Baumer

IO-Link

Operating Instructions

Smart Reflect
FNDH 14G6901/IO
FNDH 14G6901/KS34A/IO
FNDR 14G6901/S14/IO
FNDK 14G6904/IO
FNDK 14G6904/S35A/IO
FNDK 14G6904/S14/IO

Background suppression
FHDH 14G6901/IO
FHDH 14G6901/KS34A/IO
FHDR 14G6901/S14/IO

Sensor Solutions
Motion Control
Vision Technologies
Process Instrumentation

Operating Instructions for Series 14 Hygienic and Washdown Design with IO-Link

Contents

1 General information

1.1 Concerning the contents of this document

This manual contains information regarding the commissioning and communication of Baumer series 14 photoelectric diffuse sensors with SmartReflect and background suppression with the IO-Link interface. It is a supplement to the mounting instructions supplied with each sensor.
This manual applies to the following sensor types:

Diffuse sensors with SmartReflect technology
FNDH 14G6901/IO
FNDH 14G6901/KS34A/IO
FNDR 14G6901/S14/IO
FNDK 14G6904/IO
FNDK 14G6904/S35A/IO
FNDK 14G6904/S14/IO

Diffuse sensors with background suppression
FHDH 14G6901/IO
FHDH 14G6901/KS34A/IO
FHDR 14G6901/S14/IO

1.2 General information

Intended use	This product is a precision device and is used for object detection and the preparation and/or provision of values as electrical quantities for a subsequent system. Unless this product is specially labeled, it may not be used for operation in potentially explosive environments.
Commissioning	Installation, mounting and adjustment of this product may be performed only by a qualified person.
Mounting	For mounting, use only the mechanical mountings and mechanical mounting accessories intended for this product. Unused outputs must not be wired. In cable versions with unused cores, these cores must be insulated. Do not exceed admissible cable bending radii. Prior to electrical connection of the product, the system must be disconnected from the power supply. In areas where screened cables are mandatory, they must be used as protection against electromagnetic disturbances. If plug connections to screened cables are made by the customer, an EMC version of the connectors should be used, and the screen must be connected to the connector housing across a large area.

2 IO-Link introduction

These operating instructions contain a description of the most important aspects of the IO-Link interface which are required for understanding the configuration options. For detailed information about IO-Link and all specifications, go to www.io-link.com .

IO-Link is a standard interface for sensors and actuators. The device (sensor, actuator) and IO-Link master are interconnected as a point-to-point connection. Communication between master and device takes place bi-directionally via the device connecting line. Via this interface values can be read out and it is possible to configure the sensor via IO-Link. The sensor can be operated in two modes: standard input/output mode (SIO mode) and IO-Link communication mode.

The master switches the sensor to IO-Link communication mode. In this mode, process data are continuously sent from the sensor to the master and demand data (parameters, commands) are written to the device or read off it.

2.1 SIO mode

After start-up the sensor is in SIO mode. In this mode the sensor functions as a normally switching sensor. On the master side the IO-Link port is switched as a normal digital input. The sensor can be used like a standard sensor without IO-Link. Diverse functions can, however, only be controlled via IO-Link.

2.2 IO-Link communication mode

With a so-called "wake-up" the sensor is switched by the master into "communication mode". In the process the master attempts to find a connected device through a defined signal on the switching line. If the sensor responds, communication parameters are exchanged and afterwards cyclical transmission of process data is initiated.
In IO-Link communication mode:

- Process data can be read.
- Parameters can be read off the sensor.
- Parameters can be written to the sensor.
- Commands can be sent to the sensor (e.g. teaching the switching point, restoring to factory setting, etc.).

In the process data cyclical data such as outputs or quality data are transmitted to the superordinate control.
The master can leave the IO-Link communication mode again with a "fall back", and the sensor continues to operate in SIO mode until a new "wake up".

In IO-Link communication mode, sensor behavior can be adjusted in SIO mode so that the sensor can easily be parameterized according to requirements and then operate as a "normal" sensor without the IO-Link master. Alternatively, the sensor can also be operated in IO-Link communication mode, enabling use of the full range of functions via process data.

2.3 IODD (IO-Link device description)

The IODD describes the IO-Link device and can be downloaded at www.baumer.com. It consists of a set of XML and PNG files. An engineering tool or diagnosis tool reads the IODD of a sensor and therefore knows its:

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

Sensor data that can be viewed and changed is defined by the IODD. The manner of data representation and manipulation is defined by the control manufacturer and is therefore sensor-independent.

3 Sensor in SIO mode

In SIO mode the sensor operates according to the factory settings or the settings adjusted by the user via IO-Link. The range of functions in SIO mode is sensor-specific.

4 Sensor in IO-Link communication mode

4.1 Process data

If the sensor is in IO-Link communication mode, data are periodically exchanged between the IO-Link master and the device. These data consist of process data and possible commands and parameters to the sensor. In the process data the current measuring value and status bits like output, quality data, etc. are transmitted to the master. The process data do not have to be explicitly queried by the master.

4.1.1 Process data structure

Figure 1 shows the process data structure. A brief description of the individual data is provided in the following.

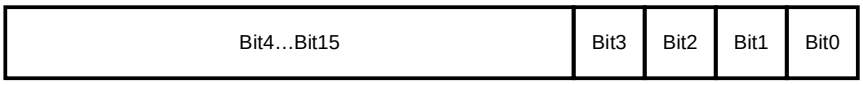

Figure 1: Process data

4.1.1.1 Back-up

Bit4…Bit15 serve solely as a back-up and are reserved with the value 0.

4.1.1.2 Meaning of status information

Bit 0: Alarm

The alarm bit indicates whether an object is in the defined scanning range (e.g. 50 to 400 mm)
Bit0 = 0 → There is an object is in the scanning range
Bit0 = 1 → There is no object in the scanning range

Bit 1: Switching bit
The switching bit assumes the function of the switching output in IO-Link communication mode
Bit1 = 0 → There is no object in the switching range
Bit0 = 1 → There is an object in the switching range

Bit 2: Quality
This bit provides information about the quantity of light reflected by the object (dust indicator).
Bit2 = 0 → reflected light above the threshold (sufficient signal)
Bit2 = 1 → reflected light below the threshold (weak signal)

Bit3: Not used

4.2 Parameters and commands

Parameters and commands are written to the device or read off the device via indices. The read and write function of indices is provided by the IO-Link master. The user can write a value into an index or read a value off an index.

4.2.1 Product data

Some parameters contain product information like manufacturer's name, product name, and number, plus room for a user-specific designation of the sensor (see: 6.1 Table of general parameters).

4.2.2 Parameters

For a description of the parameters, see 6.2 Table of work parameters.
The following settings are possible via parameters:

- Setting the switching point (numerical or manual teach-in)
- Defining the output state (light or dark switching)
- Selecting a teach-in function
- Setting a delay function at the switching output. Value range from 1 to 1000 ms
- Defining the threshold for the dust indicator

4.2.3 Commands

Commands are written to index 0x02 (system command). For a description of the commands, see 6.3 Table of system commands.
The following settings can be made via commands:

- Teach-in and application of the switching point
- Save changed parameters
- Restore to factory settings

4.2.4 Saving changes

If parameter changes are made by directly writing parameters or by a command (also restoring to factory settings), the settings must be permanently saved by the command ***Save parameters***. Otherwise the changes are lost after the sensor is restarted, and the last saved entries are reactivated.

5 Explanation of sensor configuration

The functionality of the sensor can be configured with the parameters and the commands. In the following sections, the individual configuration options are explained in detail.

5.1 Teach-in of a user-specific switching point

5.1.1 Parameters

Switching points work: This parameter contains the currently used switching point and can be written directly (numerical teach-in) or set automatically to an object via the interim register during teach-in. The parameter consists of two 16-bit parameters ***Switching point A*** and ***Switching point B***, whereby one switching point respectively must have the value 65535 (corresponds to "not valid").

- Unit: 1 mm
- Factory setting: Switching point A = 50mm, Switching point B = 65535 "not valid"

Teach-in positions interim: This parameter serves as an interim register for teaching-in the switching point to an object (1-point teach-in) or to a reference position and an object (2-point teach-in). The parameter consists of two 16-bit parameters ***Teach-in position A interim*** and ***Teach-in position B interim***.

- Unit: 1 mm

5.1.2 Commands

Teach-in position A: Command for teaching-in position A. The taught-in value is transferred to the interim register ***Teach-in position A interim***.

Teach-in position B: Command for teaching-in position B. The taught-in value is transferred to the interim register ***Teach-in position B interim***.

Transfer switching points: The positions A and B taught into the interim register ***Teach-in position interim*** are offset against one another, transferred to the working register ***Switching points work*** and activated.

5.1.3 Description

The switching point of the sensors described here can be adjusted by the user in two ways:

- Numerical teach-in: The switching point can be written directly into the parameter ***Switching points work***. The two parameters selected for the switching point must not be smaller than 50 mm and not larger than 400 mm for sensors with background suppression (or 800 mm for SmartReflect). One parameter respectively must be 65535 (not valid). The switching function (light/dark switching) is defined by the selection of the switching point parameter (A/B).
- Teach into object (1-point teach-in): The switching point is taught into an object for measurement with the command ***Teach-in position***. The switching function (light/dark switching) is defined by the selection of the teach-in parameter (A/B). If the object is outside of the adjustable sensing distance, the minimum or maximum sensing range is taught in.
- Teach into reference position and object (2-point teach-in): To teach in the switching point with 2-point teach-in, the command ***Teach-in position*** must be executed at two positions: once to a solid reference position (background of the object or a reflecting machine part) and once to the object

itself. Both teach-in parameters must be within the adjustable sensing distance and be more than 4% of the sensing distance apart. The switching function (light/dark switching) is defined by the order of the teach-in parameters (A/B).

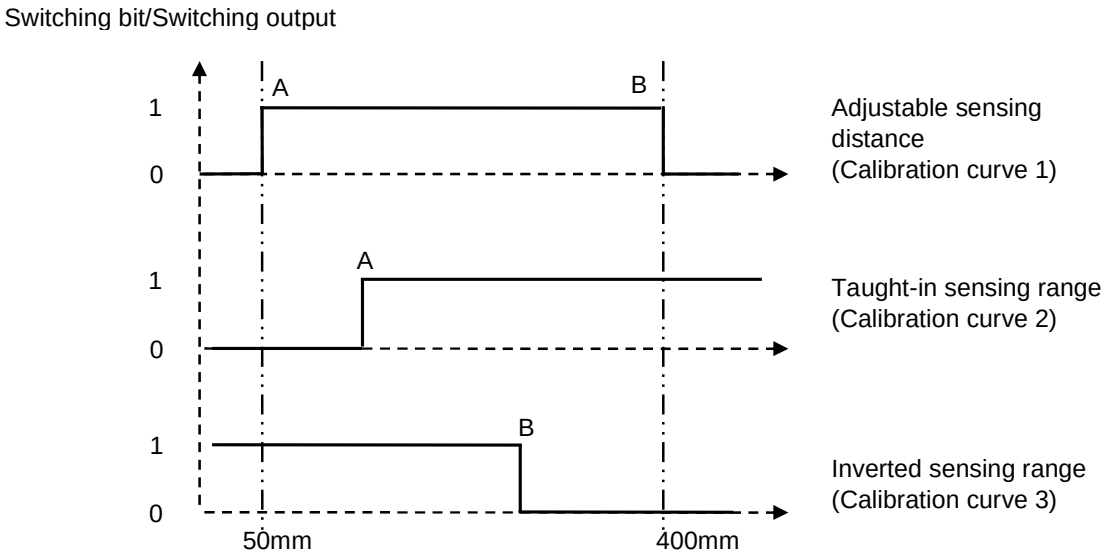

Figure 2: Possible switching curves

5.1.3.1 Sample numerical teach-in:

1) A switching point is set at 150 mm (A) (Calibration curve 2).

Point A absolute in mm: 150 mm → 0096 hex (**= *Switching point A***)
Point B absolute in mm: not valid → FFFF hex (**= *Switching point B***)

Parameter to be written:
***Switching points work*:** **0096FFFF hex**
→ ***Save parameters*** to save the values permanently!

2) The sensing range is set inversely at 200 mm (B) (Calibration curve 3).

Point A absolute in mm: not valid → FFFF hex (**= *Switching point A***)
Point B absolute in mm: 200 → 00C8 hex (**= *Switching point B***)

Parameter to be written:
***Switching points work*:** **FFFF00C8 hex**
→ ***Save parameters*** to save the values permanently!

5.1.3.2 Sample teach-in to object

The sensing range is taught into an object (Calibration curve 2).

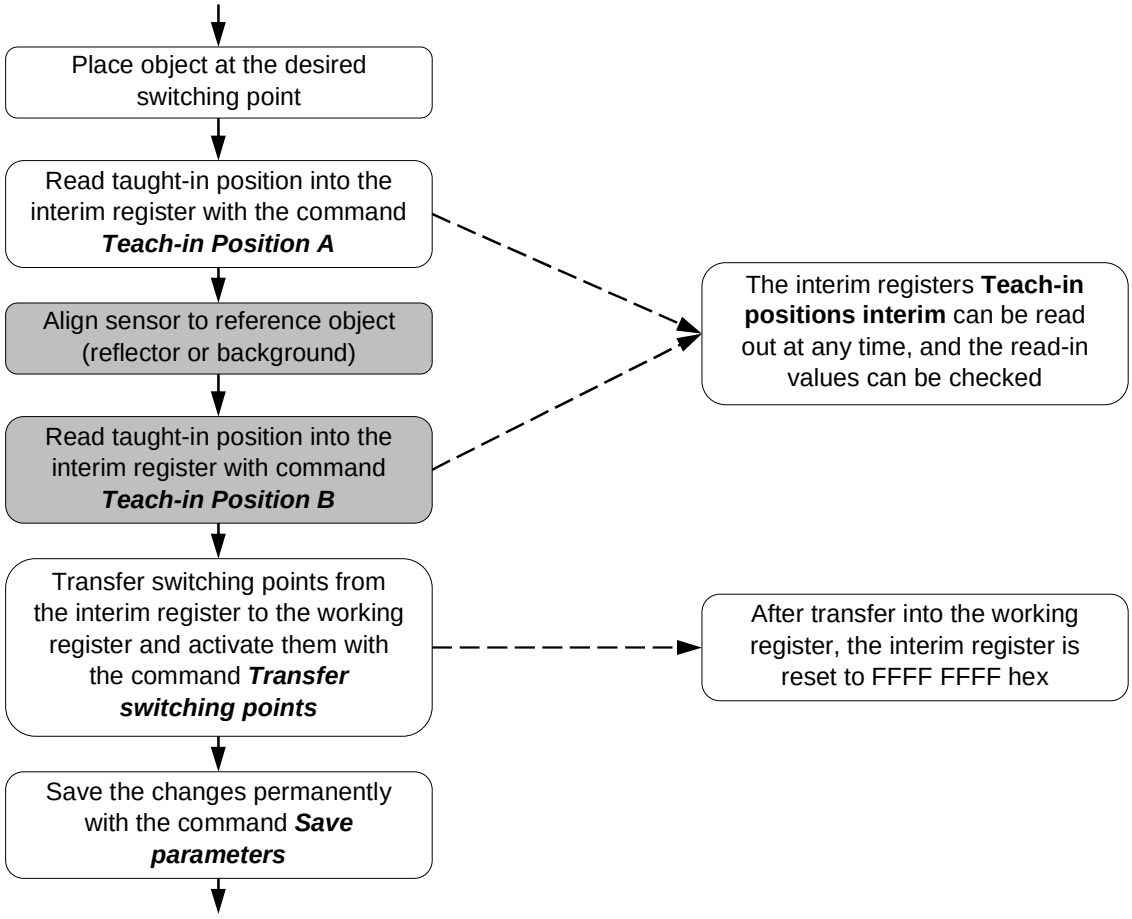

Figure 3: Teach-in switching range

Fields highlighted in gray are required only for teach-in with 2-point teach-in.
For an inverted switching range (Calibration curve 3):

- The command ***Teach-in Position B*** must be used instead of ***Teach-in Position A*** for 1-point teach-in.
- For 2-point teach-in the distance from the sensor to ***Teach-in Position A*** must be greater than the distance to ***Teach-in Position B***.

5.1.4 Hysteresis

In the direction of approach to the sensing range, the sensor actuates exactly at the taught-in switching points. When the sensing range is re-exited, a hysteresis is added (see: Figure 4).

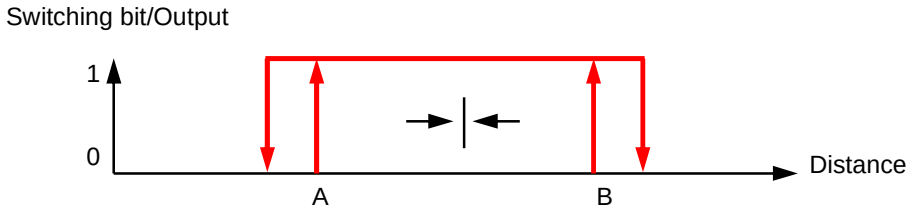

Figure 4: Hysteresis switching range

5.1.5 Error correction

The difference of the learning positions (distance between object and background/reflector) is too small; that is they are closer together than 4% of the sensing range.

- Error message ***Interfering parameter*** (see: 6.4 Table of error codes)
- Interim is set to FFFF FFFF hex
- Last valid values remain activated

The taught-in switching points are outside of the scanning range (see data sheet):

- Numerical teach-in: Writing ***Switching points work*** is not possible, error message ***Parameter value out of range,*** last valid values remain activated.
- 1-point teach-in: Error message ***Parameter value out of range***, the sensor is adjusted to maximum or minimum sensing distance.
- 2-point teach-in: ***Teach-in positions interim*** are not transferred, error message ***Parameter value out of range,*** last valid values remain activated.

5.2 Dirt indicator

5.2.1 Parameters

Nominal value quality parameter: Threshold for quality evaluation of the received signal. If the received light quantity drops below this threshold, the quality bit is set in the process data.
- Value range: 1-8
- Factory setting: 7

Quality parameter: Actual value of reception quality.

5.2.2 Description

Via the sensor exposure control it is possible to determine whether sufficient excess gain is still available for reliable measurement. This excess gain is represented quantitatively by the ***Quality parameter***. If the ***Quality parameter*** drops below the threshold specified in the ***Nominal value quality parameter***, this is indicated with the quality bit of the process data.

Application example:
During application setup it is possible to take account of this by reading out the ***Quality parameter*** regularly to determine its lowest value. Then the threshold ***Nominal value quality parameter*** can be set 1-2 levels lower. If the ***Quality parameter*** drops below this threshold for any reason during operation, this is indicated. At that moment the application still works properly, however the sensor should be checked some time. Possible reasons for activation of the ***Quality parameter*** may be:

- Sensor is soiled → Sensor must be cleaned
- Sensor has been moved → Readjust sensor
- Something in the application has changed, e.g. varying object surface finishes → Readjust sensor (***Nominal value quality parameter***) if necessary.

With the aid of this function, it is possible to detect sensor failure at an early stage and take appropriate action.

→ **Important:** The sensor still functions properly even with a ***Quality parameter*** of 1. It is not absolutely necessary to achieve the highest possible value!

6 Configuration

6.1 Table of general parameters

SPDU name	SPDU index	Number of Bytes	Format	Range of values	R/W	Comments
General information on sensors						
Vendor Name	0X10	18	String	ASCII	R	"Baumer Electric AG" for all sensors
Product Name	0X12	22	String	ASCII	R	Corresponds to Baumer article description
Product ID	0X13	8	String	ASCII	R	Corresponds to 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 work parameters

SPDU name	SPDU index	Number of Bytes	Format	Range of values	R/W	Comments
Teach-in and switching points						
Switching points work	0X40	4	Switching point A (HB, LB) Switching point B (HB, LB)	50…400	R/W	Distance information on switching points, calculated from the information on Teach-in position interim
Teach-in positions interim	0X41	4	Teach-in Position A (HB, LB) Teach-in Position B (HB, LB)	50…400, 65535	R	Distance information on Teach-in position
Sensor functions						
Teach function	0X60	1	0 = One point Teach-in (Reference position) 2 = Two point Teach-in (ON/OFF-position)	0.2	R/W	Selection of Teach mode
Nominal value quality parameter	0X65	1		1..8	R/W	Provided the internal quality parameter drops below this threshold the switching output is set.
Quality parameter	0X66	1		1..8 or 255	R	
Output functions						
Output delay function	0x71	1	Byte 0 (Subindex 1) 0 = no delay 1 = on delay 2 = off delay 3 = minimum pulse 4 = single shot positive edge 5 = single shot negative edge	0…5	R/W	Choose delay funciton
Output delay time	0x72	2	Byte 1…2, time in 1ms	0…1000	R/W	Delay time

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 position A	0X02	0XA0	Teach-in of switching point A. The measured distance is written into the interim Teach in position register.
Teach-in position B	0X02	0XA1	Teach-in of switching point A. The measured distance is written into the interim Teach in position register.
Transfer switching positions	0X02	0XA2	Transfer of the teach-in positions from the interim to the working register.
Save parameters	0X02	0XE0	Save all parameters in Flash memory

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
Distance between two taught points too small	0x80	0x40	Device error, Interfering parameter
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
Switching points work	0X40	Switching point A: 50mm Switching point B: 65535 (corresponds to “Not valid”)
Nominal value quality parameter	0X65	7
Output Delay Function	0X71	0 = No delay
Output Delay Time	0X72	1 (ms)

Baumer worldwide

Brazil
Baumer do Brasil Ltda
BR-04726-001 São Paulo-Capital
Phone +55 11 56410204

Canada
Baumer Inc.
CA-Burlington, ON L7M 4B9
Phone +1 (1)905 335-8444

China
Baumer (China) Co., Ltd.
CN-201612 Shanghai
Phone +86 (0)21 6768 7095

Denmark
Baumer A/S
DK-8230 Abyhoi
Phone +45 (0)8931 7611

France
Baumer SAS
FR-74250 Fillinges
Phone +33 (0)450 392 466

Germany / Austria
Baumer GmbH
DE-61169 Friedberg
Phone +49 (0)6031 60 070

India
Baumer India Private Ltd.
IN-411038 Pune
Phone +91 (0)20 2528 6833

Italy
Baumer Italia S.r.l.
IT-20090 Assago, MI
Phone +39 (0)245 70 60 65

USA
Baumer Ltd.
US-Southington , CT 06489
Phone +1 (1)860 621-2121

United Kingdom
Baumer Ltd.
GB-Watchfield, Swindon, SN6 8TZ
Phone +44 (0)1793 783 839

Singapore
Baumer (Singapore) Pte. Ltd.
SG-339412 Singapore
Phone +65 6396 4131

Sweden
Baumer A/S
SE-56122 Huskvarna
Phone +46 (0)36 13 94 30

Switzerland
Baumer Electric AG
CH-8501 Frauenfeld
Phone +41 (0)52 728 1122

Headquarters
Baumer Electric AG
CH-8501 Frauenfeld
Phone +41 (0)52 728 1122

www.baumer.com/worldwide