Manual

SmartLight - LED stack lights

BNI IOL-810-205-K036
BNI IOL-810-205-K037
BNI IOL-811-205-K036
BNI IOL-811-205-K037
BNI IOL-812-205-K036
BNI IOL-812-205-K037

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CONTENTS

CHAPTER

ONE

ABOUT THIS GUIDE

1.1 Validity

This guide provides all the necessary information for the safe use of the SmartLight. It applies to the following models:

Table 1: Applicable products

Type	Order code
BNI IOL-810-205-K036	BNI00LY
BNI IOL-810-205-K037	BNI00LM
BNI IOL-811-205-K036	BNI00LZ
BNI IOL-811-205-K037	BNI00LL
BNI IOL-812-205-K036	BNI00M0
BNI IOL-812-205-K037	BNI00LK

Read this manual and all related documents completely before installing and operating the product.

This manual was originally created in English. Other language versions are translations of this manual.

1.2 Other applicable documents

Additional information about this product can be found at **www.balluff.com** on the product page, e.g., in the following documents:

- Data sheet
- Declaration of conformity
- Disposal

1.3 Symbols and Conventions

Individual action **instructions** are indicated by a preceding triangle.

► Instruction

Action sequences are numbered consecutively:

1. Step 1
2. Step 2

Numbers unless otherwise indicated are decimals (e.g. 23). Hexadecimal numbers are represented with a preceding 0x (e.g. 0x12AB).

Note, Tip

This info box indicates general notes.

1.4 Explanation of the warnings

Always observe the warnings in this guide and the measures described to avoid hazards.
The warnings used here contain various signal words and are structured as follows:

SIGNAL WORD

Type and source of the hazard
Consequences if not complied with
► Measures to avoid hazards

The individual signal words mean:

NOTICE

Identifies a danger that could **damage or destroy the product**.

CAUTION

The general warning symbol together with the signal word CAUTION indicates a hazard which can lead to **slight or moderate injuries**.

WARNING

The general warning symbol together with the signal word WARNING indicates a hazard which can lead to **death or serious injuries**.

DANGER

The general warning symbol in conjunction with the signal word DANGER identifies a hazard which, if not avoided, will certainly result in **death or serious injury**.

1.5 Technical terms and abbreviations used

CE
: Conformité Européenne, EU conformity marking.

DPP
: Direct Parameter Page

EMC
: Electromagnetic Compatibility

GND
: Ground

IODD
Input-Output-Device-Description

IOL
IO-Link

ISDU
IO-Link-Parameter (Index Service Data Unit)

LSB
Least Significant Bit

MSB
Most Significant Bit

PD
Process Data

SIO
Single Input Output

1.6 Pictures

Product views and pictures in these operating instructions may differ from the specified product.

CHAPTER

TWO

SAFETY NOTES

2.1 Intended Use

This guide describes the BNI IOL-81x-205-K03x for use as a human machine interface. This is an IO-Link device that communicates with the higher level IO-Link master module via IO-Link.
Proper function according to the specifications in the technical data is only assured when the product is used solely as described in the user's guide and the respective documents as well as in compliance with the technical specifications and requirements and only with suitable original Balluff accessories.
Otherwise, there is deemed to be unintended use. Unintended use is not permitted and will result in the loss of warranty and liability claims against the manufacturer.

2.2 Reasonably foreseeable misuse

The product is not intended for the following applications and areas and may not be used there:

- In safety-oriented applications in which personal safety depends on the device function
- In explosive atmospheres
- in outdoor use
- in direct contact with food.
- by private consumers.

2.3 General safety notes

Activities such as **installation, connection** and **commissioning** may only be carried out by qualified personnel.

Qualified personnel are persons whose technical training, knowledge and experience as well as knowledge of the relevant regulations allow them to assess the work assigned to them, recognize possible hazards and take appropriate safety measures.

The **operator** is responsible for ensuring that local safety regulations are observed. In particular, the operator must take steps to ensure that a defect in the product will not result in hazards to persons or equipment.

The product must not be opened, modified or changed. If defects and unresolvable faults occur in the product, take it out of service and secure against unauthorized use.

The BNI modules generally have good chemical and oil resistance. When used in aggressive media (e.g. chemicals, oils, lubricants and coolants) in high concentrations (e.g. due to low water content), the material resistance must be checked in advance for the specific application. In the event of failure or damage to the BNI modules due to these kinds of aggressive media, claims for defects are ruled out.

Hot surfaces
The housing heats up under normal operating conditions. There is a risk of burn injuries. Avoid direct skin contact with the surface.

2.4 Cybersecurity

The product must be used in a secure environment. The operator or manufacturer of the machine is responsible for ensuring the machine is cybersecure. This also includes a cybersecurity risk analysis.
It is important to plan and implement security measures based on this risk analysis.
The operator or manufacturer must ensure that all persons working with the device have received cybersecurity training.

Cybersecure Environment:

To ensure cybersecurity, you must protect components, networks, and systems from unauthorized access and ensure data integrity.

Recommended Measures:

- Take organizational and technical measures for network-capable devices and software.
- Implement an information security management system (ISMS) to manage all information security measures.

Cybersecurity Resources:

- BSI Recommendations for ICS Operators
- CISA Best Practices for Industrial Control Systems
- NIST SP 800-82 Guide to Industrial Control Systems (ICS) Security

We recommend using a network secured according to the state of the art.
The device are intended for use at **Purdue Level 0 "Field Level / Sensors"**.

Note on Purdue Level 0: Purdue Level 0 refers to the lowest level of the Purdue reference architecture for industrial automation systems. This level includes the physical sensors and actuators directly connected to the production environment. Devices at this level are responsible for real-time data acquisition and processing.
Access to the devices from outside should only be possible for known and trusted devices and authorized users.

According to IO-Link Standard V 1.1.4, the sensor does not have authentication mechanisms.
Changing the settings/parameters of the sensor is possible for all actors who have access to the IO-Link interface.
Use the device only on an IO-Link network module that is sufficiently protected against access and operated in a secure network.
Ensure that only authorized users have access to the IO-Link network module and the secure network.

According to IO-Link Standard V 1.1.4, the sensor does not have mechanisms to protect against physical manipulation or reading of memory contents in the event of physical access.
The sensor and its interfaces must be protected against physical access by appropriate measures, such as access monitoring to the machine and barriers.

According to IO-Link Standard V 1.1.4, the sensor does not have mechanisms to protect data integrity.
Data is transmitted unencrypted from the device via the IO-Link protocol to the IO-Link network module. Eavesdropping, influencing, or interfering is possible if the network is not sufficiently protected.
The sensor and its interfaces must be protected against physical access by appropriate measures, such as access monitoring to the machine and barriers.
The sensor should only be operated on an IO-Link network module that is sufficiently protected against access.

According to the IO-Link Standard, this IO-Link device does not have an independent logging mechanism.
However, the device has mechanisms for reporting events (events) that may also be suitable for analyzing cybersecurity events.
We recommend using the device on an IO-Link network module with event logging, where the event log can be read out from the IO-Link network module via a suitable protocol.

CHAPTER

THREE

SCOPE OF DELIVERY, TRANSPORT AND STORAGE

3.1 Scope of delivery

- SmartLight
- 1x nut M18
- Rubber foot

Accessories are not included in the scope of delivery and must be ordered separately.

Note

Recommended accessories can be found at **www.balluff.com** on the product page.

3.2 Transport

► Transport product to location of use in original packaging.

3.3 Storage Conditions

► Store product in original packaging.
► Observe the ambient conditions *environmental conditions*.

CHAPTER

FOUR

PRODUCT INFORMATION

4.1 Product description

4.1.1 Construction

The following picture gives an overview of the product's most important dimensions.

BNI IOL-810-205-K03x

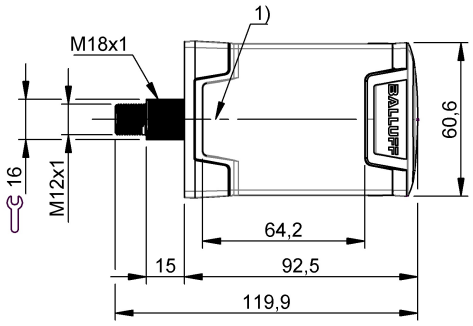


Fig. 1: Mechanical dimensions of the product

BNI IOL-811-205-K03x

BNI IOL-812-205-K03x

4.1.2 Function

The product features a highly configurable human machine interface with various visual and acoustic signal elements.

The SmartLight has three main signal functions:

- Signal LED's acting as a main signal elements
- Buzzer functionality for acoustic signaling

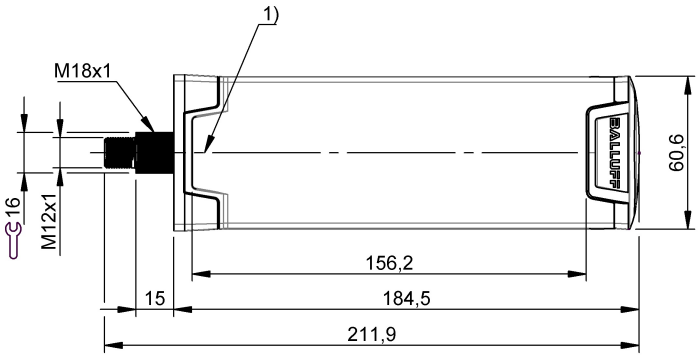


Fig. 2: Mechanical dimensions of the product

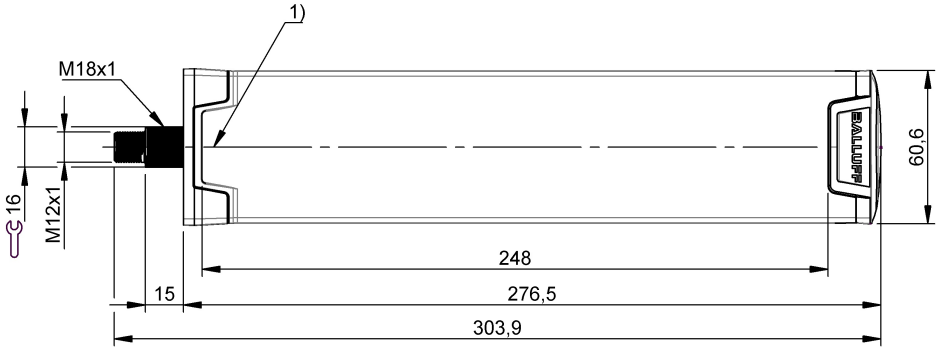


Fig. 3: Mechanical dimensions of the product

- Strobelight functionality as an additional signal light

Additional functionalities:

- Demo mode
- Synchronization

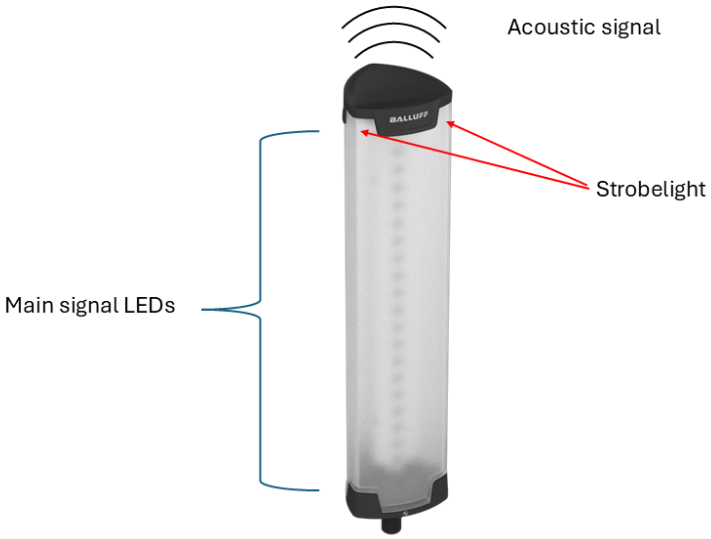


Fig. 4: SmartLight main functions

Main signal functionality

Various visual signal functions can be realized by the main signal LEDs like:

- Segment indicator
- Level indicator
- Runlight indicator
- Flexible configurable indicator (Flexible mode)
- Highly flexible configurable indicator (Ultimate mode)

Size of the main signal area

Device Variant	Number of LED levels
BNI IOL-810-205-K03x	4
BNI IOL-811-205-K03x	12
BNI IOL-812-205-K03x	20

Note

The SmartLight has LEDs above each other (if SmartLight mounted vertically). The term **LED level** will be used in this manual, which means three LEDs (one on each side of the SmartLight) in the same vertical position.

Segment indicator

The module is used as a simple status indicator when segment mode is selected.The main LEDs are divided into segments. The number of the segments are configurable. The LEDs are distributed evenly by default among the segments, but the user has the flexibility to overwrite the default configuration, resulting different size for each segments. Each segment can have up to two colors (Color A, Color B) and an animation pattern. E.g.: if the color A is set to green, color B is to red and animation is set to blinking –> Segment will blink between green and red. If color B is off, keeping all the previous settings by the others –> Segment will blink with a single green color.

Device Variant	Possible number of segments
BNI IOL-810-205-K03x	1, 2, 4
BNI IOL-811-205-K03x	1, 2, 3, 4
BNI IOL-812-205-K03x	1, 2, 3, 4, 5, 6

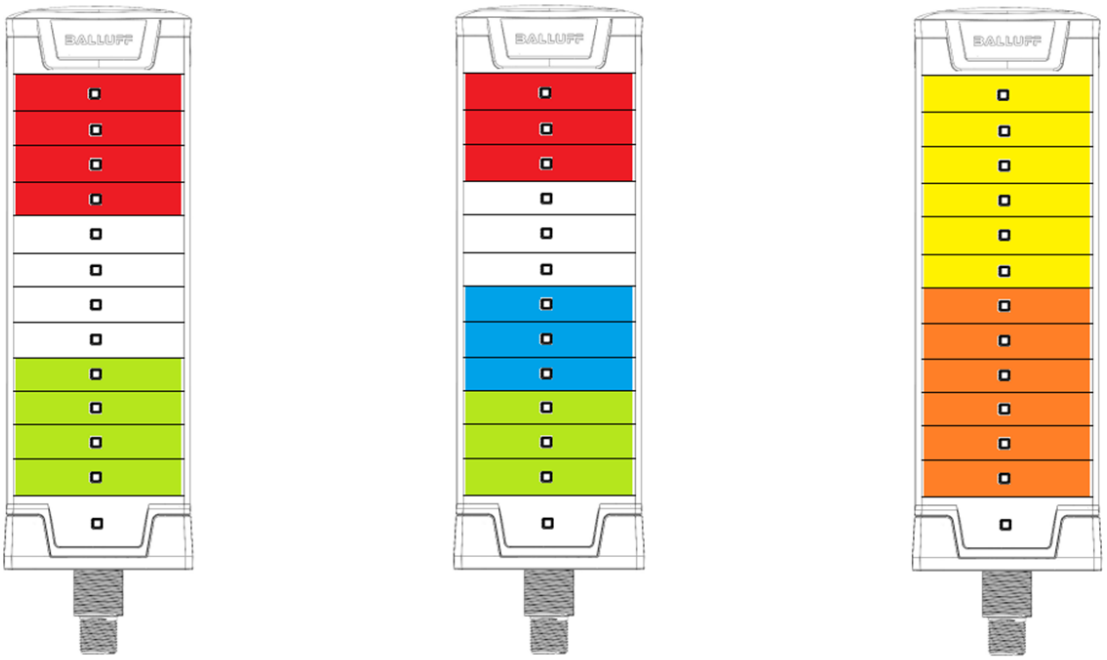


Fig. 5: Segment mode example

Note

The segments are always counted from the connector side. The orange is the segment 1 and the yellow is the segment 2 on the last example.

Level indicator

Level mode can be used to realize an analog output by means of a stacklight. In this case a level value can be displayed. The higher value the module becomes, the more LEDs will be switched on. This mode can be used as a level indicator, for example to indicate a fluid level in a tank. The number of the LEDs switched on depends on the input level.

The level display can be selected to be bottom-up or top-down. In the bottom-up mode the level indicator increases from the bottom of the module. In the top-down mode the indicator increases from the top of the module.

Although there are no real segments in the level mode, because the LEDs are controlled by the input level, the LEDs are divided into virtual segments These virtual segments can have their own color. The color of these segments can be configured. So it can be realized, that the level meter can have more colors (up to the maximum number of the segments).

Some or all colors can be set as dominant color. This means, when the input level is high enough to switch on the next LED and this LED is in another virtual segment, the LEDs, which are under the actual LED, take over the color of the actual LED. In this case, as the input level increases, the color of the full LED bar can be changed.

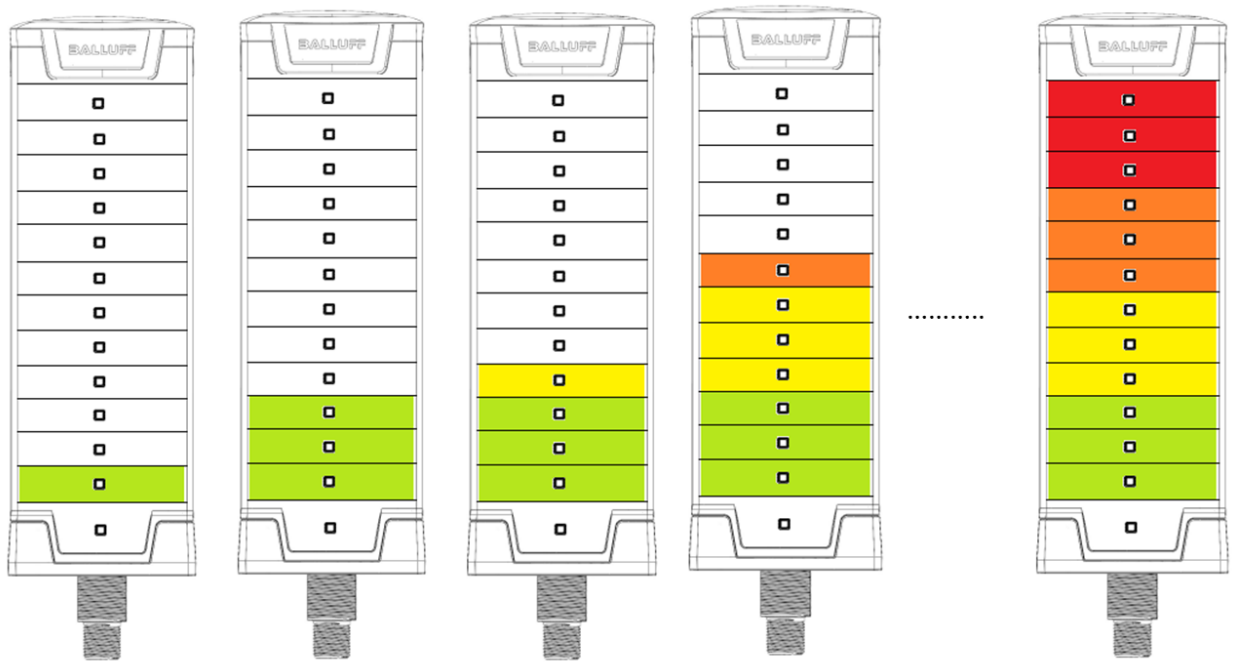


Fig. 6: Level mode example

Runlight indicator

In the runlight mode, the complete module displays a running light effect. In this case all of the LEDs are working as one runlight effect. The color, speed and size of the running segment and the background color can be configured.

Flexible mode

Each LED level can be configured individually in the flexible mode. It has the flexibility to have different colors for each LED level, but there is no animations implemented for this mode. Each LED level can be activated/deactivated separately. The active color and inactive color is configurable.

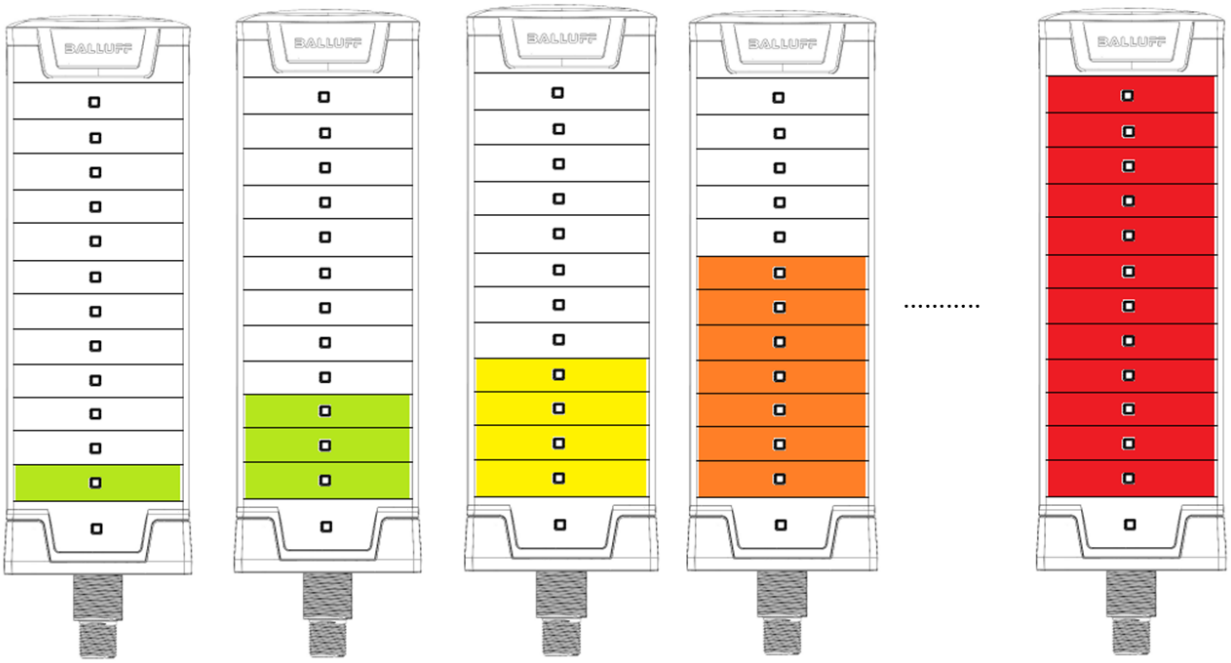


Fig. 7: Level mode example with dominance

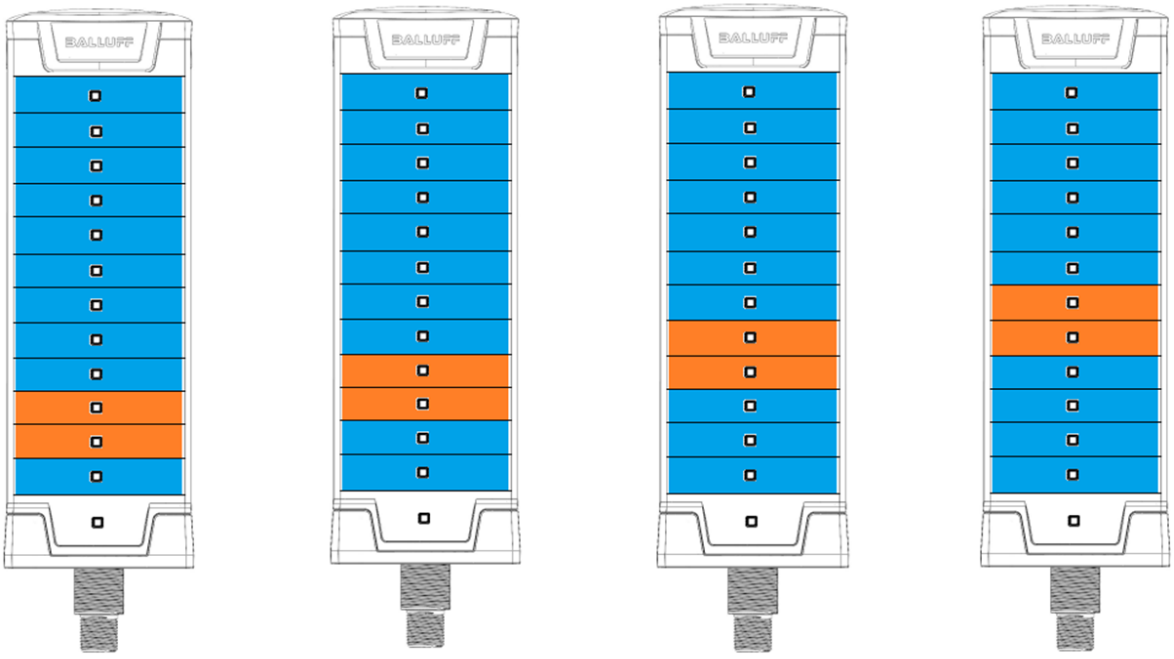


Fig. 8: Runlight mode example

Note

The LED levels are always counted from the connector side. When the SmartLight is mounted vertically and the connector is downside. The first LED level will be the lowest.

Ultimate mode

The Ultimate mode is similar to the flexible mode. It is a mixture of a segment mode and the flexible mode. The customer will have the flexibility to configure each LED level as needed, but animations are also available, to have as many signalizations as possible.

Animation patterns

There are many type of animation patterns which can be used for segment mode, ultimate mode and also for the strobe light functionality. Not every pattern will be available for all of these modes.

Blinking

The blink animation pattern is a standard blinking with 50% duty cycle.

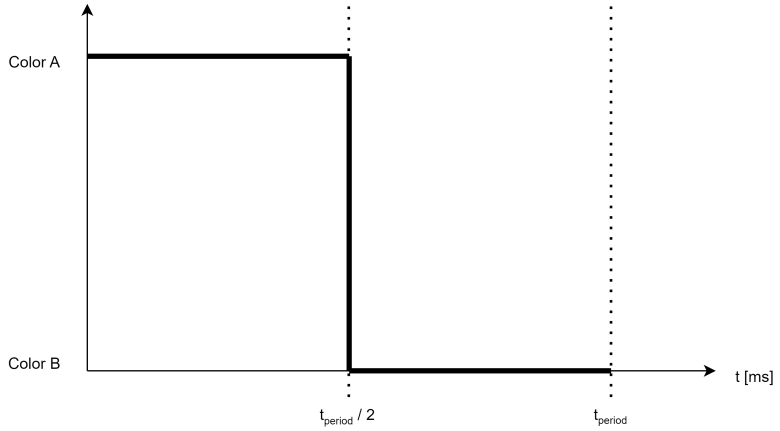


Fig. 9: Animation timing for blink pattern

Dynamic blink

The dynamic blink animation pattern is similar to the standard blink pattern, but it has smoother transition switching from Color A to Color B. Although this pattern can be used for two colors, as all of the other patterns, the intended use of this animation pattern is to have Color B switched off. In this case, the blinking will be a single On - Off blinking, but with a smooth switch on effect.

Single strobe

A single strobe signal is a blinking signal as well, but there is only a short impulse with Color A at the beginning of the blinking cycle, the rest of the cycle will have color B.

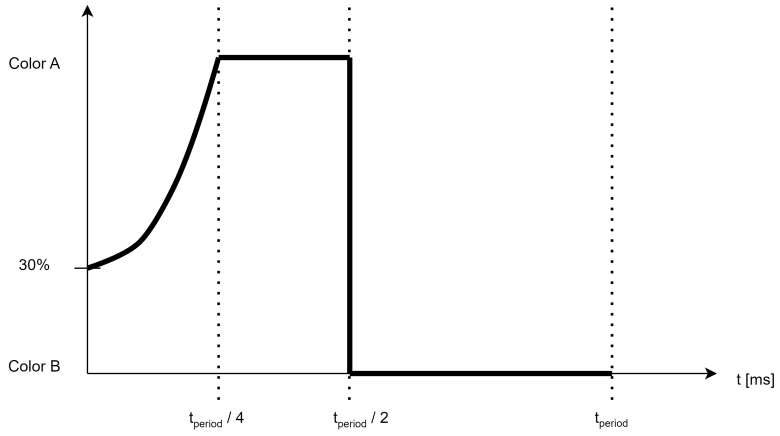


Fig. 10: Animation timing for dynamic blink pattern

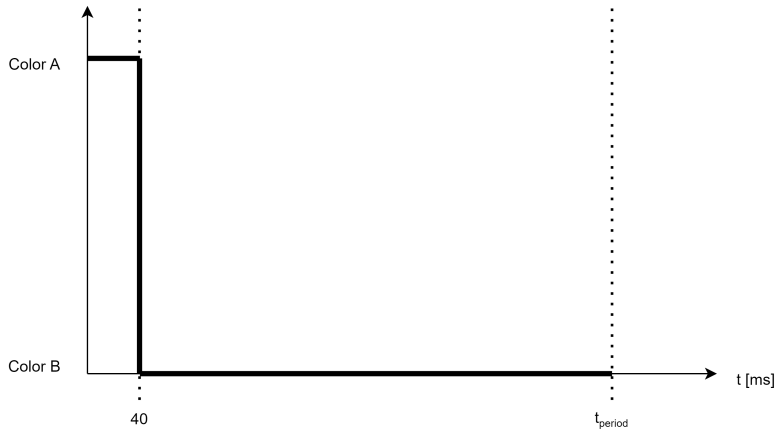


Fig. 11: Animation timing for single strobe pattern

Double strobe

There are two 40 ms pulses with Color A, the rest of the period has Color B.

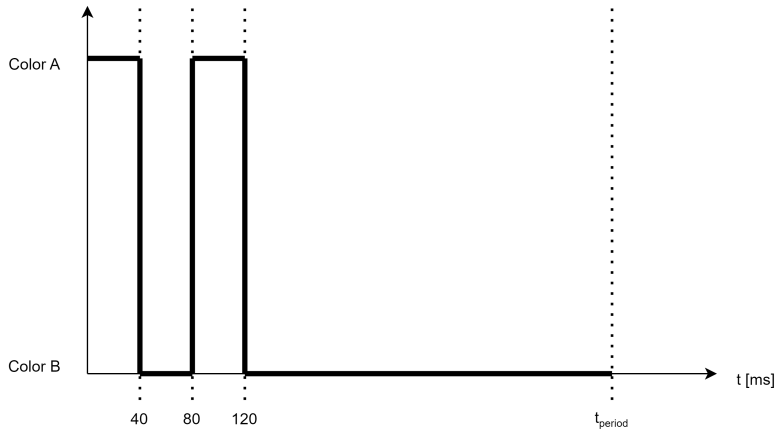


Fig. 12: Animation timing for double strobe pattern

Triple strobe

There are three 40 ms pulses with Color A, the rest of the period has Color B.

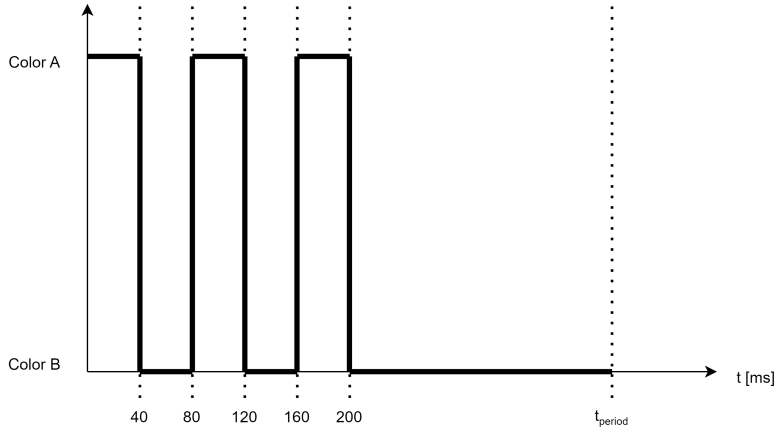


Fig. 13: Animation timing for triple strobe pattern

Revolving

The revolving animation pattern looks the same as the run light indicator mode, but the effect will be displayed not on the whole SmartLight but only on one segment.

Rotating beacon

A rotating beacon is an animation pattern in which the SmartLight emulates a light rotating around a vertical axis.

Fig. 14: Rotating beacon pattern

Custom blink

The SmartLight can have 3 different custom blink patterns, where the customer can configure the pattern from sample to sample.

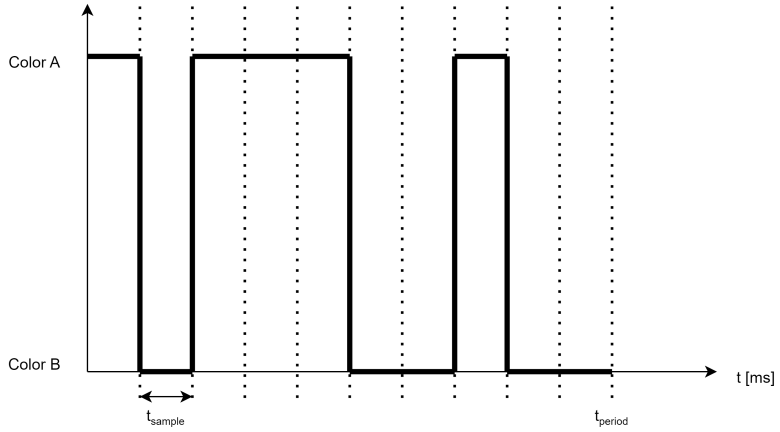


Fig. 15: Animation timing for custom pattern

Buzzer functionality

Product variants BNI IOL-81x-205-**K037** have built in buzzer for acoustic signaling. Different sound patterns can be generated with configurable frequency and sound pressure level.

Buzzer sound patterns

Constant tone

A tone with a defined frequency will be generated while the buzzer is switched on. The frequency of the tone is configurable.

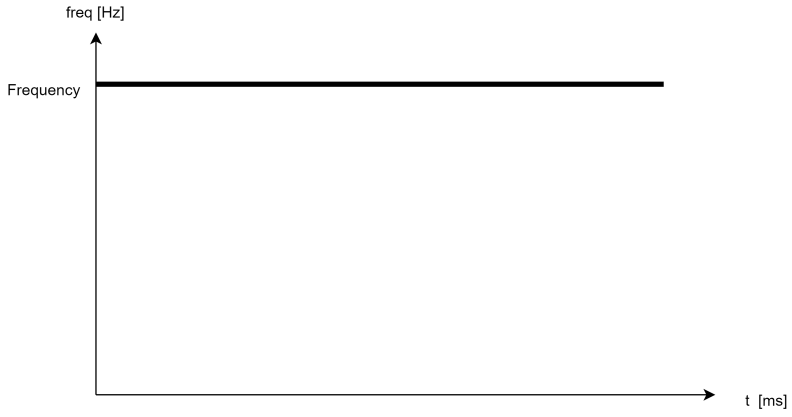


Fig. 16: Constant tone sound pattern

Pulse tone

The pulse tone is a periodic pattern. The buzzer will be switched on for a configurable time with a configurable frequency. After that the buzzer will be switched off for a configurable time.

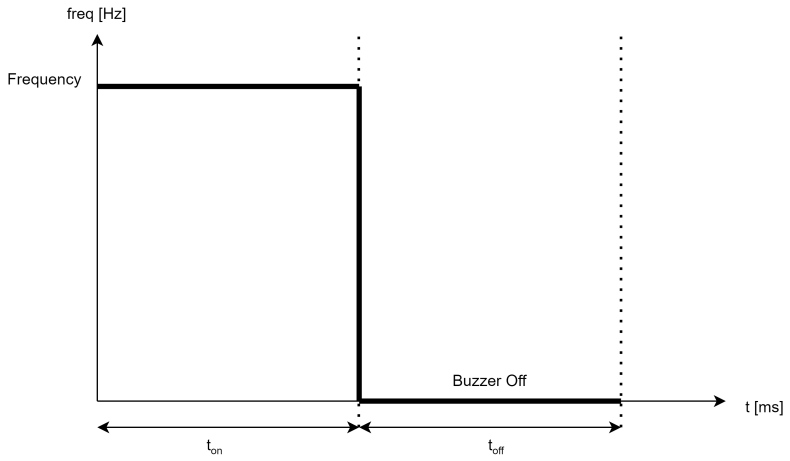


Fig. 17: Pulse tone sound pattern

Alternating pulse tone

The alternating pulse tone is a periodic pattern as well, but the buzzer won't be switched off in the second part of the cycle as in case of pulse pattern, but will have another configurable frequency.

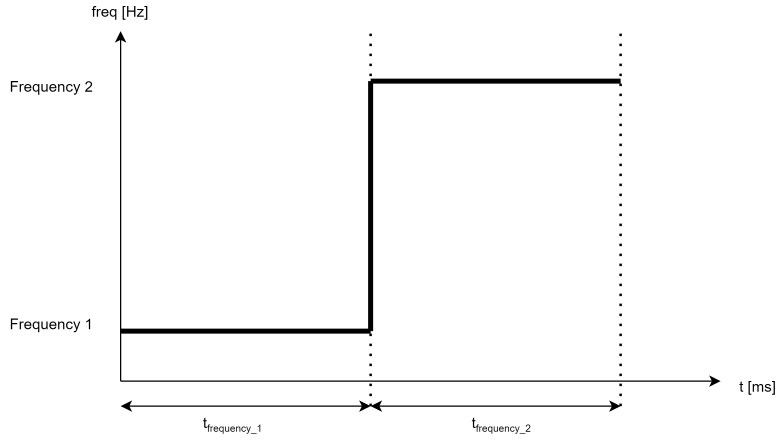


Fig. 18: Alternating pulse tone sound pattern

Wobble

The buzzer frequency will be modulated with a sine wave resulting a sound like a siren. The limit frequencies and the modulation frequency is configurable.

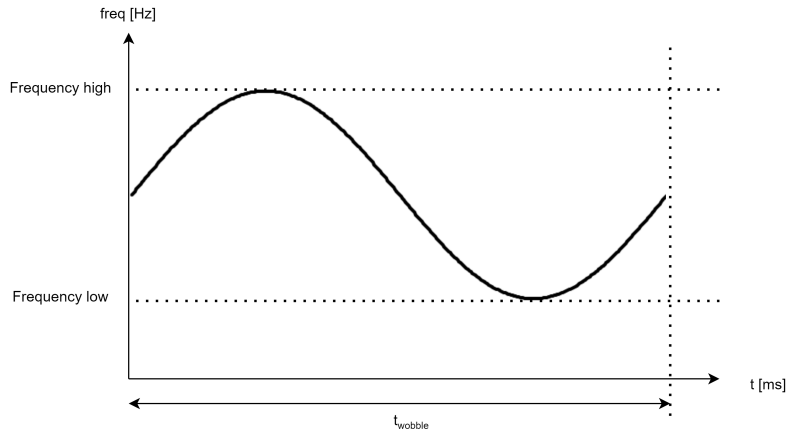


Fig. 19: Wobble sound pattern

Sweep

The frequency of the sound will be swept between two frequency back and forth. The frequencies and the timings are configurable.

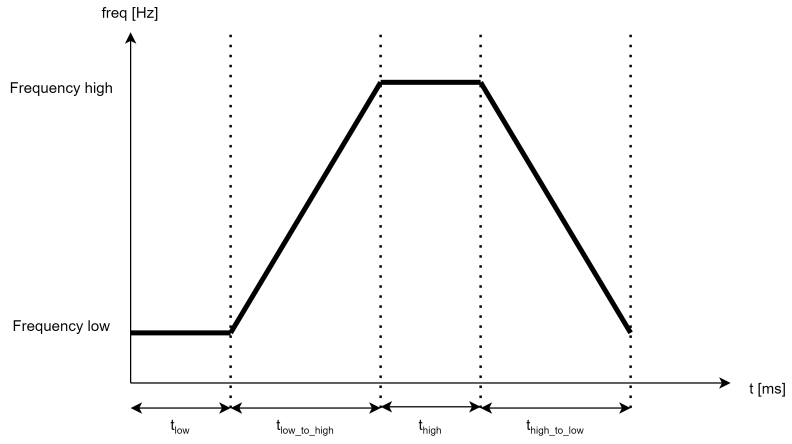


Fig. 20: Sweep sound pattern

Custom tone

The custom sound pattern is a pulsed (intermittent) sound pattern in which the pulsing behavior can be configured.

Strobe light functionality

An extra bright white color signal indicator is available for product variants BNI IOL-81x-205-**K037**. The strobe light functionality can signalize different light impulses, with configurable speed and brightness.

Demo mode

The SmartLight will start in Demo mode after the first start-up at the customer. The rich functionality of the SmartLight will be displayed. The Demo mode will automatically disappear at the second power up, but it can be activated again over IO-Link.

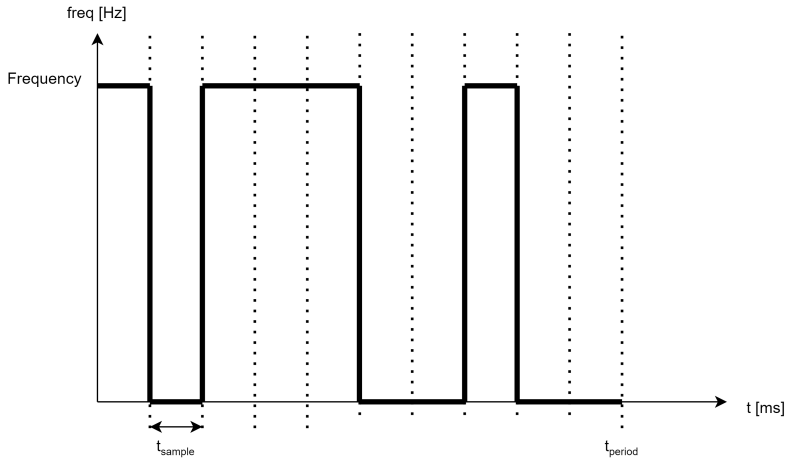


Fig. 21: Custom tone sound pattern

Synchronization

The functions (animations, strobe light and buzzer) of several Balluff SmartLights can be synchronized in synchronization mode. This functionality may be useful, in case more SmartLights are displaying the same dynamic effect (animation, strobe light, buzzer). Without synchronization, two SmartLight will signal such an effects at slightly different rates, causing uncoordinated visual or acoustic effect.

The synchronization is available only in IO-Link mode, and not available in SIO mode.

Note

For configuration information, see configuration guide at **www.balluff.com** on the product page.

4.1.3 Control interfaces

The connection to the higher-level master module is made via the IO-Link protocol.

The IO-Link interface has three operating modes:

- Single mode
- Extended mode
- Advanced digital IO mode (SIO mode)

Single mode

The single mode is the standard IO-Link mode. The device works alone as one signal indicator. All SmartLights are configured for single mode as a factory settings.

1	PLC
2	field bus
3	IO-Link master
4	Process data or ISDU data
5	SmartLight configured to single mode.

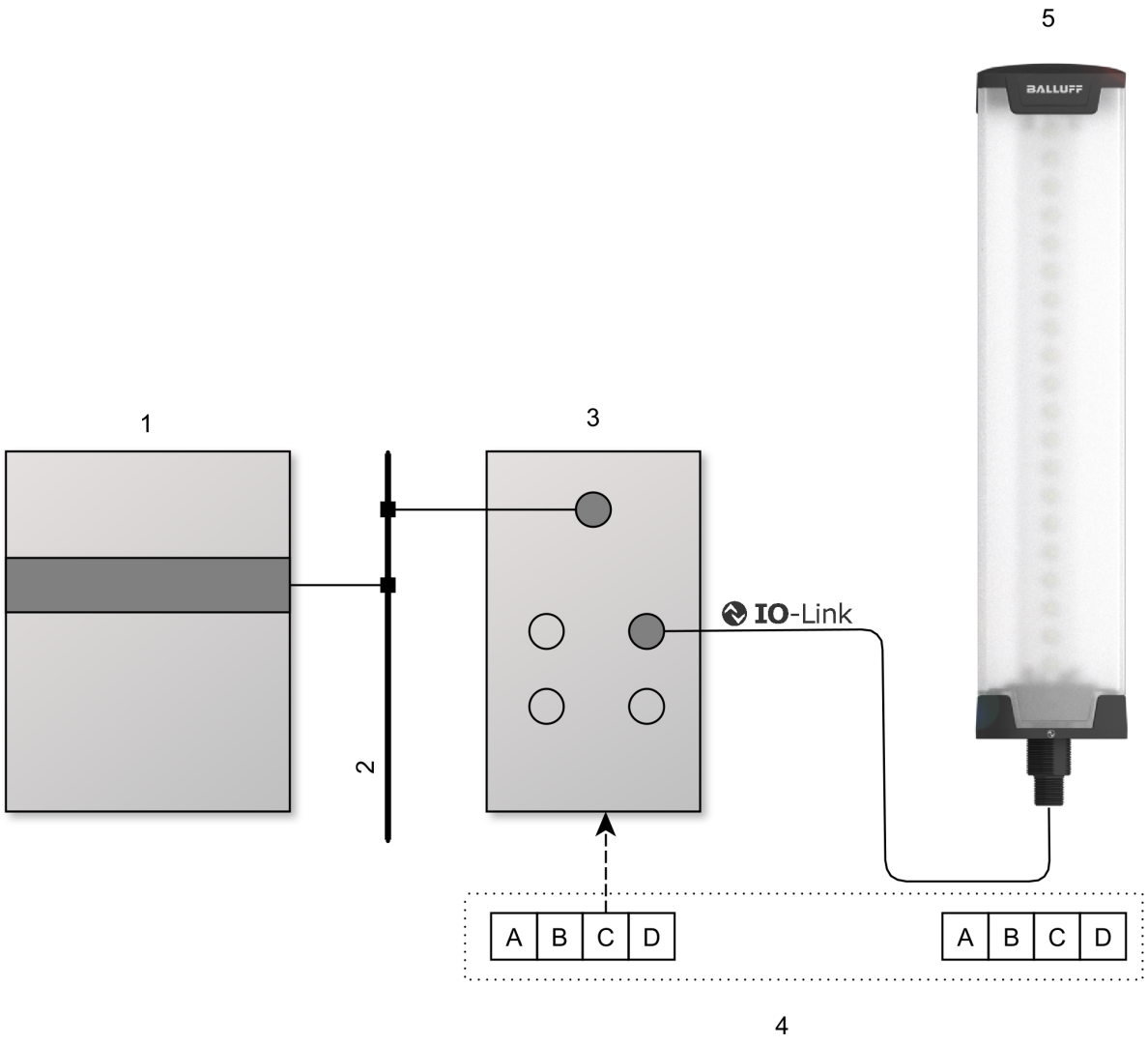


Fig. 22: SmartLight in single mode

Extended mode

The device is extended with another device from the same type, working as two separate signal indicator on a single master port. The connection is established via the extension port (integrated to the IO-Link connector), therefore no additional IO-Link master port is required.

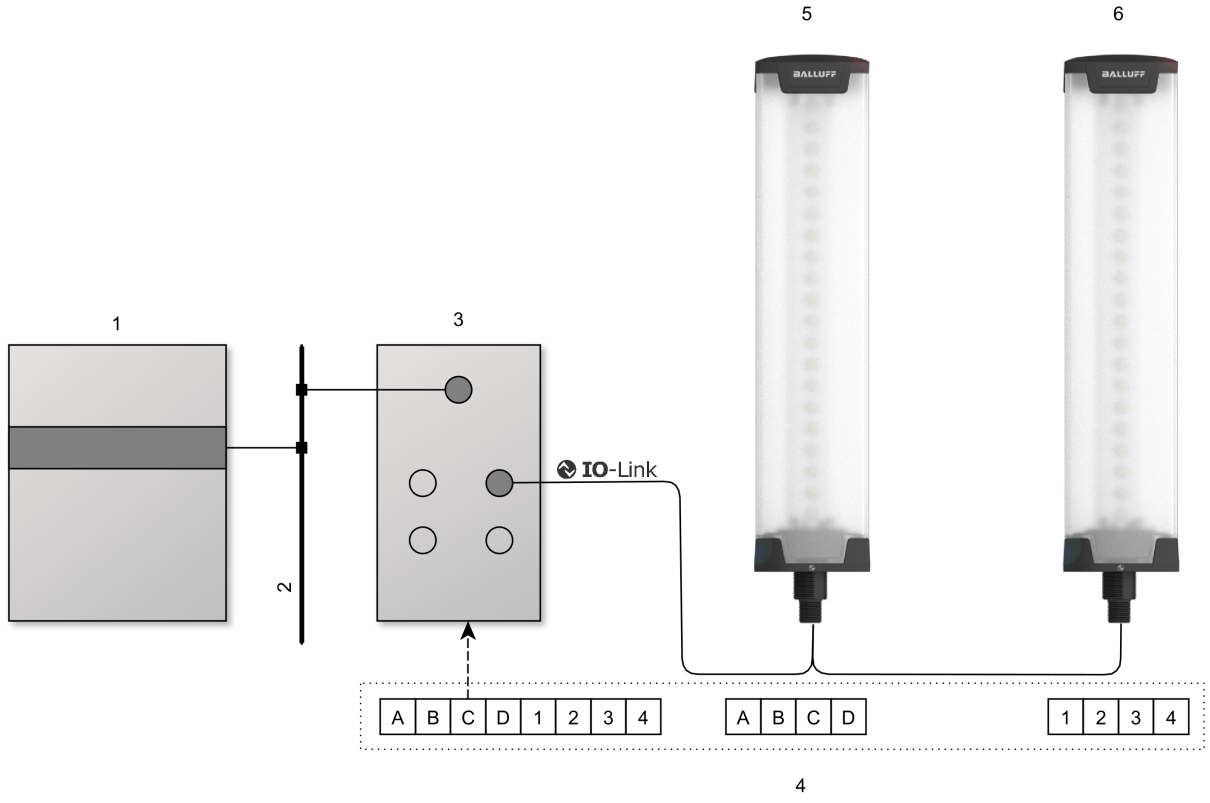


Fig. 23: SmartLight in extended mode

1	PLC
2	field bus
3	IO-Link master
4	Process data or ISDU data
5	Primary device (SmartLight configured to extended mode)
6	Secondary device (SmartLight configured to single mode)

Note

For extended mode special cable accessories are available in various length:

- BCC0K6T
- BCC0K6M
- BCC0K6R
- BCC0K6N
- BCC0K6P

Advanced digital IO mode (SIO mode)

The device works alone as one signal indicator. The setup of the SmartLight shall be made over IO-Link with the engineering tool, but no IO-Link is needed during operation. The SmartLight has 3 digital inputs. Each digital input combination shall be configured for the desired light and buzzer effect. The signal indicator will display the light and buzzer according to the current digital input configuration. This SIO mode makes it possible to integrate the product to legacy machines, where no IO-Link communication is available.

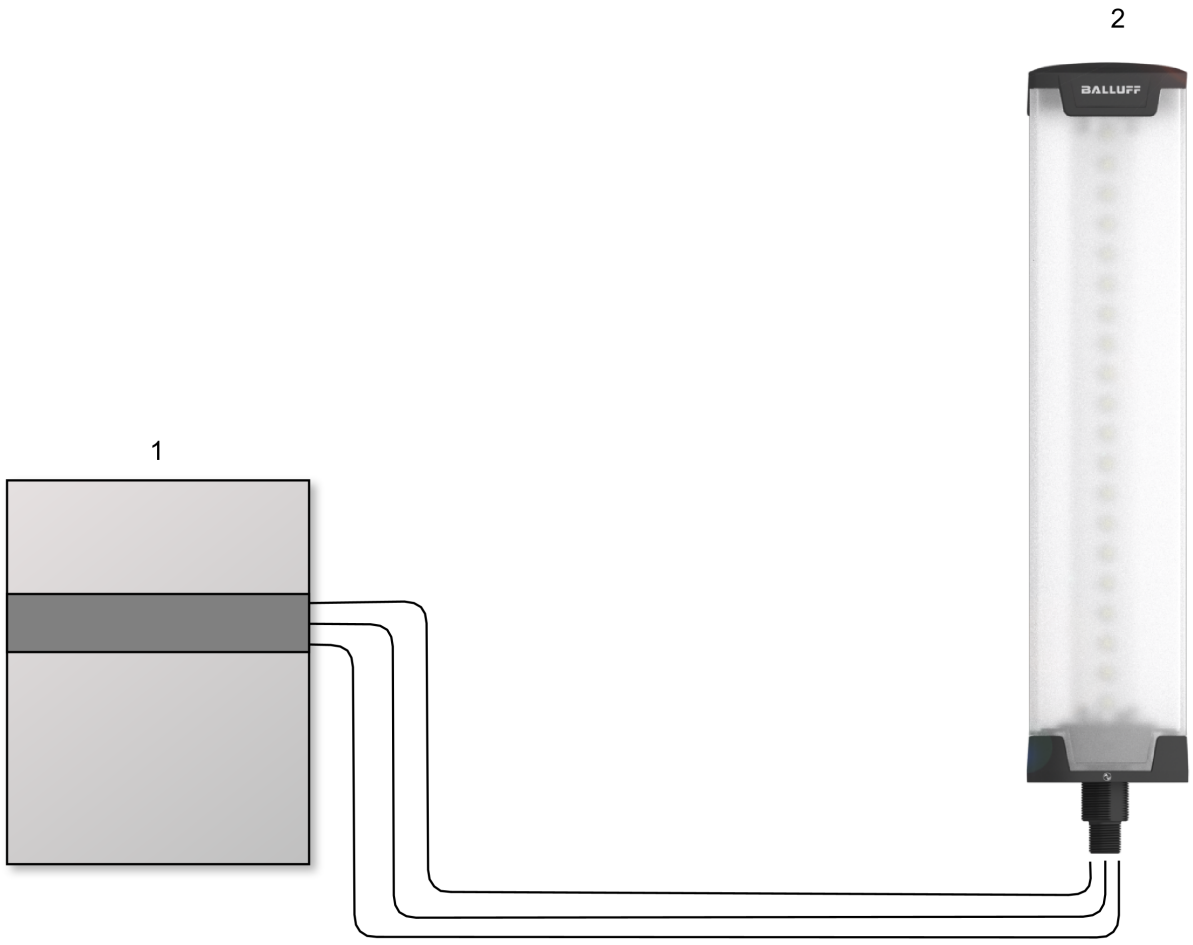
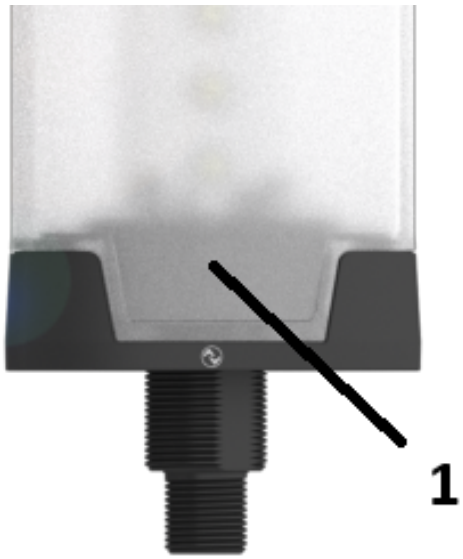


Fig. 24: SmartLight in SIO mode

1	PLC
2	SmartLight configured to SIO mode

4.1.4 Display Elements

- 1: Status LED



Module status LED

Display	Meaning
Red, static	General error
Yellow, flashing 3 Hz	Device operates out of specification
Blue, flashing 3 Hz	The Device Discovery can be activated via system command to find the device again.
Blue static	Maintenance must be performed
Green, alternating with LED off in a ratio of 10:1, 1 s period	IO-Link communication is active. The device is ready.
Green, static	No communication

4.2 Technical Data

The specifications are typical values for 24 V DC at room temperature.

The module is fully operational immediately.

Note

For more information on UL performance data, see *Underwriters Laboratories (UL)*.

4.2.1 Ambient conditions

Ambient temperature	–20 … +50 °C
Storage temperature	–40 … +50 °C
Protection class according to IEC 60529 (in screwed state)	IP65
Altitude	≤ 2,000 m (above sea level)
Relative humidity	≤ 85 %, non-condensing
Pollution	Pollution degree 2
Vibration/Shock	EN 60068-2-27
EMC	country-specific

4.2.2 Electrical data

Supply voltage US	18…30,2 V DC
Residual ripple	<1%
Nominal voltage	24 V DC

4.2.3 Buzzer data

Minimum frequency	500 Hz
Maximum frequency	4000 Hz
Sound pressure level	95 dBA @ 1 meter[1]

4.2.4 BNI IOL-810-205-K036 current consumption

Values for 24V supply voltage (unless othetrwise noted)

Idle supply current (IO-Link active, lights off, buzzer off)	< 15 mA
Maximum supply current	< 65 mA
Maximum supply current @ 18V supply voltage	< 80 mA
Maximum supply current @ 30.2V supply voltage	< 55 mA
Typical supply current LEDs (IO-Link active, only main LEDs are on)	< 60 mA

4.2.5 BNI IOL-810-205-K037 current consumption

Values for 24V supply voltage (unless othetrwise noted)

Idle supply current (IO-Link active, lights off, buzzer off)	< 30 mA
Maximum supply current	< 80 mA
Maximum supply current @ 18V supply voltage	< 95 mA
Maximum supply current @ 30.2V supply voltage	< 70 mA
Typical supply current LEDs (IO-Link active, only main LEDs are on)	< 75 mA
Typical supply current Buzzer (IO-Link active, only buzzer is on)	< 95 mA
Typical supply current Strobelight (IO-Link active, only strobelight is active)	< 75 mA

[1] Maximum sound pressure level may vary depending on the frequency.

4.2.6 BNI IOL-811-205-K036 current consumption

Values for 24V supply voltage (unless othetrwise noted)

Idle supply current (IO-Link active, lights off, buzzer off)	< 20 mA
Maximum supply current	< 160 mA
Maximum supply current @ 18V supply voltage	< 205 mA
Maximum supply current @ 30.2V supply voltage	< 135 mA
Typical supply current LEDs (IO-Link active, only main LEDs are on)	< 150 mA

4.2.7 BNI IOL-811-205-K037 current consumption

Values for 24V supply voltage (unless othetrwise noted)

Idle supply current (IO-Link active, lights off, buzzer off)	< 35 mA
Maximum supply current	< 175 mA
Maximum supply current @ 18V supply voltage	< 220 mA
Maximum supply current @ 30.2V supply voltage	< 150 mA
Typical supply current LEDs (IO-Link active, only main LEDs are on)	< 165 mA
Typical supply current Buzzer (IO-Link active, only buzzer is on)	< 100 mA
Typical supply current Strobelight (IO-Link active, only strobelight is active)	< 80 mA

4.2.8 BNI IOL-812-205-K036 current consumption

Values for 24V supply voltage (unless othetrwise noted)

Idle supply current (IO-Link active, lights off, buzzer off)	< 25 mA
Maximum supply current	< 255 mA
Maximum supply current @ 18V supply voltage	< 330 mA
Maximum supply current @ 30.2V supply voltage	< 210 mA
Typical supply current LEDs (IO-Link active, only main LEDs are on)	< 235 mA

4.2.9 BNI IOL-812-205-K037 current consumption

Values for 24V supply voltage (unless othetrwise noted)

Idle supply current (IO-Link active, lights off, buzzer off)	< 40 mA
Maximum supply current	< 270 mA
Maximum supply current @ 18V supply voltage	< 345 mA
Maximum supply current @ 30.2V supply voltage	< 225 mA
Typical supply current LEDs (IO-Link active, only main LEDs are on)	< 255 mA
Typical supply current Buzzer (IO-Link active, only buzzer is on)	< 105 mA
Typical supply current Strobelight (IO-Link active, only strobelight is active)	< 85 mA

4.2.10 Electrical Connection

IO-Link interface	M12, A-coded, 4-pin, plug

See *Electrical connection*

4.2.11 Interface

IO-Link version	1.1.4
Data transmission rate	COM3 (230,4kBit/s)
Minimum cycle time	5 ms
Input process data length	Depends on variant and configuration. See *Communication parameters*
Output process data length	Depends on variant and configuration. See *Communication parameters*

4.2.12 Mechanical features

Housing material	PBT GF30, PC
Installation	M18x1 thread
Dimensions (W x H x D), BNI IOL-810-205-K03x	60.6 x 119.9 x 60.6 mm
Dimensions (W x H x D), BNI IOL-811-205-K03x	60.6 x 211.9 x 60.6 mm
Dimensions (W x H x D), BNI IOL-812-205-K03x	60.6 x 303.9 x 60.6 mm
Weight, BNI IOL-810-205-K036	Approx: 171 g
Weight, BNI IOL-810-205-K037	Approx: 179 g
Weight, BNI IOL-811-205-K036	Approx: 254 g
Weight, BNI IOL-811-205-K037	Approx: 263 g
Weight, BNI IOL-812-205-K036	Approx: 338 g
Weight, BNI IOL-812-205-K037	Approx: 346 g

4.2.13 Approvals and designations

Note

Additional information on directives, approvals and standards can be found at www.balluff.com on the product page.

Conformité Européenne (CE)

The CE Mark verifies that our products meet the requirements of the current EU Directive.

Underwriters Laboratories (UL)

UL Requirements

File: E224277
Enclosure rating: Type 1
Ambient temperature: +50°C

The power supply has to be an isolated type or SELV type.

Power ratings

Voltage: 18 - 30 V Current: 380 mA

Cleaning

Clean the product only with dry cloth or cloth dampened only with water!

Cord sizes

Communication/Power In cord assembly:

Listed (CYJV/7) or R/C (CYJV2/8) cord assembly with threaded male A-coded M12 connector rated 24 V minimum, 2 A minimum. R/C (AVLV2) marked or specified in UL style page as suitable for external interconnection 28 AWG minimum, 300 V minimum cord.

In/Out cord assembly:

Listed (CYJV/7) or R/C (CYJV2/8) cord assembly with threaded male A-coded M12 connector rated 24 V minimum, 2 A minimum. R/C (AVLV2) marked or specified in UL style page as suitable for external interconnection Cord rated 300 V minimum, 24 AWG minimum unless marked with maximum load current and overcurrent protection for the cord in accordance with table below.

Cord conductor size	Overcurrent protection maximum ampere rating, Amps	Maximum load, Amps
14	16	16
14	12	9
16	8	8
18	5.6	5.6
20	5	4
22	3	2.4
24	2	1.6
26	1	0.8
28	0.8	0.6
30	0.5	0.4

4.3 Type code

The type code `BNI IOL-81x-205-K03x` is decoded as follows:

```
BNI IOL - 81x - 205 - K03x
          |      |     |
          |      |     └──── (3)
          |      └────────── (2)
          └──────────────── (1)
```

Table 1: Type code positions

Pos.	Designation	Code	Meaning
1	Functions	812	Large SmartLight up to 6 segments, 20 LED levels
		811	Medium SmartLight up to 4 segments, 12 LED levels
		810	Small SmartLight up to 4 segments, 4 LED levels
2	Variant	205	Next Generation SmartLight
3	Mechanical version	K036	Plastic housing, without buzzer and strobelight functionality
		K037	Plastic housing, with buzzer and strobelight functionality

CHAPTER

FIVE

IO-LINK INTERFACE

The IO-Link device supports the functions listed in this chapter.

> **Note**
>
> For a detailed description of the interface and the data provided here, see the *IO-Link interface*.

Primary Functions

- Identification
- SmartLight control
- Segment mode
- Level mode
- Runlight mode
- Flexible mode
- Ultimate mode
- Buzzer
- StrobeLight
- Locator

Secondary Functions

- Operating Hours Counter
- Boot Cycle Counter
- Voltage Monitoring

System Functions

- Device Status and Detailed Device Status
- Reset Commands
- Variant Configuration
- Process Data Info and Configuration
- Profile Characteristic
- Parameter Manager
- BLOB Firmware update

5.1 IO-Link basics

5.1.1 General

IO-Link integrates conventional and intelligent sensors and actuators in automation systems and is intended as a communication standard below classic field buses. Fieldbus-independent transfer uses communication systems that are already available (field buses or Ethernet-based systems).

IO-Link devices, such as sensors and actuators, are connected to the controlling system using a point-to-point connection via a gateway, the IO-Link master. The IO-Link devices are connected using commercially available unshielded standard sensor cables.

Communication is based on a standard UART protocol with a 24-V pulse modulation in half-duplex operation. This allows classic three-conductor physics.

5.1.2 Protocol

With IO-Link communication, permanently defined frames are cyclically exchanged between the IO-Link master and the IO-Link device. In this protocol, both process and required data, such as parameters or on demand data, is transferred. The size and the type of the frame and the cycle time used result from the combination of master and device features. (see communication properties in section *Communication parameters*).

5.1.3 Cycle Time

The cycle time used (master cycle time) results from the minimum possible cycle time of the IO-Link device (min cycle time, see chapter *Communication parameters*) and the minimum possible cycle time of the IO-Link master. When selecting the IO-Link master, please note that the larger value determines the cycle time used.

5.1.4 Communication parameters

In order to be able to establish a stable communication connection between master and device, the master requests some important communication parameters from the device at the start of communication. Settings for communication in *Preoperate* and *Operate* modes are influenced by the parameters and the device is clearly identified.

Communication parameters are described in the chapter *Communication parameters*.

5.1.5 Process Data Flow

The data transfer is based on the general profile specification (IO-Link Common Profile 1.0, see *Example of a PDinput data flow* for example).

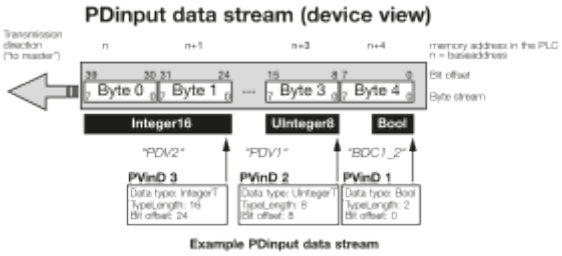


Fig. 1: Example of a PDinput data flow

The highest value byte (MSB, designated as *Byte 0*) is transferred first and can be found in the PLC under the lowest storage address. The lowest value byte (LSB) is transferred last and has the highest byte number (designated in *Example of a PDinput data flow* as *Byte 4*).

For word-based data types (> 8 bit) this means that the byte at the lowest address is the highest value byte, while the highest address contains the lowest value byte.

The description of the data flow structure in IODD uses bit offsets. Offset 0 means the least significant bit of the last byte.

Process data variables (in *Example of a PDinput data flow* PDV1, PDV2) are aligned to the byte limits in most cases.

Binary information (BDC) is transferred in the lowest value byte in most cases.

5.1.6 Process data objects

The process data flow is made up of various process data objects, which are not only shown in the process data flow, but are also used for the internal exchange of information between functions.

For example, *PdObjects* can be used to monitor threshold values in the device and trigger a warning if a limit is exceeded, or to provide status information such as the switching state directly in the process data.

Therefore, a unique object ID is assigned to this individual information, which can be used at different places.

Process data objects are described in the function chapters under *Process Data*.

5.1.7 Device Status

The *Device Status* indicates the current status of the device or of the directly connected peripherals. This functionality is part of the IO-Link specification.

The following states are output by the device:

- *Device is operating properly* (device is functioning error-free) This status indicates that no serious error has occurred in the device and the device can be operated without restrictions.
- *Maintenance-Required* Although the process data is valid, internal diagnosis functions show that the device or the operational environment of the device should be serviced.
- *Out-of-Specification* Although the process data is valid, internal diagnosis functions show that the device is operating outside of its specification. This can affect both the measurement application itself as well as the environmental conditions.
- *Functional Check* Process data is temporarily invalid while a deliberate intervention is performed on the device. For example, parameterization processes or teach-in.
- *Failure* The device or the connected peripherals have a severe error. The device cannot perform its intended function!

For further information, see section *Device Status and Detailed Device Status*.

The creation of the *Device Status* is always based on the output of diagnosis messages. A *Device Status* is output for every diagnosis message (event). Each of these can be found in the event overview list (see section *Events* or in the description of the functions).

5.1.8 Block Parameterization

Block parameterization refers to a special process in which multiple parameters are parameterized in one process. It is started with a start command and concluded with an end command.

Because the check of the data is not performed until the parameterization is concluded, pieces of data that are dependent on one another can also be set without problem.

The System Commands 0x01…0x06 are also part of the Parameter Manager (see *System Commands*).

The functionality and processes are described in the IO-Link specification.

5.1.9 Data Storage

Data Storage refers to a special process for being able to store the parameterization data of a device on the master. The master controls the process between uploads (if data is intentionally changed) or downloads (if, e.g., an incorrectly parameterized device is connected). The system comprising master and device thereby ensures that a device can be exchanged without the need for an active re-parameterization.

> **Note**
>
> The settings regarding *Data Storage* are to be performed on the IO-Link master gateway (refer to the information in the corresponding documentation).

Operation is dependent on the used IO-Link master and is explained in the corresponding description.

> **Note**
>
> All parameters that are stored for parameter management in the IO-Link master are marked appropriately in *Parameters*.

5.1.10 Variant Handling

A device can contain several different IO-Link devices. These device variants differ in the basic functionality, the IO-Link communication settings (length of the process data, communication speed) or in the IO-Link communication model or data model (e.g., support of other ISDU parameters or IO-Link profiles).

A variant can be selected via an ISDU access (see function *Variant Configuration*). Note here, that changes do not take effect until after a communication restart (e.g., through *Device Reset*, see *Reset Commands*).

All device variants can also be selected via the so-called *Compatibility Mode*. In this case, the port configuration on the master is used to switch the device to the target variant, which is then used permanently by the device.

5.1.11 Reset Commands

The device offers various reset functions. A corresponding command is executed via a *system command*.

The behavior and the values that are reset in a given case can be found in the ISDU overview (see section *Parameters* and in the individual function descriptions).

The *Reset Commands* are described in the corresponding chapter.

5.1.12 Device Functions and Master Gateway

The functions of the device are described in detail in the subsequent sections. Refer to the guide of the IO-Link master for information on the implementation of the process, parameter and diagnostic data via the master gateway.

5.2 Communication parameters

In the following tables contains the devices basic IO-Link attributes.

5.2.1 Variant independent parameters

Table 1: Communication Parameters, Variant Independent

Specification	IO-Link Description	Value
Transmission rate	COM	COM3 (230.4 kBaud)
Minimum cycle time of device	min cycle time	`0×32` (5 ms)
Frame specification:– Amount of Preoperate on demand data required – Amount of Operate on demand data required - ISDU	M-sequence capability:– Number of On-demand Data in Preoperate – Number of On-demand Data in Operate - ISDU supported	`0×1F` 2 bytes 32 bytes Supported
IO-Link protocol version	Revision ID	`0×11` (Version 1.1)
Amount of process data from the device to themaster	ProcessDataIn	see *ProcessDataIn, single mode* or*ProcessDataIn, extended mode*
Amount of process data from the master to the device	ProcessDataOut	see *ProcessDataOut, single mode* or*ProcessDataOut, extended mode*
Manufacturer ID	Vendor ID	`0×378`
Device identification	Device ID	see *Device ID, single mode* or*Device ID, extended mode*

5.2.2 ProcessDataIn, single mode

Table 2: ProcessDataIn, single mode

Prouct variant	Value
BNI IOL-**810**-205-**K036**	`0x48` (1 byte)
BNI IOL-**810**-205-**K037**	`0x48` (1 byte)
BNI IOL-**811**-205-**K036**	`0x48` (1 byte)
BNI IOL-**811**-205-**K037**	`0x48` (1 byte)
BNI IOL-**812**-205-**K036**	`0x48` (1 byte)
BNI IOL-**812**-205-**K037**	`0x48` (1 byte)

5.2.3 ProcessDataIn, extended mode

Table 3: ProcessDataIn, extended mode

Prouct variant	Value
BNI IOL-**810**-205-**K036** withBNI IOL-**810**-205-**K036**	`0x50` (2 bytes)
BNI IOL-**810**-205-**K037** withBNI IOL-**810**-205-**K037**	`0x50` (2 bytes)
BNI IOL-**811**-205-**K036** withBNI IOL-**811**-205-**K036**	`0x50` (2 bytes)
BNI IOL-**811**-205-**K037** withBNI IOL-**811**-205-**K037**	`0x50` (2 bytes)
BNI IOL-**812**-205-**K036** withBNI IOL-**812**-205-**K036**	`0x50` (2 bytes)
BNI IOL-**812**-205-**K037** withBNI IOL-**812**-205-**K037**	`0x50` (2 bytes)

5.2.4 ProcessDataOut, single mode

Table 4: ProcessDataOut, single mode

Prouct variant	Value
BNI IOL-**810**-205-**K036**	`0x8B` (12 bytes)
BNI IOL-**810**-205-**K037**	`0x8B` (12 bytes)
BNI IOL-**811**-205-**K036**	`0x8F` (16 bytes)
BNI IOL-**811**-205-**K037**	`0x8F` (16 bytes)
BNI IOL-**812**-205-**K036**	`0x97` (24 bytes)
BNI IOL-**812**-205-**K037**	`0x97` (24 bytes)

5.2.5 ProcessDataOut, extended mode

Table 5: ProcessDataOut, extended mode

Prouct variant	Value
BNI IOL-**810**-205-**K036** withBNI IOL-**810**-205-**K036**	`0x97` (24 bytes)
BNI IOL-**810**-205-**K037** withBNI IOL-**810**-205-**K037**	`0x97` (24 bytes)
BNI IOL-**811**-205-**K036** withBNI IOL-**811**-205-**K036**	`0x9F` (32 bytes)
BNI IOL-**811**-205-**K037** withBNI IOL-**811**-205-**K037**	`0x9F` (32 bytes)
BNI IOL-**812**-205-**K036** withBNI IOL-**812**-205-**K036**	`0x9F` (32 bytes)
BNI IOL-**812**-205-**K037** withBNI IOL-**812**-205-**K037**	`0x9F` (32 bytes)

5.2.6 Device ID, single mode

Table 6: Device ID, single mode

Prouct variant	Value
BNI IOL-**810**-205-**K036**	`0x050A59`
BNI IOL-**810**-205-**K037**	`0x050A53`
BNI IOL-**811**-205-**K036**	`0x050A5B`
BNI IOL-**811**-205-**K037**	`0x050A55`
BNI IOL-**812**-205-**K036**	`0x050A5D`
BNI IOL-**812**-205-**K037**	`0x050A57`

5.2.7 Device ID, extended mode

Table 7: Device ID, extended mode

Prouct variant	Value
BNI IOL-**810**-205-**K036** withBNI IOL-**810**-205-**K036**	`0x050A5A`
BNI IOL-**810**-205-**K037** withBNI IOL-**810**-205-**K037**	`0x050A54`
BNI IOL-**811**-205-**K036** withBNI IOL-**811**-205-**K036**	`0x050A5C`
BNI IOL-**811**-205-**K037** withBNI IOL-**811**-205-**K037**	`0x050A56`
BNI IOL-**812**-205-**K036** withBNI IOL-**812**-205-**K036**	`0x050A5E`
BNI IOL-**812**-205-**K037** withBNI IOL-**812**-205-**K037**	`0x050A58`

5.3 IO-Link interface reference

The device contains the following IO-Link functions:

5.3.1 Primary Functions

- *Identification*
- *SmartLight control*
- *Segment mode*
- *Level mode*
- *Runlight mode*
- *Flexible mode*
- *Ultimate mode*
- *Buzzer functionlaity*
- *Strobelight functionality*
- *Locator*

5.3.2 Secondary Functions

- *Operating Hours Counter*
- *Boot Cycle Counter*
- *Voltage and Current Monitoring*

5.3.3 System Functions

- *Device Status and Detailed Device Status*
- *Reset Commands*
- *Variant Configuration*
- *Process Data Info and Configuration*
- *Profile Characteristic*
- *Parameter Manager*
- *BLOB Firmware Update*

5.3.4 Process Data Profiles

The SmartLight family has 6 different product variants. Each device supports two different process data profile. One profile is relevant for single mode operation, the other for the extended mode operation. Therefore there will be 12 different process data profile available. All of these process data profiles will have its own IODD. A process data profile will have a defined length of input and output process data. Some part of the output process data can be interpreted several ways, depending on the required main signal functionality.

There are 5 main signal functionalities:

- Segment mode
- Level mode

- Runlight mode
- Flexible mode
- Ultimate mode

Because of the 5 different interpretation for each process data profiles, there will be totally 60 different process data interpretation available. To avoid describing 60 different possible process data, and most of the descriptions will be the same for all of the variants, a top down approach will be used. At first the different process data profiles will be described on higher level, and the lower level descriptions will be done at the different primary device functions.

For general description of single IO-Link and extended IO-Link operation see chapter *Single mode* and *Extended mode*

For more details on process data profiles and settings see chapter *Process Data Info and Configuration*.

PDInput

Single mode

BNI IOL-812-205-K036

Byte	Value
Byte 0	*Error code*

BNI IOL-812-205-K037

Byte	Value
Byte 0	*Error code*

BNI IOL-811-205-K036

Byte	Value
Byte 0	*Error code*

BNI IOL-811-205-K037

Byte	Value
Byte 0	*Error code*

BNI IOL-810-205-K036

Byte	Value
Byte 0	*Error code*

BNI IOL-810-205-K037

Byte	Value
Byte 0	*Error code*

Extended mode

BNI IOL-812-205-K036

Byte	Value
Byte 0	*Error code* primary device
Byte 1	*Error code* secondary device

BNI IOL-812-205-K037

Byte	Value
Byte 0	*Error code* primary device
Byte 1	*Error code* secondary device

BNI IOL-811-205-K036

Byte	Value
Byte 0	*Error code* primary device
Byte 1	*Error code* secondary device

BNI IOL-811-205-K037

Byte	Value
Byte 0	*Error code* primary device
Byte 1	*Error code* secondary device

BNI IOL-810-205-K036

Byte	Value
Byte 0	*Error code* primary device
Byte 1	*Error code* secondary device

BNI IOL-810-205-K037

Byte	Value
Byte 0	*Error code* primary device
Byte 1	*Error code* secondary device

PDOutput

Single mode

BNI IOL-812-205-K036

Byte	Value
Byte 0	*SmartLight control 1*
Byte 1	*SmartLight control 2 and main signal function control*
Byte 2	Reserved
Byte 3	Reserved
Byte 0…23	*Main signal function control*

BNI IOL-812-205-K037

Byte	Value
Byte 0	*SmartLight control 1*
Byte 1	*SmartLight control 2 and main signal function control*
Byte 2	*Buzzer control*
Byte 3	*Strobelight control*
Byte 0…23	*Main signal function control*

BNI IOL-811-205-K036

Byte	Value
Byte 0	*SmartLight control 1*
Byte 1	*SmartLight control 2 and main signal function control*
Byte 2	Reserved
Byte 3	Reserved
Byte 0…15	*Main signal function control*

BNI IOL-811-205-K037

Byte	Value
Byte 0	*SmartLight control 1*
Byte 1	*SmartLight control 2 and main signal function control*
Byte 2	*Buzzer control*
Byte 3	*Strobelight control*
Byte 0…15	*Main signal function control*

BNI IOL-810-205-K036

Byte	Value
Byte 0	*SmartLight control 1*
Byte 1	*SmartLight control 2 and main signal function control*
Byte 2	Reserved
Byte 3	Reserved
Byte 0…11	*Main signal function control*

BNI IOL-810-205-K037

Byte	Value
Byte 0	*SmartLight control 1*
Byte 1	*SmartLight control 2 and main signal function control*
Byte 2	*Buzzer control*
Byte 3	*Strobelight control*
Byte 0…11	*Main signal function control*

Extended mode

BNI IOL-812-205-K036

Byte	Value
Byte 0…15	Process data for the primary device
Byte 16…31	Process data for the secondary device

BNI IOL-812-205-K037

Byte	Value
Byte 0…15	Process data for the primary device
Byte 16…31	Process data for the secondary device

Note

The IO-Link specification defines maximum 32 bytes of output process data. There are 32 bytes output process data in case of extended mode, therefore 16 bytes will be available for both devices. The BNI IOL-812-205-K036 and BNI IOL-812-205-K037 have 24 bytes of process data in single mode. The first 16 bytes will be used in case of extended mode. Functionalities which would need all of the 24 bytes to control the signal function won't be available in extended mode.

BNI IOL-811-205-K036

Byte	Value
Byte 0…15	Process data for the primary device
Byte 16…31	Process data for the secondary device

BNI IOL-811-205-K037

Byte	Value
Byte 0…15	Process data for the primary device
Byte 16…31	Process data for the secondary device

BNI IOL-810-205-K036

Byte	Value
Byte 0…11	Process data for the primary device
Byte 12…23	Process data for the secondary device

BNI IOL-810-205-K037

Byte	Value
Byte 0…11	Process data for the primary device
Byte 12…23	Process data for the secondary device

Byte descriptions

Error code

Most of the parametrization of the device is made via output process data. different bit-field in the output process data has different set of available configurations. In case of improper output process data setting for those bitfields, an error will be reported in the input process data.

Value	Description
0x00	No error
0x01	Device lost on extension port[1]
0x02	Wrong mode
0x03	Wrong buzzer type[2]
0x04	Level value out of range
0x05	Wrong number of segments
0x06	Wrong number of revolving LEDs
0x10	Wrong pattern for Segment 1
0x20	Wrong pattern for Segment 2
0x30	Wrong pattern for Segment 3
0x40	Wrong pattern for Segment 4
0x50	Wrong pattern for Segment 5[3]
0x60	Wrong pattern for Segment 6[3]

SmartLight control 1

Bit	Value
Bit 0…3	*Mode selection*
Bit 4…5	Reserved
Bit 6	*Sync start*
Bit 7	*Sync impulse*

SmartLight control 2 and main signal function control

Bit	Value
Bit 0…2	*Number of segments*[4] *Level direction*[5]
Bit 3	Reserved
Bit 4…7	*Brightness reduction*

[1] Only for the primary device in case of extended mode
[2] Only for BNI IOL-81x-205-**K037**
[3] Only for BNI IOL-**812**-205-K03x
[4] In case of segment indicator mode has been selected.
[5] In case of level indicator mode has been selected.

Buzzer control

Bit	Value
Bit 0…3	*Buzzer sound volume*
Bit 4…6	*Buzzer sound type*
Bit 7	Reserved

Strobelight control

Bit	Value
Bit 0…3	*Strobelight brightness reduction*
Bit 4…5	*Strobelight animation pattern*
Bit 6…7	*Strobelight animation speed*

Main signal function control

The main signal function control bytes depends on the selected indicator mode (segment indicator, level indicator, …). The exact descriptions can be found at the descriptions of primary device functions.

- *Segment mode*
- *Level mode*
- *Runlight mode*
- *Flexible mode*
- *Ultimate mode*

5.3.5 Parameters

Identification

Name	Index	Subindex	Access	Length	Data Type	Data Storage	Default
Vendor Name	0x0010 (16)	0	R	7 bytes	STRING	n/a	“Balluff”
Vendor text	0x0011 (17)	0	R	15 bytes	STRING	n/a	“www.balluff.com”
Product Name	0x0012 (18)	0	R	51	STRING	n/a	Variant specific
Product ID	0x0013 (19)	0	R	51	STRING	n/a	Variant specific
Product text	0x0014 (20)	0	R	43	STRING	n/a	Variant specific
Serial Number	0x0015 (21)	0	R	16 bytes	STRING	n/a	
Hardware Revision	0x0016 (22)	0	R	2 bytes	STRING	n/a	
Firmware Revision	0x0017 (23)	0	R	≤ 10 bytes	STRING	n/a	
Application Specific Tag	0x0018 (24)	0	R/W	≤ 32 bytes	STRING	Yes	“***”
Function Tag	0x0019 (25)	0	R/W	≤ 32 bytes	STRING	Yes	“***”
Location Tag	0x001A (26)	0	R/W	≤ 32 bytes	STRING	Yes	“***”
Product Type Code	0x0700 (1792)	0	R	≤ 64 bytes	STRING	n/a	Variant specific
Product Order Code	0x0701 (1793)	0	R	7 bytes	STRING	n/a	Variant specific

SmartLight control

Name	Index	Subindex	Access	Length	Data Type	DataStorage	Default
Global Brightness	0x01B3 (435)	0	R/W	1 bte	UINT8	Yes	100
Safe State	0x01B4 (436)	0	R/W	1 byte	BOOL	Yes	false
User Color 1	0x01B5 (437)	0	R/W	4 bytes	UINT32	Yes	0x00FF7F00
User Color 2	0x01B6 (438)	0	R/W	4 bytes	UINT32	Yes	0x007FFF00
User Color 3	0x01B7 (439)	0	R/W	4 bytes	UINT32	Yes	0x00000FF7F
User Color 4	0x01B8 (440)	0	R/W	4 bytes	UINT32	Yes	0x00007FFF
User Color 5	0x01B9 (441)	0	R/W	4 bytes	UINT32	Yes	0x007F00FF
User Color 6	0x01BA (442)	0	R/W	4 bytes	UINT32	Yes	0x00FF007F
User Color 7	0x01BB (443)	0	R/W	4 bytes	UINT32	Yes	0x007F7F7F
Advanced Digital - 000	0x0215 (533)	0	R/W	[1]	ARRAYT	Yes	[^2]
Advanced Digital - 001	0x0216 (534)	0	R/W	[1]	ARRAYT	Yes	[^2]
Advanced Digital - 010	0x0217 (535)	0	R/W	[1]	ARRAYT	Yes	[^2]
Advanced Digital - 011	0x0218 (536)	0	R/W	[1]	ARRAYT	Yes	[^2]
Advanced Digital - 100	0x0219 (537)	0	R/W	[1]	ARRAYT	Yes	[^2]
Advanced Digital - 101	0x021A (538)	0	R/W	[1]	ARRAYT	Yes	[^2]
Advanced Digital - 110	0x021B (539)	0	R/W	[1]	ARRAYT	Yes	[^2]
Advanced Digital - 111	0x021C (540)	0	R/W	[1]	ARRAYT	Yes	[^2]
Status LED Brightness	0x01BC (444)	0	R/W	1 byte	UINT8 (ENUM)	Yes	2
Demo Pattern Selector	0x01CD (461)	0	R/W	1 byte	UINT8 (ENUM)	Yes	0

Segment mode

Name	Index	Subindex	Access	Length	Data Type	DataStorag
Custom Frequency of 50% blink	0x01C3 (451)	0	R/W	1 byte	UINT8	Yes
Custom Blink Pattern 1	0x01C4 (452)	0	R/W	32 bytes	UIN32	Yes
Custom Blink Pattern 2	0x01C5 (453)	0	R/W	32 bytes	UIN32	Yes

contir

[1] ISUDs are available only in case of BNI IOl-**812**-205-K03x.

Table 8 – continued from previous page

Name	Index	Subindex	Access	Length	Data Type	DataStorag
Custom Blink Pattern 3	0x01C6 (454)	0	R/W	32 bytes	UIN32	Yes
Number of Samples in Custom Blink Pattern 1	0x01C7 (455)	0	R/W	1 byte	UINT8	Yes
Number of Samples in Custom Blink Pattern 2	0x01C8 (456)	0	R/W	1 byte	UINT8	Yes
Number of Samples in Custom Blink Pattern 3	0x01C9 (457)	0	R/W	1 byte	UINT8	Yes
Duration of Custom Blink Samples	0x01CA (458)	0	R/W	1 byte	UINT8 (ENUM)	Yes
Size of Revolving Segment	0x01CB (459)	0	R/W	1 byte	UINT8 (ENUM)	Yes
6 Segment Mode - Segment 1	0x01D1 (465)	0	R/W	2 bytes	UINT16	Yes
6 Segment Mode - Segment 2	0x01D2 (466)	0	R/W	2 bytes	UINT16	Yes
6 Segment Mode - Segment 3	0x01D3 (467)	0	R/W	2 bytes	UINT16	Yes
6 Segment Mode - Segment 4	0x01D4 (468)	0	R/W	2 bytes	UINT16	Yes
6 Segment Mode - Segment 5	0x01D5 (469)	0	R/W	2 bytes	UINT16	Yes
6 Segment Mode - Segment 6	0x01D6 (470)	0	R/W	2 bytes	UINT16	Yes
5 Segment Mode - Segment 1	0x01D7 (471)	0	R/W	2 bytes	UINT16	Yes
5 Segment Mode - Segment 2	0x01D8 (472)	0	R/W	2 bytes	UINT16	Yes
5 Segment Mode - Segment 3	0x01D9 (473)	0	R/W	2 bytes	UINT16	Yes
5 Segment Mode - Segment 4	0x01DA (474)	0	R/W	2 bytes	UINT16	Yes
5 Segment Mode - Segment 5	0x01DB (475)	0	R/W	2 bytes	UINT16	Yes
4 Segment Mode - Segment 1	0x01DC (476)	0	R/W	2 bytes	UINT16	Yes
4 Segment Mode - Segment 2	0x01DD (477)	0	R/W	2 bytes	UINT16	Yes
4 Segment Mode - Segment 3	0x01DE (478)	0	R/W	2 bytes	UINT16	Yes
4 Segment Mode - Segment 4	0x01DF (479)	0	R/W	2 bytes	UINT16	Yes
3 Segment Mode - Segment 1	0x01E0 (480)	0	R/W	2 bytes	UINT16	Yes
3 Segment Mode - Segment 2	0x01E1 (481)	0	R/W	2 bytes	UINT16	Yes
3 Segment Mode - Segment 3	0x01E2 (482)	0	R/W	2 bytes	UINT16	Yes
2 Segment Mode - Segment 1	0x01E3 (483)	0	R/W	2 bytes	UINT16	Yes
2 Segment Mode - Segment 2	0x01E4 (484)	0	R/W	2 bytes	UINT16	Yes
1 Segment Mode - Segment 1	0x01E5 (485)	0	R/W	2 bytes	UINT16	Yes

Level mode

Name	Index	Subindex	Access	Length	Data Type	DataStorage	Default
Level mode input type	0x01BD (445)	0	R/W	1 byte	UINT8 (ENUM)	Yes	0
Level mode limit 1-2	0x01BE (446)	0	R/W	2 bytes	UINT16	Yes	17
Level mode limit 2-3	0x01BF (447)	0	R/W	2 bytes	UINT16	Yes	34
Level mode limit 3-4	0x01C0 (448)	0	R/W	2 bytes	UINT16	Yes	50
Level mode limit 4-5[Page 47, 1]	0x01C1 (449)	0	R/W	2 bytes	UINT16	Yes	67
Level mode limit 5-6[Page 47, 1]	0x01C2 (450)	0	R/W	2 bytes	UINT16	Yes	84

Felxible mode

Name	Index	Subindex	Access	Length	Data Type	DataStorage	Default
Flexible mode LED 1 Color A	0x02B7 (695)	0	R/W	4 bytes	UINT8	Yes	0x00FF0000
Flexible mode LED 2 Color A	0x02B8 (696)	0	R/W	4 bytes	UINT8	Yes	0x00FF0000
Flexible mode LED 3 Color A	0x02B9 (697)	0	R/W	4 bytes	UINT8	Yes	0x00FF0000
Flexible mode LED 4 Color A	0x02BA (698)	0	R/W	4 bytes	UINT8	Yes	0x00FF0000
Flexible mode LED 5 Color A	0x02BB (699)	0	R/W	4 bytes	UINT8	Yes	0x00808080
Flexible mode LED 6 Color A	0x02BC (700)	0	R/W	4 bytes	UINT8	Yes	0x00808080
Flexible mode LED 7 Color A	0x02BD (701)	0	R/W	4 bytes	UINT8	Yes	0x00808080
Flexible mode LED 8 Color A	0x02BE (702)	0	R/W	4 bytes	UINT8	Yes	0x00808080
Flexible mode LED 9 Color A	0x02BF (703)	0	R/W	4 bytes	UINT8	Yes	0x0000FF00
Flexible mode LED 10 Color A	0x02C0 (704)	0	R/W	4 bytes	UINT8	Yes	0x0000FF00
Flexible mode LED 11 Color A	0x02C1 (705)	0	R/W	4 bytes	UINT8	Yes	0x0000FF00
Flexible mode LED 12 Color A	0x02C2 (706)	0	R/W	4 bytes	UINT8	Yes	0x0000FF00
Flexible mode LED 13 Color A	0x02C3 (707)	0	R/W	4 bytes	UINT8	Yes	0x00FFFF00
Flexible mode LED 14 Color A	0x02C4 (708)	0	R/W	4 bytes	UINT8	Yes	0x00FFFF00
Flexible mode LED 15 Color A	0x02C5 (709)	0	R/W	4 bytes	UINT8	Yes	0x00FFFF00
Flexible mode LED 16 Color A	0x02C6 (710)	0	R/W	4 bytes	UINT8	Yes	0x00FFFF00
Flexible mode LED 17 Color A	0x02C7 (711)	0	R/W	4 bytes	UINT8	Yes	0x000000FF
Flexible mode LED 18 Color A	0x02C8 (712)	0	R/W	4 bytes	UINT8	Yes	0x000000FF
Flexible mode LED 19 Color A	0x02C9 (713)	0	R/W	4 bytes	UINT8	Yes	0x000000FF
Flexible mode LED 20 Color A	0x02CA (714)	0	R/W	4 bytes	UINT8	Yes	0x000000FF
Flexible mode LED 1 Color B	0x02CB (715)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 2 Color B	0x02CC (716)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 3 Color B	0x02CD (717)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 4 Color B	0x02CE (718)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 5 Color B	0x02CF (719)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 6 Color B	0x02D0 (720)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 7 Color B	0x02D1 (721)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 8 Color B	0x02D2 (722)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 9 Color B	0x02D3 (723)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 10 Color B	0x02D4 (724)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 11 Color B	0x02D5 (725)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 12 Color B	0x02D6 (726)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 13 Color B	0x02D7 (727)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 14 Color B	0x02D8 (728)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 15 Color B	0x02D9 (729)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 16 Color B	0x02DA (730)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 17 Color B	0x02DB (731)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 18 Color B	0x02DC (732)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 19 Color B	0x02DD (733)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 20 Color B	0x02DE (734)	0	R/W	4 bytes	UINT8	Yes	0x00000000

Buzzer

Name	Index	Subindex	Access	Length	Data Type	DataStorage	Default
Buzzer constant frequency	0x01E6 (486)	0	R/W	2 bytes	UINT16	Yes	2600
Buzzer pulse mode frequency	0x01E7 (487)	0	R/W	2 bytes	UINT16	Yes	2600
Buzzer pulse mode on time	0x01E8 (488)	0	R/W	1 byte	UINT8	Yes	50
Buzzer pulse mode off time	0x01E9 (489)	0	R/W	1 byte	UINT8	Yes	50
Buzzer alternating mode frequency 1	0x01EA (490)	0	R/W	2 bytes	UINT16	Yes	1000
Buzzer alternating mode frequency 2	0x01EB (491)	0	R/W	2 bytes	UINT16	Yes	4000
Buzzer alternating mode frequency 1 duration	0x01EC (492)	0	R/W	1 byte	UINT8	Yes	50
Buzzer alternating mode frequency 2 duration	0x01ED (493)	0	R/W	1 byte	UINT8	Yes	50
Buzzer wobble mode lower frequency	0x01EE (494)	0	R/W	2 bytes	UINT16	Yes	1000
Buzzer wobble mode higher frequency	0x01EF (495)	0	R/W	2 bytes	UINT16	Yes	4000
Buzzer wobble mode shifting frequency	0x01F0 (496)	0	R/W	1 byte	UINT8(ENUM)	Yes	1
Buzzer sweep mode lower frequency	0x01F1 (497)	0	R/W	2 bytes	UINT16	Yes	500
Buzzer sweep mode higher frequency	0x01F2 (498)	0	R/W	2 bytes	UINT16	Yes	1000
Buzzer sweep mode low to high time	0x01F3 (499)	0	R/W	1 byte	UINT8	Yes	10
Buzzer sweep mode high to low time	0x01F4 (500)	0	R/W	1 byte	UINT8	Yes	10
Buzzer sweep mode low time	0x01F5 (501)	0	R/W	1 byte	UINT8	Yes	100
Buzzer sweep mode high time	0x01F6 (502)	0	R/W	1 byte	UINT8	Yes	100
Buzzer custom mode pattern	0x01F7 (503)	0	R/W	4 bytes	UINT32	Yes	0x850A8000
Buzzer custom mode sample duration	0x01F8 (504)	0	R/W	1 byte	UINT8	Yes	5
Buzzer custom mode number of samples	0x01F9 (505)	0	R/W	1 byte	UINT8	Yes	28

Strobelight

Name	Index	Subindex	Access	Length	Data Type	DataStorage	Default
Strobelight brightness	0x01CC (460)	0	R/W	1 byte	UINT8	Yes	100

Boot cycle counter

Name	Index	Subindex	Access	Length	Data Type	Data Storage	Default
Boot Cycle Counter	0x0058 (88)	0	R	8 bytes		n/a	
Boot Cycle Counter	0x0058 (88)	1	R	4 bytes	UINT32	n/a	–
Custom Boot Cycle Counter	0x0058 (88)	2	R	4 bytes	UINT32	n/a	–

Operating hours counter

Name	Index	Subindex	Access	Length	Data Type	DataStorage	Default
Operating Hours Counter	0x0057 (87)	0	R	12 bytes		n/a	
Current Operating Hours		1	R	4 bytes	UINT32	n/a	–
Total Operating Hours		2	R	4 bytes	UINT32	n/a	–
Custom Operating Hours		3	R	4 bytes	UINT32	n/a	–
Operating Hours Saving Mode	0x0074 (116)	0	R/W	1 byte	UINT8 (ENUM)	Yes	0

Voltage and current monitoring

Name	Index	Subindex	Access	Length	Data Type	Data Storage	Default
Voltage Monitoring Detection Time Duration	0x2200 (8704)	0	R/W	2 bytes	UINT16	Yes	10 (ms)

Device status and detailed device status

Name	Index	Subindex	Access	Length	Data Type	Data Storage	Default
Device Status	0x0024 (36)	0	R	1 byte	UINT8	n/a	–
Detailed Device Status	0x0025 (37)	0	R	30 bytes	UINT8[]	n/a	0x00 0x00 …0x00

Process data information and configuration

Name	Index	Subindex	Access	Length	Data Type	Data Storage	Default
Process Data Profile Selection	0x0051 (81)	0	R/W	1 byte	UINT8 (ENUM)	Yes	0x01
Process Data Input Descriptor	0x000E (14)	0	R	21 bytes	UINT8[]	n/a	–
Last Valid Process Data Inputs	0x0028 (40)	0	R	12 bytes	–	n/a	–

Profile characteristic

Name	Index	Subindex	Access	Length	Data Type	Data Storage	Default
Profile Characteristic	0x000D (13)	0	R	14 bytes	UINT16[]	n/a	–

5.3.6 Events

Table 10: Events

Event Code	Event Type	Event – Description – Remedy	Device Status
Process Data Profile Selection			
0x1850 (6224)	Notification	Process data profile selection cannot be used – default value is used.	0 – Device is operating properly.
0x1851 (6225)	Notification	Process Data Update Timeout – For information purposes only. A PDinput has been delayed over an extended period of time.	0 – Device is operating properly.
0x1852 (6226)	Warning	Multiple Process Data Update Timeout – For information purposes only. A PDinput has been delayed over an extended period of time.	0 – Device is operating properly.
Device Temperature			
0x4000 (16384)	Error	Temperature Fault – Overload – The device is operated outside of the device-specific temperature limits. Risk of device damage.	4 – Failure
0x4210 (16912)	Warning	Device Temperature Overrun – Clear Heat Of Source – Risk of device damage. The device is too hot. ► Remove heat source, provide the device with heat insulation if necessary.	2 – Out-of-Specification
0x4220 (16928)	Warning	Device Temperature Underrun – Insulate Device – Risk of device damage. The device is too cold. ► Insulate the device.	2 – Out-of-Specification
0x8D10 (36112)	Warning	Customer-defined upper warning for device temperature. The upper threshold value for the temperature warning has been exceeded.	0 – Device is operating properly.
0x8D20 (36128)	Warning	Customer-defined lower warning for device temperature. The lower threshold value for the temperature warning has been dropped below.	0 – Device is operating properly.
Electrical monitoring			
0x5110 (20752)	Warning	Primary supply voltage exceeded. ► Check for deviations in the supply.	2 – Out-of-Specification
0x5111 (20753)	Warning	Primary supply voltage below minimum value. ► Check for deviations in the supply.	2 – Out-of-Specification
0x8D0B (36107)	Warning	Overload or short circuit at pin 2. ► Check wiring.	2 – Out-of-Specification
0x8D0D (36109)	Warning	Incorrect load/cable breakage, analog current output pin 2. ► Check wiring or connected devices.	2 – Out-of-Specification
0x8D15 (36117)	Warning	Overload at pin 2. ► Check wiring.	2 – Out-of-Specification
Parameter manager			
0x8D24 (36132)	Notification	An error occurred during the EEPROM write – for information only.	0 – Device is operating properly.
0x8D25 (36133)	Error	Parameters not consistent – basic settings are used, service required. Parameterization processes and resets can no longer be performed.	4 – Failure
0x8D26 (36134)	Warning	User data was reset to the default settings. ► Check settings and acknowledge warning.	1 – Maintenance required
Switching profiles			

5.3.7 System Commands

The device supports various commands that can be accessed via *System Commands*. This function is defined in the IO-Link specification and is implemented accordingly. (see section *Reset Commands*)

Table 11: System Commands

Command Value	Device Action
Basic commands	
0x00 (0)	Reserved
0x01 (1)	ParamUploadStart – Starts parameter upload.
0x02 (2)	ParamUploadEnd – Ends parameter upload.
0x03 (3)	ParamDownloadStart – Starts parameter download.
0x04 (4)	ParamDownloadEnd – Ends parameter download.
0x05 (5)	ParamDownloadStore – Finishes parameter setting and starts data storage.
0x06 (6)	ParamBreak – Cancels all Param commands.
Locator	
0x7E (126)	Start Locator
0x7F (127)	Stop Locator
General Settings	
0x80 (128)	Device Reset – Warm start; parameters unchanged. (see *System Commands*)
0x81 (129)	Application Reset (see *System Commands*)
0x82 (130)	Restore Factory Settings (see *System Commands*)
0x83 (131)	Back-to-Box Reset (see *System Commands*)
0xA5 (165)	Maintenance Reset (see *System Commands*)
Demo mode	
0xD0 (208)	Deactivate demo mode
0xD1 (209)	Activate demo mode
Advanced Digital IO mode	
0xC2 (194)	Teach current PD for advanced IO mode, input combination 000
0xC3 (195)	Teach current PD for advanced IO mode, input combination 001
0xC4 (196)	Teach current PD for advanced IO mode, input combination 010
0xC5 (197)	Teach current PD for advanced IO mode, input combination 011
0xC6 (198)	Teach current PD for advanced IO mode, input combination 100
0xC7 (199)	Teach current PD for advanced IO mode, input combination 101
0xC8 (200)	Teach current PD for advanced IO mode, input combination 110
0xC9 (201)	Teach current PD for advanced IO mode, input combination 111

5.4 Primary device functions

This section describes the primary device functions of the product.

5.4.1 Identification

Description

The identification data is used for the identification and management of the IO-Link devices.

ISDU

Name	Index	Subindex	Access	Length	Data Type	Data Storage	Default
Vendor Name	0x0010 (16)	0	R	7 bytes	STRING	n/a	“Balluff”
Vendor text	0x0011 (17)	0	R	15 bytes	STRING	n/a	“www.balluff.com”
Product Name	0x0012 (18)	0	R	51	STRING	n/a	Variant specific
Product ID	0x0013 (19)	0	R	51	STRING	n/a	Variant specific
Product text	0x0014 (20)	0	R	43	STRING	n/a	Variant specific
Serial Number	0x0015 (21)	0	R	16 bytes	STRING	n/a	
Hardware Revision	0x0016 (22)	0	R	2 bytes	STRING	n/a	
Firmware Revision	0x0017 (23)	0	R	≤ 10 bytes	STRING	n/a	
Application Specific Tag	0x0018 (24)	0	R/W	≤ 32 bytes	STRING	Yes	“***”
Function Tag	0x0019 (25)	0	R/W	≤ 32 bytes	STRING	Yes	“***”
Location Tag	0x001A (26)	0	R/W	≤ 32 bytes	STRING	Yes	“***”
Product Type Code	0x0700 (1792)	0	R	≤ 64 bytes	STRING	n/a	Variant specific
Product Order Code	0x0701 (1793)	0	R	7 bytes	STRING	n/a	Variant specific

Default variant

Name	Index	Subindex	Access	Length	Data Type	Data Storage	Default
Product Name	0x0012 (18)	0	R	55	STRING	n/a	BNI LH1-742-S13-R012
Product ID	0x0013 (19)	0	R	55	STRING	n/a	BNI LH1-742-S13-R012
Product text	0x0014 (20)	0	R	63	STRING	n/a	Hub M12, 4x AO (V/A), 4x AI (V/A)

Application Specific Tag

With the *Application Specific Tag* parameter, a string (maximum 32 bytes) can be written to the device. This value typically describes the application in which the product is used.

Function Tag

With the *Function Tag* parameter, a string (maximum 32 bytes) can be written to the device. This value typically describes the function of the product in the application area.

Location Tag

With the *Location Tag* parameter, a string (maximum 32 bytes) can be written to the device. This value typically describes the location of the product in the application area.

Product Type Code

The Balluff type code is stored permanently in the device.

Product Order Code

The Balluff order code is stored permanently in the device.

System Commands

For an overview of all System Commands, see section *System Commands*.

Variant Dependence

The functionality is available in all variants.

5.4.2 SmartLight control

Description

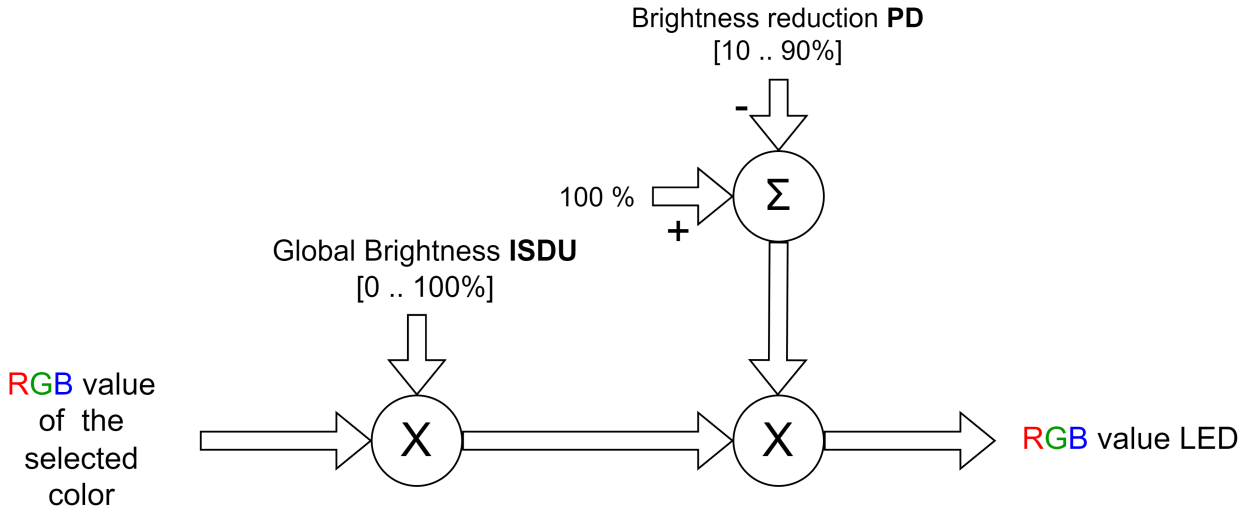
Using the SmartLight control feature, the following operations can be performed:

- Selection of the main LED functionality (segment inmodedicator, level mode, etc.)
- Adjustment of the brightness of the main LEDs
- Configuration of customer specific colors
- Advanced digital IO mode configuration
- Demo mode configuration
- Safe state configuration
- Status LED configuration
- Synchronization

Adjustment of the brightness of the main LEDs

The brightness of the main LEDs are adjustable as a global brightness functionality. All of the LEDs will be affected by this brightness. It is implemented as a two stage brightness modification.

The RGB value defined by the current color will be weighted by the brightness ISDU in the first stage. The intended use of the Brightness ISDU is setting the brightness once, in case the default value is not proper for the current application. There is a second stage for the brightness correction, which is called brightness reduction. This can be done via process data. The intended use of this brightness value is reducing the brightness temporary. With the temporary reduction the brightness can be reduced for example during the night shift.



Configuration of customer specific colors

The SmartLight has 8 pre-definied colors. It is possible to configure 7 additional colors as a user defined color.

Advanced IO mode configuration

The SmartLight can operate in advanced IO mode (SIO mode) where no IO-Link is available. There are default values configured for the SIO mode, but the user has the capability to overwrite them to have a customer specific SIO functionlaity. The desired signal functionality can be set via ISDU, or can be teached-in with a system command.

Demo mode configuration

Demo mode can be activated and deactivated with a system comment, to see the rich functionality of the device. It is intended to use for demo purpose. The demo sequence type can be selected from some pre-defined sequences.

Safe state configuration

In case of communication loss, the SmartLight will signalize the so called safe state condition. The upper LEDs will blink in red to signalize the lost of communication, when the safe-state signal is enabled.

Status LED configuration

The brightness of the status LED is configurable.

Output process data bitfield descriptions

Mode selection

The main LEDs can realize differnet indicators:

- Segment mode
- Level mode
- Runlight mode
- Flexible mode
- Ultimate mode The process data will be interpredet different, depending on the selected indicator mode.

Value	Description
0	Forced OFF mode
1	*Segment mode*
2	*Level mode*
3	*Runlight mode*
4	*Flexible mode*
5	*Ultimate mode*

Sync start

When a rising edge is detected on the Sync start bit, the SmartLight resets its internal state. This assures that the syncronised SmartLights start to work in the same state. The Sync start rising edge has to be generated once after a reset.

Sync impulse

When a rising edge is detected on the Sync impulse bit, the SmartLight resets its internal timer. It has to be generated cyclically in order to keep the SmartLights synchronised. The time period of the Sync impluse can be configured by the user. It´s recommended to set the values between 1 sec. and 15 sec., depending on the frequency of the synchronised parameters.

Brightness reduction

The global brightness of the main signal LEDs can be changed via ISDU and process data. The conbination of the two settings will result the brightness of the main signal LEDs.

Value	Description
0	No reduction
1…9	Reduction by 10% … 90%
11…15	Reduce by 90%

ISDU

Name	Index	Subindex	Access	Length	Data Type	DataStorage	Default
Global Brightness	0x01B3 (435)	0	R/W	1 bte	UINT8	Yes	100
Safe State	0x01B4 (436)	0	R/W	1 byte	BOOL	Yes	false
User Color 1	0x01B5 (437)	0	R/W	4 bytes	UINT32	Yes	0x00FF7F00
User Color 2	0x01B6 (438)	0	R/W	4 bytes	UINT32	Yes	0x007FFF00
User Color 3	0x01B7 (439)	0	R/W	4 bytes	UINT32	Yes	0x00000FF7F
User Color 4	0x01B8 (440)	0	R/W	4 bytes	UINT32	Yes	0x00007FFF
User Color 5	0x01B9 (441)	0	R/W	4 bytes	UINT32	Yes	0x007F00FF
User Color 6	0x01BA (442)	0	R/W	4 bytes	UINT32	Yes	0x00FF007F
User Color 7	0x01BB (443)	0	R/W	4 bytes	UINT32	Yes	0x007F7F7F
Advanced Digital - 000	0x0215 (533)	0	R/W	[1]	ARRAYT	Yes	[2]
Advanced Digital - 001	0x0216 (534)	0	R/W	[1]	ARRAYT	Yes	[2]
Advanced Digital - 010	0x0217 (535)	0	R/W	[1]	ARRAYT	Yes	[2]
Advanced Digital - 011	0x0218 (536)	0	R/W	[1]	ARRAYT	Yes	[2]
Advanced Digital - 100	0x0219 (537)	0	R/W	[1]	ARRAYT	Yes	[2]
Advanced Digital - 101	0x021A (538)	0	R/W	[1]	ARRAYT	Yes	[2]
Advanced Digital - 110	0x021B (539)	0	R/W	[1]	ARRAYT	Yes	[2]
Advanced Digital - 111	0x021C (540)	0	R/W	[1]	ARRAYT	Yes	[2]
Status LED Brightness	0x01BC (444)	0	R/W	1 byte	UINT8 (ENUM)	Yes	2
Demo Pattern Selector	0x01CD (461)	0	R/W	1 byte	UINT8 (ENUM)	Yes	0

[1] BNI IOL-812-205-K03x: 24 bytesBNI IOL-811-205-K03x: 16 bytesBNI IOL-810-205-K03x: 12 bytes
[2] The default values are described at *Advanced Digital - XYZ*

Global Brightness

The global brightness can be set as a percent value. Values from 0 to 100 are allowed.

Safe State

Value	Meaning	Description
0x0 (0)	Disabled	All of the LEDs will be switched on in case of communication lost.
0x1 (1)	Enabled	Safe-state signel will be signalized in case of communication lost.

User Color X

The RGB code of the user defined color can be set. Each color component can have an 8 bit value.

Bits	Meaning
0…7	8 bit value for component blue
8…15	8 bit value for component green
16…23	8 bit value for component red
23…31	Reserved

Advanced Digital - XYZ

The state of the SmartLight (main LEDs, buzzer, and strobe light) is determined at all times by the current process data and the ISDU content. In advanced digital I/O mode, no IO-Link communication is active, therefore no process data is available. The ISDU values are still available in the device, as they are stored internally. To define the state of the SmartLight for each advanced digital I/O mode combination, a simulated process data value is stored in the corresponding ISDU. This allows the device, despite not receiving any actual process data, to use the stored value as if it were provided by the IO-Link master, ensuring that the SmartLight state is fully defined.

BNI IOL-812-205-K03x, BNI IOL-812-205-K03x, default configurations

The SmartLight is configured for Segment indicator, with 3 segments.

Input combination	Segment 1	Segment 2	Segment 3
000	off	off	off
001	off	off	red
010	off	yellow	off
011	off	yellow	red
100	green	off	off
101	green	off	red
110	green	yellow	off
111	green	yellow	red

BNI IOL-810-205-K03x, default configurations

Input combination	Segment 1	Strobelight
000	off	off
001	red	off
010	yellow	off
011	green	off
100	off	on
101	red	on
110	yellow	on
111	green	on

Status LED Brightness

Value	Meaning
0x00	Off
0x01	Low
0x02	Medium
0x03	High

Demo Pattern Selector

Differnet patterns can be set as a demo mode.

Value	Demo pattern
0x00	Default demo sequence showing the rich functinality of the SmartLight
0x01	Lava lamp, color red and yellow
0x02	Lava lamp, color magenta and cyan
0x03	Lava lamp, color blue and magenta
0x04…0x08	The same pattern as in case 0x00

System Commands

Command Value	Device Action
0x81 (129)	*Application Reset* – Reset ISDUs of SmartLight control functionality to the default value.
0x82 (130)	*Restore Factory Settings* – Reset ISDUs of SmartLight control functionality to the default value.
0xD0 (208)	Deactivate demo mode
0xD1 (209)	Activate demo mode
0xC2 (194)	Teach current PD for advanced IO mode, input combination 000
0xC3 (195)	Teach current PD for advanced IO mode, input combination 001
0xC4 (196)	Teach current PD for advanced IO mode, input combination 010
0xC5 (197)	Teach current PD for advanced IO mode, input combination 011
0xC6 (198)	Teach current PD for advanced IO mode, input combination 100
0xC7 (199)	Teach current PD for advanced IO mode, input combination 101
0xC8 (200)	Teach current PD for advanced IO mode, input combination 110
0xC9 (201)	Teach current PD for advanced IO mode, input combination 111

For an overview of all System Commands, see section *System Commands*.

5.4.3 Segment mode

Description

The following chapters are relevant, in case the **Segment mode** mode has been selected via the *SmartLight control* feature.

General description: *Segment indicator*

Output Process Data

> **Note**
>
> Only mode dependent bytes are described in these chapter.

Byte	Description
Byte 0	Defined by other primary device functions
Byte 1	*SmartLight control 2 and main signal function control* containing bitfield *Number of segments*
Byte 2…3	Defined by other primary device functions
Byte 4	*Segment 1 animation*
Byte 5	*Segment 1 color*
Byte 6	*Segment 2 animation*
Byte 7	*Segment 2 color*
Byte 8	*Segment 3 animation*
Byte 9	*Segment 3 color*
Byte 10	*Segment 4 animation*
Byte 11	*Segment 4 color*
Byte 12	*Segment 5 animation*[1]
Byte 13	*Segment 5 color*[1]
Byte 14	*Segment 6 animation*[1]
Byte 15	*Segment 6 color*[1]
Byte 16…xx	Not used in this mode

Output process data bitfield descriptions

Number of segments

The number of the segments can be set. The auto scale functionality will set the number of segments automatically. Only segments, which have meaningful color setting, will be displayed, so that there will be no blank LEDs for inactive segments.

Value	Description
0	Reserved
1…6	Number of segements to be displayed[2]
7	Auto scale mode

[1] Bytes for segment 5 and segment 6 are used only in case of BNI IOl-**812**-205-K03x.
[2] values 5 and 6 is available only for BNI IOL-**812**-205-K03x.

Segment X animation

Bit	Description
Bit 0…3	Animation pattern
Bit 4	Animation direction
Bit 5	Reserved
Bit 6…7	Animation speed

Animation pattern

Value	Description
0x0	No animation, color A will be displayed
0x1	50% Blinking
0x2	Dynamic blink
0x3	Single strobe
0x4	Double strobe
0x5	Tripple strobe
0x6	Revolving
0x7	Rotating beacon
0x8	Custom blink 1
0x9	Custom blink 2
0xA	Custom blink 3
0xB…0xF	Reserved

Animation direction

The direction is relevant for the revolving segment animation pattern.

Value	Description
0	Top -> down
1	Bottom -> up

Animation speed

The animation speed values has different meaning depending on the selected animation pattern.

Value	BlinkDynamic blink	Single strobe	Double strobeTripple storbe	Rotating beacon	Revolving
0	1 Hz	1 Hz	2/3 Hz	1 rev/sec	0.5 rev/sec
1	2 Hz	2 Hz	1 Hz	1.5 rev/sec	1 rev/sec
2	5 Hz	5 Hz	1.5 Hz	2 rev/sec	1.5 rev/sec
3	custom[3]	10 Hz	2 Hz	5 rev/sec	2 rev/sec

Segment X color

Bit	Value
Bit 0…3	Color A
Bit 4…7	Color B

[3] *Custom Frequency of 50% blink*

Color A, Color B

Color A is the primary color. Without any animation the color A will be displayed. In case of an animation pattern has been set, the color of the segment will be changed between A and B according to the animation pattern.

Value	Description
0x0	Off
0x1	Red
0x2	Green
0x3	Yellow
0x4	Blue
0x5	Magenta
0x6	Cyan
0x7	White
0x8	Amber
0x9	User color 1
0xA	User color 2
0xB	User color 3
0xC	User color 4
0xD	User color 5
0xE	User color 6
0xF	User color 7

ISDU

Name	Index	Subindex	Access	Length	Data Type	DataStorag
Custom Frequency of 50% blink	0x01C3 (451)	0	R/W	1 byte	UINT8	Yes
Custom Blink Pattern 1	0x01C4 (452)	0	R/W	32 bytes	UIN32	Yes
Custom Blink Pattern 2	0x01C5 (453)	0	R/W	32 bytes	UIN32	Yes
Custom Blink Pattern 3	0x01C6 (454)	0	R/W	32 bytes	UIN32	Yes
Number of Samples in Custom Blink Pattern 1	0x01C7 (455)	0	R/W	1 byte	UINT8	Yes
Number of Samples in Custom Blink Pattern 2	0x01C8 (456)	0	R/W	1 byte	UINT8	Yes
Number of Samples in Custom Blink Pattern 3	0x01C9 (457)	0	R/W	1 byte	UINT8	Yes
Duration of Custom Blink Samples	0x01CA (458)	0	R/W	1 byte	UINT8 (ENUM)	Yes
Size of Revolving Segment	0x01CB (459)	0	R/W	1 byte	UINT8 (ENUM)	Yes
6 Segment Mode - Segment 1	0x01D1 (465)	0	R/W	2 bytes	UINT16	Yes
6 Segment Mode - Segment 2	0x01D2 (466)	0	R/W	2 bytes	UINT16	Yes
6 Segment Mode - Segment 3	0x01D3 (467)	0	R/W	2 bytes	UINT16	Yes
6 Segment Mode - Segment 4	0x01D4 (468)	0	R/W	2 bytes	UINT16	Yes
6 Segment Mode - Segment 5	0x01D5 (469)	0	R/W	2 bytes	UINT16	Yes
6 Segment Mode - Segment 6	0x01D6 (470)	0	R/W	2 bytes	UINT16	Yes
5 Segment Mode - Segment 1	0x01D7 (471)	0	R/W	2 bytes	UINT16	Yes
5 Segment Mode - Segment 2	0x01D8 (472)	0	R/W	2 bytes	UINT16	Yes
5 Segment Mode - Segment 3	0x01D9 (473)	0	R/W	2 bytes	UINT16	Yes
5 Segment Mode - Segment 4	0x01DA (474)	0	R/W	2 bytes	UINT16	Yes
5 Segment Mode - Segment 5	0x01DB (475)	0	R/W	2 bytes	UINT16	Yes
4 Segment Mode - Segment 1	0x01DC (476)	0	R/W	2 bytes	UINT16	Yes
4 Segment Mode - Segment 2	0x01DD (477)	0	R/W	2 bytes	UINT16	Yes
4 Segment Mode - Segment 3	0x01DE (478)	0	R/W	2 bytes	UINT16	Yes
4 Segment Mode - Segment 4	0x01DF (479)	0	R/W	2 bytes	UINT16	Yes
3 Segment Mode - Segment 1	0x01E0 (480)	0	R/W	2 bytes	UINT16	Yes

contin

Table 12 – continued from previous page

Name	Index	Subindex	Access	Length	Data Type	DataStorag
3 Segment Mode - Segment 2	0x01E1 (481)	0	R/W	2 bytes	UINT16	Yes
3 Segment Mode - Segment 3	0x01E2 (482)	0	R/W	2 bytes	UINT16	Yes
2 Segment Mode - Segment 1	0x01E3 (483)	0	R/W	2 bytes	UINT16	Yes
2 Segment Mode - Segment 2	0x01E4 (484)	0	R/W	2 bytes	UINT16	Yes
1 Segment Mode - Segment 1	0x01E5 (485)	0	R/W	2 bytes	UINT16	Yes

Custom Frequency of 50% blink

The customizable frequency of the 50% blinking can be set between 0.5 and 10 Hz in a step of 0.5 Hz.

Value	Frequency
0	0.5 Hz
1	1.0 Hz
2	1.5 Hz
3	2.0 Hz
4	2.5 Hz
5	3.0 Hz
6	3.5 Hz
7	4.0 Hz
8	4.5 Hz
9	5.0 Hz
10	5.5 Hz
11	6.0 Hz
12	6.5 Hz
13	7.0 Hz
14	7.5 Hz
15	8.0 Hz
16	8.5 Hz
17	9.0 Hz
18	9.5 Hz
19	10.0 Hz

Custom Blink Pattern general description

The product provides three customizable animation patterns. Each pattern has a **Custom Blink Pattern** parameter that defines the actual animation sequence. For each pattern, the **Number of Samples in Custom Blink Pattern** register specifies how many samples (steps) the given pattern consists of. The **Duration of Custom Blink Samples** register defines the time duration of a single sample, and this duration is common for all three patterns. In other words, every sample within any custom blink pattern is displayed for the same, globally defined time. The duration of a single periode of the aninmation pattern will be determined by the number of samples for the pattern, multiplied by the common sample duration.

Custom Blink Pattern X

Each bit of this parameter means a sample value for the blink pattern. Value 1 for the sample will result Color A to be signalized in the corresponding time slot, value 0 will display Color B. The bits will be displayed from direction MSB to LSB.

Number of Samples in Custom Blink Pattern X

The number of the samples in the pattern can be set between 4 and 32.

Duration of Custom Blink Samples

Value	Sample time
0	50 ms
1	60 ms
2	70 ms
3	80 ms
4	90 ms
5	100 ms
6	120 ms
7	150 ms
8	200 ms
9	250 ms
10	500 ms
11	1000 ms

Size of Revolving Segment

The size of the revolving light can be configured. The exact amount of LED levels which are revolving will be automatic defined, becasue segment size may differ depending on other configurations.

Value	Description
0	Small
1	Medium
2	Large

X Segment Mode - Segment Y

The size of each segments can be configured independently. Different configurations are available depending on how many segments are selected as acitve segment. This description is relevan for all segments, in case of all possible number of segments selected. The ISDU adresses can be found at the *ISDU* table, here the subindex structure will be described. Each ISDU (for example 6 Segment Mode - Segment 5) has two numbers in their name. The first number (6 Segment mode) shows, that the ISDU is relevant, in case X (6 in the example) active segments has been set. The second number defines (Segment 5) which segment will be set. The ISDU value will define how big the segment shall be.

ISDU **6 Segment Mode - Segment 5** defines the size of the fifth segment, in case 6 segment mode has been selected.

The segment size can be defined by setting the lower and upper limit. The lower limit defines the first LED level, the upper limit defines the last LED level, which will be in the selected segment.

> **Note**
>
> The LEDs are equally splitted between the segments in case *Number of segments* has been set to auto scale mode, therefore **X Segment Mode - Segment Y** has no affect in such a case.

Name	Index	Subindex	Access	Length	Data Type	DataStorage	Default
X Segment Mode - Segment Y		0	R	2 bytes		yes	
Lower		1	R	1 byte	UINT32	yes	–
Upper		2	R	1 byte	UINT32	yes	–

System Commands

Command Value	Device Action
0x81 (129)	*Application Reset* – Reset ISDUs of Segment indicator functionality to the default value.
0x82 (130)	*Restore Factory Settings* – Reset ISDUs of Segment indicator functionality to the default value.

For an overview of all System Commands, see section *System Commands*.

5.4.4 Level mode

Description

The following chapters are relevant, in case the **Level mode** mode has been selected via the *SmartLight control* feature.

General description: *Level indicator*

Output Process Data

Note

Only mode dependent bytes are described in these chapter.

Byte	Description
Byte 0	Defined by other primary device functions
Byte 1	*SmartLight control 2 and main signal function control* containing bitfield *Level direction*
Byte 2…3	Defined by other primary device functions
Byte 4	*Level value high byte*
Byte 5	*Level value low byte*
Byte 6	*Background color*
Byte 7	*Segment 1 Color and dominance*
Byte 8	*Segment 2 Color and dominance*
Byte 9	*Segment 3 Color and dominance*
Byte 10	*Segment 4 Color and dominance*
Byte 11	*Segment 5 Color and dominance*[1]
Byte 12	*Segment 6 Color and dominance*[1]
Byte 13…xx	Not used in this mode

[1] Bytes for segment 5 and segment 6 are used only in case of BNI IOl-**812**-205-K03x.

Output process data bitfield descriptions

Level direction

Value	Description
0	Bottom -> up
1	Top -> down

Level value high byte

Contains the highest byte of the level value. The level value is always right aligned.

Level value low byte

Contains the lowest byte of the level value. The level value is always right aligned.

Background color

Defines the background color of the Level indicator. An LED will have the background color, in case the level value is not high enough to switch on the LED.

Value	Description
0x0	Off
0x1	Red
0x2	Green
0x3	Yellow
0x4	Blue
0x5	Magenta
0x6	Cyan
0x7	White
0x8	Amber
0x9	User color 1
0xA	User color 2
0xB	User color 3
0xC	User color 4
0xD	User color 5
0xE	User color 6
0xF	User color 7

Segment X Color and dominance

Bit	Value
Bit 0…3	Segment X color
Bit 4	Dominance segment X
Bit 5…7	Reserved

Segment X color

Each segment may have color from the standard color palette.

Value	Description
0x0	Off
0x1	Red
0x2	Green
0x3	Yellow
0x4	Blue
0x5	Magenta
0x6	Cyan
0x7	White
0x8	Amber
0x9	User color 1
0xA	User color 2
0xB	User color 3
0xC	User color 4
0xD	User color 5
0xE	User color 6
0xF	User color 7

Dominance Segment X

Value	Description
0	Segment is not dominant
1	Segment is dominant

ISDU

Name	Index	Subindex	Access	Length	Data Type	DataStorage	Default
Level mode input type	0x01BD (445)	0	R/W	1 byte	UINT8 (ENUM)	Yes	0
Level mode limit 1-2	0x01BE (446)	0	R/W	2 bytes	UINT16	Yes	17
Level mode limit 2-3	0x01BF (447)	0	R/W	2 bytes	UINT16	Yes	34
Level mode limit 3-4	0x01C0 (448)	0	R/W	2 bytes	UINT16	Yes	50
Level mode limit 4-5Page 68, 1	0x01C1 (449)	0	R/W	2 bytes	UINT16	Yes	67
Level mode limit 5-6Page 68, 1	0x01C2 (450)	0	R/W	2 bytes	UINT16	Yes	84

Level mode input type

The level mode input type defines how the level value is interpreted. The level value can be given as a percentage or as an absolute value with different resolutions.

Value	Description
0	Percentage [0…100]
1	8 bit input
2	10 bit input
3	12 bit input
4	14 bit input
5	16 bit input

Level mode limit X-Y

The value of this register determines the limits between two segments in level mode. The limit values are always right justified.

> **Note**
>
> Before changing the limit values, the Resolution and Limit type should be set to the desired value!

System Commands

Command Value	Device Action
0x81 (129)	*Application Reset* – Reset ISDUs of Level indicator functionality to the default value.
0x82 (130)	*Restore Factory Settings* – Reset ISDUs of Level indicator functionality to the default value.

For an overview of all System Commands, see section *System Commands*.

5.4.5 Runlight mode

Description

The following chapters are relevant, in case the **Runlight mode** mode has been selected via the *SmartLight control* feature.

General description: *Runlight indicator*

Output Process Data

> **Note**
>
> Only mode dependent bytes are described in these chapter.

Byte	Description
Byte 0…3	Defined by other primary device functions
Byte 4	*Animation*
Byte 5	*Color*
Byte 6	*Nr of running LED levels*
Byte 7…xx	Not used in this mode

Output process data bitfield descriptions

Animation

Bit	Value
Bit 0…3	Reserved
Bit 4	Animation direction
Bit 5	Reserved
Bit 6…7	Animation speed

Animation direction

Value	Description
0	Top -> down
1	Bottom -> up

Animation speed

Value	Description
0	Slow
1	Medium
2	Fast
3	Very fast

Color

Bit	Value
Bit 0…3	Running color
Bit 4…7	Background color

Color definitions:

Value	Description
0x0	Off
0x1	Red
0x2	Green
0x3	Yellow
0x4	Blue
0x5	Magenta
0x6	Cyan
0x7	White
0x8	Amber
0x9	User color 1
0xA	User color 2
0xB	User color 3
0xC	User color 4
0xD	User color 5
0xE	User color 6
0xF	User color 7

Nr of running LED levels

The number of LED levels, which are running.

Value	Description
0	Reserved
1…3	Allowed for all variants
4…11	For variants BNI IOL-**811**-205-K03x and BNI IOL-**812**-205-K03x
12…19	Only for variant BNI IOL-**812**-205-K03x
20…255	Reserved

System Commands

Command Value	Device Action
0x81 (129)	*Application Reset* – Reset ISDUs of Runlight indicator functionality to the default value.
0x82 (130)	*Restore Factory Settings* – Reset ISDUs of Runlight indicator functionality to the default value.

For an overview of all System Commands, see section *System Commands*.

5.4.6 Flexible mode

Description

The following chapters are relevant, in case the **Flexible mode** mode has been selected via the *SmartLight control* feature.

The flexible mode gives the possibility to the user to define separate colors for all of the LED levels independently. Each LED level may have Color A and Color B defined by an ISDU parameter. Both colors can be set as an RGB value. The color for each LED level can be set to Color A or Color B by toggling a process data bit.

Output Process Data

> **Note**
>
> Only mode dependent bytes are described in these chapter.

Byte	Description
Byte 0…3	Defined by other primary device functions
Byte 4	*LED 1…8 control*
Byte 5	*LED 9…16 control*
Byte 6	*LED 17…20 control*
Byte 7…xx	Not used in this mode

Output process data bitfield descriptions

LED 1...8 control

Bit	Description
Bit 0	*LED 1 state*
Bit 1	*LED 2 state*
Bit 2	*LED 3 state*
Bit 3	*LED 4 state*
Bit 4	*LED 5 state*
Bit 5	*LED 6 state*
Bit 6	*LED 7 state*
Bit 7	*LED 8 state*

Note

LED 5 … 8 are available only for BNI IOL-**811**-205-K03x and BNI IOL-**812**-205-K03x

LED 9...16 control

Bit	Description
Bit 0	*LED 9 state*
Bit 1	*LED 10 state*
Bit 2	*LED 11 state*
Bit 3	*LED 12 state*
Bit 4	*LED 13 state*
Bit 5	*LED 14 state*
Bit 6	*LED 15 state*
Bit 7	*LED 16 state*

Note

LED 9 … 12 are available only for BNI IOL-**811**-205-K03x and BNI IOL-**812**-205-K03x
LED 13 … 20 are available ony for BNI IOL-**812**-205-K03x

LED 17...20 control

Bit	Description
Bit 0	*LED 17 state*
Bit 1	*LED 18 state*
Bit 2	*LED 19 state*
Bit 3	*LED 20 state*
Bit 4…7	Reserved

Note

LED 9 … 12 are available only for BNI IOL-**811**-205-K03x and BNI IOL-**812**-205-K03x
LED 13 … 20 are available ony for BNI IOL-**812**-205-K03x

LED x state

Value	Description
0	LED level will display Color B defined by ISDU
1	LED level will display Color A defined by ISDU

ISDU

Name	Index	Subindex	Access	Length	Data Type	DataStorage	Default
Flexible mode LED 1 Color A	0x02B7 (695)	0	R/W	4 bytes	UINT8	Yes	0x00FF0000
Flexible mode LED 2 Color A	0x02B8 (696)	0	R/W	4 bytes	UINT8	Yes	0x00FF0000
Flexible mode LED 3 Color A	0x02B9 (697)	0	R/W	4 bytes	UINT8	Yes	0x00FF0000
Flexible mode LED 4 Color A	0x02BA (698)	0	R/W	4 bytes	UINT8	Yes	0x00FF0000
Flexible mode LED 5 Color A	0x02BB (699)	0	R/W	4 bytes	UINT8	Yes	0x00808080
Flexible mode LED 6 Color A	0x02BC (700)	0	R/W	4 bytes	UINT8	Yes	0x00808080
Flexible mode LED 7 Color A	0x02BD (701)	0	R/W	4 bytes	UINT8	Yes	0x00808080
Flexible mode LED 8 Color A	0x02BE (702)	0	R/W	4 bytes	UINT8	Yes	0x00808080
Flexible mode LED 9 Color A	0x02BF (703)	0	R/W	4 bytes	UINT8	Yes	0x0000FF00
Flexible mode LED 10 Color A	0x02C0 (704)	0	R/W	4 bytes	UINT8	Yes	0x0000FF00
Flexible mode LED 11 Color A	0x02C1 (705)	0	R/W	4 bytes	UINT8	Yes	0x0000FF00
Flexible mode LED 12 Color A	0x02C2 (706)	0	R/W	4 bytes	UINT8	Yes	0x0000FF00
Flexible mode LED 13 Color A	0x02C3 (707)	0	R/W	4 bytes	UINT8	Yes	0x00FFFF00
Flexible mode LED 14 Color A	0x02C4 (708)	0	R/W	4 bytes	UINT8	Yes	0x00FFFF00
Flexible mode LED 15 Color A	0x02C5 (709)	0	R/W	4 bytes	UINT8	Yes	0x00FFFF00
Flexible mode LED 16 Color A	0x02C6 (710)	0	R/W	4 bytes	UINT8	Yes	0x00FFFF00
Flexible mode LED 17 Color A	0x02C7 (711)	0	R/W	4 bytes	UINT8	Yes	0x000000FF
Flexible mode LED 18 Color A	0x02C8 (712)	0	R/W	4 bytes	UINT8	Yes	0x000000FF
Flexible mode LED 19 Color A	0x02C9 (713)	0	R/W	4 bytes	UINT8	Yes	0x000000FF
Flexible mode LED 20 Color A	0x02CA (714)	0	R/W	4 bytes	UINT8	Yes	0x000000FF
Flexible mode LED 1 Color B	0x02CB (715)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 2 Color B	0x02CC (716)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 3 Color B	0x02CD (717)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 4 Color B	0x02CE (718)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 5 Color B	0x02CF (719)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 6 Color B	0x02D0 (720)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 7 Color B	0x02D1 (721)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 8 Color B	0x02D2 (722)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 9 Color B	0x02D3 (723)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 10 Color B	0x02D4 (724)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 11 Color B	0x02D5 (725)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 12 Color B	0x02D6 (726)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 13 Color B	0x02D7 (727)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 14 Color B	0x02D8 (728)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 15 Color B	0x02D9 (729)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 16 Color B	0x02DA (730)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 17 Color B	0x02DB (731)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 18 Color B	0x02DC (732)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 19 Color B	0x02DD (733)	0	R/W	4 bytes	UINT8	Yes	0x00000000
Flexible mode LED 20 Color B	0x02DE (734)	0	R/W	4 bytes	UINT8	Yes	0x00000000

Flexible mode LED X color Y

Bits	Meaning
0…7	8 bit value for component blue
8…15	8 bit value for component green
16…23	8 bit value for component red
23…31	Reserved

System Commands

Command Value	Device Action
0x81 (129)	*Application Reset* – Reset ISDUs of Flexible mode indicator functionality to the default value.
0x82 (130)	*Restore Factory Settings* – Reset ISDUs of Flexible mode indicator functionality to the default value.

For an overview of all System Commands, see section *System Commands*.

5.4.7 Ultimate mode

Description

The following chapters are relevant, in case the **Ultimate mode** mode has been selected via the *SmartLight control* feature.

The basic principle of the ultimate mode is the same as the flexible mode. The LED levels can be controlled independently. It is called ultimate mode, because it has even higher flexibility, than the standard flexible mode. Each LED level may have a color defined in process data, and can be adjusted easily without any ISDU access. The color can be selected from the standard color palette including customer specific colors.

Output Process Data

> **Note**
>
> Only mode dependent bytes are described in these chapter.

Byte	Description
Byte 0…3	Defined by other primary device functions
Byte 4	*LED 1 color and animation*
Byte 5	*LED 2 color and animation*
Byte 6	*LED 3 color and animation*
Byte 7	*LED 4 color and animation*
Byte 8	*LED 5 color and animation*
Byte 9	*LED 6 color and animation*
Byte 10	*LED 7 color and animation*
Byte 11	*LED 8 color and animation*
Byte 12	*LED 9 color and animation*
Byte 13	*LED 10 color and animation*
Byte 14	*LED 11 color and animation*
Byte 15	*LED 12 color and animation*
Byte 16	*LED 13 color and animation*
Byte 17	*LED 14 color and animation*
Byte 18	*LED 15 color and animation*
Byte 19	*LED 16 color and animation*
Byte 20	*LED 17 color and animation*
Byte 21	*LED 18 color and animation*
Byte 22	*LED 19 color and animation*
Byte 23	*LED 20 color and animation*

Note

LED 5 … 12 are available only for BNI IOL-**811**-205-K03x and BNI IOL-**812**-205-K03x
LED 13 … 20 are available ony for BNI IOL-**812**-205-K03x

Output process data bitfield descriptions

LED X color and animation

Bit	Description
Bit 0…3	*LED X color*
Bit 4…5	*LED X animation pattern*
Bit 6…7	*LED X speed*

LED X color

Value	Description
0x0	Off
0x1	Red
0x2	Green
0x3	Yellow
0x4	Blue
0x5	Magenta
0x6	Cyan
0x7	White
0x8	Amber
0x9	User color 1
0xA	User color 2
0xB	User color 3
0xC	User color 4
0xD	User color 5
0xE	User color 6
0xF	User color 7

LED X animation pattern

Value	Description
0	No animation
1	Dynamic blink
2	Single strobe
3	Rotating beaacon

LED X speed

Value	Dynamic blink	Single strobe	Rotating beacon
0	1 Hz	1 Hz	1 rev/sec
1	2 Hz	2 Hz	1.5 rev/sec
2	5 Hz	5 Hz	2 rev/sec
3	custom	10 Hz	5 rev/sec

Note

The custom frequency of the dynamic blink can be set, as in case of Segment indicator mode.
See ISDU's of Segment indicator mode: *ISDU* and *Custom Frequency of 50% blink*

System Commands

Command Value	Device Action
0x81 (129)	*Application Reset* – Reset ISDUs of Ultimate mode indicator functionality to the default value.
0x82 (130)	*Restore Factory Settings* – Reset ISDUs of Ultimate mode indicator functionality to the default value.

For an overview of all System Commands, see section *System Commands*.

5.4.8 Buzzer

Description

> **Note**
>
> The buzzer functionality is available only for product variants BNI IOL-81x-**K037**

The buzzer functionality offers a wide range of configuration options. Various tone patterns are available, most of which are highly configurable in terms of frequency and timing. The buzzer loudness is also adjustable.

Process Data

> **Note**
>
> Only mode dependent bytes are described in these chapter.

Byte	Description
Byte 0…1	Defined by other primary device functions
Byte 2	*Buzzer control*containing bitfields:*Buzzer sound volume* and*Buzzer sound type*
Byte 3…xx	Not used in this mode

Buzzer sound volume

The volume can be set between the minimum and maximum sound pressure level as a percent value.

Value	Description
0	Sound off
1…9	Volume set in percent between 10% and 90%
10…15	100%

Buzzer sound type

Value	Description
0	Buzzer disabled
1	Constant tone
2	Pulse
3	Alternating pulse
4	Wobble
5	Sweep
6	Custom tone
7	Reserved

ISDU

Name	Index	Subindex	Access	Length	Data Type	DataStorage	Default
Buzzer constant frequency	0x01E6 (486)	0	R/W	2 bytes	UINT16	Yes	2600
Buzzer pulse mode frequency	0x01E7 (487)	0	R/W	2 bytes	UINT16	Yes	2600
Buzzer pulse mode on time	0x01E8 (488)	0	R/W	1 byte	UINT8	Yes	50
Buzzer pulse mode off time	0x01E9 (489)	0	R/W	1 byte	UINT8	Yes	50
Buzzer alternating mode frequency 1	0x01EA (490)	0	R/W	2 bytes	UINT16	Yes	1000
Buzzer alternating mode frequency 2	0x01EB (491)	0	R/W	2 bytes	UINT16	Yes	4000
Buzzer alternating mode frequency 1 duration	0x01EC (492)	0	R/W	1 byte	UINT8	Yes	50
Buzzer alternating mode frequency 2 duration	0x01ED (493)	0	R/W	1 byte	UINT8	Yes	50
Buzzer wobble mode lower frequency	0x01EE (494)	0	R/W	2 bytes	UINT16	Yes	1000
Buzzer wobble mode higher frequency	0x01EF (495)	0	R/W	2 bytes	UINT16	Yes	4000
Buzzer wobble mode shifting frequency	0x01F0 (496)	0	R/W	1 byte	UINT8(ENUM)	Yes	1
Buzzer sweep mode lower frequency	0x01F1 (497)	0	R/W	2 bytes	UINT16	Yes	500
Buzzer sweep mode higher frequency	0x01F2 (498)	0	R/W	2 bytes	UINT16	Yes	1000
Buzzer sweep mode low to high time	0x01F3 (499)	0	R/W	1 byte	UINT8	Yes	10
Buzzer sweep mode high to low time	0x01F4 (500)	0	R/W	1 byte	UINT8	Yes	10
Buzzer sweep mode low time	0x01F5 (501)	0	R/W	1 byte	UINT8	Yes	100
Buzzer sweep mode high time	0x01F6 (502)	0	R/W	1 byte	UINT8	Yes	100
Buzzer custom mode pattern	0x01F7 (503)	0	R/W	4 bytes	UINT32	Yes	0x850A8000
Buzzer custom mode sample duration	0x01F8 (504)	0	R/W	1 byte	UINT8	Yes	5
Buzzer custom mode number of samples	0x01F9 (505)	0	R/W	1 byte	UINT8	Yes	28

Buzzer constant frequency

The frequency of the constant tone and custom sound pattern. Description of the parameter values see: *Frequency parameters*

Buzzer pulse mode frequency

The frequency of the pulse tone. Description of the parameter vvalues see: *Frequency parameters*

Buzzer pulse mode on time

The active time of the pulse tone. Description of the parameter values see: *Time parameters*

Buzzer pulse mode off time

The time between two tone pulses. During this time the buzzer is switched off. Description of the parameter values see: *Time parameters*

Buzzer alternating mode frequency 1

The first frequency of the alternating tone pattern. Description of the parameter values see: *Frequency parameters*

Buzzer alternating mode frequency 2

The second frequency of the alternating tone pattern. Description of the parameter values see: *Frequency parameters*

Buzzer alternating mode frequency 1 duration

The time duration of the first frequency. Description of the parameter values see: *Time parameters*

Buzzer alternating mode frequency 2 duration

The time duration of the second frequency. Description of the parameter values see: *Time parameters*

Buzzer wobble mode lower frequency

The lower frequency of the wobble tone pattern. Description of the parameter values see: *Frequency parameters*

Buzzer wobble mode higher frequency

The higher frequency of the wobble tone pattern. Description of the parameter values see: *Frequency parameters*

Buzzer wobble mode shifting frequency

The modulation frequency in case of wobble tone pattern.

Value	Description
0	0.5 Hz
1	1 Hz
2	1.5 Hz
3	2 Hz
4	2.5 Hz
5	3 Hz
6	3.5 Hz
7	4 Hz
8	4.5 Hz
9	5 Hz

Buzzer sweep mode lower frequency

Lower frequency of the sweep pattern. Description of the parameter values see: *Frequency parameters*

Buzzer sweep mode higher frequency

Higher frequency of the sweep pattern. Description of the parameter values see: *Frequency parameters*

Buzzer sweep mode low to high time

Sweep time from the lower frequency to the higher frequency. Description of the parameter values see: *Time parameters*

Buzzer sweep mode high to low time

Sweep time from the higher frequency to the lower frequency. Description of the parameter values see: *Time parameters*

Buzzer sweep mode low time

Duration of the lower frequency, while the frequency will be kept. Description of the parameter values see: *Time parameters*

Buzzer sweep mode high time

Duration of the higher frequency, while the frequency will be kept. Description of the parameter values see: *Time parameters*

Buzzer custom mode pattern

Each bit of this parameter means a sample value for the custom sound pattern. Value 1 for the sample will switch on the buzzer in the corresponding time slot, value 0 will switch off the buzzer. The bits will be interpreted from direction MSB to LSB.

The tone frequency, while the buzzer is switched on, will be defined by *Buzzer constant frequency*

Buzzer custom mode sample duration

Value	Sample time
0	50 ms
1	60 ms
2	70 ms
3	80 ms
4	90 ms
5	100 ms
6	120 ms
7	150 ms
8	200 ms
9	250 ms
10	500 ms
11	1000 ms

Buzzer custom mode number of samples

The number of the samples in the pattern can be set between 4 and 32.

Frequency parameters

Frequency values are allowed between 500 and 4000. The values are given in [Hz]

Time parameters

Time values are allowed between 4 and 100. The time granulate is 10 ms.

For example: Value 10 means 10 x 10 ms = 100 ms

System Commands

Command Value	Device Action
0x81 (129)	*Application Reset* – Reset ISDUs of Buzzer functionality to the default value.
0x82 (130)	*Restore Factory Settings* – Reset ISDUs of Buzzer functionality to the default value.

For an overview of all System Commands, see section *System Commands*.

5.4.9 Strobelight

Description

> **Note**
>
> The strobelight functionality is available only for product variants BNI IOL-81x-**K037**

The Strobelight functionality has various conffiguration options. The Strobelight can have different animation patterns:

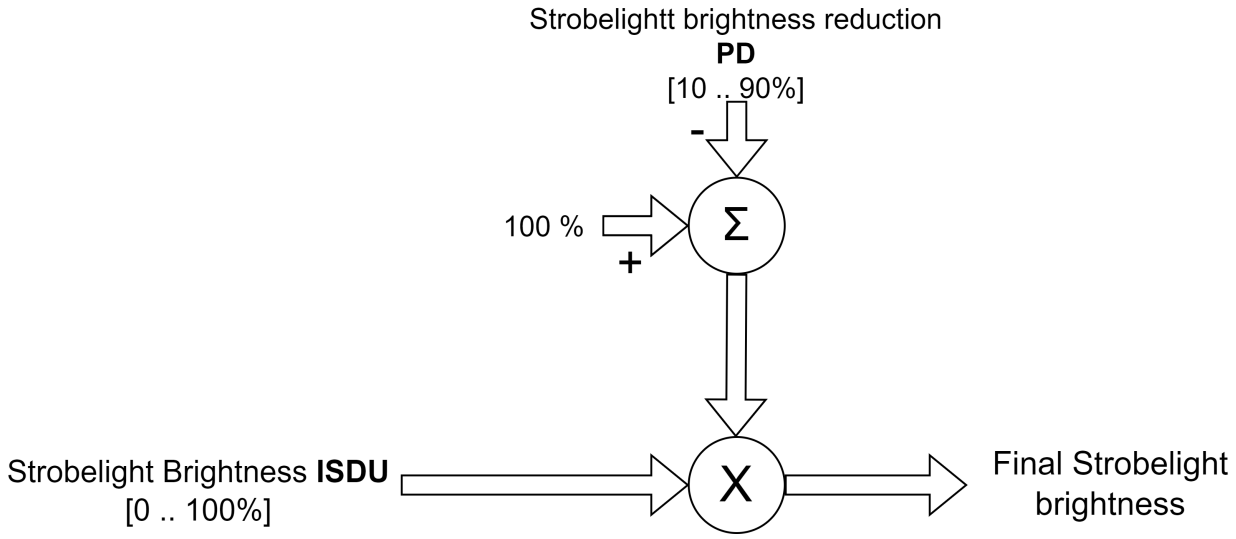
- single storbe
- double strobe
- tripple strobe

The speed ot the animation is also configurable. The brightness of the Strobelight is configurable in a two steps:

The brightness value is defined by an ISDU in the first stage. The intended use of the Brightness ISDU is setting the brightness once, in case the default value is not proper for the current application. There is a second stage for the brightness correction, which is called brightness reduction. This can be done via process data. The intended use of this brightness value is reducing the brightness temporary. With the temporary reduction the brightness can be reduced for example during the night shift.

Process Data

> **Note**
>
> Only mode dependent bytes are described in these chapter.



Byte	Description
Byte 0…2	Defined by other primary device functions
Byte 3	*Strobelight control*containing bitfields:*Strobelight brightness reduction* and*Strobelight animation pattern* and*Strobelight animation speed*
Byte 3 … xx	Not used in this mode

Strobelight brightness reduction

The brightness of the Strobelight can be changed via ISDU and process data. The conbination of the two settings will result the brightness of the main signal LEDs.

Value	Description
0	No reduction
1…9	Reduction by 10% … 90%
11…15	Reduce by 90%

Strobelight animation pattern

Value	Description
0	Strobelight off
1	Single strobe
2	Double strobe
3	Tripple strobe

Strobelight animation speed

Value	Description	Single strobe	Double strobeTripple storbe
0	Slow	1 Hz	2/3 Hz
1	Medium	2 Hz	1 Hz
2	Fast	5 Hz	1.5 Hz
3	Very fast	10 Hz	2 Hz

ISDU

Name	Index	Subindex	Access	Length	Data Type	DataStorage	Default
Strobelight brightness	0x01CC (460)	0	R/W	1 byte	UINT8	Yes	100

Strobelight brightness

The brightness of the Strobelight can be set as a percent value. Values from 0 to 100 are allowed. By default the Strobelight is dimmed.

System Commands

Command Value	Device Action
0x81 (129)	*Application Reset* – Reset ISDUs of Strobelight functionality to the default value.
0x82 (130)	*Restore Factory Settings* – Reset ISDUs of Strobelight functionality to the default value.

For an overview of all System Commands, see section *System Commands*.

5.4.10 Locator

With the *Locator* function, an IO-Link device can be found again by starting signaling on the LED of the device using a system command. Signaling can be stopped with another system command.

The functionality corresponds to the specification in the IO-Link Common Profile – *Locator* function class.

ISDU

Locator Timeout

The *Locator Timeout* parameter sets the duration of the Locator signal that is displayed via LEDs. The value is specified in minutes. The value range from 1 to 30 minutes is allowed. The parameter is reset by *Application Reset* and *Factory Reset* (also see section Reset Commands).

Table 14: Locator Timeout Parameter

Name	Index	Subindex	Access	Length	Data Type	Data Storage	Default
Locator timeout	`0x00FE` (254)	0	R/W	1 byte	UINT8	Yes	10

System Commands

Table 15: Locator System Commands

Command Value	Device Action
0x7E (126)	Start Locator
0x7F (127)	Stop

5.5 Secondary device functions

This section describes the secondary device functions of the product.

5.5.1 Boot Cycle Counter

Description

After each start, the current Boot Cycle Counter is read from the non-volatile memory, incremented by 1 and rewritten. In addition, a second Boot Cycle Counter is implemented that can be reset.

The output of the current boot cycle can serve as a control for the service interval as well as for preventative maintenance. Schedules for regular maintenance can be tied to the values of the Boot Cycle Counter.

ISDU

Name	Index	Subindex	Access	Length	Data Type	Data Storage	Default
Boot Cycle Counter	0x0058 (88)	0	R	8 bytes		n/a	
Boot Cycle Counter	0x0058 (88)	1	R	4 bytes	UINT32	n/a	–
Custom Boot Cycle Counter	0x0058 (88)	2	R	4 bytes	UINT32	n/a	–

Note

The maximum number of storage cycles is 1000000 and, with switch-on and switch-off every 12 minutes, this means a service life of over 1.000.000 × 12 min = ~22,8 years.

Boot Cycle Counter

This parameter saves the value of the current boot cycle, which is incremented on each start.

Custom Boot Cycle Counter

This parameter saves the value of the current, user-defined counter, which is incremented on each start and can be reset via the *Maintenance Reset* system command.

System Commands

Command Value	Device Action
0x81 (129)	*Application Reset* – Resets the Custom Boot Cycle Counter with ISDU-index 0x58 subindex 2 to the default value 0.
0x82 (130)	*Restore Factory Settings* – Resets the Custom Boot Cycle Counter with ISDU-index 0x58 subindex 2 to the default value 0.
0xA5 (165)	*Maintenance Reset* – Resets the Custom Boot Cycle Counter with ISDU-index 0x58 subindex 2 to the default value 0.

For an overview of all System Commands, see section *System Commands*.

5.5.2 Operating Hours Counter

Description

The operating hours counter can record the operating hours of a device accurately to the second. There are a total of three operating hours counters. In addition to an operating hours counter for the operating hours since the start of the device, there is a total operating hours counter and a customer-specific operating hours counter that can be reset. The storage interval is configurable and the operating hours are not stored once 1000000 storage cycles have been reached.

Algorithm

While the counter is incremented every second, the storage interval doubles after each save operation. Starting with a save operation after 1 minute, then after 2 minutes, then after 4 minutes, then after 8 minutes, up to a maximum storage rate of 12 minutes.

The output of the operating hours can serve as a time control for the service interval as well as for preventative maintenance. Schedules for regular service can be tied to the operating hour values. Moreover, a high value of the total operating hours is indicative of intensive use of a device and possible deterioration of the performance. The risk of failure can be countered preventively through replacement.

Process Data

Object ID	Name	Description	Direction
0x001B (27)	Current Operating Hours	Output of the current operating hours counter	Input
0x001C (28)	Total Operating Hours	Output of the total operating hours counter	Input
0x001D (29)	Custom Operating Hours	Output of a user-defined operating hours counter	Input

Also see section Process Data Profiles.

ISDU

Name	Index	Subindex	Access	Length	Data Type	DataStorage	Default
Operating Hours Counter	0x0057 (87)	0	R	12 bytes		n/a	
Current Operating Hours		1	R	4 bytes	UINT32	n/a	–
Total Operating Hours		2	R	4 bytes	UINT32	n/a	–
Custom Operating Hours		3	R	4 bytes	UINT32	n/a	–
Operating Hours Saving Mode	0x0074 (116)	0	R/W	1 byte	UINT8 (ENUM)	Yes	0

Note

The maximum number of storage cycles is 1000000 and, with a switch-on and switch-off every 12 minutes (with static counter), this means a service life of over ~22,8 years (1.000.000 × 12 min). If switched on and off more frequently or in the case of dynamic storage, the maximum storage time is reduced depending on the application.

Current Operating Hours

This parameter saves the value of the operating hours since the last commissioning in seconds.

Total Operating Hours

This parameter saves the value of the operating hours since the first commissioning in seconds.

Custom Operating Hours

This parameter saves the value of the operating hours since the last reset in seconds.

Operating Hours Saving Mode

The current storage behavior can be set.

Value	Meaning	Description
0x00 (0)	Dynamic	The first save operation is performed 1 minute after switching on; the storage interval then doubles after every save operation. This is limited to a storage interval of 12 minutes. The intervals are 1, 2, 4, 8, 12 minutes.
0x01 (1)	Static	Operating hours counters are stored every 12 minutes.

System Commands

Command Value	Device Action
0x81 (129)	*Application Reset* – Resets Custom Operating Hours to the default value.
0x82 (130)	*Restore Factory Settings* – Resets Custom Operating Hours and Operating Hours Saving Mode to the default value.
0xA5 (165)	*Maintenance Reset* – Resets Custom Operating Hours to the default value.

For an overview of all System Commands, see section *System Commands*.

5.5.3 Voltage and Current Monitoring

Description

The voltage and current module sends messages about over-current, short-circuit, wire breakage, over-voltage and under-voltage. Over-voltage and under-voltage detection starts a timer. If the timer has expired and the voltage level has not returned to the normal operating voltage threshold, the module sends out the messages.

The messages include device status, IO-Link events, process data and LED signaling.

Mathematics/Algorithm

In SIO mode the threshold for undervoltage is 17V and for overvoltage is 32V.

If the device is in IO-Link mode, undervoltage occurs at 17V
and overvoltage occurs at 32V.

Process Data

Object ID	Name	Description	Direction
0x0017 (23)	Undervoltage	TRUE = the voltage level is below the threshold value.	Input
0x0018 (24)	Overvoltage	TRUE = the voltage level is above the threshold value.	Input

Also see section Process Data Profiles

ISDU

With the parameter *Voltage Monitoring Detection Time Duration* is possible to change the time between the detection of over/under voltage and the reporting of the event. (This parameter is used to eliminate unstable (transition) state as a filter)

Name	Index	Subindex	Access	Length	Data Type	Data Storage	Default
Voltage Monitoring Detection Time Duration	0x2200 (8704)	0	R/W	2 bytes	UINT16	Yes	10 (ms)

Voltage Monitoring Detection Time Duration

This parameter is used to define how long the under-voltage or over-voltage must be present before it is displayed. The unit is given in milliseconds. The values must be in the range between 10 and 1000. The default value is 10 milliseconds.

System Commands

Command Value	Device Action
0x81 (129)	*Application Reset* – Resets the Voltage Monitoring Detection Time Duration with ISDU-index 0x2200 to the default value 10.
0x82 (130)	*Restore Factory Settings* – Resets the Voltage Monitoring Detection Time Duration with ISDU-index 0x2200 to the default value 10.

For an overview of all System Commands, see section *System Commands*.

Events

Event Code	Event Type	Event – Description – Remedy	Device Status
0x5110 (20752)	Warning	Primary supply voltage exceeded ► Check for deviations in the supply.	2 – Out-of-Specification
0x5111 (20753)	Warning	Primary supply voltage below minimum value ► Check for deviations in the supply.	2 – Out-of-Specification
0x8D0B (36107)	Warning	Overload or short circuit at pin 2 ► Check wiring.	2 – Out-of-Specification
0x8D0D (36109)	Warning	Incorrect load/cable breakage, analog current output pin 2 ► Check wiring or connected devices.	2 – Out-of-Specification
0x8D15 (36117)	Warning	Overload at pin 2 ► Check wiring.	2 – Out-of-Specification

5.6 System functions

This section describes the system functions of the product.

5.6.1 Device Status and Detailed Device Status

Description

The *Device Status* feature provides information about the current device status.

Each *Device Status* is combined with a corresponding diagnostic message (see chapter *Events*).

It is also possible to actively read out current pending events of the device.

Process Data

Object ID	Name	Description	Direction
0x002F (47)	System Error	This bit is set (TRUE) if there is an error in the device. This information is linked to the device status (4-Failure), which can be triggered by different device functions or diagnostic messages. The bit is reset as soon as the error status is no longer displayed (FALSE).	Input

Also see section Process Data Profiles.

ISDU

Name	Index	Subindex	Access	Length	Data Type	Data Storage	Default
Device Status	0x0024 (36)	0	R	1 byte	UINT8	n/a	–
Detailed Device Status	0x0025 (37)	0	R	30 bytes	UINT8[]	n/a	0x00 0x00 …0x00

Device Status values

The parameters are accessed via subindex 0.

The output values are to be interpreted as follows:

Value	Status	Description
0	Device is operating properly	Device working correctly.
1	Maintenance Required	Although the process data is valid, internal diagnoses show that the device will soon lose its ability to function properly. Maintenance is necessary.
2	Out-of-Specification	Although the process data is valid, internal diagnoses show that the device is operating outside of its specified measurement range or environmental conditions. The installation must be checked for unintentional malfunctions.
3	Functional Check	Process data is temporarily invalid due to intentional changes to the device, e.g., parameterization or teaching-in.
4	Failure	Process data is invalid due to a malfunction of the device or its peripheral devices. The device is not able to perform its intended function. Re-configuration (resetting to factory settings) can help. Otherwise, Balluff service must be contacted or the device replaced.

Detailed Device Status values

Detailed Device Status indicates the currently pending diagnosis messages (error, warning). For an event overview, see chapter *Events*.

It can be used to perform a more detailed error analysis or to find the corresponding error source in the event of an unexpected device status.

The length of the list varies dynamically depending on the number of entries. Each entry in the list consists of the *EventQualifier* and the *EventCode* and has a data length of 3 bytes. The total list can be queried via subindex 0, individual entires with the corresponding subindex. Each of the entries in the lists can only be called while the event is pending.

Subindex	Object name	Data Type	Comment
1	Error_Warning_1	3 bytes	[1]
2	Error_Warning_2	3 bytes	[1]
3	Error_Warning_3	3 bytes	[1]
4	Error_Warning_4	3 bytes	[1]
…			
n	Error_Warning_n	3 bytes	[1]

[1] As for all bytes:

- `0x00` (0): no error/warning

5.6.2 Parameter Manager

Description

The parameter manager is responsible for the saving of parameters in the permanent memory of the device. On startup, all stored parameters are read from permanent memory; if parameters are changed, the data is stored within the permanent memory by the parameter manager.

All data is protected with a CRC32 checksum. In the event of damaged memory, the parameter manager outputs the *Parameters not consistent* event.

If this error only affects parameters which can be restored, the memory is repaired directly by the device. In this case all set data is reset to the default settings and the device signals this state via a warning.

Acknowledge warning

- Check set data.
- Acknowledge warning by sending the system command *0xC1- Acknowledge User Parameters Reset* to the device.

Data can be very easily restored via the IO-Link parameter server (see *Data Storage*).

System Commands

Command Value	Device Action
0xC1 (193)	*Acknowledge User Parameter Reset* – Acknowledge message and restore the correct device parameters.

Events

Event Code	Event Type	Event – Description – Remedy	Device Status
0x8D24 (36132)	Notification	An error occurred during the EEPROM write – for information only.	0 – Device is operating properly.
0x8D25 (36133)	Error	Parameters not consistent – basic settings are used, service required. Parameterization pro-cesses and resets can no longer be performed.	4 – Failure
0x8D26 (36134)	Warning	User data was reset to the default settings. ► Check settings and acknowledge warning.	1 - Maintenance required

5.6.3 Process Data Info and Configuration

Description

Process data information and configuration offers various possibilities related to process data:

- Selection of a process dataset specified by the device
- Information about the structure of the input and output data

- Byte 1: EventQualifier
- Byte 2, 3: EventCode

- Information about the last valid value for input and output data

As a diagnosis function, monitoring of the updates of certain process values is available. If these are not updated in the specified time, the device sends corresponding diagnosis messages.

Invalid Process Data

Input data (from the device to the master) is only marked as invalid if the device has the *Failure* device status.

> **Note**
>
> In the case of individual pieces of faulty data, the data is not marked as invalid but is instead replaced by substitution values or error codes. This is to be taken into account during the evaluation.

ISDU

Name	Index	Subindex	Access	Length	Data Type	Data Storage	Default
Process Data Profile Selection	0x0051 (81)	0	R/W	1 byte	UINT8 (ENUM)	Yes	0x01
Process Data Input Descriptor	0x000E (14)	0	R	21 bytes	UINT8[]	n/a	–
Last Valid Process Data Inputs	0x0028 (40)	0	R	12 bytes	–	n/a	–

PD Profile Selection

This parameter offers the user the possibility to select the process data profiles offered by the device for the corresponding variants.

BNI IOL-810-205-K036

PD Configuration ID	Name	Description
0x03	BNI IOL-810-205-K036	Single mode
0x04	BNI IOL-810-205-K036 with BNI IOL-810-205-K036	Extended mode

BNI IOL-810-205-K037

PD Configuration ID	Name	Description
0x01	BNI IOL-810-205-K037	Single mode
0x02	BNI IOL-810-205-K037 with BNI IOL-810-205-K037	Extended mode

BNI IOL-811-205-K036

PD Configuration ID	Name	Description
0x03	BNI IOL-811-205-K036	Single mode
0x04	BNI IOL-811-205-K036 with BNI IOL-811-205-K036	Extended mode

BNI IOL-811-205-K037

PD Configuration ID	Name	Description
0x01	BNI IOL-811-205-K037	Single mode
0x02	BNI IOL-811-205-K037 with BNI IOL-811-205-K037	Extended mode

BNI IOL-812-205-K036

PD Configuration ID	Name	Description
0x03	BNI IOL-812-205-K036	Single mode
0x04	BNI IOL-812-205-K036 with BNI IOL-812-205-K036	Extended mode

BNI IOL-812-205-K037

PD Configuration ID	Name	Description
0x01	BNI IOL-812-205-K037	Single mode
0x02	BNI IOL-812-205-K037 with BNI IOL-812-205-K037	Extended mode

PD Description

This parameter is used to specify the structure of the currently selected process data profile for input and output data. The individual process data variables are described.

The total list is accessible via subindex 0, a single entry is possible using a specific subindex. Subindex 1 corresponds to the *least significant* (or the element most recently transferred in the process data stream). When reading out the entire list, this element is transferred first.

The length of the list is dependent on which process data profile is selected. A single element has a length of 3 bytes.

Table 16: Process data info and configuration – PD Description

Byte number	Contents	Values
Byte 1	Data type	• 0: OctetStringT • 1: Set of BoolT • 2: UIntegerT • 4: Float32T • 5…255: reserved
Byte 2	TypeLength	0…255 bits
Byte 3	Bit offset	0…255 bits

Last Valid Process Data

This parameter indicates the most recently valid input or output data of the device. The first transferred byte in the process data (MSB) is transferred first. This is an exact representation. Access occurs via subindex 0.

Events

PD Update Timeout

With special process data values, the device automatically checks whether the values are updated in the time period specified by the device. If an update timeout is triggered as a result, this is output via the following diagnosis messages:

Event Code	Event Type	Event – Description – Remedy	Device Status
0x1851 (6225)	Notification	Process Data Update Time-out – for information purposes only. A PDinput has been delayed over an extended period of time.	0 – Device is operating properly.
0x1852 (6226)	Warning	Multiple Process Data Update Time-out – for information purposes only. A PDinput has been delayed over an extended period of time.	0 – Device is operating properly.

Tab. 7-40: Process data information and configuration – Events

PD Profile Selection after Change of Variant

If the variant of the device is changed, the currently set profile is retained.

In the case that the corresponding PD profile is not valid for this variant, the default profile for the corresponding variant is selected.

Event Code	Event Type	Event – Description – Remedy	Device Status
0x1850 (6224)	Notification	Process data profile selection cannot be used – default value is used.	0 – Device is operating properly.

Tab. 7-41: Process data information and configuration – Events

Variant Dependence

There is no variant dependency in PD-Profiles. All variants use the same PD-profile.

PD Invalid

PD Inputs Invalid:

Input data (device-to-master) is marked as invalid if the *device status* (see section *Device Status and Detailed Device Status*) of the device is *Failure*. In all other states, replacement values for the data are output for which the content cannot be output correctly.

5.6.4 Profile Characteristic

Description

Profile Characteristic is a readable parameter that provides information about which IO-Link profiles are supported. It is used mainly to allow profile function modules of the control unit to detect which profile or functions on the device are available.

This parameter is defined in the IO-Link specification.

ISDU

Name	Index	Subindex	Access	Length	Data Type	Data Storage	Default
Profile Characteristic	0x000D (13)	0	R	14 bytes	UINT16[]	n/a	–

The parameter can be read via subindex 0 and consists of multiple profile indices and function classes (each 16-bit values).

If a profile ID is specified, this means that all included function classes are supported. If only sub-functions are supported, these are output explicitly as an individual function class.

This device supports the following profiles:

Profile ID	Name / Description
0x0015	Measuring and Switching Sensor, high resolution, 2 channel
0x0030	BLOB transfer
0x0031	Firmware Update
0x4000	Common Application Profile: Identification and Diagnosis

The following function classes are supported:

Function Class ID	Name / Description
0x8011	Teach two point extension
0x8012	Teach dynamic extension
0x8101	Locator

All individual functions are described in this guide. For more exact descriptions of the profiles, refer to the corresponding profile specifications (see www.io-link.com).

Variant Dependence

There is no variant dependency of profile characteristics

5.6.5 Reset Commands

Description

The device supports various reset commands for resetting the set parameters to default values. Each of these commands is accessed by means of *System Commands*.

This function is defined in the IO-Link specification and is implemented according to version 1.1.4

ISDU

System Commands

Command Value	Device Action
0x80 (128)	*Device Reset* – Device Reset means a warm start of the device. During this process, the microcontrollers are restarted and all initializations performed again without any change made to the parameter values.
0x81 (129)	*Application Reset* – This reset is performed using IO-Link specification version 1.1.4 • Resets all parameters and device settings to default values (with the exception of the identification and tagging parameters) • No reset of the configuration of the device variant • No communication stop or restart
0x82 (130)	*Restore Factory Settings* – This reset is performed using IO-Link specification version 1.1.4 • Reset all parameters and device settings to default settings (including identification and tagging parameters) • Reset the configuration of the device variants to the default variant • Communication stop and restart possible.
0x83 (131)	*Back-to-Box Reset* – This reset is performed using IO-Link specification version 1.1.4 • Reset all parameters and device settings to default settings (including identification and tagging parameters) • Reset the configuration of the device variants to the default variant • Communication stop until the next restart.
0xA5 (165)	*Maintenance Reset* – Resets all resettable maintenance and service life parameters for the user so that the next maintenance cycle can begin.

For an overview of all System Commands, see section *System Commands*.

5.6.6 Variant Configuration

Description

The device variant can be changed either via ISDU with this parameter or by using the IO-Link compatibility mode. If this parameter is written, the device variant is not changed immediately but instead after the device is restarted. If the device variant is changed via the IO-Link compatibility mode, the change in this parameter is visible immediately.

This parameter is not changed by a reset.

Hint

After a variant changeover, an inconsistent configuration may occur because there is no automatic changeover of parameters.
It is therefore recommended that the setup be done in the following order:

1. Variant setting
2. Activate the variant with a **device restart**.
3. Check parameters and set valid parameters if necessary or use Data Storage (see *Data Storage*).

ISDU

Device Variant

This parameter indicates which variant is currently set.

The following device variants are available:

Value	Description	Device Id
0x01 (1)	Distance/ Object detection	`0x0C0102` (786690)
0x02 (2)	Radar Reflex Gate	`0x0C0103` (786691)

5.6.7 Blob Firmware Update

Description

The *BLOB Firmware Update* feature offers the option of importing firmware updates for the IO-Link device itself. Version 1.1 of the BLOB FW update profile specified by the IO-Link consortium for all manufacturers is used for this purpose.

So-called IOLFW packages containing the necessary binaries and metadata are available via the Balluff Update Platform. These packages can be downloaded to the device using *BLOB FW update*-capable tools or controllers.

Info

Changes to the device firmware should only be carried out by trained specialist personnel and during specially designated maintenance periods. Before recommissioning, it must be ensured that the device parameters are correct and that the device is working properly.

Info

The device will signalize the update process by blinking in a specific pattern.

ISDU / System Commands

There are a number of defined ISDUs and system commands to control the feature, but these are not explained further here. Necessary sequences are stored in BLOB-FW update-capable tools and do not have to be used explicitly.

Password protection disabled

During the update, the tool will **not** request a password that must be entered.

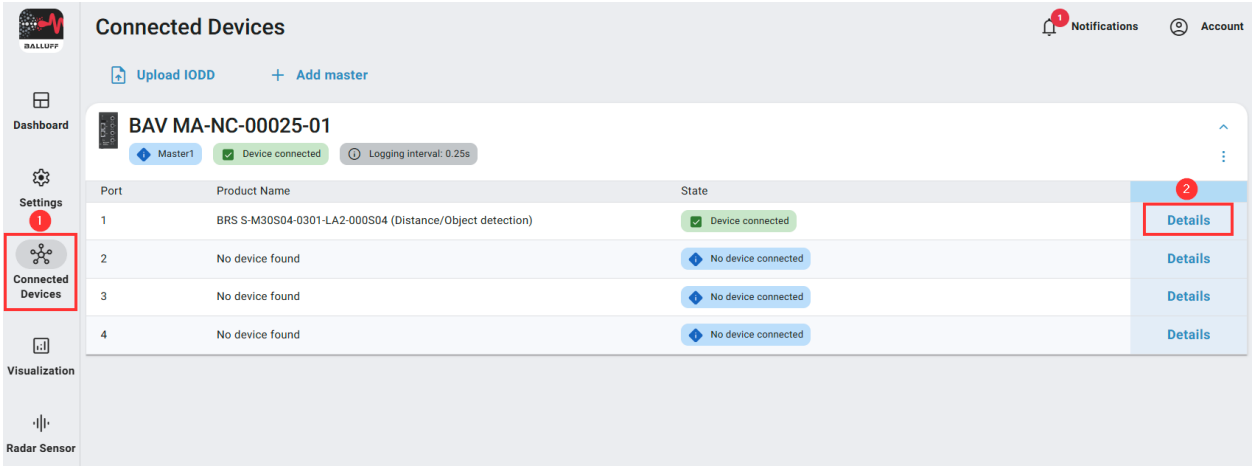
Balluff Engineering Tool (BET)

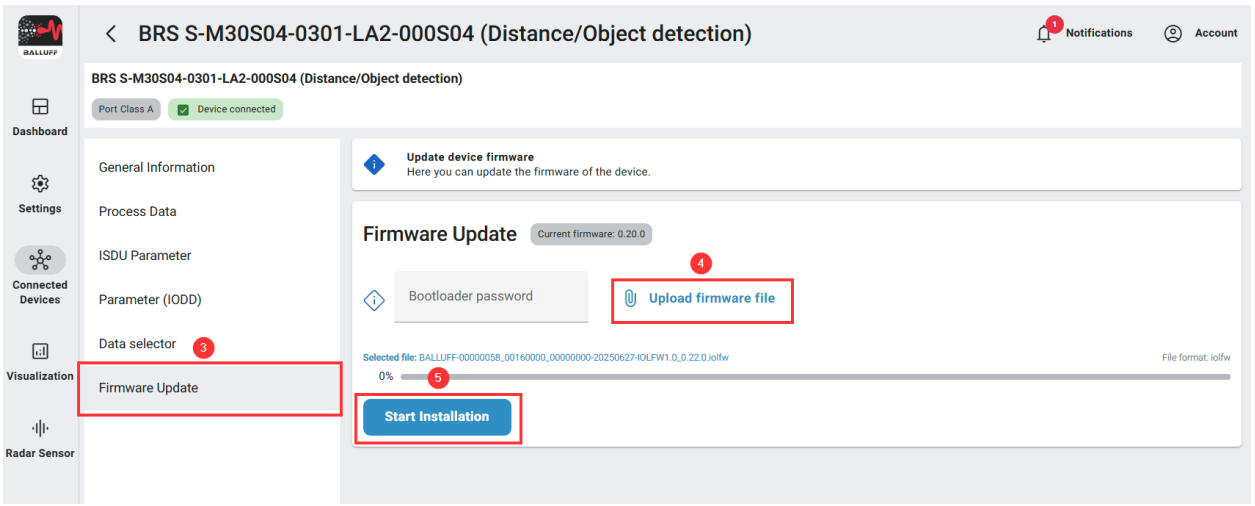
We recommend using the Balluff Engineering Tool for the system. A very simple integration of the Balluff Update Platform and the update mechanisms is implemented there. Documentation for the update via BET can be found here

Condition Monitoring Toolkit (CMTK)

The update process can be started from the device details page.

1. Click on “Connected Devices” on the left hand side
2. Click on “Details” of the sensor you would like to update
3. Select “ Firmware Update”
4. Select and upload an *.iolfw* update file via the “Upload firmware file” button
5. After an successfull upload start the installation on the sensor by clicking the “Start installation” button





Info

If the update fails, please repeat step 5 or contact the Balluff support.

CHAPTER

SIX

INSTALLATION AND CONNECTION

6.1 Installation

Note

For dimensions, see *Product description*.

Note

You can find mounting accessories under **www.balluff.com** on the product page.

► Fasten the module with the M18 nut and a tightening torque of 6-8 Nm. (see fig-product-overview).

The use of a tooth lock washer is recommended in environments subject to heavy vibrations.

6.2 Electrical connection

6.2.1 Power supply

NOTICE

Unwanted voltage dips
► Make sure that the power supply of the device is sufficiently dimensioned to cover start-up and peak currents and design the fuse protection concept accordingly.

NOTICE

Loss of function and property damage
Improper installation, e.g. due to misconnection or incorrect polarity of the connections, can result in a loss of the function and property damage.
► Take measures to prevent misconnection or polarity reversal.
► Prevent tampering at the connections.
► Never exceed the value of 36 V between any of the pins.

Note

For UL: observe cable requirements and power supply requirements (see *Underwriters Laboratories (UL)*).

The supply voltage for the module is provided via the IO-Link interface from the higher-level IO-Link master.

6.2.2 IO-Link interface

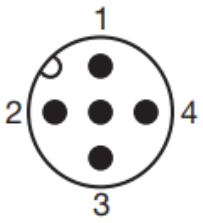


Fig. 1: IO-Link port (M12, A-coded, plug)

PIN	Function IO-Link mode	Function IO-Link with extension port mode	Function SIO mode
1	US - Supply voltage for the module	US - Supply voltage for the module	US - Supply voltage for the module
2	n.c.[1]	C/Q for the secondary device	Digital Input 1
3	GND, reference potential	GND, reference potential	GND, reference potential
4	C/Q (from master device)	C/Q (from master device)	Digital Input 2
5	n.c.[1]	n.c.[1]	Digital Input 3

6.3 Cable routing

The connection to the higher-level IO-Link master or programmable controller is made with a standard sensor cable. Depending on the selected operating mode, the cable must have 3, 4 or 5 wires.

Cable length

The connection cable may be max. 20 meters long in case of IO-Link mode and SIO mode. Additional max. 20 m cable may be there between the primary device and secondary device in case of Extension port mode.

[1] Not connected

CHAPTER

SEVEN

SYSTEM INTEGRATION

Parameter settings are necessary. For detailed information, see *IO-Link interface*.

The module must be integrated into the control system. The corresponding IODD file is used for this.

Note

The IODD can be downloaded free of charge from **www.balluff.com**.

Note

For a detailed description of the interface and the data provided here, see the *IO-Link interface*.

CHAPTER

EIGHT

STARTUP AND OPERATION

8.1 Startup

DANGER

Uncontrolled system movement
When starting up, if the BNI module is part of a closed loop system whose parameters have not yet been set, the system may perform ncontrolled movements. This could result in personal injury and equipment damage.
► Persons must keep away from the system's hazardous zones.
► Startup must be performed only by trained technical personnel.
► Observe the safety instructions of the equipment or system manufacturer.

1. Check connections for tightness and correct polarity. Replace damaged connections.
2. Turn on the system.
3. Check adjustable parameters and reconfigure the BNI if necessary.

Note

Check for the correct values, especially after replacing the BNI or after repair by the manufacturer

8.2 Operating notes

- Regularly check function of the BNI and all associated components.
- Depending on the operating conditions, it may be necessary to regularly check and, if necessary, retighten the tightening torques of the plugs and caps to maintain the protection classes (see *Installation and connection*).
- Direct UV radiation can lead to discoloration of the housing. However, this possible discoloration has no influence on the mechanical properties described.
- Take the hub out of service whenever there is a malfunction.
- Secure the system against unauthorized use.
- Check fasteners and retighten if needed.

8.3 Cleaning

> **Note**
>
> UL requirements, see in chapter *Technical Data*

The product may only be cleaned when switched off.

► Clean the product regularly.

The cleaning intervals depend on the ambient conditions and the frequency of use.

8.4 Maintenance

The product is maintenance-free.

Depending on the operating conditions, it may be necessary to regularly check and, if necessary, retighten the tightening torques of the plugs and caps to maintain the protection classes (see chapter *Installation and connection*).

CHAPTER

NINE

DECOMMISSIONING

9.1 Disassembly

► Only disassemble the device when it is de-energized!

9.2 Disposal

► Observe the national regulations for disposal.

> **Note**
>
> Additional information can be found at www.balluff.com on the product page.

CHAPTER

TEN

SUPPORT

10.1 Repair

Repairs to the product may only be performed by Balluff. If the product is defective, contact our technical customer service.

Headquarters and Technical Service Hubs

www.balluff.com/go/contact

Headquarters and Technical Service Hub Region EMEA	**Technical Service Hub Region APAC**	**Technical Service Hub Region Americas**
Balluff GmbH Zabergäustraße 8 73765 Neuhausen a.d.F. Germany	Balluff Automation (Shanghai) Co., Ltd. No. 800 Chengshan Rd, 8F, Building A, Yunding International Commercial Plaza 200125, Pudong, Shanghai	Balluff Inc. 8125 Holton Drive Florence, KY 41042 USA

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