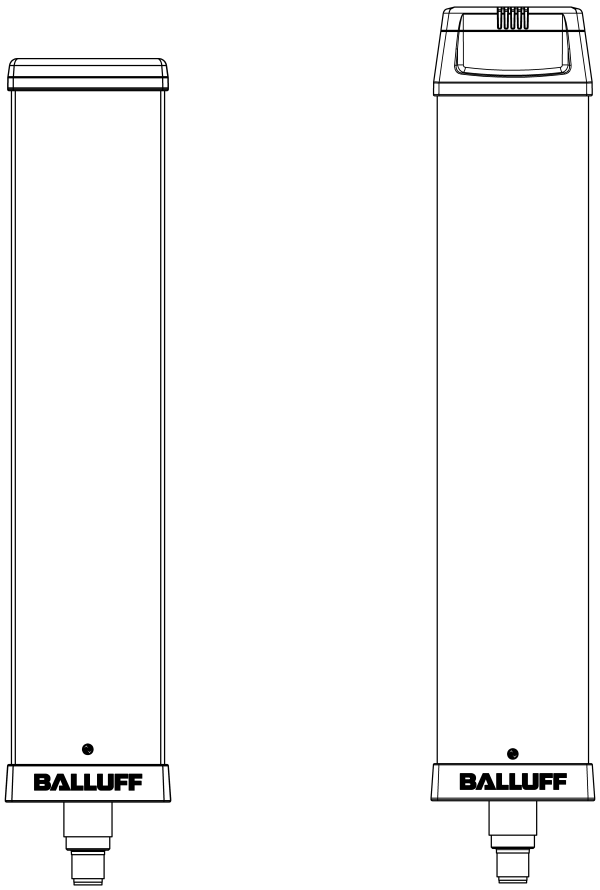
BALLUFF

BNI IOL-802-000-Z036
BNI IOL-802-000-Z036-006
BNI IOL-802-000-Z037
BNI IOL-802-000-Z037-006

Smart Light
User's Guide



Content

1 Notes to the user

1.1 Structure of the guide

The guide is organized so that the sections build on one another.
Section 2: Basic safety information.
Section 3: The main steps for installing the device.
….

1.2 Typographical conventions

The following typographical conventions are used in this Guide.

Enumerations

Enumerations are shown in list form with bullet points.

- Entry 1,
- Entry 2.

Actions

Action instructions are indicated by a preceding triangle. The result of an action is indicated by an arrow.

- ➢ Action instruction 1.
  - ↳ Action result.
- ➢ Action instruction 2.

Syntax

Numbers:
Decimal numbers are shown without additional indicators (e.g. 123),
Hexadecimal numbers are shown with the additional indicator $_{hex}$ (e.g. 00_{hex}).

Cross-references

Cross-references indicate where additional information on the topic can be found.

1.3 Symbols

Attention!
This symbol indicates a security notice which must be observed.

Note
This symbol indicates general notes.

1.4 Abbreviations

BNI	Balluff Networking Interface
DPP	Direct Parameter Page
EMC	Electromagnetic Compatibility
FE	Function Earth
IOL	IO-Link
ISDU	Indexed Service Data Unit

1.5 Deviating views

Product views and illustrations in this guide may differ from the actual product. They are intended only as illustrative material.

2 Safety

2.1 Intended use

This guide describes the Balluff BNI IOL-802-000-Z03x for the application as status light module. Hereby it is about an IO-Link device which communicates by means of IO-Link protocol with the superordinate IO-Link master assembly.

2.2 Installation and startup

Attention!
Installation and startup are to be performed only by trained specialists. Qualified personnel are persons who are familiar with the installation and operation of the product, and who fulfills the qualifications required for this activity. Any damage resulting from unauthorized manipulation or improper use voids the manufacturer's guarantee and warranty. The Operator is responsible for ensuring that applicable of safety and accident prevention regulations are complied with.

2.3 General safety instructions

Commissioning and inspection
Before commissioning, carefully read the operating manual.
The system must not be used in applications in which the safety of persons is dependent on the function of the device.
Authorized Personnel
Installation and commissioning may only be performed by trained specialist personnel.
Intended use
Warranty and liability claims against the manufacturer are rendered void by:

- Unauthorized tampering
- Improper use
- Use, installation or handling contrary to the instructions provided in this operating manual

Obligations of the Operating Company
The device is a piece of equipment from EMC Class A. Such equipment may generate RF noise. The operator must take appropriate precautionary measures. The device may only be used with an approved power supply. Only approved cables may be used.
Malfunctions
In the event of defects and device malfunctions that cannot be rectified, the device must be taken out of operation and protected against unauthorized use.
Intended use is ensured only when the housing is fully installed.

2.4 Resistance to aggressive substances

Attention!
The BNI modules generally have a good chemical and oil resistance. When used in aggressive media (eg chemicals, oils, lubricants and coolants each in high concentration (ie, low water content)) must be checked prior application-related material compatibility. In the event of failure or damage to the BNI modules due to such aggressive media are no claims for defects.

Hazardous voltage

Attention!
Disconnect all power before servicing equipment.

Note
In the interest of product improvement, the Balluff GmbH reserves the right to change the specifications of the product and the contents of this manual at any time without notice.

3 Getting Started

3.1 Overview BNI IOL-802-000-Z036

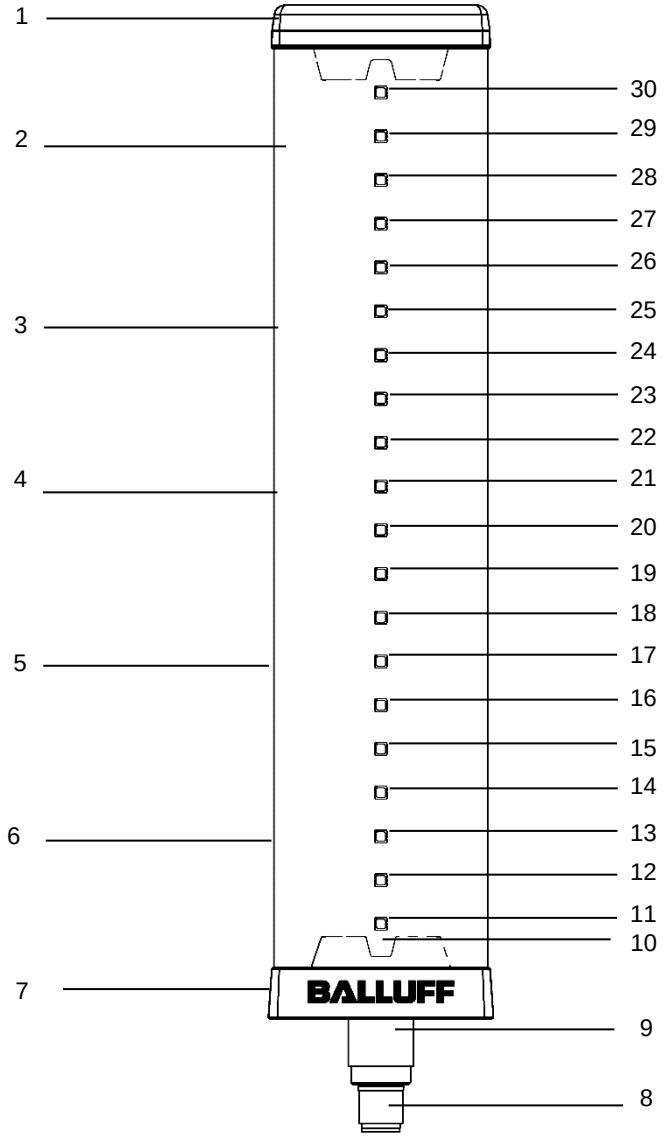


Fig. 3-1: BNI IOL-802-000-Z036

1	Cap	9	M18 thread for mounting	17	LED14	25	LED06
2	Segment 1	10	Status LED	18	LED13	26	LED05
3	Segment 2	11	LED20	19	LED12	27	LED04
4	Segment 3	12	LED19	20	LED11	28	LED03
5	Segment 4	13	LED18	21	LED10	29	LED02
6	Segment 5	14	LED17	22	LED09	30	LED01
7	Socket	15	LED16	23	LED08		
8	M12 connector	16	LED15	24	LED07		

3 Getting Started

3.2 Overview BNI IOL-802-000-Z037

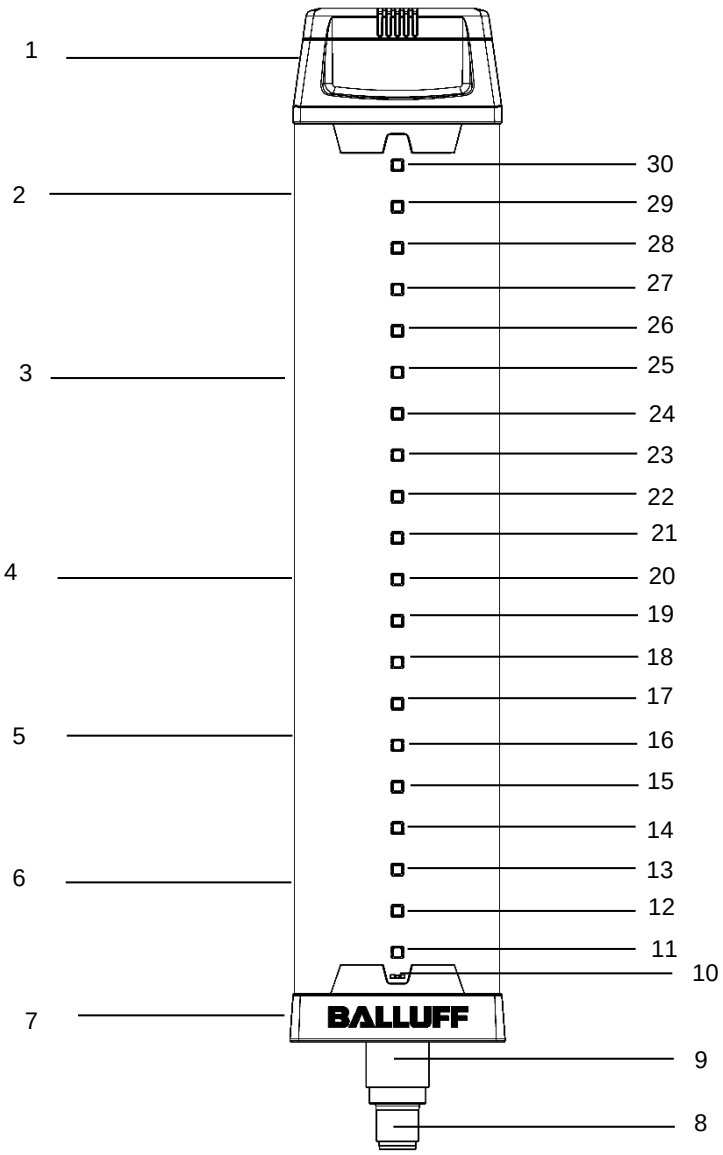


Fig. 3-2: BNI IOL-802-000-Z037

1	Cap with buzzer	9	M18 thread for mounting	17	LED14	25	LED06
2	Segment 1	10	Status LED	18	LED13	26	LED05
3	Segment 2	11	LED20	19	LED12	27	LED04
4	Segment 3	12	LED19	20	LED11	28	LED03
5	Segment 4	13	LED18	21	LED10	29	LED02
6	Segment 5	14	LED17	22	LED09	30	LED01
7	Socket	15	LED16	23	LED08		
8	M12 connector	16	LED15	24	LED07		

3 Getting Started

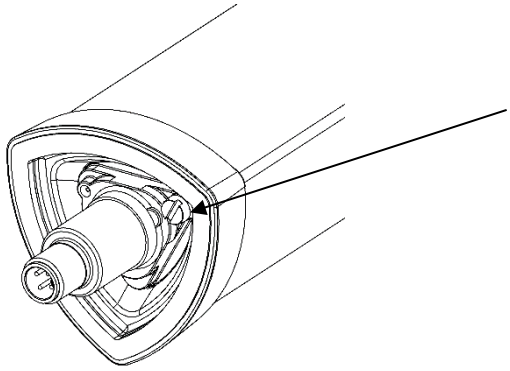
3.3 Mechanical connection

The BNI IOL-802-000-Z03x modules are attached by using an M18 nut.

3.4 Electrical connection

The BNI IOL-802-000-Z03x modules require no separate supply voltage connection. Power is provided through the IO-Link interface by the host IO-Link Master.

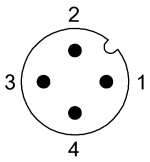
3.5 Function ground



Note
The FE connection from the housing to the machine must be low-impedance and as short as possible. There is no need to use an additional FE connection if a low impendance connection to FE can be assured through the M18 Smart Light connector thread.

3.6 IO-Link connection

IO-Link (M12, A-coded, male)



Pin	Function
1	Power supply controller, +24V
2	-
3	GND, reference potential
4	C/Q, IO-Link Data transmission channel

Smart Light connection

- Connection protection ground to FE terminal, if present.
- Connect the incoming IO-Link line to the Smart Light.

Note
A standard 3 wire sensor cable is used for connecting to the host IO-Link master.

Module versions

Version	Description
BNI IOL-802-000-Z036	Maximum 5 segment configurable signal light with level meter, runlight mode and flexible mode.
BNI IOL-802-000-Z036-006	Maximum 5 segment configurable signal light with level meter, runlight mode and flexible mode. In die-cast zinc housing with chrome finishing.
BNI IOL-802-000-Z037	Maximum 5 segment configurable signal light with level meter, runlight mode, flexible mode and buzzer.
BNI IOL-802-000-Z037-006	Maximum 5 segment configurable signal light with level meter, runlight mode, flexible mode and buzzer. In die-cast zinc housing with chrome finishing.

3 Getting Started

3.7 Short description of the functionality

The functionality of the Balluff status light module can be controlled through process data and ISDU registers. It has four main mode of functionality:

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

With the help of these four modes various warning and indication signals can be indicated. The buzzer function is available in all modes. The synchronisation* is available in segment and runlight mode and if the Smartlight contains buzzer it is also available in level and flexible mode.

3.8 Segment mode

To use the module as a standard status light, the Mode ISDU register must be set to segment mode. In the segment mode the module can be used as a standard status light, with configurable number of segments. Maximum five segments can be set. Irrespectively of the selected number of segments, always all of the LEDs are used as a display element. The number of the segments can be set any number between 1 and 5. The module has 20 LEDs, which are equally distributed between the segments. (When three segments are set, one-one LEDs between the segments will be always switched off). The color of each segment can be selected from a color table, which has six pre-defined colors and one user defined color. The combinations of the pre-defined colors are not limited. In the segment mode, the segments can be set to blink too. Each segment has a control bit in process data, which determines the blinking of the corresponding segment. The blinking has two modus. Either normal blinking or flash mode can be selected. In normal blinking the LEDs are switched on and off periodically with a 50% duty cycle. In the flash mode, the LEDs are switched on and off quickly three times. The flash is repeated in every second. The type of the blinking can be set in ISDU register. The frequency of the normal blinking can be changed through an ISDU register.

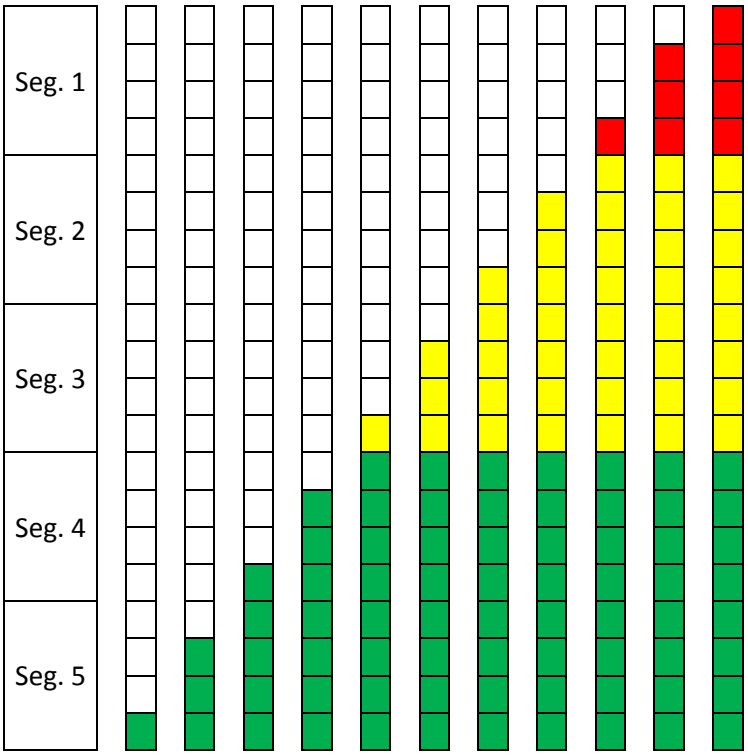
3.9 Level mode

To use the signal light as a level meter, the Mode ISDU register must be set to level mode. In level mode the complete module works as one indicator element. In this case a level value can be displayed. The process data does not give the colors of the segment, but the level. 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 resolution of the input level can be selected from 8 bit up to 16 bit. In the level mode various parameters can be controlled through ISDU registers. These parameters should be set before the level mode is used. 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 five virtual segments. These virtual segments can have their own color. The color of these segments can be set through ISDU register (Level mode segment x color ISDU register). 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.

For example:
The lower two segments are green, the middle two segments are yellow and the upper segment is red. The LEDs are shown in the next figures, when the Smartlight level mode is configured differently.

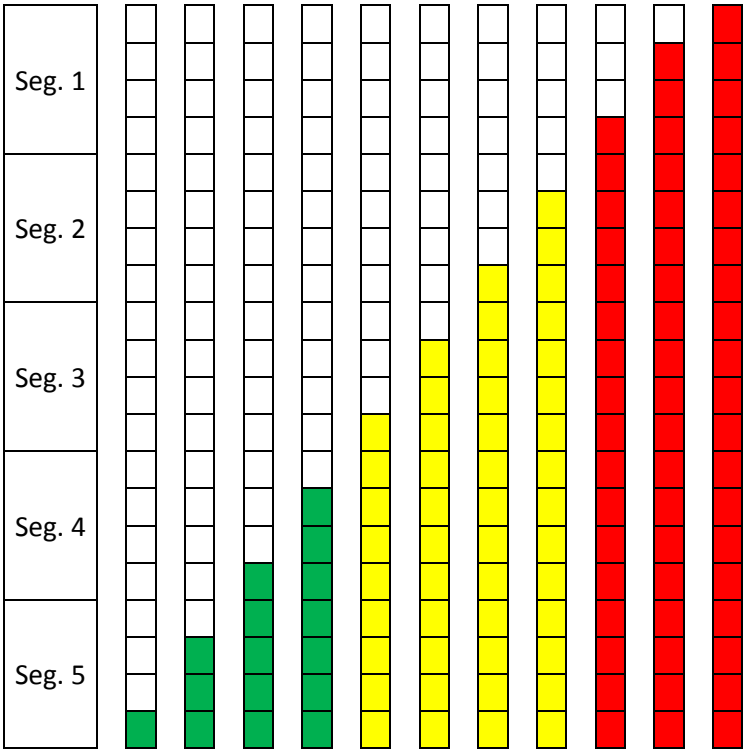
*Available from software version 3.0

The LED bar at increasing input data and no color dominance. (The virtual segments can be seen on the left side.) Of course the segment 2 or 4 does not have to be the same color as segment 3 or 5.



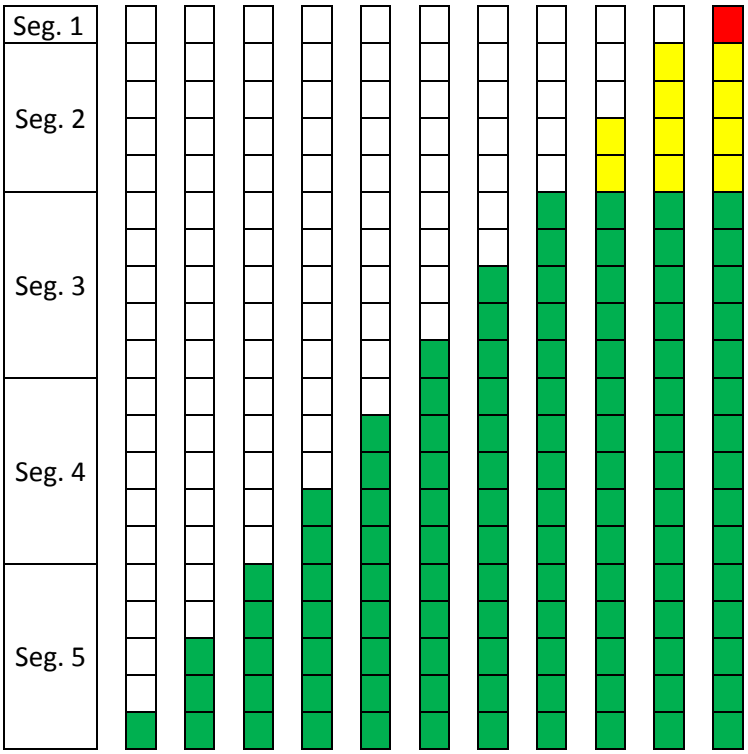
3 Getting Started

The LED bar at increasing input data, all the colors are dominant.



By default the 20 LEDs are divided into equal virtual segments. The height of the virtual segments can be modified too. There are four ISDU registers (Level mode limit x-y ISDU register), in which the limits of the virtual segments can be modified. For example: If the input level value is higher than the limit value of the 2. and 3. segment (Level mode limit 2-3), the current LED will become the color of the Level mode segment 2 color. The limits can be given either in percent or in absolute value.

The LED bar at increasing input data, there is no color dominance. The limits of the segments are modified, so they are not equally distributed. Of course segment 3, 4 and 5 could have different colors too.



3.10 Runlight mode

To use the module as a runlight display, the Mode ISDU register must be set to runlight mode. 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 runlight mode is controlled by ISDU registers.
Four registers set the functionality of the runlight. The color of the running LEDs, the background color, the number of the running segments and the speed of the running segment can be set in the ISDU registers. One segment has a size of 4 LEDs. The number of the running segment can be set between 1 and 3.

3 Getting Started

3.11 Flexible mode

In the flexi mode each LED-ring can be configured individually. With BNI IOL-802… you can realize up to 20 different segments. To use the flexi mode, the ISDU register must be set to flexi mode. There is an ISDU register for each LED ring, which has 5 subindices, 3 for the color channels, one for brightness ON and one for brightness OFF. In the process data there is one bit for every LED-ring, which sets the LED state (ON or OFF)

3.12 Synchronisation

In synchronisation mode you can syncronise functions (blinking, flashing, buzzer) of several Balluff SmartLights. The function is available in runlight- and segment mode. The synchronisation is controlled by 2 bits in the process data: (Sync Start and Sync Impluse). 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. 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 (blinking, flashing, buzzer).

4 IO-Link Interface

4.1 IO-Link Data

The BNI IOL-802-000-Z036 and BNI IOL-802-000-Z037 Smart Light modules have 3 byte output process data. The output process data has different meaning depending on the selected mode (segment mode, level mode, runlight mode or flexible mode).

BNI IOL-802-000-Z036, BNI IOL-802-000-Z037		
Data transmission rate	COM2 (38,4 kBaud)	
Minimal cycle time	5 ms	
Process data length	3 Byte output	
IO-Link Revision	**1.1**	**1.0**
Frame type	2.V	1
Process data cycle time*	5 ms	30 ms

* by min. cycle time

4.2 Process data / Output data

BNI IOL-802-000-Z03x, Segment Mode

Byte	**0**								**1**							
Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Description	Segment 2 blink	Segment 2 color			Segment 1 blink	Segment 1 color			Segment 4 blink	Segment 4 color			Segment 3 blink	Segment 3 color		

Byte	**2**							
Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Description	Buzzer state	Sync impulse	Sync start	-	Segment 5 blink	Segment 5 color		

Bit definitions in segment mode

Bit 0-2/4-6, Segment color

000 = Off
001 = Green
010 = Red
011 = Yellow
100 = Blue
101 = Orange*
110 = User defined*
111 = White

*color is available from software version 2.1

Bit 3, Segment blink

0 – Segment does not blink
1 – Segment blinks according to the blink modus settings

Bit 7, Buzzer state
(Only in case of BNI IOL-802-000-Z037)

0 – Buzzer is off
1 – Buzzer is on

Bit 5/6, Sync start/Sync impulse
(available from software version 3.0)

These bits are rising edge sensitive

4 IO-Link Interface

BNI IOL-802-000-Z03x, Level Mode

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Description	MSB	8 bit level value						LSB								
	MSB	10 bit level value								LSB						
	MSB	12 bit level value										LSB				
	MSB	14 bit level value													LSB	
	MSB	16 bit level value														LSB

Byte	2							
Bit	7	6	5	4	3	2	1	0
Description	Buzzer state	Sync impulse	Sync start	-	-	-	-	-

Bit definitions in level mode

Level value
The 8, 10, 12, 14 or 16 bit value for level indicator. The resolution can be set in Level resolution ISDU register. The Level value is always left justified.

Bit 7, Buzzer state
(Only in case of BNI IOL-802-000-Z037)

0 – buzzer is off
1 – buzzer is on

Bit 5/6, Sync start/Sync impulse
(available from software version 3.0)

These bits are rising edge sensitive

BNI IOL-802-000-Z03x, Runlight Mode

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Description	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Byte	2							
Bit	7	6	5	4	3	2	1	0
Description	Buzzer state	Sync impulse	Sync start	Run direction	-	-	-	-

Bit definitions in runlight mode

Bit 7, Buzzer state
(Only in case of BNI IOL-802-000-Z037)

0 – buzzer is off
1 – buzzer is on

Bit 4, Run direction
(available from software version 4.0)

0 – bottom-up
1 – top-down

Bit 5/6, Sync start/Sync impulse
(available from software version 3.0)

These bits are rising edge sensitive

4 IO-Link Interface

BNI IOL-802-000-Z03x, Flexible Mode

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Description	LED08 state	LED07 state	LED06 state	LED05 state	LED04 state	LED03 state	LED02 state	LED01 state	LED16 state	LED15 state	LED14 state	LED13 state	LED12 state	LED11 state	LED10 state	LED09 state

Byte	2							
Bit	7	6	5	4	3	2	1	0
Description	Buzzer state	Sync impulse	Sync start	-	LED20 state	LED19 state	LED18 state	LED17 state

Bit definitions in flexible mode

Bit 7, Buzzer state
(Only in case of BNI IOL-802-000-Z037)

0 – buzzer is off
1 – buzzer is on

Bit 0-8/0-4, LEDxx state

0 – LED is off
1 – LED is on

Bit 5/6, Sync start/Sync impulse
(available from software version 3.0)

These bits are rising edge sensitive

4.3 Parameter data/ Request data

	DPP	ISDU		Object name	Length	Access right	Default Value
	Index	Index	Sub-index				
Identification Data	07hex			Vendor ID	2 Byte	Read only	0378hex
	08hex						
	09hex			Device ID	3 Byte		050A01 hex 050A03hex
	0Ahex						
	0Bhex						
		10hex	0	Vendor name	7 Byte		BALLUFF
		11hex	0	Vendor text	15 Byte		www.balluff.com
		12hex	0	Product name	20 Byte 24 Byte		BNI IOL-802-000-Z036 BNI IOL-802-000-Z036-006 BNI IOL-802-000-Z037 BNI IOL-802-000-Z037-006
		13hex	0	Product ID	7 Byte		BNI007F BNI0072
		14hex	0	Product text	21 Byte 28 Byte 33 Byte 40 Byte		Smart Light 5 segment Smart Light 5 segment Chrome Smart Light 5 segment with buzzer Smart Light 5 segment with buzzer Chrome
		15hex	0	Serial Number	16 Byte		
		16hex	0	Hardware Revision	1 Byte		
		17hex	0	Firmware Revision	48 Byte		
		18hex	0	Application tag*	32 Byte	Read / Write	

* 32 Byte string adjustable by the user

4 IO-Link Interface

	ISDU		Object name	Length	Range	Default Value
	Index	Sub-index				
Parameter Data	40hex	0	Mode	1 Byte	0…3	0
	41hex	0	Number of segments	1 Byte	1…5	5
	42hex	0	Level type	1 Byte	0…1	0
	43hex	0	Level resolution	1 Byte	0…4	0
	44hex	0	Level mode segment 1 color	1 Byte	0_{hex}…F_{hex}	2hex
	45hex	0	Level mode segment 2 color	1 Byte	0_{hex}…F_{hex}	3hex
	46hex	0	Level mode segment 3 color	1 Byte	0_{hex}…F_{hex}	3hex
	47hex	0	Level mode segment 4 color	1 Byte	0_{hex}…F_{hex}	1hex
	48hex	0	Level mode segment 5 color	1 Byte	0_{hex}…F_{hex}	1hex
	49hex	0	Level mode limit 1-2	2 Byte	0_{hex}…$FFFF_{hex}$	80
	4Ahex	0	Level mode limit 2-3	2 Byte	0_{hex}…$FFFF_{hex}$	60
	4Bhex	0	Level mode limit 3-4	2 Byte	0_{hex}…$FFFF_{hex}$	40
	4Chex	0	Level mode limit 4-5	2 Byte	0_{hex}…$FFFF_{hex}$	20
	4Dhex	0	Runlight mode background color	1 Byte	0…7	0
	4Ehex	0	Runlight mode running color	1 Byte	0…7	1
	4Fhex	0	Runlight mode number of running segments	1 Byte	1…3	1
	50hex	0 1-2	Supply monitoring*	1 Byte	-	-
	51hex	0 1-3	Brightness	3 Byte	0_{hex}…$7F7F7F_{hex}$	$7F7F7F_{hex}$
	52hex	0	Blinking frequency / Runlight speed	1 Byte	1…5	2
	53hex	0	Blinking mode	1 Byte	0_{hex}…$1F_{hex}$	0hex
	54hex	0	Serial Number Set*****	16 Byte	-	16x00hex
	57hex	0 1-3	Operating Hours Counter**	12 Byte	-	-
	58hex	0	Boot Cycle Counter**	4 Byte	-	-
	59hex	0 1-5	Device Temperature**	5 Byte	-	-

*Read only
**Read only, available from software version 4.0
*****Available from software version 4.0

	ISDU		Object name	Length	Range	Default Value
	Index	Sub-index				
Parameter Data	A1hex	0 1-5	LED01 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$FF0000FF01_{hex}$
	A2hex	0 1-5	LED02 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$FF0000FF01_{hex}$
	A3hex	0 1-5	LED03 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$FF0000FF01_{hex}$
	A4hex	0 1-5	LED04 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$FF0000FF01_{hex}$
	A5hex	0 1-5	LED05 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$808080FF01_{hex}$
	A6hex	0 1-5	LED06 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$808080FF01_{hex}$
	A7hex	0 1-5	LED07 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$808080FF01_{hex}$
	A8hex	0 1-5	LED08 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$808080FF01_{hex}$
	A9hex	0 1-5	LED09 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$00FF00FF01_{hex}$
	AAhex	0 1-5	LED10 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$00FF00FF01_{hex}$
	ABhex	0 1-5	LED11 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$00FF00FF01_{hex}$
	AChex	0 1-5	LED12 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$00FF00FF01_{hex}$
	ADhex	0 1-5	LED13 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$FFFF00FF01_{hex}$
	AEhex	0 1-5	LED14 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$FFFF00FF01_{hex}$
	AFhex	0 1-5	LED15 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$FFFF00FF01_{hex}$
	B0hex	0 1-5	LED16 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$FFFF00FF01_{hex}$
	B1hex	0 1-5	LED17 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$0000FFFF01_{hex}$
	B2hex	0 1-5	LED18 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$0000FFFF01_{hex}$
	B3hex	0 1-5	LED19 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$0000FFFF01_{hex}$
	B4hex	0 1-5	LED20 settings****	5 Byte	0_{hex}…$FFFFFFFFFF_{hex}$	$0000FFFF01_{hex}$
	FBhex	0	Safe State*****	1 Byte	0…1	0
	FChex	0 1-3	User color***	3 Byte	0_{hex}…$FFFFFF_{hex}$	008080hex
	FDhex	0	Limit type***	1 Byte	0…1	0
	FEhex	0 1-2	Buzzer *****	2 Byte	0_{hex}…$3FF_{hex}$	07Fhex

**Only in case of BNI IOL-802-000-Z037
***Available from software version 2.1
****Available from software version 3.0
*****Available from software version 4.0

4 IO-Link Interface

Mode
40hex

The operating mode of the Smart Light can be selected in the Mode ISDU register.

0 = Segment mode
1 = Level mode
2 = Runlight mode
3 = Flexible mode*

*Available from software version 3.0

Number of segments
41hex

The number of the displayed segments can be set in this register. The minimum value for the segment number is one and the maximum value is five.

Note
When the module is configured to have 3 segments, 1-1 LED is always switched of between the segments.

Level type
42hex

The type of the level indicator.

0 = bottom up
1 = top down

Level resolution
43hex

The resolution of the input data in level mode.

0 = 8 bit
1 = 10 bit
2 = 12 bit
3 = 14 bit
4 = 16 bit

Level mode segment x color
44hex
45hex
46hex
47hex
48hex

Byte	0							
Bit	7	6	5	4	3	2	1	0
Description	-	-	-	-	Dominance	Segment x color	Segment x color	Segment x color

Bit 0-2, Color of the segment

000 = Off
001 = Green
010 = Red
011 = Yellow
100 = Blue
101 = Orange*
110 = User defined*
111 = White

*color is available from software version 2.1

Bit 3, Color dominance

0 - Color is not dominant
1 - Color is dominant

Level mode limit x-y
49hex
4Ahex
4Bhex
4Chex

The level limit values are interpreted either as a percent value or as an absolute value depending on the value of the Limit type register (FDhex). The values are interpreted as a percent value between 0% and 100% by default. When the Limit type is set to absolute value, an 8, 10, 12, 14, 16 bit number (depends on the resolution) determines the limits between two segments in level mode. The limit values are always right justified.

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Limit type is absolute									MSB 8 bit limit value LSB							
							MSB 10 bit limit value LSB									
					MSB 12 bit limit value LSB											
			MSB 14 bit limit value LSB													
	MSB 16 bit limit value LSB															
Limit type is percent	Percent value: 0 – 100															

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

4 IO-Link Interface

Runlight mode, background color 4Dhex

Byte	0							
Bit	7	6	5	4	3	2	1	0
Description	-	-	-	-	-	Background color		

The background of the runlight effect can be set in this register.

Bit 0-2, Background color

000 = Off
001 = Green
010 = Red
011 = Yellow
100 = Blue
101 = Orange*
110 = User defined*
111 = White

*color is available from software version 2.1

Runlight mode, running color 4Ehex

Byte	0							
Bit	7	6	5	4	3	2	1	0
Description	-	-	-	-	-	Running color		

The color of the running segment in runlight mode can be set in this register.

Bit 0-2, Running color

000 = Off
001 = Green
010 = Red
011 = Yellow
100 = Blue
101 = Orange*
110 = User defined*
111 = White

*color is available from software version 2.1

Runlight mode, number of running segments 4Fhex

Number of the running segments. Each segment contains 4 LED. Values between 1 and 3 can be set.

Supply monitoring 50hex

Bit	7	6	5	4	3	2	1	0
Sub Index							2	1
Description	-	-	-	-	-	-	LED Voltage failure	Under voltage Us

Under voltage Us
0: Us voltage is Ok
1: Low voltage on IO-Link pin 1

LED Voltage failure
0: LED Voltage is Ok
1: LED Voltage failure

Brightness 51hex

This register sets the brightness for each channel (red, green and blue). Values from 0x00 to 0x7F are accepted for each channel. This register can be accessed through the subindices 0, 1, 2 or 3. Reading/writing the subindex 0 the whole 3 byte brightness data can be accessed. Subindex 1, 2 and 3 contains the brightness data for red, green and blue channels.

Byte	0	1	2
Sub Index	1	2	3
Description	Brightness value for red channel	Brightness value for green channel	Brightness value for blue channel

4 IO-Link Interface

Blinking frequency / Runlight speed 52hex

The frequency of the blinking in segment mode and the speed of the running segment in runlight mode can be set in this register. Values between 1 and 5 are accepted. One means the slowest and five means the fastest blinking or running speed.

Note
The blinking frequency is only valid for 50% duty cycle blinking. The frequency of the flashing cannot be changed.

Blinking mode 53hex

Byte	1							
Bit	7	6	5	4	3	2	1	0
Description	-	-	-	Segment 5 flashing	Segment 4 flashing	Segment 3 flashing	Segment 2 flashing	Segment 1 flashing

The segment X flashing bit sets the mode of the blinking.

0 - blinking with 50% duty cycle
1 - flashing

Note
Through this register only the mode of the blinking can be set (either 50% duty cycle or flash). The blinking of the desired segment must be activated in process data to enable blinking.

Setting the serial number 54hex

The serial number has a default value of 16x 00_{hex}.
In order to use the "Identity" master validation mode, a serial number can be set using this parameter.
This prevents a device from connecting to the wrong master port.

Note
It is recommended to set a unique serial number for each device, and use the “Indentity” master validation mode.

Operating Hours Counter 57hex

The register contains the operating hours of the device.
Operating Hours (Subindex1): operating hours during lifetime, not resettable.
Opterating Hours Maintenance (Subindex 2): operating hours, resettable with system command 0xA5.
Operating Hours Power Up (Subindex 3): operating hours since last power up.

Byte	3	2	1	0	3	2	1	0	3	2	1	0
Sub-index	1				2				3			
Description	Operating Hours				Operating Hours Maintenance				Operating Hours Power Up			

Boot Cycle Counter 58hex

Boot Cycle Counter counts the number of start-ups.

Byte	3	2	1	0
Sub-index	0			
Description	Boot Cycle Counter			

Device Temperature 59hex

The device measures its temperature and stores the minimum and maximum temperature values during life-time and since last start-up.

The temperature value is stored as a signed 8 bit integer (from -128°C to 127°C), with 1°C resolution.

For example:
$1E_{hex} = 30_{dec} = 30°C$
$FD_{hex} = -3_{dec} = -3°C$

Byte	0	1	2	3	4
Sub-index	1	2	3	4	5
Description	Actual Temperature Value (ºC)	Max. Temperature Value Since Last Start (ºC)	Min. Temperature Value Since Last Start (ºC)	Max. Temperature Value Since First Start (ºC)	Min. Temperature Value Since First Start (ºC)

4 IO-Link Interface

Flexible mode, LEDxx settings A1hex...B4hex

This register contains the settings for the flexible LEDs. Values from 0x00 to 0xFF are accepted for each setting. This register can be accessed through the subindices 0, 1, 2, 3, 4 or 5. Reading/writing the subindex 0 the whole 5 byte data can be accessed. Subindex 1, 2 and 3 contains the red, green and blue color component, subindex 4 is the ON brightness and subindex 5 is the OFF brightness.

Note
These registers are available from software version 3.0.
The Brightness ISDU register (51hex) determines the maximum brightness of each channel. It is recommended to set the Brightness ISDU register's value to 7F7F7Fhex in case of using flexible mode.

Byte	0	1	2	3	4
Sub Index	1	2	3	4	5
Description	LED color, red channel	LED color, green channel	LED color, blue channel	On brightness	Off brightness

Safe State FBhex

The safe state function can be activated with this register.

0 = Not Active
1 = Active

Safe state not active: when there is no IO-Link communication all LEDs are switched off.
Safe state active: when there is no IO-Link communication segment 1 blinks red, with 5 Hz frequency.

User color FChex

This register sets the value of the user defined color. Values from 0x00 to 0xFF are accepted for each channel. This register can be accessed through the subindices 0, 1, 2 or 3. Reading/writing the subindex 0 the whole 3 byte user color data can be accessed. Subindex 1, 2 and 3 contains the red, green and blue channel data for the user color.

Note
This register is available from software version 2.1.

Byte	0	1	2
Sub Index	1	2	3
Description	User defined color, red channel	User defined color, green channel	User defined color, blue channel

Limit type FDhex

The limit registers are evaluated either as a percent value or as an absolute value. The Limit type register sets the type of the evaluation.

0x00 – Limit type is given in a percent value
0x01 – Limit type is given in an absolute value

Note
This register is available from software version 2.1.

Buzzer FE$_{hex}$

This register is available only for BNI IOL-802-000-Z037. The type and volume of the buzzer sound can be set in this register.

Byte	0	1
Sub-index	1	2
Description	Buzzer Type	Buzzer Volume

Buzzer Type:
0 = continuous sound
1 = 1 Hz chopped sound
2 = 5 Hz chopped sound
3 = 3 short beep, 2 sec pause

Buzzer Volume:
Range: 0-255
0: minimum volume
255: maximum volume

4.4 Errors

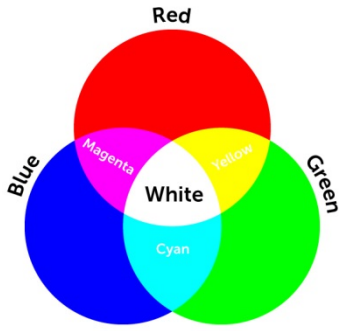
Error Code	Description
0x8011	Index not available
0x8012	Subindex not available
0x8023	Access Denied
0x8030	Parameter Value out of Range
0x8033	Parameter length overrun
0x8034	Parameter length underrun

4.5 Events

IO-Link Revision 1.0	
Event Code	**Description**
0x5112	Low supply voltage (US)
IO-Link Revision 1.1	
Event Code	**Description**
0x5111	Low supply voltage (US)

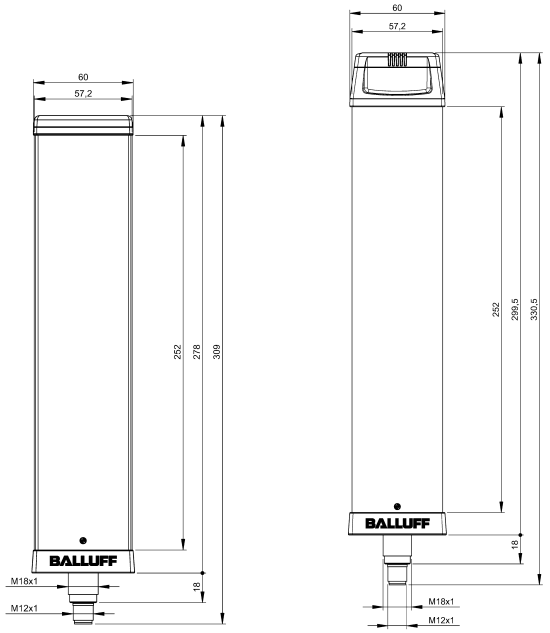
4.6 RGB Color

The RGB color model is an additive color model in which red, green and blue light are added together in various ways to reproduce a broad array of colors. The name of the model comes from the initials of the three additive primary colors, red, green and blue.
By changing the respective red - green - blue channels different colors can be created



5 Technical Data

5.1 Dimensions



BNI-IOL-802-000-Z036-xxx BNI IOL-802-000-Z037-xxx

5.2 Mechanical data

Housing Material	BNI IOL-802-000-Z03x: Polycarbonate transparent - die-cast zinc housing BNI IOL-802-000-Z03x-006: Polycarbonate transparent – die-cast zinc housing with chrome finishing
IO-Link-Port	M12, A-coded, male
Enclosure rating	BNI IOL-802-Z036-xxx IP65 (only when plugged-in) BNI IOL-802-Z037-xxx IP30 (only when plugged-in)
Weight	BNI IOL-802-000-Z036-xxx: ca. 500 g BNI IOL-802-000-Z037-xxx: ca. 570 g
Dimensions (L × W × H, excluding connector)	BNI IOL-802-000-Z036-xxx: 309 × 60 × 60 mm BNI IOL-802-000-Z037-xxx: 330.5 × 60 × 60 mm

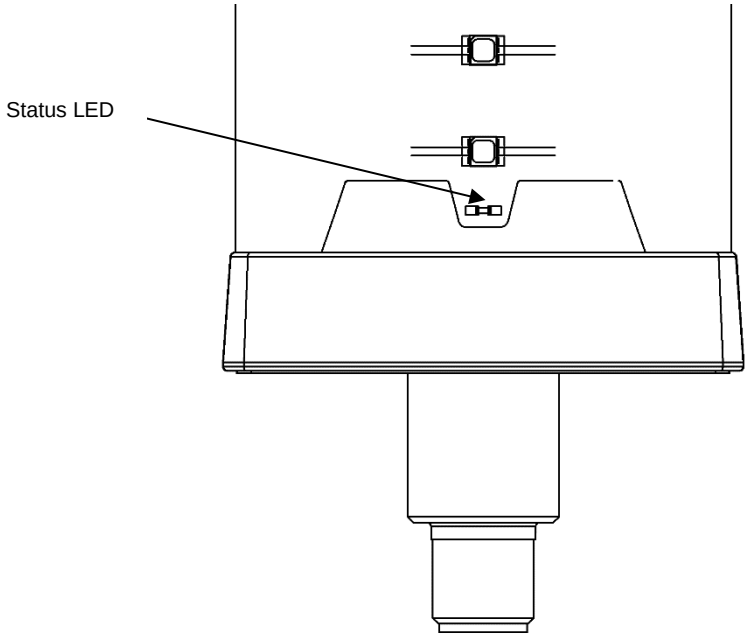
5.3 Electrical data

Operating voltage	18 ... 30,2 V DC, per EN 61131-2
Ripple	< 1 %
Current draw all segments off	≤ 40 mA @24V
Current draw all segments white, buzzer on	BNI IOL-802-000-Z036-xxx: ≤ 400 mA @ 24V BNI IOL-802-000-Z037-xxx: ≤ 410 mA @ 24V
Volume of the buzzer module	100dB at 1m distance
Tone frequency of the buzzer module	2800 ± 500 Hz
Total number of signal lights (all 3 pages)	3 x 20

5.4 Operating conditions

Operating temperature	-5 °C … +50 °C
Storage temperature	-15 °C … +50 °C

5.5 LED indicator



Status LED

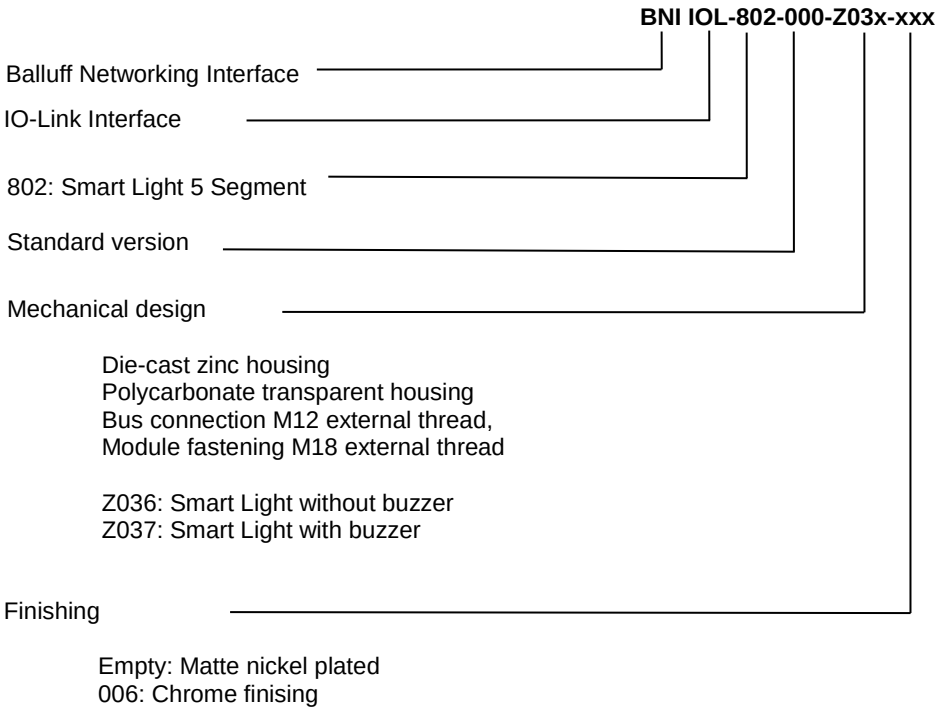
LED	Indicator	Function
Status LED	Green, green flashing	Status for supply and communication

The status LED indicates the current status of the power supply and the communication. It can be switched on, switched of and flashing.

	Communication error	Communication ok
Supply modul undervoltage	LED is static off	LED is flashing 
Supply module ok	LED is static on	LED is flashing 

6 Appendix

6.1 Product ordering code



6.2 Order information

Type	Order Code
BNI IOL-802-000-Z036	BNI0072
BNI IOL-802-000-Z036-006	BNI0081
BNI IOL-802-000-Z037	BNI0083
BNI IOL-802-000-Z037-006	BNI0084

Included material

BNI IOL-802-000-Z03x consists of the following components:

- signal light
- M18x1 nut
- rubber foot
- screw M4
- spring washer
- user's guide

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