

***Instruction Manual***

**UNCK 09G8914/IO**

**UNCK 09G8914/KS35A/IO**

**UNDK 09G8914/IO**

**UNDK 09G8914/KS35A/IO**

**Sensor Solutions**

Motion Control

Vision Technologies

Process Instrumentation

# Instruction Manual for UNxK 09 with IO Link

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# 1 General Information

## 1.1 About this Document

These instructions contain information related to commissioning and communications with the Baumer Series 14 photoelectric distance sensor equipped with the IO Link interface. They supplement the installation instructions, already provided with each sensor.

These instructions apply to the following sensor versions:

UNCK 09G8914/IO  
UNCK 09G8914/KS35A/IO  
UNDK 09G8914/IO  
UNDK 09G8914/KS35A/IO

## 1.2 General Information

<b>Rules for proper usage</b>	This product is a precision measuring device which has been designed for the detection of objects and parts. It generates and provides measured values issued as electrical signals for following systems. Unless this product has not been specifically marked it may not be used in hazardous areas.
<b>Set-up</b>	Installation, mounting and adjustment of this product may only be executed by skilled employees.
<b>Installation</b>	Only mounting devices and accessories specifically provided for this product may be used for installation. Unused outputs may not be connected. Unused strands of hard-wired sensors must be isolated. Do not exceed the maximum permissible bending radius of the cable. Before connecting the product electrically the system must be powered down. Where screened cables are mandatory, they have to be used in order to assure EMI protection. When assembling connectors and screened cables at customer site the screen of the cable must be linked to the connector housing via a large contact area.

## 2 IO Link Introduction

In order to fully understand the various configuration options, these operating instructions describe the most important aspects of the IO Link interface. More detailed information concerning IO Link, together with all specifications, is available at [www.IO-Link.com](http://www.IO-Link.com).

IO Link is a standard interface for sensors and actuators. Devices (sensors, actuators) are connected to an IO Link master via point-to-point connections. Communications between the master and the device are bidirectional, via the device switching line. This interface permits measuring values to be recorded. An option to configure the sensor via the IO Link is also provided. There are two modes of sensor operation: the standard input/output mode (SIO mode) and the IO Link communication mode.

The master switches the sensor to the IO Link communication mode. In this mode, process data (measurement data) are now continuously transferred from the sensor to the master, while requirement data (parameters, commands) are either written to the device or read from it.

### 2.1 SIO Mode

After start up, the sensor is automatically in the SIO mode. In this mode, the sensor operates as a standard switching or measuring sensor. On the master side, the IO Link port is set as a normal digital input. The sensor can be used like a standard sensor without IO Link. However, various functions can only be controlled with the aid of IO Link.

### 2.2 IO Link Communication Mode

The sensor is switched to the “communication mode” by means of a so-called “wake up” signal sent by the master. With this action, the master attempts to locate a connected device by means of a defined signal transmitted along the switching line. If the sensor responds, communication parameters are exchanged, after which the cyclic transmission of process data can begin.

The following can be performed in the IO Link communication mode:

- Process data can be received;
- Parameters (SPDUs) can be read from the sensor;
- Parameters (SPDUs) can be written to the sensor;
- Commands can be transmitted to the sensor (e.g., switching point teaching, resets to factory settings, etc.).

The process data contain cyclic data such as measuring value; switch status or quality information which is transferred to the higher level controller.

The master can exit the IO Link communication mode by using a “fall back”, after which the sensor once again operates in the SIO mode until it receives the next “wake up”.

The sensor’s behavior in the SIO mode can be adjusted in the IO Link communication mode. This allows the sensor to be easily adapted to the requirements of corresponding parameters, and to then continue operating as a “normal” sensor, without the use of IO Link. Alternately, the sensor can also operate continuously in the IO Link communication mode in order to fully utilize the entire functional scope provided by the process data.

## 2.3 IODD (IO Link Device Description)

The IODD describes the IO Link device, and can be downloaded at [www.baumer.com](http://www.baumer.com). It comprises a set of XML and PNG files. An engineering or diagnostic tool reads a sensor's IODD in order to determine the following:

- Identification (manufacturer, designation, part number, etc.);
- Communication characteristics (communication speed, frame type, etc.);
- Parameters and commands;
- Process data;
- Diagnostic data (events).

The IODD determines who is permitted to review and modify which sensor data. How the data are presented and how they are manipulated is defined by the sensor manufacturer and is therefore independent of the sensor itself.

## 3 Sensor in the SIO Mode

In the SIO mode, the sensor operates in accordance with its factory settings or according to the settings defined by the user via IO Link. The functional scope in the SIO mode is sensor specific.

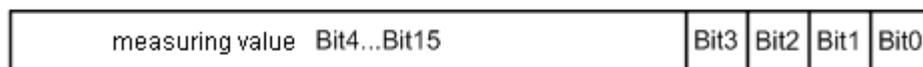
## 4 Sensor in the IO Link Communication Mode

### 4.1 Process Data

With the sensor in the IO Link communication mode, data are periodically exchanged between the IO Link master and the device. These data comprise process data and possibly commands and parameters for the sensor. Process data transfer the current measuring value and status bits such as the switch status, quality information, etc. to the master. The master does not need to explicitly request these process data.

#### 4.1.1 Process Data Structure

Figure 1 illustrates the structure of process data. The following provides a brief description of the individual information.



**Figure 1: Process data**

##### 4.1.1.1 Significance of the Measuring Value

The measuring value (Bit4...Bit15) has a range between 0...4095. The measuring value reflects the sensor's current measuring range. If the object being measured lies at the start of the measurement value range (e.g., 30mm), a measuring value of 0 is output. If the object being measured lies at the end of the measurement value range (e.g., 200mm) a measuring value of 4095 is output.

#### 4.1.1.2 Significance of the Status Information

##### **Bit 0: Alarm**

The alarm bit indicates whether an object lies within the measurement value range.

Bit0 = 0 An object lies within the specified measuring range.

Bit0 = 1 There is no object within the specified measuring range.

##### **Bit 1: Switch bit**

In the IO Link communication mode, the switch bit performs the function of a switching output.

Bit1 = 0 There is no object within the switching range.

Bit1 = 1 An object lies within the switching range.

##### **Bit 2: Quality**

This bit provides information about the quality of the sonic echo reflected by the object.

Bit2 = 0 The amount of reflected sonic is OK.

Bit2 = 1 The amount of reflected sonic is critical.

##### **Bit3: Not used**

## 4.2 Parameters and Commands

Parameters and commands are either written to the device or read from it using SPDU (Service Protocol Data Unit) indices. The read and write function is provided by the IO Link master. The user can write a value to an index, or can have a value read from it.

### 4.2.1 Product Information

Some parameters contain product information such as the manufacturer's name, the product name and number, together with a user-specific sensor designation (refer to Table 6, Table of General Information SPDUs).

### 4.2.2 Parameters

For a description of parameters, refer to Table 6.2, Table of Parameter SPDUs.

### 4.2.3 Commands

Commands are written to SPDU Index 0x02 (system commands). Refer to Table 6.3 Table of System Commands.

### 4.2.4 Saving Modifications

Modification of parameters either by direct overwriting or by a command don't have to be saved explicitly. They remain automatically valid also after a restart.

## 5 Explanation of the Sensor Configuration

Parameters and commands can be used to configure the sensor functionalities. The following sections provide a detailed description of the various configuration options.

### 5.1 Teaching a User-Specific Measuring Range

#### 5.1.1 Parameter

**Measuring range work:** This parameter covers the currently used beginning and end values for the measuring range. The beginning and end values can either be entered directly into the parameter (numerical teaching), or they can be automatically set via the interim register to teach an object the parameter comprises two 16 bit components: **Measuring range limit A** and **Measuring range limit B**.

- Unit: 0.1mm
- Factory setting: 30 ... 200mm

**Measuring range interim:** This parameter serves as a supplemental register to teach the measuring range for an object.

- Unit: 0.1mm

#### 5.1.2 Commands

**Teach-in measuring range limit A:** Command used to teach measuring range limit A. The taught value is transferred to the interim register, **Measuring range interim**.

**Teach-in measuring range limit B:** Command used to teach measuring range limit B. The taught value is transferred to the interim register, **Measuring range interim**.

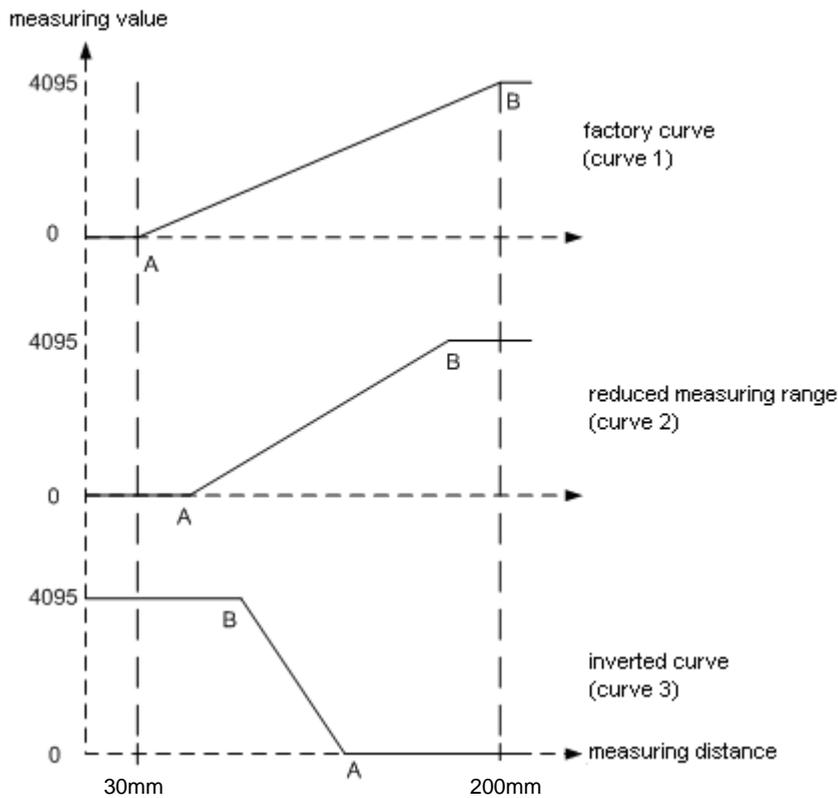
**Transfer measuring range:** The measuring range learned in the interim register, **Measuring range interim**, is transferred to the **Measuring range work** register and is set to active.

#### 5.1.3 Description

There are two methods which the user can employ to adjust the measuring range of the UNxK 09:

- Numerical teaching: The beginning and end values of the measuring range are written directly to the **Measuring range work** parameter;
- Teaching an object: the beginning and end values of the measuring range are learned for an object by applying the corresponding measuring commands. If the object lies outside the original measuring range, the minimum or maximum measuring distance are learned.

The measuring value between measuring value limits A and B is output as a relative value between 0 and 4095. Measuring value limits A and B are output as absolute distances from the leading sensor edge in 0.1 millimeter increments. Figure 2 illustrates possible characteristic measuring value curves.



**Figure 2: Possible characteristic measuring value curves**

### 5.1.3.1 Example numerical Teach-in:

1) The measuring range shall be defined from 50mm (A) to 180mm (B) -> (curve 2).

**Point A absolute in tenth of mm:** 500 → 01F4 hex (= Measuring range limit A)

**Point B absolute in tenth of mm:** 1800 → 0708 hex (= Measuring range limit B)

Parameter to be written:

**Measuring range work:** 01F40708 hex

2) The output signal shall be inverted; measuring range is from 60mm (B) to 120mm (A) -> (curve 3).

**Point A absolute in tenth of mm:** 1200 → 04B0 hex (= Measuring range limit A)

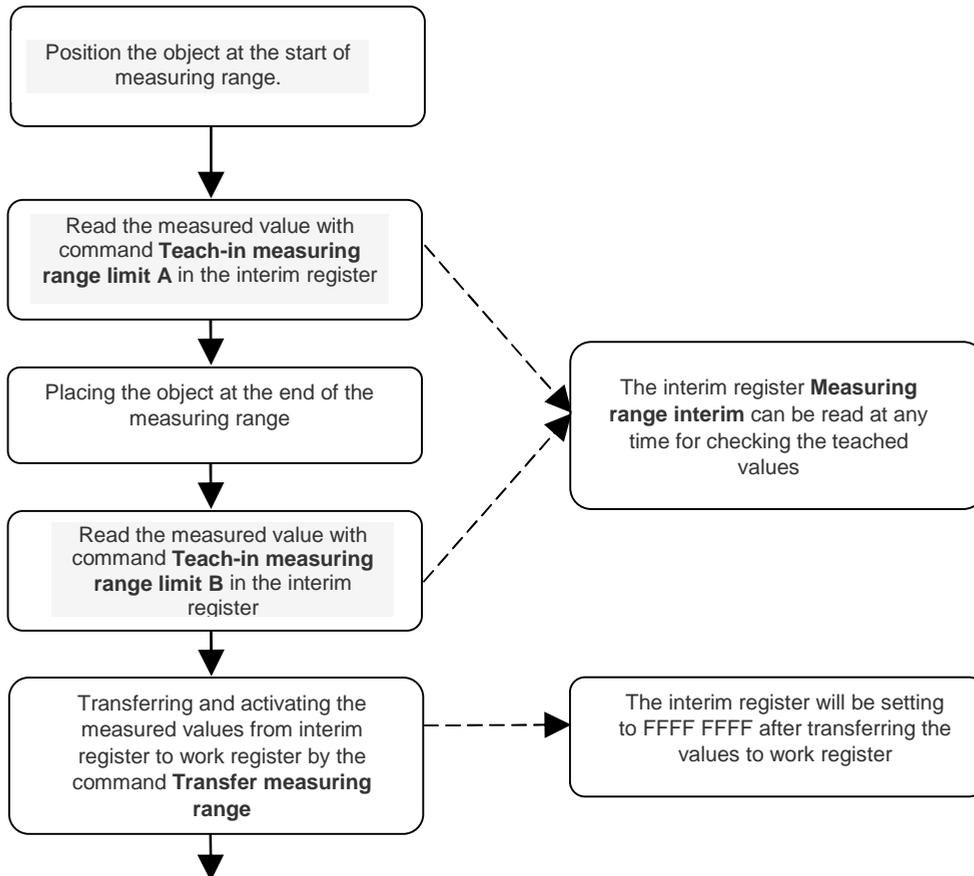
**Point B absolute in tenth of mm:** 600 → 0258 hex (= Measuring range limit B)

Parameter to be written:

**Measuring range work:** 04B00258 hex

### 5.1.3.2 Example Teach-in on object

The measuring range has to be taught against an object (curve 2).



**Figure 3: Teach-in of output curve**

In order to obtain an inverted output signal (curve 3) the distance from the sensor to the **Measuring range limit A** must be bigger than the one to the **Measuring range limit B**.

### 5.1.4 Error handling

The measuring range limits taught lie beyond the sensor's max. measuring range (Consult sensor specification sheet for applicable range):

- Numerical Teach-in: writing of **Measuring range work** not possible, error message **Parameter value out of range**.
- Teach-in on object: measured value in **Measuring range interim** is set to FFFF hex, error message **Parameter value out of range**. Transfer of data from the interim register to the work register is not possible, error message **Parameter value out of range**.

## 5.2 Teach-in of user specific switching points

### 5.2.1 Parameter

#### **Switching- /**

#### **Teach function:**

Using this parameter the function of the digital output can either be set to a single switching point or the two trigger points of a window can be set.

- Values ranges: 0 (switching point), 1 (window)
- Factory setting: 0

#### **Switching points work:**

This parameter contains the currently set ON and OFF trigger points of the digital output. The parameter can directly be written on with the required ON and OFF trigger thresholds (numerical Teach-in), or it is automatically set via the interim register when teaching against an object. The parameter is composed of the two 16Bit parameters **Switching point A** and **Switching point B**.

- unit: 0.1mm
- factory setting: switching point A = FFFF hex, switching point B = 200mm

#### **Switching points interim:**

This parameter acts as a helping register when teaching the switching points against an object.

- unit: 0.1mm

### 5.2.2 Commands

#### **Teach-in switching point A:**

Command for teaching in the switching point A. The taught value is transferred to the interim register **Switching points interim**.

#### **Teach-in switching point B:**

Command for teaching in the switching point B. The taught value is transferred to the interim register **Switching points interim**.

#### **Transfer switching points:**

The **Switching points interim** held by the interim register are transferred to the work register and are then activated.

### 5.2.3 Description

Ex works the sensor has been programmed to have only one switching point like most standard digital sensors. With the parameter **Switching- / Teach function** the switching function can be extended to window function. By changing the switching function both the Teach-in procedure via the Teach-in button and also via the Teach-in input in SIO mode are changed. The same applies for teaching in the switching points in the IO-link communication mode.

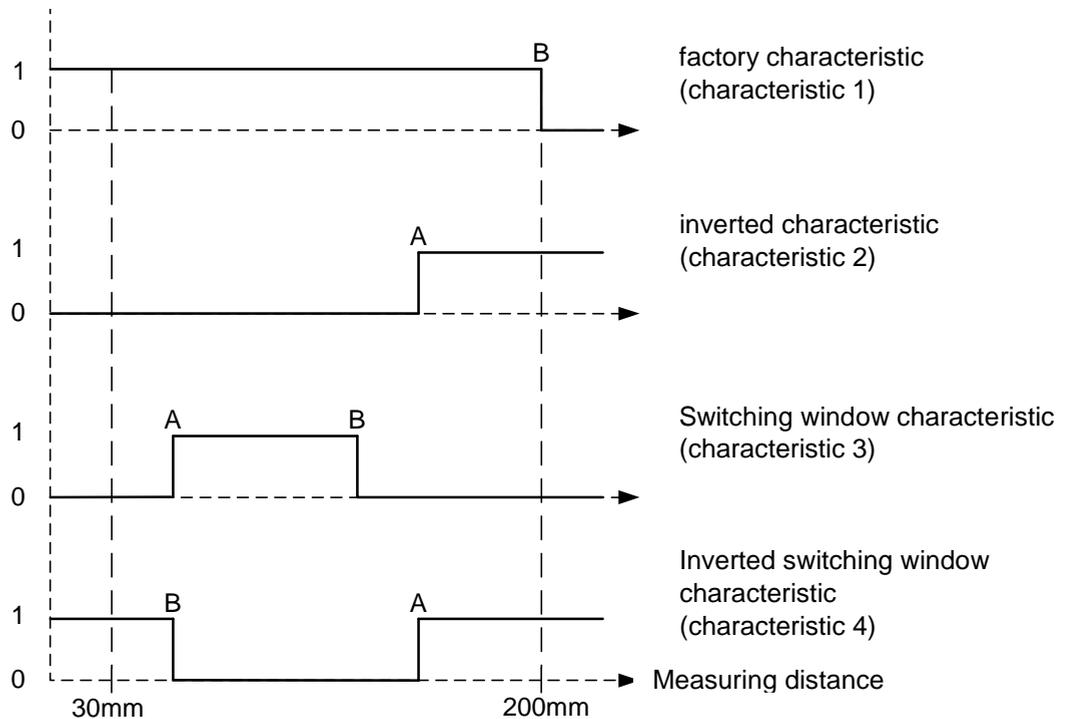
The UNXK 09 can be adjusted by the user in two ways:

- Numerical Teach-in: ON and OFF thresholds are written directly into the **Switching points work**.
- Teach-in against object: ON and OFF thresholds are written with the applicable commands for measuring against an object.

The thresholds A and B define the switching pattern which again defines the state of the switching bit. Both thresholds, A and B, are indicated as an absolute value, measured from the front edge of the sensor enclosure, in tenth of mm.

Figure 4 shows all possible switching patterns.

switching bit / switching output



**Figure 4: all possible switching patterns**

### 5.2.3.1 Examples for numerical Teach-in:

1) An “ON” threshold shall be set at 130mm distance (B) -> (characteristic 1).

Setting the switching function:

**Switching- / Teach function: 0**

**Point A absolute in tenth of mm:** 65535 → FFFF hex (= **Switching point A**)

(Must be set to 65535 since only one switching point required)

**Point B absolute in tenth of mm:** 1300 → 0514 hex (= **Switching point B**)

Parameter to be written:

**Switching points work: FFFF0514 hex**

2) An “OFF” threshold shall be set at 70mm distance (A) -> (characteristic 2).

Setting the switching function:

**Switching- / Teach function: 0**

**Point A absolute in tenth of mm:** 700 → 02BC hex (= **Switching point A**)

**Point B absolute in tenth of mm:** 65535 → FFFF hex (= **Switching point B**)

(Must be set to 65535 since only one switching point required)

Parameter to be written:

**Switching points work: 02BCFFFF hex**

3) Two window thresholds shall be set at 40mm (A) and at 60mm (B) -> (characteristic 3).

Setting the window function:

**Switching- / Teach function: 1**

**Point A absolute in tenth of mm:** 400 → 0190 hex (= **Switching point A**)

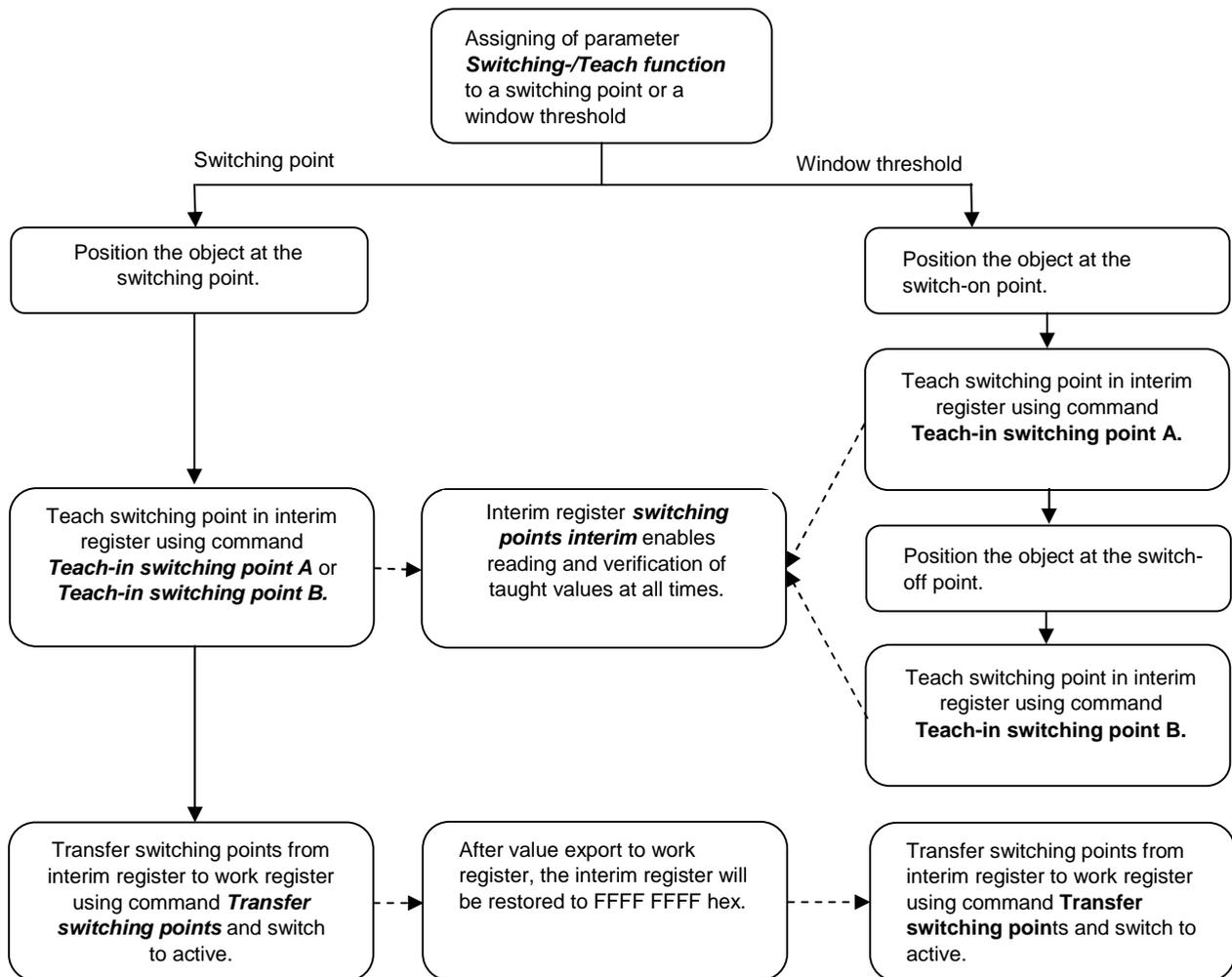
**Point B absolute in tenth of mm:** 600 → 0258 hex (= **Switching point B**)

Parameter to be written:

**Switching points work: 01900258 hex**

### 5.2.3.2 Example Teach-in on object

The switching points are taught against an object.



**Figure 5: Teaching the switching points**

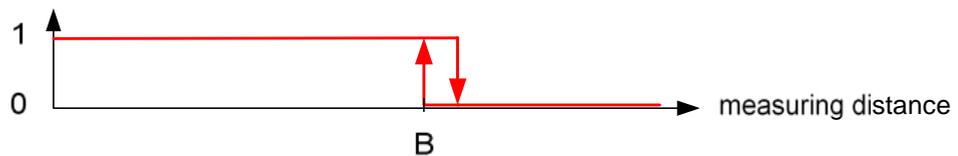
In order to obtain an inverted switching (characteristic 4) the distance from the sensor to **Switching point A** must be bigger than the one to **Switching point B**.

## 5.2.4 Hysteresis

### Switching point:

When moving towards the sensor/trigger point the sensor commutates exactly at the trigger point taught. When moving away from the sensor's trigger point the hysteresis is added (see figure 6).

switching bit / switching output

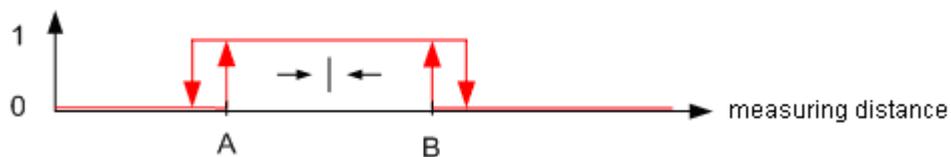


**Figure 6: Hysteresis of switching point**

### Switching window:

When moving towards the window trigger points from either direction the sensor commutates exactly at the trigger points taught. Once the target is „leaving“ the window a hysteresis is added to either one of the two trigger points (see: figure 7).

switching bit / switching output



**Figure 7: Hysteresis of switching window trigger points**

## 5.2.5 Error handling

The measuring range limits taught lie beyond the sensor's max. measuring range (Consult sensor specification sheet for applicable range):

- Numerical Teach-in: writing of **Switching points work** not possible, error message **Parameter value out of range**
- Teach-in on object: measured value in **Switching points interim** is set to FFFF hex, error message **Parameter value out of range**. Transfer of data from the interim register to the work register is not possible, error message **Parameter value out of range**.

## 5.3 Averaging

### 5.3.1 Parameter

**Average:** Number of measurements across which the measured value is being averaged.

- Range of values: 0, 2, 4, 8, 16, 32, 64
- Factory setting: 4

### 5.3.2 Description

By averaging an adjustable number of measured values the white noise in a measuring set-up can be minimized resulting in increased sensor repeat accuracy and resolution. Signal averaging reduces the response time whilst the measuring speed is unaffected by this method.

Averaging algorithm: Floating average (single sided floating average value)

Averaged value x:  $Y_n = (Y_n + Y_{n-1} + Y_{n-2} + \dots + Y_{n-x})/x$

## 5.4 Temperature compensation

### 5.4.1 Parameter

#### **Temperature compensation:**

With this parameter the temperature compensation can be switched on and off.

- Range of values: 0, 1
- Factory setting: 0 (off)

### 5.4.2 Description

The temperature compensation is used to compensate the speed of sound's dependency on air temperature. Provided the temperature compensation is active changes in the ambient temperature is compensated to 2% of  $S_o$  (distance sensor to object). Note: the temperature compensation becomes active not until 15 minutes after power-on. When temperature compensation is off the sensor provides correct measurements immediately after power-on. But changing ambient temperature induces a measuring error of 0.18 % Sde/K.

## 5.5 Locking/releasing of Teach-in button

### 5.5.1 Parameter

#### **Teach-in lock:**

With this parameter it can be configured if and when the Teach-in button is locked.

- Range of values: 0 (Button always locked)  
1 (Button always unlocked)  
2 (Button locked 5 min after Power-On)
- Factory setting: 2 (Button locked 5 min after Power-On)

### 5.5.2 Description

The Teach-in button, which is required to teach the switching point and/or the two thresholds of the switching window in SIO mode, has been factory set to lock automatically 5 minutes after power-on. This is to prevent any accidental changes to the sensors' settings being executed. Whether and when the Teach-in button has to be locked is configurable in the IO-Link communication mode. Teach-in via Teach-in wire is remains unlocked. Note: both ways of teaching - via button and via wire - are possible only provided the sensor is in the SIO mode. Teach-in is not possible as long as the sensor remains in the IO-Link Communication mode.

## 6 Overview of SPDUs

### 6.1 Table of General Information SPDUs

SPDU name	SPDU index	Number of Bytes	Format	Range of values	R/W	Comments
<b>General information on sensors</b>						
Vendor Name	0X10	18	String	ASCII	R	"Baumer Electric AG" for all sensors
Product Name	0X12	22	String	ASCII	R	Corresponds with Baumer article description
Product ID	0X13	8	String	ASCII	R	Corresponds with Baumer article number
Serial Number	0X15	4	String	ASCII	R	Baumer P-Code
Firmware Revision	0X17	8	String	ASCII	R	Baumer Firmware Revision
Application Specific Name	0X18	8	-	-	R/W	8 Byte at customer disposal

### 6.2 Table of Parameter SPDUs

SPDU name	SPDU index	Number of Bytes	Format	Range of values	R/W	Comments
<b>Measuring range and switching points</b>						
Switching points work	0X40	4	Switching point A (HB, LB) Switching point B (HB, LB)	300...2000, 65535	R/W	Distance information on switching points
Switching points interim	0X41	4	Switching point A (HB, LB) Switching point B (HB, LB)	300...2000, 65535	R	Distance information on switching points
Measuring range work	0X42	4	Measuring range limit A (HB, LB) Measuring range limit B (HB, LB)	300...2000	R/W	Distance information on measuring range limits
Measuring range interim	0X43	4	Measuring range limit A (HB, LB) Measuring range limit B (HB, LB)	300...2000, 65535	R	Distance information on measuring range limits
<b>Sensor functions</b>						
Average	0X50	1	-	0,1,2,4,8, 16, 32, 64	R/W	Number of measuring cycles across which it is being averaged. Average value = 0 or 1: Average is switched off.
Temperature compensation	0X51	1	-	0,1	R/W	Temperature compensation on/off respectively. 0 = Temperature compensation off 1 = Temperature compensation on
Switching- / Teach function	0X60	1	-	0,1	R/W	Selection of switching function and Teach mode 0 = one switching point 1 = window function

SPDU name	SPDU index	Number of Bytes	Format	Range of values	R/W	Comments
Teach-in lock	0X61	1	-	0,1,2	R/W	Teach-in button lock/unlock respectively 0 = Teach-in button always locked. 1 = Teach-in button always unlocked. 2 = Teach-in button locked 5 min after Power-On.

### 6.3 Table of System Commands

Name of Command	SPDU Index	CMD Value	Comments
Restore factory setting	0X02	0X82	Restores all original factory settings of the sensor
Teach-in switching point A	0X02	0XA0	Teach-in of switching point A. The measured distance is written into the interim switching points register.
Teach-in switching point B	0X02	0XA1	Teach-in of switching point B. The measured distance is written into the interim switching points register.
Transfer switching points	0X02	0XA2	Transfer of the switching points from the interim register to the working register.
Teach-in measuring range limit A	0X02	0XA3	Teach-in of measuring range limit A. The measured distance is written into the measuring range interim register
Teach-in measuring range limit B	0X02	0XA4	Teach-in of measuring range limit B. The measured distance is written into the measuring range interim register.
Transfer measuring range	0X02	0XA5	Transfer of the measuring range from the interim register to the working register

### 6.4 Table of error Codes

Error Case	Error Code 1	Error Code 2	Description of Error Codes
Communication error (Checksum, ...)	0x10	0x00	Communication error, No details
Length of written SPDU is wrong	0x10	0x00	Communication error, No details
Reading an unimplemented SPDU	0x80	0x11	Device error, Index not available
Writing to an unimplemented SPDU	0x80	0x11	Device error, Index not available
Reading Index 2	0x80	0x23	Device error, Access denied
Writing to a read only SPDU	0x80	0x23	Device error, Access denied
Writing an unimplemented System Command	0x80	0x23	Device error, Access denied
Written parameter out of defined range	0x80	0x30	Device error, Parameter value out of range

## 6.5 Table of Factory Settings

SPDU name	SPDU index	Default value
Application Specific Name	0X18	empty
Switching points work	0X40	Switching point A: FFFF hex Switching point B: 200mm
Measuring range work	0X42	Measuring range limit A: 30mm Measuring range limit B: 200mm
Average	0X50	4
Temperature compensation	0x51	0 (off)
Switching- / Teach function	0x60	0 (one switching point)
Teach-in lock	0X61	2 (locked 5 min after Power-On)

## 7 Mounting

### 7.1 Mounting options and installation hints

#### UNDK 09

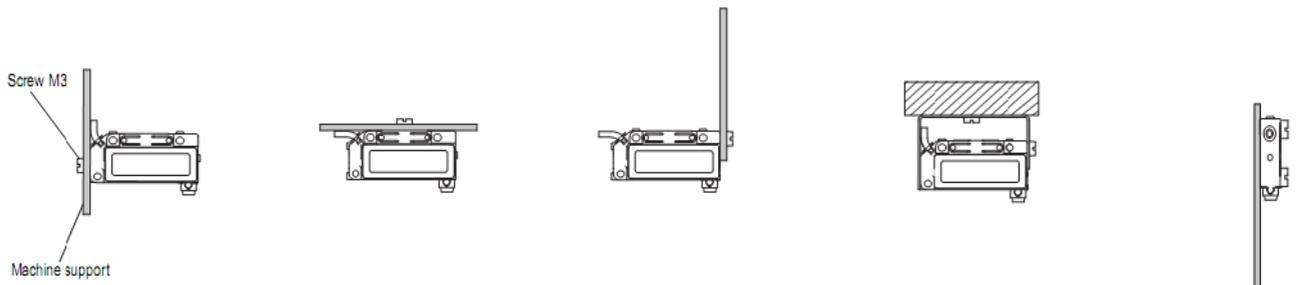


Figure 8: Mounting options and installation hints for UNDK 09

#### UNCK 09

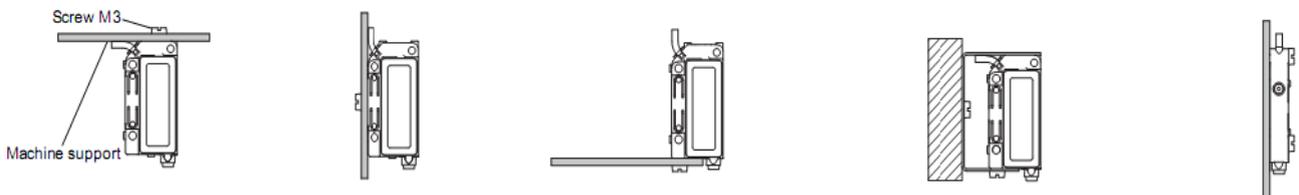


Figure 9: Mounting options and installation hints UNDK 09

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