical data



### Measuring range specifications

Measuring range	0...360°
Measuring range x-axis	0...360°
Measuring range y-axis	0...360°

### System

Resolution	16 bit
Repeatability/accuracy	≤ 0.03 %, depending on filter setting
Linearity deviation	≤ 0.2 % of full scale
Temperature drift	≤ ± 0.015 % / K
Ambient temperature	B2N360-Q42-E2LiUPN8X2-H1181: -25...+70 °C B2N360-Q42-E2LiUPN8X2-H1181/S97: -40...+70 °C

### Electrical data

Operating voltage	B2N360-Q42-E2LiUPN8X2-H1181: 15...30 VDC B2N360-Q42-E2LiUPN8X2-H1181/S97: 7...30 VDC
Residual ripple	≤ 10 % U <sub>pp</sub>
DC rated operational current	≤ 150 mA
Rated insulation voltage	≤ 0.5 kV
Short-circuit protection	yes
Wire breakage/reverse polarity protection	yes/entirely
Output function	8-wire, NO/NC, PNP/NPN, analog output
Voltage output	0...10 V
Current output	4...20 mA parametrizable via IO-Link, e.g. 0...20 mA
Load resistance voltage output	≥ 4.7 kΩ
Load resistance current output	≤ 0.4 kΩ
Sampling rate	500 Hz

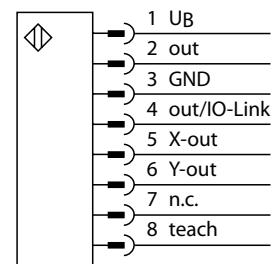
### Housing

Housing style	rectangular, Q42
Dimensions	67.5 × 42.5 × 42.5 mm
Housing material	plastic, PA 12-GF30
Connection	male, M12 × 1
Vibration resistance	55 Hz (1 mm)
Shock resistance	30 g (11 ms)
Protection class (IEC 60529/EN 60529)	IP68/IP69K
MTTF	159 years acc. to SN 29500 (Ed. 99) 40 °C

### LED indication

Power-on indication	1 × LED green
Switching status	1 × LED yellow

### Wiring diagram



## 7 IO-Link – Technical data

Physics	Physics 2 (3-Wire)
Com-Type	Standard: COM 2 (38400 Baud)
Frametype	Frametype 2.2

### 7.1 Parameter data

You can read and write to the sensor via the IO-Link parameter dataset.

#### 7.1.1 System parameters (System Command)

Restarting the communication.

Index (hex.)	Index (dez.)	R/W	Function
0x02	2	W	1: restart

#### 7.2.2 Identification

The following parameters can be read out:

- Manufacturer's name
- Manufacturer text
- Product name
- Product ID
- Product text
- Serial number
- Hardware version
- Firmware version

The following parameter can be read out and set:

- Specific name of the application

Index (hex.)	Index (dez.)	R/W	Function
0x10	16	R	Manufacturer's name
0x11	17	R	Manufacturer text
0x12	18	R	Product name
0x13	19	R	Product ID
0x14	20	R	Product text
0x15	21	R	Serial number
0x16	22	R	Hardware version
0x17	23	R	Firmware version
0x18	24	R/W	Specific name of the application

# Inclinometers with IO-Link technology – Technical data I/O-Link

## 7.1.3 Analog process data

Here, you can read out the angle in X-direction and Y-direction.

Index (hex.)	Index (dez.)	R/W	Function
0x40	64	R	Measuring angle X
0x41	65	R	Measuring angle Y

## 7.1.4 Teach in

The following teachable parameters can be read or written.

Index (hex.)	Index (dez.)	R/W	Function
0x70	112	R/W	Operation 1: Inclination/(2: Vibration)/3: Acceleration XY/4: Acceleration 2D
0x71	113	R/W	Lowpass filter A, 0...30, 255: Disabled
0x72	114	R/W	Lowpass filter B, 0...30, 255: Disabled
0x73	115	R/W	Lowpass filter C, 0...30, 255: Disabled
0x74	116	R/W	Active filter: 1...3
0x75	117	R/W	Angle compensation 0 OFF; 1 ON
0x80	128	R/W	Configuration analog output X, 1: I/2: U
0x81	129	R/W	Configuration analog output X, "Start value" in mV / 0.001 mA
0x82	130	R/W	Configuration analog output X, "End value" in mV / 0.001 mA
0x83	131	R/W	Overrange behaviour X 1: End value/2: error beep
0x84	132	R/W	Configuration analog output X, rotation direction 1: CW/2: CCW
0x85	133	R/W	Start position measuring range X entry in ° × 100, defined between 0...36000
0x86	134	W	Start position measuring range X measurement of current angle, 1: Recording of measured value
0x87	135	R/W	End position measuring range X entry in ° × 100, defined between 0...36000
0x88	136	W	End position measuring range X measurement of current angle, 1: Recording of measured value
0x89	137	R/W	Zero point reference X entry in ° × 100, defined between 0...36000
0x8A	138	W	Zero point reference X measurement of current angle, 1: Recording the measured value
0x8B	139	R/W	Zero point reference acceleration XY: X entry
0x8C	140	W	Zero point reference acceleration XY: X measurement of current value, 1: Recording of measured value
0x8D	141	W	Zero point reference acceleration XY X, 1: Reset
0x90	144	R/W	Configuration analog output Y, 1: I/2: U
0x91	145	R/W	Configuration analog output Y, "Start value" in mV / 0.001 mA
0x92	146	R/W	Configuration analog output Y, "End value" in mV / 0.001 mA
0x93	147	R/W	Overrange behaviour X 1: End value/2: error beep
0x94	148	R/W	Configuration analog output Y, rotation direction 1: CW/2: CCW
0x95	149	R/W	Start position measuring range Y entry in ° × 100, defined between 0...36000
0x96	150	W	Start position measuring range Y measurement of current angle, 1: Recording of measured value
0x97	151	R/W	End position measuring range Y entry in ° × 100, defined between 0...36000
0x98	152	W	End position measuring range Y measurement of current angle, 1: Recording of measured value

# Inclinometers with IO-Link technology – Technical data I/O-Link

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Index (hex.)	Index (dez.)	R/W	Function
0xA0	160	R/W	Switching output 1 axis, 1: X/2: Y
0xA1	161	R/W	Switching output 1 type NPN/PNP, 1: PNP/2: NPN
0xA2	162	R/W	Switching output 1 ON entry in ° × 100, defined between 0...36000
0xA3	163	W	Switching output 1 ON measurement of current angle, 1: Recording of measured value
0xA4	164	R/W	Switching output 1 OFF entry in ° × 100, defined between 0...36000
0xA5	165	W	Switching output 1 OFF measurement of current angle, 1: Recording of measured value
0xA6	166	R/W	Switching output 1, hysteresis in ° × 100, defined between 0...36000
0xA7	167	R/W	Switching output 1, inversion of switching range
0xA8	168	R/W	Switching output 1, enter threshold 0 ...2000 mg, acceleration XY, X-direction
0xA9	169	R/W	Switching output 1, enter threshold 0 ...2000 mg, acceleration 2D
0xAA	170	R/W	Switching output 1, enter threshold 0 ...2000 mg, acceleration 3D
0xB0	176	R/W	Switching output 2 axis, 1: X/2: Y
0xB1	177	R/W	Switching output 2 type NPN/PNP, 1: PNP/2: NPN
0xB2	178	R/W	Switching output 2 ON entry in ° × 100, defined between 0...36000
0xB3	179	W	Switching output 2 ON measurement of current angle, 1: Recording of measured value
0xB4	180	R/W	Switching output 2 OFF entry in ° × 100, defined between 0...36000
0xB5	181	W	Switching output 2 OFF measurement of current angle, 1: Recording of measured value
0xB6	182	R/W	Switching output 2, hysteresis in ° × 100, defined between 0...36000
0xB7	183	R/W	Switching output 2, inversion of switching range
0xB8	184	R/W	Switching output 1, enter threshold 0 ...2000 mg, acceleration XY, Y-direction
0xC0	192	R/W	Selection of the functions 1: upper hemisphere; 2: lower hemisphere; 3: 2 × 360°; 4: 360° X; 5: 360° Y
0xC1	193	R/W	Mounting position, 1: Normal; 2: 90° Y; 3: 180°; 4: 270° Y; 5: 90° X; 6: 270° X

## 7.1.5 Factory reset

Index (hex.)	Index (dez.)	R/W	Function
0xCF	207	W	1: Factory Reset

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