Smart Light

Data sheet version: 1.07

1 Module description

After **Smart Camera**, the intelligent core element of **machine vision**, **Smart Light** is the second essential component in B&R's vision technology, which is fully integrated in the machine controller. With various flexible light bars (**Light Bar**) and backlights (**Backlight**), a wide range of lighting components is available for mastering a multitude of difficult lighting situations.

Smart Light modules are fully integrated real-time fieldbus devices. That means that the lighting is directly integrated into the machine's real-time network via POWERLINK. The protocol is not only used for high-precision synchronization with control and drive technology, but also for transferring information for the HMI application. Image triggers from the camera and lighting control can be set in hard real-time directly from the controller or drive application. This means that the integrated LEDs of a **Smart Camera** can be used to carry out a synchronized exposure (flash).

A single **Smart Light** module consists of multiple LED segments which in turn consist of multiple LED units. Individual **Smart Light** modules are then installed on the mounting plate in various arrangements (1x4, 2x2, etc.) and can be ordered as a separate product.

2 Smart Lights - Order number key

Code	Backlight	Light bar
Product area		
V	Integrated Machine Vision	Integrated Machine Vision
Product group		
S L B	Backlight	
S L L		Light bar
Expansion level / Size		
1 1	1x1 Backlight	1x1 Light bar
1 2	1x2 Backlight	1x2 Light bar
1 3	1x3 Backlight	1x3 Lightbar
1 4	1x4 Backlight	1x4 Light bar
2 2	2x2 Backlight	
2 3	2x3 Backlight	
R 4		4x1 Light bar ring light
R 6		6x1 Light bar ring light
R 8		8x1 Light bar ring light
LED lighting		
3	Blue	Blue
8	Red	Red
D	IR	IR
F	White	White
H	IR / White	IR / White
Q	R / G / B / Lime	R / G / B / Lime
R	R / B / IR / White	R / B / IR / White
LED lens		
0	Without LED lens	
1		LED lens type 1, wide beam
2		LED lens type 2, standard
3		LED lens type 3, narrow beam
Placeholder for future options		
0	Standard variant	Standard variant
Placeholder for future options		
. 5 4	Standard variant	
. 6 7		Standard variant
Front glass		
A		Plastic without anti-reflective coating
C	Plastic with polarizing filter	
D	Plastic diffuser	
E	Plastic with telecentric filter	
Variants		
P - 0 0 0	Standard variant	Standard variant
Examples		
V S L B 1 1 Q 0 0 . 5 4 D P - 0 0 0	Smart Light, 1x1 backlight, 5 LED segments with 5 multicolored LEDs each, without LED lens, plastic cover diffuser, POWERLINK interface with integrated 2-port hub	
V S L L 1 1 Q 2 0 . 6 7 A P - 0 0 0		Smart Light, 1x1 light bar, 4 LED segments with 4 multicolored LEDs each, type 2 LED lens, plastic cover without anti-reflective coating, POWERLINK interface with integrated 2-port hub

Information:

The order key serves as an overview and should make it easier to distinguish the existing modules. Not every order key combination is technically feasible and is therefore not available as an orderable module variant.

3 Smart Light - Backlight

3.1 Order data - General

Order number	Short description	Figure
	Smart Light	
VSLB11xx0.54xP-000	Backlight, 1x1 size, 5 LED segments with 5 multicolored LEDs each, IP51 protection, plastic cover, POWERLINK interface with integrated 2-port hub	

3.2 Technical data VSLB

This section contains the technical data for the individual configurable components of the lighting. The product name (material number) and order key of a lighting configuration can be used to determine the technical data of a specific **Smart Light**.

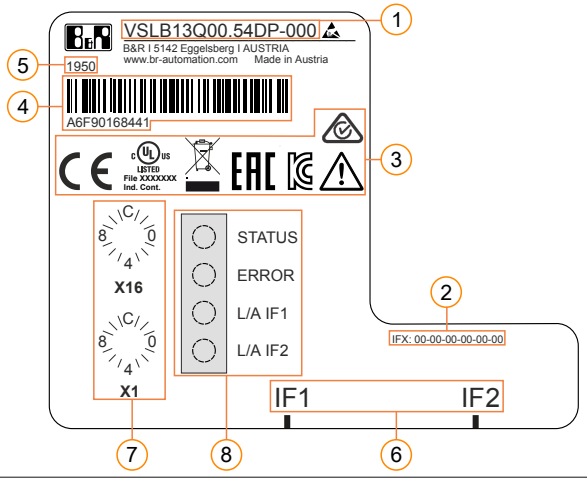
Order number	VSLB11x00. 54xP-000	VSLB12x00. 54xP-000	VSLB13x00. 54xP-000	VSLB14x00. 54xP-000	VSLB22x00. 54xP-000	VSLB23x00. 54xP-000
Short description						
Illumination	Vision Backlight					
General information						
System requirements						
Automation Studio	4.7.2 or later					
Automation Runtime	C4.7.2 or later					
Cooling	Passive					
Status indicators	Module status, Error, Link1, Link2					
Diagnostics	Yes, using LED "Status" and software					
Undervoltage detection	No					
Reverse polarity protection	Yes					
Certifications	CE					
Module power supply						
Connection	M12, 8-pin, Y-coded					
Nominal voltage	24 VDC -15% / +20%, SELV/PELV					
Max. input current	0.75 A	1.40 A	2.04 A	2.69 A		2.90 A
Power consumption	Max. 15.3 W	Max. 28.6 W	Max. 41.6 W	Max. 54.9 W		Max. 59.2 W
Max. output current	3 A / string (for forwarding)					
Interfaces						
Quantity	2					
Connection designation	IF1, IF2					
Fieldbus	POWERLINK					
Type	POWERLINK (V2) controlled Node					
Variant	M12, 8-pin, Y-coded (2-port hub, daisy-chain wiring possible)					
Cable length	Max. 20 m between 2 stations (segment length)					
Transfer rate	100 Mbit/s					
Transfer						
Physical	100BASE-TX					
Half-duplex	Yes					
Full-duplex	No					
Autonegotiation	Yes					
Auto MDI/MDIX	Yes					
Min. cycle time	400 µs[1)]					
Integrated LED lighting						
Number of module LED status indicators	4					
Min. exposure time	1 µs					
Max. pulse length	10 ms					
Min. pause duration	9x pulse duration (with 10 ms pulse duration this means 90 ms pause duration)					14x pulse duration (with 10 ms pulse duration this means 140 ms pause duration)
Max. duty cycle[2)]	10 %					6.67 %
Peak wavelength						
Blue	468 nm					
Green	519 nm					
Lime (neon green)	544 nm					
Red	632 nm					
Infrared	856 nm					
White	None (Entire visible spectrum present)					
Spectral half width						
Blue	20 nm					
Green	35 nm					
Lime (neon green)	100 nm					
Red	17 nm					
Infrared	35 nm					
White	None (Entire visible spectrum present)					
Risk group per EN 62471:2008[3)]	RG0: Blue, Red, Green, Lime (Neon green), Infrared, White RG1: - RG2: -					
LED lens						
Type 0 - Without LED lens	Yes					
Front glass (cover)	Plastic with polarizing filter Plastic diffuser Plastic with telecentric filter					

Order number	VSLB11x00.54xP-000	VSLB12x00.54xP-000	VSLB13x00.54xP-000	VSLB14x00.54xP-000	VSLB22x00.54xP-000	VSLB23x00.54xP-000
Operating conditions						
Mounting orientation						
Horizontal	Yes					
Vertical	Yes					
Face-up	Yes					
Installation elevation above sea level						
0 to 2000 m	No limitations					
>2000 m[4]	Reduction of ambient temperature by 0.5 °C per 100 m					
Pollution degree per EN 60664-1	2					
Overvoltage category per EN 60664-1	II					
Degree of protection per EN 60529	IP51					
Ambient conditions						
Temperature[5]						
Operation	-25 °C to +50 °C[6]					
Storage	-40 °C to +85 °C					
Transport	-40 °C to +85 °C					
Relative humidity						
Operation	5 to 95 % condensing					
Storage	5 to 95 % condensing					
Transport	5 to 95 % condensing					
Mechanical properties						
Note	Size 1x1	Size 1x2	Size 1x3	Size 1x4	Size 2x2	Size 2x3
Dimensions						
Width	162.3 mm	317.3 mm	472.3 mm	627.3 mm	317.3 mm	472.3 mm
Height	162.3 mm				317.3 mm	
Depth	55.3 mm					

1) The maximum cycle time should not exceed 10 ms.
2) Pulse length in comparison to the sum of pulse length and pause duration (e.g. for flash operation)
3) For a working distance of 200 mm, pulse length of 10 ms, and a 10% duty cycle (or 6.67% for size 2x3)
4) Maximum 5000 m possible
5) All mounting orientations
6) Operation below 0 °C: Condensation or icing can impair the camera function.

3.2.1 Product label

Backlight



1	Smart Light - Order number (Example)	**2**	MAC address
3	Standards and certifications	**4**	Serial number (barcode type 128 and hexadecimal)
5	Production date: Year and calendar week (yyww)	**6**	Interface name
7	Node number switch	**8**	LED status indicators

3.3 Operating and connection elements

3.3.1 Dimensioned drawing

Dimensions in mm.

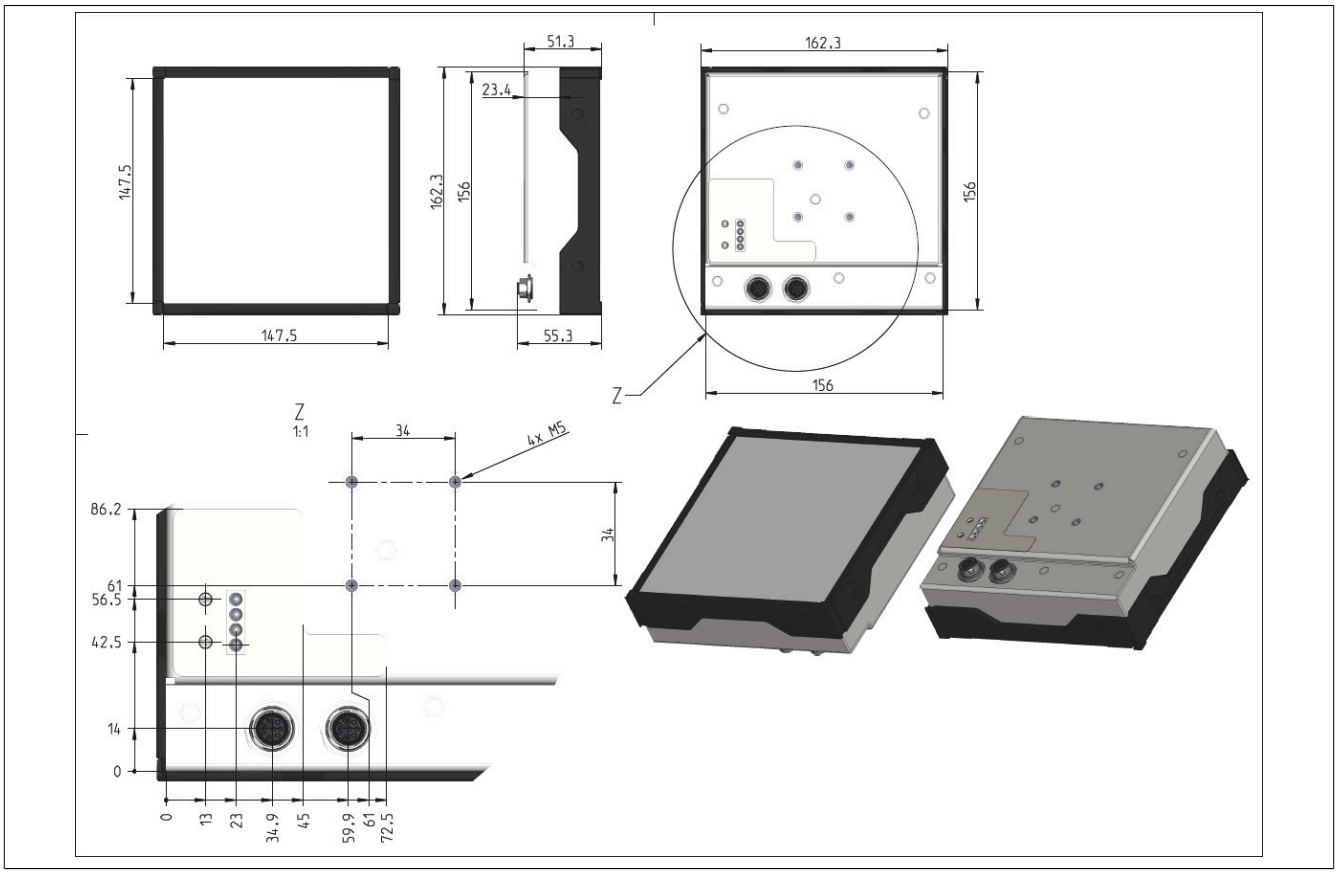


Figure 1: 1x1 Backlight

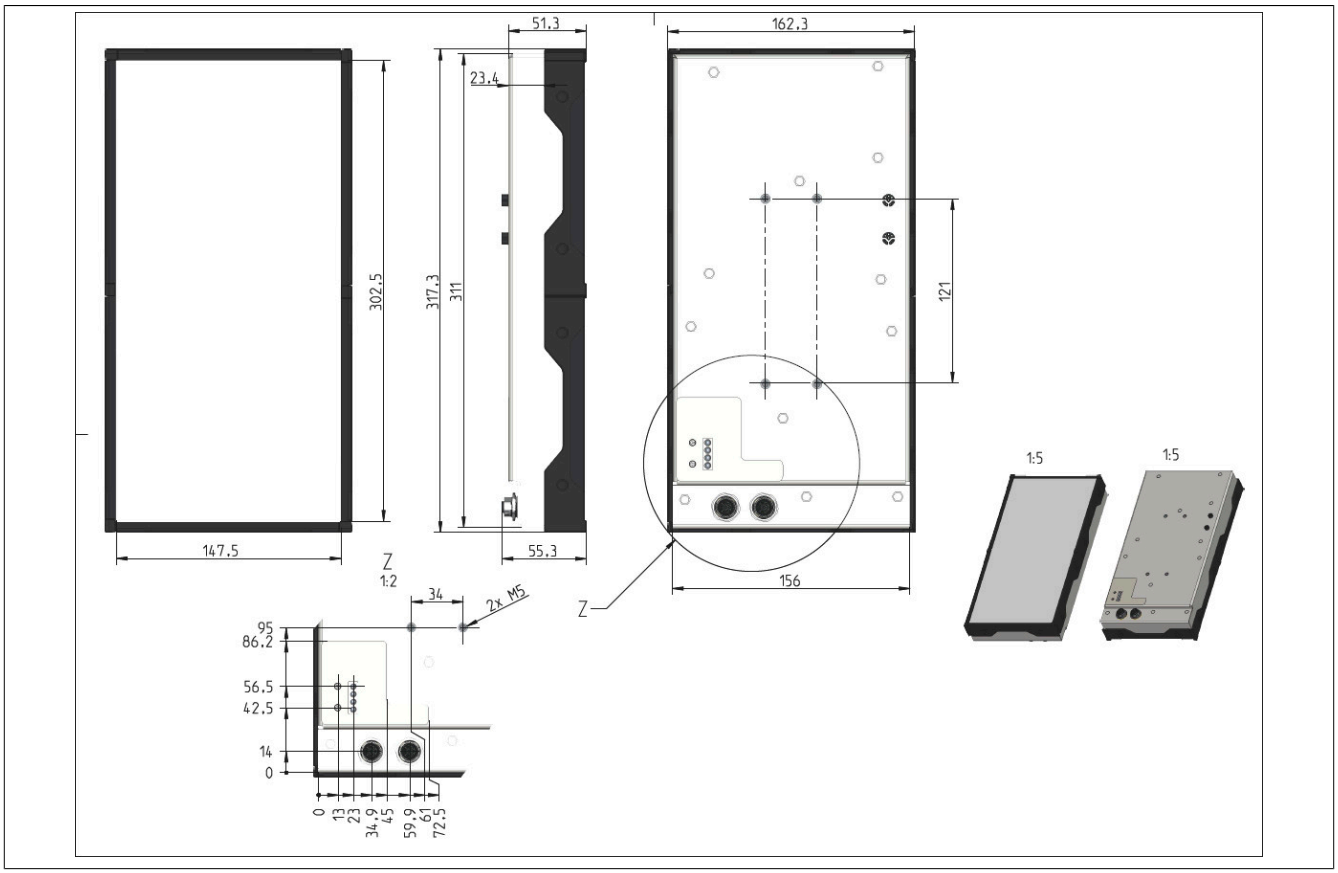


Figure 2: 1x2 Backlight

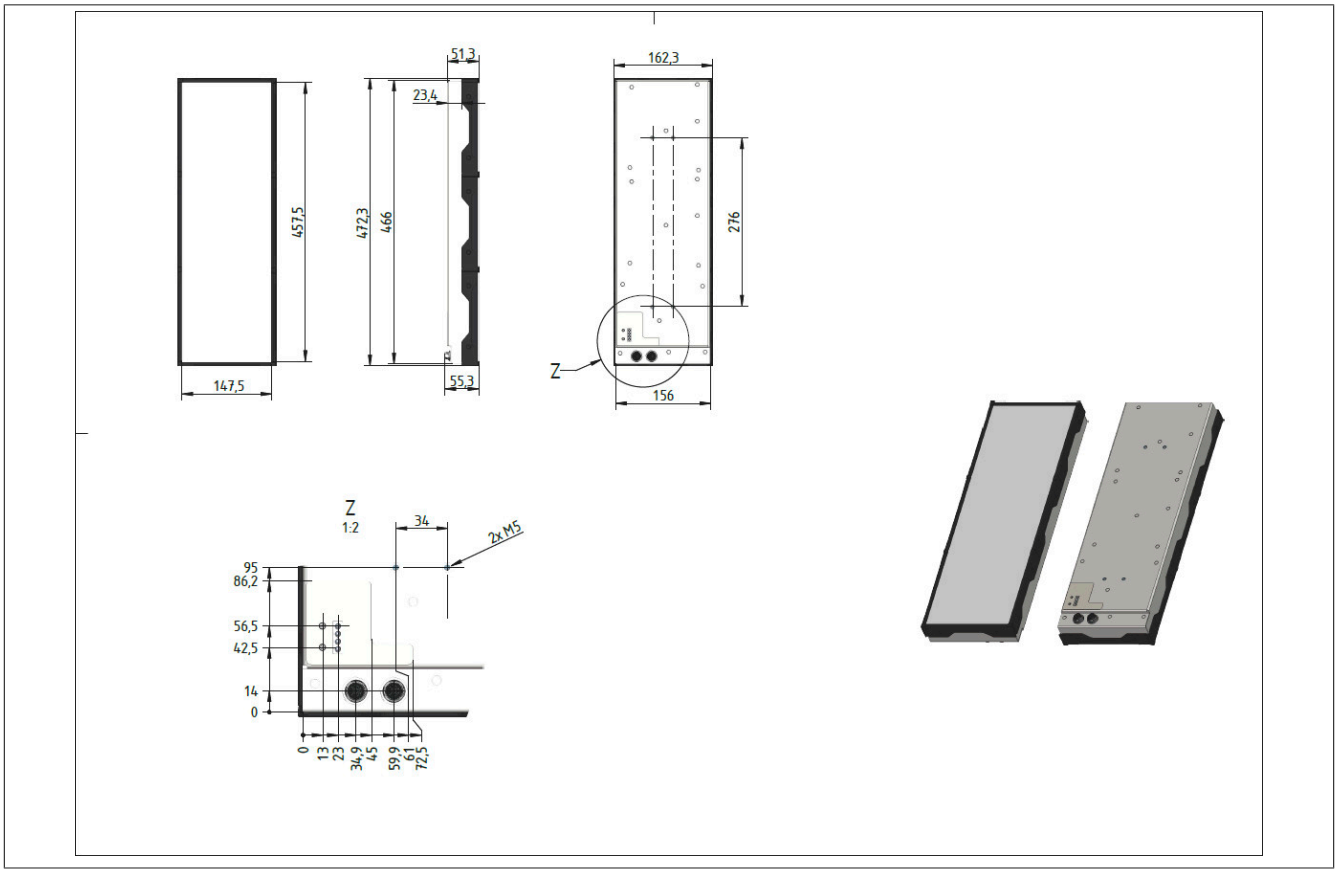


Figure 3: 1x3 Backlight

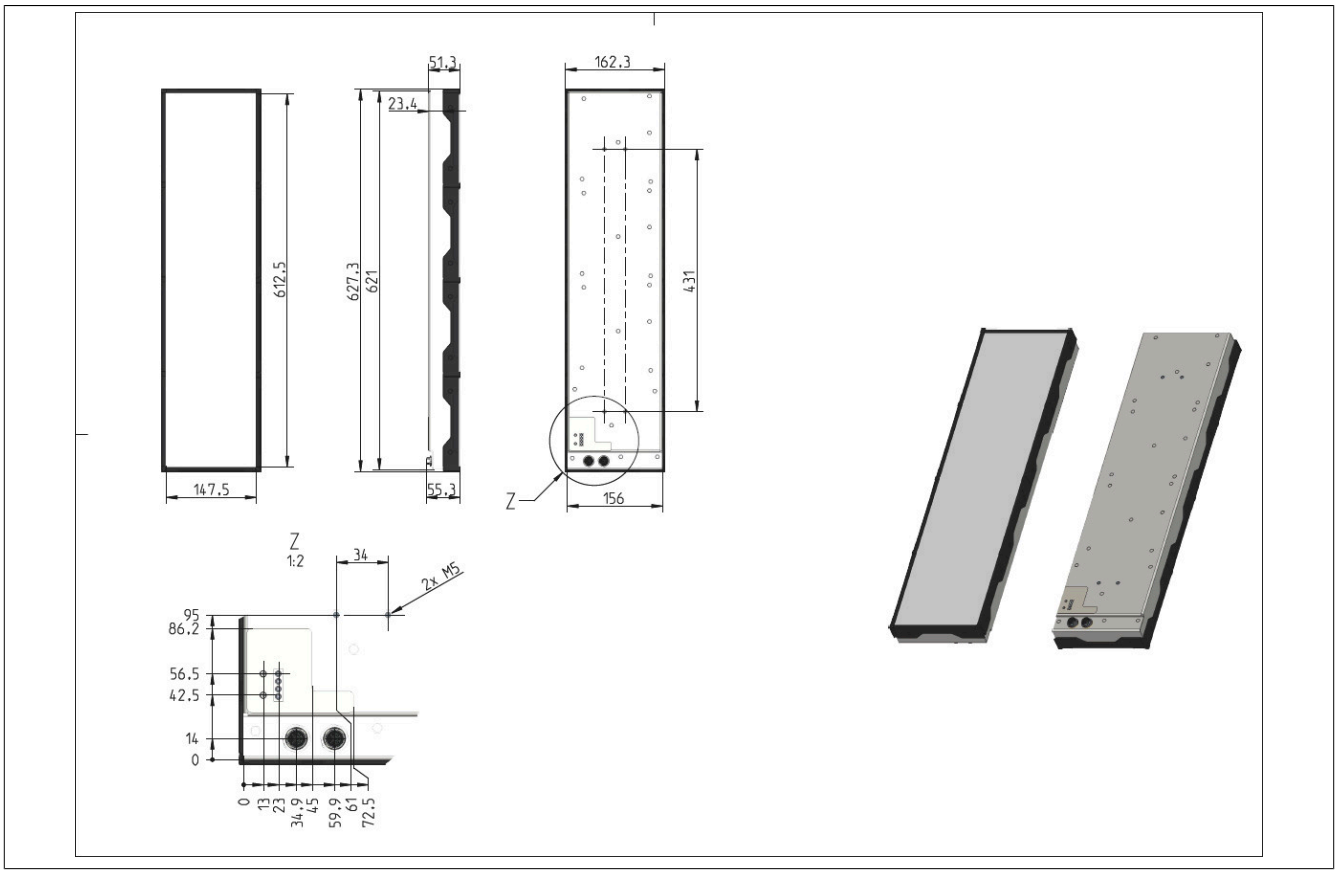


Figure 4: 1x4 Backlight

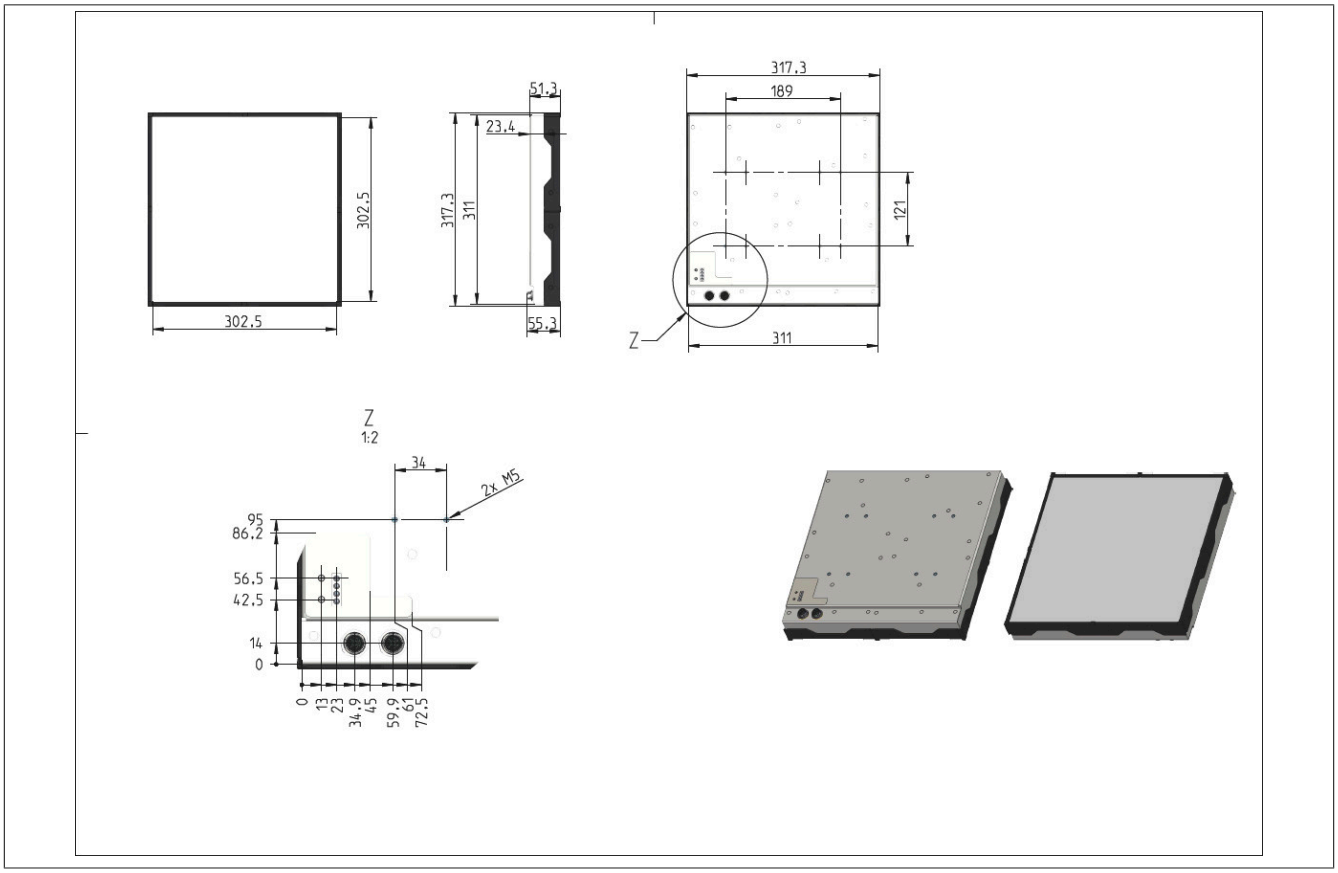


Figure 5: 2x2 Backlight

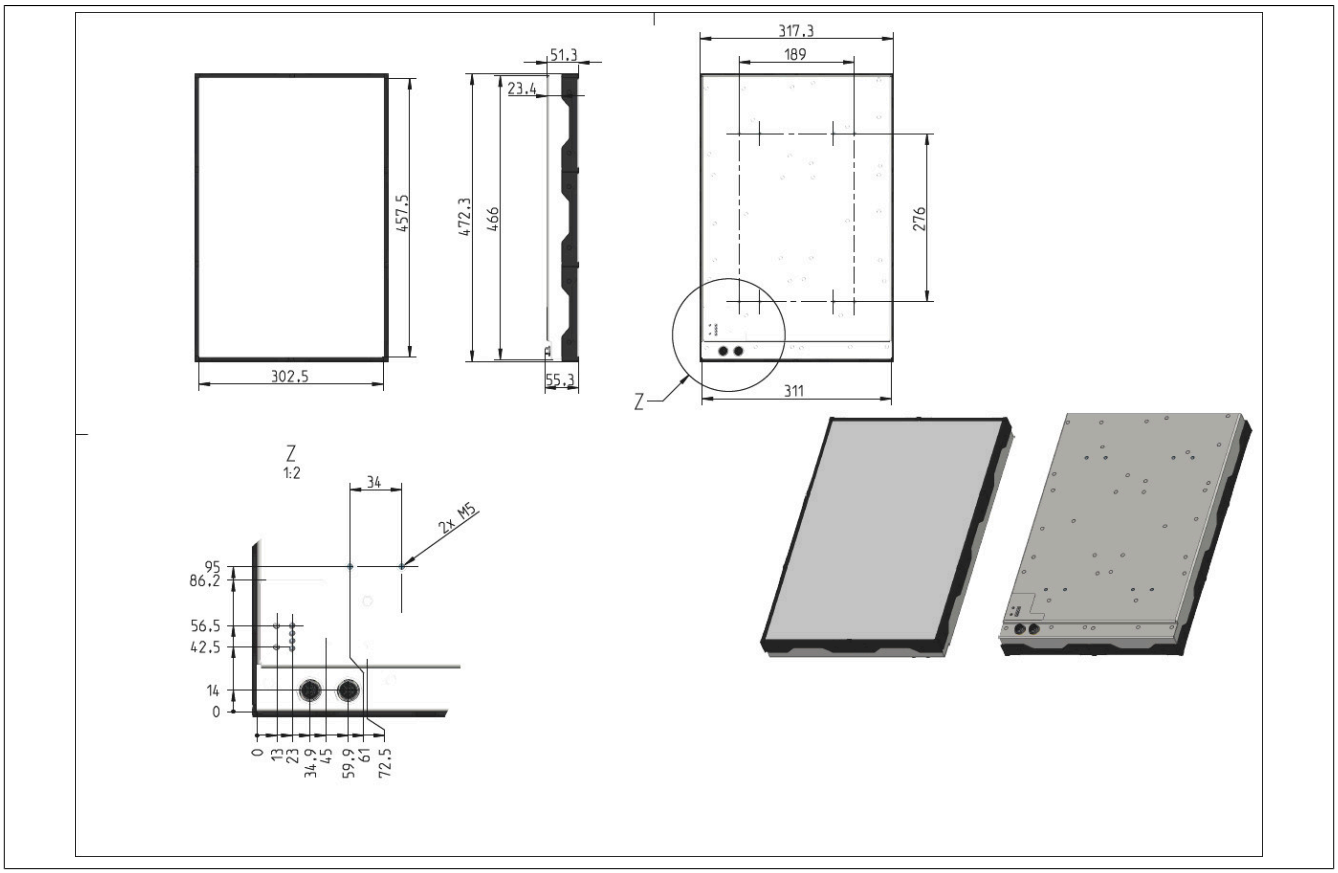


Figure 6: 2x3 Backlight

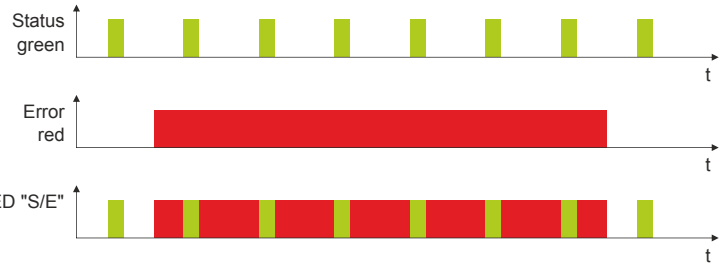
3.3.2 LED status indicators

Backlight
The LED status indicators are located at the bottom left of the back of the housing

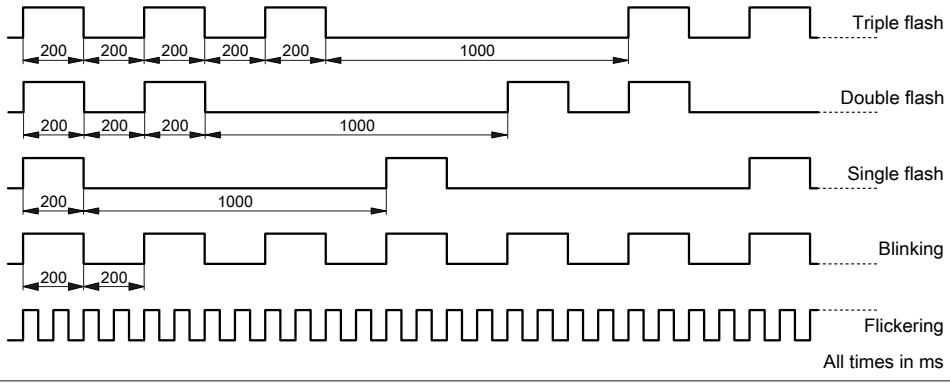
1	STATUS Status LED of the POWERLINK interface	**2**	ERROR Error LED of the POWERLINK interface
3	L/A IF1 POWERLINK Link/Activity LED of IF1	**4**	L/A IF2 POWERLINK Link/Activity LED of IF2

During Smart Light startup, the LED behavior corresponds to the behavior described in section POWERLINK V2 mode.

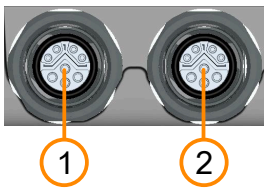
3.3.2.1 POWERLINK V2 mode

LED	Color	Status	Description
STATUS	Green	Off	No power supply or mode NOT_ACTIVE. The controlled node (CN) is either not supplied with power or it is in state NOT_ACTIVE. The CN waits in this state for about 5 s after a restart. Communication is not possible with the CN. If no POWERLINK communication is detected during these 5 s, the CN changes to state BASIC_ETHERNET (flickering). If POWERLINK communication is detected before this time expires, however, the CN immediately changes to state PRE_OPERATIONAL_1.
		Flickering	Mode BASIC_ETHERNET. The CN has not detected any POWERLINK communication. In this state, it is possible to communicate directly with the CN (e.g. with UDP, IP). If POWERLINK communication is detected in this state, the CN changes to state PRE_OPERATIONAL_1.
		Single flash	Mode PRE_OPERATIONAL_1. When operated on a POWERLINK V2 manager, the CN waits until an SoC frame is received and then switches to the PRE_OPERATIONAL_2 state.
		Double flash	Mode PRE_OPERATIONAL_2. The CN is normally configured by the manager in this state. It is then switched to state READY_TO_OPERATE by command (POWERLINK V2).
		Triple flash	Mode READY_TO_OPERATE. In a POWERLINK V2 network, the manager switches to the OPERATIONAL state by issuing a command.
		On	Mode OPERATIONAL. PDO mapping is active, and cyclic data is evaluated.
		Blinking	Mode STOPPED. Output data is not being output, and no input data is being provided. It is only possible to switch to or leave this state after the manager has given the appropriate command.
Error	Red	On	The controlled node (CN) is in an error state (failed Ethernet frames, increased number of collisions on the network, etc.). If an error occurs in the following states, the red LED is superimposed by the green flashing LED: • PRE_OPERATIONAL_1 • PRE_OPERATIONAL_2 • READY_TO_OPERATE  Note: • Several red blinking signals are displayed immediately after the device is switched on. This is not an error, however. • The LED is lit red for CNs with configured physical node number 0 but that have not yet been assigned a node number via dynamic node allocation (DNA).
L/A IFx	Green	On	The link to the remote station is established.
		Blinking	The link to the remote station is established, and Ethernet activity is taking place on the bus.

LED status indicators - Blink times



3.3.3 Connection elements



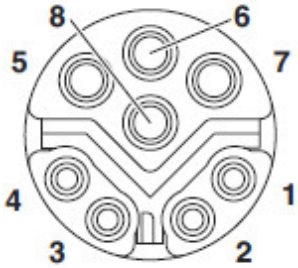
1	IF1: 24 VDC module power supply and POWERLINK 1	2	IF2: 24 VDC module power supply and POWERLINK 2

3.3.3.1 POWERLINK interface including 24 VDC module power supply

The POWERLINK interface with integrated 2-port hub connects to the fieldbus system for machine automation. The interface is designed for 100BASE-TX, and the two circular connectors also contain the 24 VDC module power supply.

The two hex address switches for setting the POWERLINK node number are located on the back of the device.

Pinout



Pin	Pinout	Explanation
1	TXD	PLK transmit signal
2	TXD\	PLK transmit signal inverted
3	RXD	PLK receive signal
4	RXD\	PLK receive signal inverted
5	GND	Supply line 1 (max. 3 A)
6	GND	Supply line 2 (max. 3 A)
7	+24 VDC	Supply line 2 (max. 3 A)
8	+24 VDC	Supply line 1 (max. 3 A)

POWERLINK node number

The node number for the POWERLINK node is set using the two number switches.

Switch position	Description
0x00	Only permitted when operating the POWERLINK node in DNA mode.
0x01 - 0xEF	Node number of the POWERLINK node. Operation as a controlled node (CN).
0xF0 - 0xFF	Reserved, switch position not permitted.

3.3.3.1.1 Dynamic node allocation (DNA)

Most POWERLINK bus controllers have the ability to dynamically assign node numbers. This has the following advantages:

- No setting of the node number switch
- Easier installation
- Reduced error sources

For information regarding configuration as well as an example, see Automation Help → Communication → POWERLINK → General information → Dynamic node allocation (DNA)

3.4 Function description

3.4.1 Daisy-chain wiring

The POWERLINK interface is designed as a 2-port hub and equipped with two circular connectors that are also located in the 24 V module power supply. Thanks to this interface, it is possible for several Smart Lights to be quickly and easily connected in series in terms of power supply and bus cabling (see "POWERLINK interface including 24 VDC module power supply" on page 11).

3.4.2 Monochrome lighting

> **Caution!**
>
> **Possible eye injuries due to optical radiation!**
>
> **The device corresponds to risk group 1 as described in EN 62471:2008 (with a working distance of 20 cm, pulse length of 10 ms and a 10% duty cycle).**
>
> - **Do not look directly into the lighting during operation.**
> - **Workstations must maintain the minimum distance to the device specified in the standard.**

The use of colored lighting is of great importance in industrial image processing in connection with colored objects. Different light colors represent different wavelengths, regardless of whether it is the light from lighting or the reflected light of an object.

If the lighting color and the color of the object are approximately the same (i.e. their wavelengths are approximately the same), the object in the acquired image is displayed as very bright to completely white (since the object reflects this wavelength particularly well in incident light or absorbs it particularly badly in transmitted light). Conversely, with a complementary color (opposing color in the color circle), the object can be displayed very dark to completely black.

The right lighting color (in relation to the object color) can improve contrast and help highlight or hide structures.

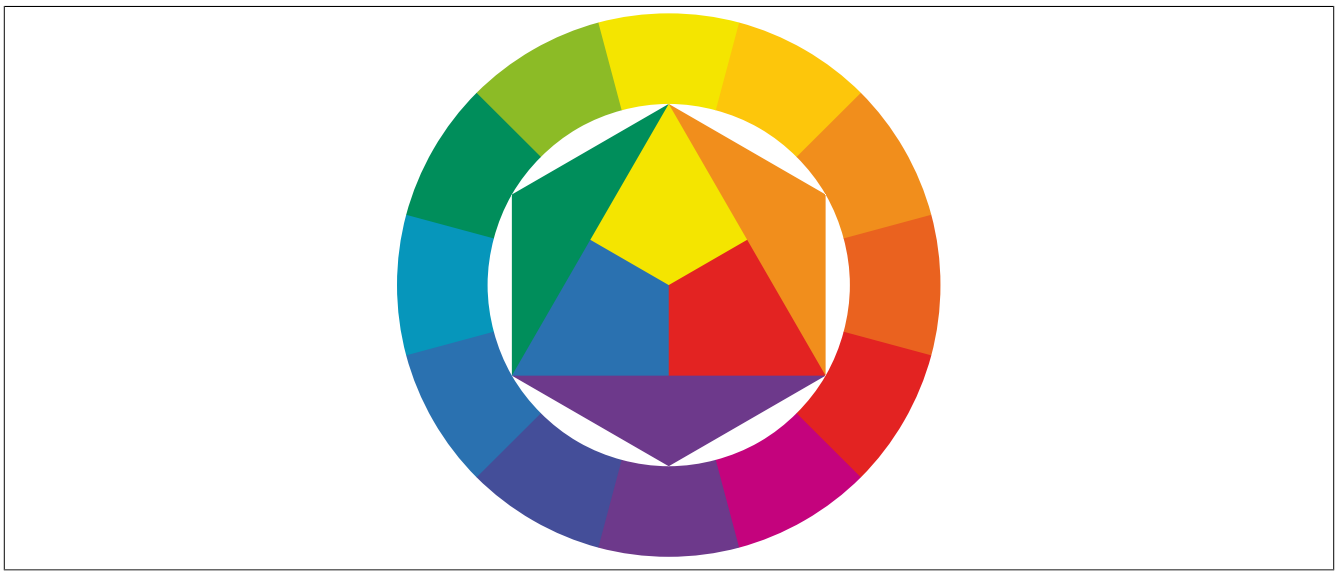
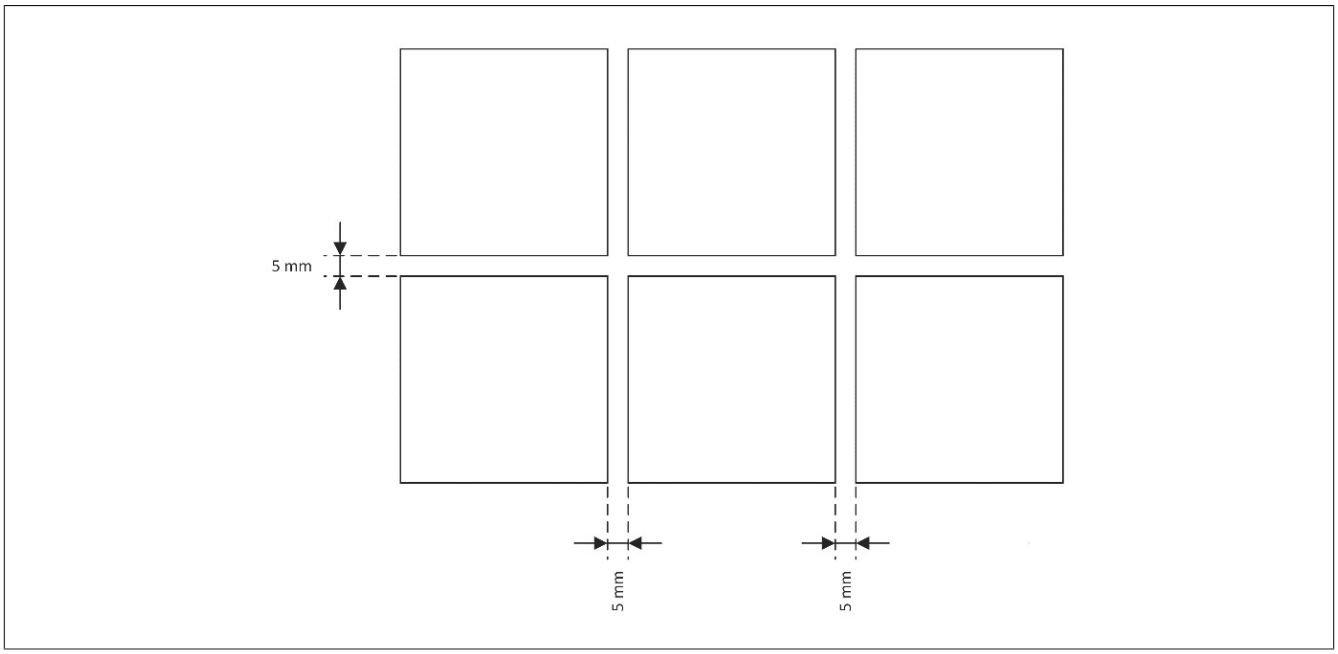


Figure 7: Color circle per Johannes Itten, 1961, in the public domain

3.4.3 Modular arrangements

The **backlights** are also available in modular arrangements, for example in a 2x3 configuration.



Information:

All modular arrangements can be ordered separately as finished configurations, see Smart Lights - Order number key

3.5 Commissioning

Information:

A Smart Light module must be operated directly on the Smart Camera (without any further hub level). This is necessary so that there is no delay between light and image acquisition.

3.5.1 Factory alignment

Smart Light products from B&R are aligned during production. This "factory alignment" includes the following aspects, which can be enabled in the application if required:

- Adjustment of LED temperature drift, see parameter LEDTempDriftCorrection.

3.5.2 Photobiological safety - User information

The standard EN 62471 "Photobiological safety of lamps and lamp systems" divides lighting sources into a series of risk groups:

- Risk group (RG) 0 = Harmless / no photobiological hazard, even with continuous, unrestricted use
- Risk group (RG) 1 = Low risk / no danger due to normal constraints of behaviour
- Risk group (RG) 2 = Moderate risk / does not present a hazard due to aversion reactions of bright light sources or thermal discomfort
- Risk group (RG) 3 = High risk / danger even for volatile or short-term irradiation

Notice!

Possible injuries to eyes and skin due to optical radiation!

The device corresponds to risk group 0 according to IEC 62471:2006 (at working distance 20 cm, pulse length 10 ms, duty cycle 10%, or duty cycle 6.67% for size 2x3).

- **Do not look directly into the lighting during operation.**
- **Workstations must maintain the minimum distance to the device specified in the standard.**
- **The risk related to the observer depends on the installation and use of the device**

Information:

Depending on the activated color of a multiple LED, different risk groups can arise with the same output power.

For further information on photobiological safety see "Photobiological safety" on page 34.

3.5.2.1 Protection measures

Technical protection measures

- Protection of adjacent workplaces against the light cone of an LED lighting
- Enclosures preventing access to the danger zone
- Reduction of the intensity (limitation of the duty cycle of the LEDs) Organisational protective measures

Organisational protective measures

- Limitation of the residence time in the vicinity of the LED illumination (compliance with the maximum exposure time)
- Hazard-related labelling of risk groups
- Marking of the danger area

Personal protection measures

- Avoid staring directly into an LED illumination, regardless of the light colour used and the duration of the light pulse.
- When staying in the immediate vicinity of LED lighting, appropriate safety goggles or protective clothing (UV) must be used!

3.5.3 Installation and wiring

3.5.3.1 Installation

When mounting machine vision modules, it must be ensured that the modules are mounted on a sufficiently large, thermally conductive, flat surface on the machine side that is free of contamination. The maximum operating temperature specified in the technical data and the protection class must be observed during installation (see "Technical data VSLB" on page 4).

The **Smart Light** module must be attached using the 4 fixing points on the rear of the housing with a thermal and electrically conductive material, see "Dimensioned drawing".

For mounting and heat dissipation, the mounting points specified in the dimensioned drawing must lie on the entire surface of the mounting surface! Fixing on uneven mounting surfaces can lead to impairment of the the heat dissipation of machine vision modules.

Furthermore, it is essential that a free space is provided above and below the machine vision modules to ensure sufficient heat dissipation through air circulation. The products must be protected against impermissible contamination.

The use of the installation accessories, that can be ordered, is strongly recommended for mounting, see "Installation accessories".

3.5.3.2 Wiring

Only the available cables (see "Cables" on page 73) and the available cable accessories (see "Cable accessories" on page 81) are intended for wiring.

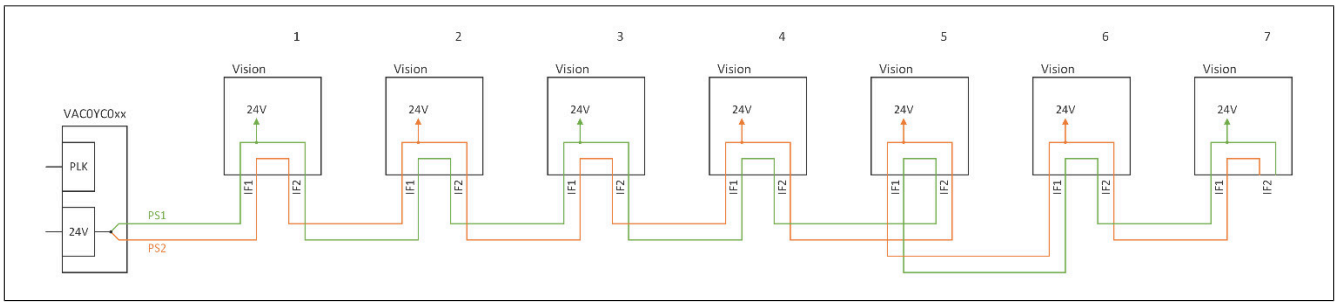
3.5.3.3 Vision modules supply concept

All vision modules (both **Smart Camera** and **Smart Light** modules) must be supplied with 24 V SELV / PELV. The voltage range at the input of 20.4 VDC to 28.8 VDC must be observed for correct function.

Power is supplied via the Vision POWERLINK hybrid cables. Each cable has 2 separate supply lines. The voltage is fed into the hybrid distributor and then split into the 2 supply lines PS1 and PS2. The energy for supplying the first vision module is taken from line PS1 from interface IF1. The line PS2 is only looped through. Both lines are crossed out on the circuit board. The maximum nominal current for the Smart Light is 3 A per line (2 supply lines per cable), so a section can be loaded with a maximum of 3 A.

Series connection example of vision modules:

As shown in the following illustration, the choice of the supply line (PS1 or PS2) for supplying the vision product depends on the position and the choice of the interface (IF1 or IF2) facing the hybrid distributor. With the vision module in position 5, IF2 was assigned to the hybrid distributor. So it is supplied with PS2. If IF1 were assigned to the hybrid distributor in position 5, as with the other positions, then the vision product in position 5 would be supplied with PS1.



However, a POWERLINK line can not only consist of Vision modules, but can also be continued with a POWERLINK hybrid distributor. In principle, no separate power supply is required for this second POWERLINK hybrid distributor, since the power supply can be provided via the line. However, if a separate power supply is provided for the second POWERLINK hybrid distributor, the power supply source of the first distributor box must be used.

Both distribution boxes must therefore be supplied from a single voltage supply source (they must have the same reference potential)!

3.5.4 Overtemperature behavior

The module has an internal overtemperature shutoff that triggers at the internal temperature sensors at 100 °C and above (this is indicated in Automation Studio by a logger message) and switches off the module.
The hysteresis for the restart temperature is 5 °C.

Information:

The environmental conditions specified in the technical data must be adhered to independently of a temperature monitoring system.

Cooling measures

The corresponding requirements of mechanical assembly must be observed to ensure heat dissipation.

On the application side, the internal temperature sensors can be read out with the `SensorTemperature` data point in order to implement a user overtemperature shutdown. For example, if the internal temperature exceeds a specified threshold (e.g. 80 °C), the pulse-pause ratio can be increased to reduce the power consumption.

3.6 Maintenance

Notice!

Possible damage to the device due to improper handling!

- **Carry out maintenance work only when the power is switched off.**
- **Make sure that all modules and components are handled carefully.**

3.6.1 Cleaning the Smart Light

The characteristics of the Smart Light can be affected by dirt (reduced cooling power due to dust, poor light quality due to dirty glass cover, etc.) or condensation (e.g. water drops on the glass front). The Smart Light must therefore be kept clean or cleaned regularly. To clean the device, proceed as follows:

- Use a clean synthetic microfiber wipe to clean the device.
- Moisten the wipe with IPA (isopropanol) or a mixture of distilled water and IPA. A mixing ratio in the range of 30/70 to 70/30 is recommended.
- Do not spray the cleaning agent directly onto the device, but first onto the wipe.

Notice!

Possible damage to the device due to incorrect cleaning!

Never use aggressive solvents, chemicals, abrasives, compressed air or steam jets.

3.7 Register descriptions

The default configuration of a lighting unit is set using the registers described. The registers can be accessed in Automation Studio as follows:

- Cyclic parameters and general data points are accessible via the I/O mapping of the lighting unit. They can be modified at runtime.
- Acyclic camera parameters are accessible via the lighting unit configuration. They cannot be modified at runtime.

For all Backlights with multiple light segments, the individual segments of a lighting unit cannot be selected (they are controlled simultaneously and therefore all behave in the same way).

3.7.1 General data points

The module has the following general data points that provide access to general module information:

3.7.1.1 ModuleOK

Status bit that indicates whether the module is physically present and configured. Detection takes place via the fieldbus connection.

Data type	Values	Information
BOOL	0	Module not ready for operation
	1	Module present and configured

3.7.1.2 SerialNumber

The module's unique serial number can be read from this register. This 7-digit serial number is printed in decimal form on the module's housing.

Data type	Values
UDINT	0 to 4,294,967,295

Information:

Module serial number

The complete module serial number is made up of the 4-digit ModuleID and subsequent 7-digit SerialNumber.

Example:

- **ModuleID = 0xE908**
- **SerialNumber = 0x0001234**
- **Serial number printed on the module = 0xE9080001234**

3.7.1.3 ModuleID

The module hardware ID used to determine the type of device can be read from this register. This is also listed in the respective technical data as the "B&R ID code". In addition, a serial number is printed on each module; the module hardware ID corresponds to the first four positions of this serial number.

Data type	Values	Information
UDINT	0 to 65535	Module hardware ID. 4-digit hexadecimal number
	65536 to 4,294,967,295	Reserve

3.7.1.4 HardwareVariant

The hardware variant of the module can be read from this data point.

Data type	Values	Information
UDINT	0 to 65535	Hardware variant
	65536 to 4,294,967,295	Reserve

3.7.1.5 FirmwareVersion

The firmware version of the module can be read from this data point.

The last two positions correspond to the number after the decimal point.

Example: 345 corresponds to version 3.45.

Data type	Values	Information
UDINT	1 to 99	Release version of older modules or developmental versions of new modules
	100 to 29999	Release version
	30,000 to 59999	Test version
	60000 to 4,294,967,295	Reserve

3.7.2 Overview of registers

Parameter	Type	Range of values	Description	Cyclic	Acyclic
Ready	BOOL	0 or 1	Lighting unit availability status	R	
Status	UDINT	0x00000000 to 0xFFFFFFFF	This parameter specifies the status of the lighting unit.	R	
AcceptedFlashCnt	USINT	0 to 255	Counter for accepted lighting jobs	R	
CompletedFlashCnt	USINT	0 to 255	Counter for executed lighting jobs	R	
FailedFlashCnt	USINT	0 to 255	Counter for failed lighting jobs	R	
LightWarningCnt	USINT	0 to 255	Counter for errors or warnings that have occurred related to lighting.	R	
SensorTemperature	SINT	-128 to +127	Current lighting unit temperature in °C	R	
FlashTrigger	BOOL	0 or 1	Enables/Disables the trigger for the lighting job	W	
ResetFlashTrigger	BOOL	0 or 1	Canceling an lighting job triggered by NetTime	W	
Nettime(n)	DINT	-2.147.483.648 to 2.147.483.647	Sets the NetTime for the trigger in µs	W	
ExposureTime(n)	UDINT	1 to 16.777.216	Sets the exposure time in µs	W	
FlashColor(n)	USINT	0 to 255	Select LED colors of the LED lighting	W	
CyclicLineScanNettime	DINT	-2.147.483.648 to 2.147.483.647	Specifies the NetTime for dynamic line sensor mode.	W	
CyclicLineScanPeriod	UDINT	0 to 4.294.967.295	Time between 2 flashes in dynamic line sensor mode.	W	
LEDTempDriftCorrection	BOOL	0 or 1	Enables/Disables LED temperature drift correction		W
LineSensorModeFlashCount	UINT	1 to 4096	After a flash of light has been triggered, this process can be repeated with a certain interval.		W
LineSensorModeTimeDelay	UDINT	0 to 4.294.967.295	Time between flashes [nsec]		W
UseDynamicLineScan	BOOL	0 or 1	Switches the line sensor mode		W
MultiCaptureCount	USINT	1 to 10	Number of lighting jobs during a multiple image acquisition.		W

3.7.2.1 Smart Light data (cyclic read)

Information:

The parameters specified in this section are part of the I/O mapping of the hardware module that can be accessed via Automation Studio.

3.7.2.1.1 Ready

The status bit indicates whether the lighting unit is ready for image processing (Ready) or busy (Busy).

Also during startup and initialization the lighting unit is busy and therefore the status bit **Ready** = 0.

Data type	Values	Information
BOOL	0	Busy. Module is busy with other tasks.
	1	Ready. Module is ready for lighting.

Information:

As long as the lighting unit is busy, neither a trigger nor new jobs can be started.

3.7.2.1.2 Status

This parameter specifies the status of the lighting unit

This parameter must be checked for 0 in the application during operation.

Values	Information
Bit 0	**FlashTrigger** is active.
Bit 1	**FlashTrigger** is waiting for a trigger of the set **NetTime**.
Bit 3 to Bit 5	Reserve
Bit 6	Software reset **ResetFlashTrigger** is currently still being executed.
Bit 7 to Bit 11	Reserve
Bit 12	HW error. Not all segments were found.
Bit 13	Operating temperature too high
-	-

Information:

During startup, a check is carried out to determine whether all segments are present, otherwise the power supply for the LEDs is not enabled. In this case, bit 12 is set in the Status parameter.

3.7.2.1.3 AcceptedFlashCnt

Counter for accepted lighting jobs.

Data type	Values	Information
USINT	0 to 255	Counter for accepted lighting jobs.

Information:

When evaluating the counter, a potential value overflow must be taken into account!

3.7.2.1.4 CompletedFlashCnt

Counter for executed lighting jobs.

Data type	Values	Information
USINT	0 to 255	Counter for executed lighting jobs.

Information:

When evaluating the counter, a potential value overflow must be taken into account!

3.7.2.1.5 FailedFlashCnt

Counter for failed or invalid lighting jobs, for example jobs with incorrect timing. **CompletedFlashCnt** can still count up.

Data type	Values	Information
USINT	0 to 255	Counter for failed or invalid lighting jobs.

Information:

When evaluating the counter, a potential value overflow must be taken into account!

3.7.2.1.6 LightWarningCnt

Counter for errors or warnings that have occurred related to lighting. The value of this parameter is incremented in the following cases:

- If the exposure was too long.
- If there is not enough power available.
- If the sampling behavior is not correct.

Data type	Values	Information
USINT	0 to 255	Counter for errors or warnings that have occurred related to lighting.

Information:

When evaluating the counter, a potential value overflow must be taken into account!

3.7.2.1.7 SensorTemperature

Current temperature of the vision module in °C.

Data type	Values	Information
SINT	-128 to 127	Highest measured temperature at the temperature sensors in the vision module in °C.

3.7.2.2 Smart Light parameters (cyclic write)

Information:

The parameters specified in this section are part of the I/O mapping of the hardware module that can be accessed via Automation Studio.

3.7.2.2.1 FlashTrigger

Trigger to enable the lighting job. A positive edge of this parameter enables the lighting job (The positive edge is only accepted with **Ready** =1). Nettime (n), ExposureTime (n) and FlashColor (n) are returned.

In order to enable additional lighting job, this value must be reset to 0 so that another lighting job is possible.

Data type	Values	Information
BOOL	0	Do not start a job (default value).
	1	Lighting job enabled.

3.7.2.2.2 ResetFlashTrigger

A positive edge, cancels all pending future jobs or not yet executed ones using NetTime. A lighting job in progress is not aborted.

Data type	Values	Information
BOOL	0	Trigger abort off (default value).
	1	Cancel trigger.

3.7.2.2.3 Nettime(n)

Delay time (the set NetTime) for the trigger.

If multiple images are acquired due to a trigger event (MultiCapture >1), the delay is always based on the actual trigger event and not the last acquisition.

Information:

Triggering takes place immediately if the Nettime is in the past. In this case, both FailedFlashCnt and CompletedFlashCnt are increased.

Data type	Values	Information
DINT	-2.147.483.648 to 2.147.483.647	32-bit value for set NetTime from 1 µs to 4294 s in increments of 1 µs (absolute NetTime).

Information:

Depending on the calculated value of parameter MultiCapture, this parameter (with indices 01, 02, etc.) occurs n times.

3.7.2.2.4 ExposureTime(n)

Illumination duration of the LED lighting.

Data type	Values	Information
UDINT	1 to 16.777.216	24-bit value for an integration time of 1 µs to 16.8 s in increments of 1 µs.

Information:

Depending on the calculated value of parameter MultiCapture, this parameter (with indices 01, 02, etc.) occurs n times.

3.7.2.2.5 FlashColor(n)

This parameter specifies which LED color should be used during a lighting job. For a lighting variant with a single LED color, this parameter must only be set once at the beginning. For lighting variants with multiple LED colors, these can consequently be switched during application depending on the requirements.

If an LED color is set that the lighting unitdoes not have, no light is used during the lighting job!

Data type	Values	Information
USINT	0	No light (default value)
	1	Red
	2	Green
	3	Blue
	4	Lime
	99	White
	100	Infrared
	Rest	Invalid

Information:

Depending on the calculated value of parameter MultiCapture, this parameter (with indices 01, 02, etc.) occurs n times.

3.7.2.2.6 CyclicLineScanNettime

Parameter **CyclicLineScanNettime** is only active if **UseDynamicLineScan** is set to 1 (cyclic/dynamic line sensor)

CyclicLineScanPeriod is valid from this Nettime on.

Data type	Values	Information
DINT	-2.147.483.648 to 2.147.483.647	Specifies the NetTime for dynamic line sensor mode.

3.7.2.2.7 CyclicLineScanPeriod

Parameter **CyclicLineScanPeriod** is only active if **UseDynamicLineScan** is set to 1 (cyclic/dynamic line sensor).

Data type	Values	Information
UDINT	0 to 4.294.967.295	Time between 2 flashes in line sensor mode from 0 to 4.29 s in increments of 1 ns.

3.7.2.3 Smart Light configuration (acyclic write)

Information:

The parameters specified in this section are part of the hardware module configuration that can be accessed via Automation Studio.

3.7.2.3.1 LEDTempDriftCorrection

This parameter can be used to enable an automatic correction of the temperature drift of the LED lighting.

The intensity of the LEDs is adjusted to each other. Slightly less light output is therefore available with **LEDTempDriftCorrection** enabled. Subsequently, the exposure time increases.

Data type	Values	Information
BOOL	0	No correction of the LED temperature drift (default value).
	1	LED temperature drift correction enabled.

3.7.2.3.2 LineSensorModeFlashCount

Number of flashes in static line sensor mode.

Data type	Values	Information
UINT	1 to 4096	Number of flashes in line sensor mode. The default value is 1.

3.7.2.3.3 LineSensorModeTimeDelay

The length of time between triggered flashes configured via **LineSensorModeFlashCount** in static line sensor mode.

Data type	Values	Information
UDINT	1 to 4.294.967.295	Time between two flashes in line sensor mode from 1 ns to 4.29 s in increments of 1 ns.

3.7.2.3.4 UseDynamicLineScan

Parameter to switch the operating mode (mode) between static and dynamic line sensors. The value of this parameter must always be set in relation to a **Smart Camera**.

Information:

For further information on the line sensor operation of a Smart Camera, see the chapter "mapp Vision" in the Automation Help.

Data type	Values	Information
BOOL	0	Static line sensor (LineSensorModeFlashCount, LineSensorModeTimeDelay)
	1	Dynamic (cyclic) line sensor (CyclicLineScanNettime, CyclicLineScanPeriod)

3.7.2.3.5 MultiCaptureCount

Parameter for multiple lighting of the lights during multiple image acquisitions of the camera. Specifies the number of flashes within a cycle.

Information:

For correct operation, the value of MultiCaptureCount of the Smart Light must be equal to the value of AcquisitionCount of the ahead camera.

As long as parameter **MultiCaptureCount** = 1, the parameters with index 01 are used. Otherwise, the parameter sets are processed one after the other until the value of **MultiCaptureCount** valid at the time of the trigger edge is reached.

Data type	Values	Information
USINT	1 to 10	Number of flashes. Default = 1

3.8 International and national certifications

Machine vision devices meet the requirements of the listed certifications and their relevant standards. We are committed to ensuring the reliability of our products in industrial environments.

Information:

Certifications applicable to the respective module are available at the following locations:

- **Section "General information > Certifications in section "Technical data" in the data sheet**
- **On the website www.br-automation.com in section "Technical data" for the individual products (possible to search using model number).**
- **On the product label of the module.**

Changes and new certifications are promptly made available in electronic form on the B&R website at www.br-automation.com.

3.8.1 Overview of certifications

Mark	Explanation	Certificate authority	Region
CE	CE marking	Notified bodies	Europe (EU)

3.8.2 EU directives and standards (CE)

CE marking

The respective product complies with all applicable EU directives and relevant harmonized standards.

Certification of these products is performed in cooperation with accredited testing laboratories.

Validity: Europe (EU)

EMC Directive 2014/30/EU

Il devices satisfy the protection requirements of the "EMC Directive" and are designed for industrial use:

Applicable standards from this directive:

EN 61131-2	Programmable logic controllers - Part 2: Equipment requirements and tests
EN 61000-6-2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments
EN 61000-6-4	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emissions standard for industrial environments

The corresponding declaration of conformity is available for download from the B&R website.
For information about the versions of applicable standards, see the declaration of conformity.

Declaration of conformity

Declarations of conformity

3.8.2.1 Overview of standards

Standard	Description
EN 50581	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances
EN 55011 (CISPR 11)	Industrial, scientific and medical equipment - Radio frequency disturbance characteristics - Limits and methods of measurement
EN 55016-2-1 (CISPR 16-2-1)	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-1: Methods of measurement of disturbances and immunity - Conducted disturbance measurements
EN 55016-2-3 (CISPR 16-2-3)	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity - Radiated disturbance measurements
EN 55022 (CISPR 22)	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
EN 60068-2-6	Environmental testing - Part 2-6: Procedures - Test Fc: Vibration (sinusoidal)
EN 60068-2-27	Environmental testing - Part 2-27: Test procedure - Test Ea and guidance: Shock
EN 60068-2-31[1)]	Environmental testing - Part 2-31: Test procedure - Test Ec: Rough handling shocks, mainly for devices
EN 60529	Degrees of protection provided by enclosures (IP code)
EN 60664-1	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests
EN 60721-3-2	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 2: Transport and handling
EN 60721-3-3	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 3: Stationary use at weather-protected locations
EN 61000-4-2	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test
EN 61000-4-3	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test
EN 61000-4-4	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test
EN 61000-4-5	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measuring techniques - Surge immunity test
EN 61000-4-6	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
EN 61000-4-8	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measuring techniques - Power frequency magnetic field immunity test
EN 61000-4-11	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measuring techniques - Voltage dips, short interruptions and voltage variations
EN 61000-4-29	Electromagnetic compatibility (EMC) - Part 4-29: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests
EN 61000-6-2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments
EN 61000-6-4	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
EN 61131-2	Programmable logic controllers - Part 2: Guidance for inspection and routine testing
EN 62471	Photobiological safety of lamps and lamp systems

1) Replacement for EN 60068-2-32

3.8.2.2 Requirements for immunity to disturbances

Immunity	Testing performed per standard:	Requirements per standard:	
		EN 61131-2 [1]	EN 61000-6-2 [2]
Electrostatic discharge (ESD)	EN 61000-4-2	✓	✓
High-frequency electromagnetic fields (HF field)	EN 61000-4-3	✓	✓
High-speed transient electrical disturbances (Burst)	EN 61000-4-4	✓	✓
Surge voltages (Surge)	EN 61000-4-5	✓	✓
Conducted disturbances	EN 61000-4-6	✓	✓
Magnetic fields with electrical frequencies	EN 61000-4-8	✓	✓
Voltage dips (AC) Short-term interruptions (AC) Voltage fluctuations (AC)	EN 61000-4-11	✓	✓
Short-term interruptions (DC) Voltage fluctuations (DC)	EN 61000-4-29	✓	-

1) EN 61131-2: Product standard - Programmable logic controllers
2) EN 61000-6-2: Generic standard - Immunity for industrial environments

Criteria to prove the performance of a PLC system against EMC disturbances

Criteria	During test	After test
A	The PLC system shall continue to operate as intended. No loss of function or performance.	The PLC system shall continue to operate as intended.
B	Degradation of performance accepted. The operating mode is not permitted to change. Irreversible loss of stored data is not permitted.	The PLC system shall continue to operate as intended. Temporary degradation of performance must be self-recoverable.
C	Loss of functions accepted, but no destruction of hardware or software (program or data).	The PLC system shall continue to operate as intended automatically, after manual restart or power off / power on.
D	Degradation or failure of functionality that can no longer be restored.	PLC system permanently damaged or destroyed.

Electrostatic discharge (ESD)

Testing performed per standard: EN 61000-4-2	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
Contact discharge (CD) On conductive accessible parts	±4 kV Criteria B	
Air discharge (AD) On insulating accessible parts	±8 kV Criteria B	

High-frequency electromagnetic fields (HF field)

Testing performed per standard: EN 61000-4-3	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
Housing, completely wired	80 MHz to 1 GHz, 10 V/m 1.4 to 2 GHz, 3 V/m 2 to 2.7 GHz, 1 V/m Criteria A	

High-speed transient electrical disturbances (Burst)

Testing performed per standard: EN 61000-4-4	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
AC power inputs	±2 kV / 5 kHz Criteria B	
AC power outputs	±2 kV / 5 kHz [1] Criteria B	±2 kV / 5 kHz Criteria B
Other AC I/O	±2 kV / 5 kHz [1] Criteria B	-
DC mains inputs/outputs	±2 kV / 5 kHz [1] Criteria B	
Other I/Os and interfaces	±1 kV / 5 kHz [1] Criteria B	

1) Only for connections with a permitted cable length greater than 3 m.

Surge voltages (Surge)

Testing performed per standard: EN 61000-4-5	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
AC mains inputs/outputs Line / line	±1 kV Criteria B	
AC mains inputs/outputs Line / ground	±2 kV Criteria B	
DC mains inputs/outputs Line / line	±0.5 kV 1) Criteria B	±0.5 kV Criteria B
DC power inputs Line / ground	±0.5 kV 1) Criteria B	±0.5 kV Criteria B
DC power outputs Line / ground	±0.5 kV 1) Criteria B	±0.5 kV Criteria B
Signal connections, unshielded Line / ground	±1 kV 1) Criteria B	
All shielded cables Line / ground	±1 kV 1) Criteria B	-

1) Only for connections with a permitted cable length greater than 30 m.

Conducted disturbances

Testing performed per standard: EN 61000-4-6	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
AC mains inputs/outputs	10 V 150 kHz to 80 MHz 80% AM (1 kHz) Criteria A	
DC mains inputs/outputs	10 V 150 kHz to 80 MHz 80% AM (1 kHz) Criteria A	
Other I/Os and interfaces	10 V 1) 150 kHz to 80 MHz 80% AM (1 kHz) Criteria A	

1) Only for connections with a permitted cable length greater than 3 m.

Magnetic fields with electrical frequencies

Testing performed per standard: EN 61000-4-8	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
Housing, completely wired	30 A/m 3 axes (x, y, z) 50/60 Hz 1) Criteria A	

1) Mains frequency per manufacturer data

Voltage dips

Testing performed per standard: EN 61000-4-11	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
AC power inputs	0% residual voltage 250/300 periods (50/60 Hz) 1) 20 attempts Criteria C	
	40% residual voltage 10/12 periods (50/60 Hz) 1) 20 attempts Criteria C	
	70% residual voltage 25/30 periods (50/60 Hz) 1) 20 attempts Criteria C	

1) Mains frequency per manufacturer data

Short-term interruptions

Testing performed per standard: EN 61000-4-11 / EN 61000-4-29	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
AC power inputs	0% residual voltage 0.5 periods (50/60 Hz) 1) 20 attempts Criteria A	0% residual voltage 1 period (50/60 Hz) 1) 3 attempts Criteria B
DC power inputs	0% residual voltage ≥10 ms (PS2) 2) 20 attempts Criteria A	-

1) Mains frequency per manufacturer data
2) Use of a B&R power supply guarantees that these requirements are met.

Voltage fluctuations

Testing performed per standard: EN 61000-4-11 / EN 61000-4-29	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
AC power inputs	-15% / +10% Test duration per 30 minutes Criteria A	-
DC power inputs	-15% / +20% Test duration per 30 minutes Criteria A	-

3.8.2.3 Emission requirements

Phenomenon	Testing performed per standard:	Limit values per standard:	
		EN 61131-2 [1]	EN 61000-6-4 [2]
Emissions related to lines	EN 55011 / EN 55022 EN 55016-2-1	✓	✓
Radiated emissions	EN 55011 / EN 55022 EN 55016-2-3	✓	✓

1) EN 61131-2: Product standard - Programmable logic controllers
2) EN 61000-6-4: Generic standards - Emission standard for industrial environments

Emissions related to lines

Testing performed per standard: EN 55011 / EN 55022 / EN 55016-2-1	Limit values per standard: EN 61131-2 / Zone B	Limit values per standard: EN 61000-6-4
AC mains connection 150 kHz to 30 MHz	150 to 500 kHz 79 dB (µV) quasi-peak value 66 dB (µV) average value	
	500 kHz to 30 MHz 73 dB (µV) quasi-peak value 60 dB (µV) average value	
Telecommunications / network connection 150 kHz to 30 MHz	-	150 to 500 kHz 97 to 87 dB (µV) quasi-peak value 53 to 40 dB (µA) quasi-peak value 84 to 74 dB (µV) average value 40 to 30 dB (µA) average value
	-	500 kHz to 30 MHz 87 dB (µV) quasi-peak value 43 dB (µA) quasi-peak value 74 dB (µV) average value 30 dB (µA) average value

Radiated emissions

Testing performed per standard: EN 55011 / EN 55022 / EN 55016-2-3	Limit values per standard: EN 61131-2 / Zone B	Limit values per standard: EN 61000-6-4
Electric field / Measured from 10 m 30 MHz to 1 GHz	30 to 230 MHz 40 dB (µV/m) quasi-peak value	
	230 MHz to 1 GHz 47 dB (µV/m) quasi-peak value	
Electric field / Measured from 3 m 1 to 6 GHz [1]	-	1 to 3 GHz 76 dB (µV/m) peak value 56 dB (µV/m) average value
	-	3 to 6 GHz 80 dB (µV/m) peak value 60 dB (µV/m) average value

1) Depends on the highest internal frequency

3.8.2.4 Mechanical conditions

Testing	Testing performed per standard:	Requirements per standard:				
		EN 61131-2 [1]	EN 60721-3-2 Class 2M1	EN 60721-3-2 Class 2M2	EN 60721-3-2 Class 2M3	EN 60721-3-3 Class 3M4
Vibration (sinusoidal) / Operation	EN 60068-2-6	✓	-	-	-	✓
Shock / Operation	EN 60068-2-27	✓	-	-	-	✓
Vibration (sinusoidal) / Transport (packaged)	EN 60068-2-6	-	✓	✓	✓	-
Shock / Transport (packaged)	EN 60068-2-27	-	✓	✓	-	-
Free fall / Transport (packaged)	EN 60068-2-31 [2]	✓	✓	-	-	-
Toppling / Transport (packaged)	EN 60068-2-31	-	✓	✓	✓	-

1) EN 61131-2: Product standard - Programmable logic controllers
2) Replacement for EN 60068-2-32

Vibration (sinusoidal) / Operation

Testing performed per standard: EN 60068-2-6	Requirements per standard: EN 61131-2		Requirements per standard: EN 60721-3-3 / Class 3M4	
Vibration (sinusoidal) [1] Operation	Frequency	Amplitude	Frequency	Amplitude
	5 to 8.4 Hz	Deflection 3.5 mm	2 to 9 Hz	Deflection 3 mm
	8.4 to 150 Hz	Acceleration 1 g [2]	9 to 200 Hz	Acceleration 1 g [2]
	20 sweeps for each axis [3]			

1) Uninterrupted duty with movable frequency in all 3 axes (x, y, z); 1 octave per minute
2) 1 g = 10 m/s²
3) 2 sweeps = 1 frequency cycle ($f_{min} \rightarrow f_{max} \rightarrow f_{min}$)

Shock / Operation

Testing performed per standard: EN 60068-2-27	Requirements per standard: EN 61131-2	Requirements per standard: EN 60721-3-3 / Class 3M4
Shock [1] Operation	Acceleration 15 g Duration 11 ms 18 shocks	Acceleration 10 g Duration 11 ms 18 shocks

1) Pulse (half-sine) stress in all 3 axes (x, y, z), 1 octave per minute

Vibration (sinusoidal) / Transport (packaged)

Testing performed per standard: EN 60068-2-6	Requirements per standard: EN 60721-3-2 / Class 2M1		Requirements per standard: EN 60721-3-2 / Class 2M2		Requirements per standard: EN 60721-3-2 / Class 2M3	
Vibration (sinusoidal) [1] Transport (packaged)	Frequency	Amplitude	Frequency	Amplitude	Frequency	Amplitude
	2 to 9 Hz	Deflection 3.5 mm	2 to 9 Hz	Deflection 3.5 mm	2 to 8 Hz	Deflection 7.5 mm
	9 to 200 Hz	Acceleration 1 g [2]	9 to 200 Hz	Acceleration 1 g [2]	8 to 200 Hz	Acceleration 2 g [2]
	200 to 500 Hz	Acceleration 1.5 g [2]	200 to 500 Hz	Acceleration 1.5 g [2]	200 to 500 Hz	Acceleration 4 g [2]
	20 sweeps for each axis[3]					

1) Uninterrupted duty with movable frequency in all 3 axes (x, y, z); 1 octave per minute
2) 1 g = 10 m/s²
3) 2 sweeps = 1 frequency cycle ($f_{min} \rightarrow f_{max} \rightarrow f_{min}$)

Shock / Transport (packaged)

Testing performed per standard: EN 60068-2-27	Requirements per standard: EN 60721-3-2 / Class 2M1	Requirements per standard: EN 60721-3-2 / Class 2M2
Shock [1] Transport (packaged)	Type I Acceleration 10 g Duration 11 ms 18 shocks	
	Type II -	Type II Acceleration 30 g Duration 6 ms 18 shocks

1) Pulse (half-sine) stress in all 3 axes (x, y, z)

Free fall / Transport (packaged)

Testing performed per standard: EN 60068-2-31 [1]	Requirements per standard: EN 61131-2 with shipping packaging		Requirements per standard: EN 61131-2 with product packaging		Requirements per standard: EN 60721-3-2 / Class 2M1	
Free fall Transport (packaged)	Weight	Height	Weight	Height	Weight	Height
	<10 kg	1.0 m	<10 kg	0.3 m	<20 kg	0.25 m
	10 to 40 kg	0.5 m	10 to 40 kg	0.3 m	20 to 100 kg	0.25 m
	>40 kg	0.25 m	>40 kg	0.25 m	>100 kg	0.1 m
	5 attempts					

1) Replacement for EN 60068-2-32

Toppling / Transport (packaged)

Testing performed per standard: EN 60068-2-31	Requirements per standard: EN 60721-3-2 / Class 2M1		Requirements per standard: EN 60721-3-2 / Class 2M2		Requirements per standard: EN 60721-3-2 / Class 2M3	
Toppling Transport (packaged)	**Weight**	**Required**	**Weight**	**Required**	**Weight**	**Required**
	<20 kg	Yes	<20 kg	Yes	<20 kg	Yes
	20 to 100 kg	-	20 to 100 kg	Yes	20 to 100 kg	Yes
	>100 kg	-	>100 kg	-	>100 kg	Yes
	Topple on all edges		Topple on all edges		Topple on all edges	

3.8.2.5 Electrical safety

Overvoltage category

Requirement per standard: EN 61131-2	Explanation per standard: EN 60664-1
Overvoltage category II	Equipment of "overvoltage category II" is energy-consuming equipment to be supplied from the fixed installation.

Pollution degree

Requirement per standard: EN 61131-2	Explanation per standard: EN 60664-1
Pollution degree 2	Only non-conductive pollution occurs. Temporary conductivity caused by condensation must occasionally be expected, however.

Protection rating provided by enclosure (IP code)

Requirement per EN 61131-2	Meaning of codes per EN 60529	Meaning for the protection of equipment	Meaning for the protection of personnel
≥IP20	First number IP**2**x	Protected against solid foreign bodies with a diameter ≥12.5 mm.	Protected against touching dangerous parts with fingers.
	Second number IPx**0**	Not protected.	-

Requirement per manufacturer	Meaning of codes per EN 60529	Meaning for the protection of equipment	Meaning for the protection of personnel
IP54	First number IP**5**x	Dust protected.	Protected against touching dangerous parts with conductor.
	Second number IPx**4**	Protected against splash water.	

Requirement per manufacturer	Meaning of codes per EN 60529	Meaning for the protection of equipment	Meaning for the protection of personnel
IP65	First number IP**6**x	Dust-proof	Protected against touching dangerous parts with conductor.
	Second number IPx**5**	Protected against water jets.	

3.8.2.6 Photobiological safety

3.8.2.6.1 Risk group classification

The following table shows the result of the risk group classification according to IEC 62471:2006 at a distance of 20 cm in front of the LEDs.

Smart Light		LED colors					
		Red (1)	Green (2)	Blue (3)	Lime (4)	White (99)	Infrared (100)
Backlight	1x1	RG0	RG0	RG0	RG0	RG0	RG0
	1x2	RG0	RG0	RG0	RG0	RG0	RG0
	1x3	RG0	RG0	RG0	RG0	RG0	RG0
	1x4	RG0	RG0	RG0	RG0	RG0	RG0
	2x2	RG0	RG0	RG0	RG0	RG0	RG0
	2x3	RG0	RG0	RG0	RG0	RG0	RG0

3.8.2.6.2 Marking on plant/machine

According to the IEC TR 62471-2 standard and the risk group classification carried out, **no** hazard-related marking of the risk groups is required on the plant/machine.

However, a symbol is applied to indicate that further information can be found in the manual, as shown in the following illustration:

3.8.2.6.3 Exposure hazard value (EHV)

The hazard value of exposure (EHV) indicates the relationship between the actual measured value of exposure (exposure level) at a distance of 20 cm and the exposure limit value.

EHV = exposure level / exposure limit value

If the exposure level (measured value of exposure at a distance of 20 cm) exceeds the exposure limit value, EHV is greater than 1. Since the backlight corresponds to risk group 0, every EHV value is less than 1.

3.8.2.6.4 Maximum permissible exposure time

The maximum duration of exposure that can be exposed without exceeding the exposure limit value. The duration of exposure thus has an influence on the limit value. The maximum exposure duration must be calculated over a whole day.

Since the backlight corresponds to risk group 0, no limitation of the exposure duration is necessary.

3.8.2.6.5 Hazard distances (HD)

The hazardous distance (HD) indicates the distance from the LEDs at which the exposure limit value is maintained when operating with 10 ms pulse length and 10% duty cycle (6.67% for size 2x3).

Since the backlight corresponds to risk group 0 and the risk group classification was carried out at 20 cm, the limit value is always observed at a distance of 20 cm.

3.8.2.6.6 Duty Cycle LEDs

The duty cycle of the LEDs depends on the pulse duration and the pause duration:

Duty cycle = pulse duration / (pause duration + pulse duration)

Since the backlight corresponds to risk group 0, no reduction in the duty cycle is required to comply with the limit values at a distance of 20 cm.

4 Smart Light - Light Bar

4.1 Order data - General

Order number	Short description	Figure
	Smart Light	
VSLL11xx0.67xP-000	Light bar, 1x1 size, 4 LED segments with 4 multicolor LEDs each, IP65 degree of protection, plastic cover, POWERLINK interface with integrated 2-port hub	

4.2 Technical data VSLL

This section contains the technical data for the individual configurable components of the lighting. The product name (material number) and order key of a lighting configuration can be used to determine the technical data of a specific **Smart Light**.

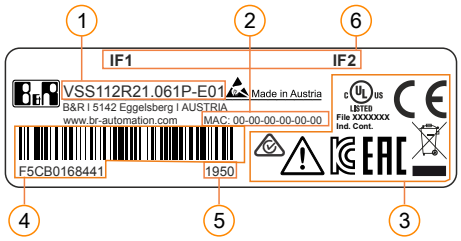
Order number	VSLL11xx0.67xP-000	VSLL12xx0.67xP-000	VSLL13xx0.67xP-000	VSLL14xx0.67xP-000	VSLLR4xx0.67xP-000	VSLLR6xx0.67xP-000	VSLLR8xx0.67xP-000
Short description							
Illumination	Vision Light Bar						
General information							
System requirements							
Automation Studio	4.7.2 or later						
Automation Runtime	C4.7.2 or later						
Cooling	Passive						
Status indicators	Module status, Error, Link1, Link2						
Diagnostics	Yes, using LED "Status" and software						
Undervoltage detection	No						
Reverse polarity protection	Yes						
Certifications	CE						
Module power supply							
Connection	M12, 8-pin, Y-coded						
Nominal voltage	24 VDC -15% / +20%, SELV/PELV						
Max. input current	0.41 A	0.75 A	1.09 A	1.43 A		2.11 A	2.25 A
Power consumption	max. 8.4 W	max. 15.3 W	max. 22.2 W	max. 29.2 W		max. 43.0 W	max. 45.9 W
Max. output current	3 A / string (for forwarding)						
Interfaces							
Quantity	2						
Connection designation	IF1, IF2						
Fieldbus	POWERLINK						
Type	POWERLINK (V2) controlled Node						
Variant	M12, 8-pin, Y-coded (2-port hub, daisy-chain wiring possible)						
Cable length	Max. 20 m between 2 stations (segment length)						
Transfer rate	100 Mbit/s						
Transfer							
Physical	100BASE-TX						
Half-duplex	Yes						
Full-duplex	No						
Autonegotiation	Yes						
Auto MDI/MDIX	Yes						
Min. cycle time	400 µs[1)]						
Integrated LED lighting							
Number of module LED status indicators	4						
Min. exposure time	1 µs						
Max. pulse length	10 ms						
Min. pause duration	14x pulse duration (with 10 ms pulse duration this means 140 ms pause duration)						19x pulse duration (with 10 ms pulse duration this means 190 ms pause duration)
Max. duty cycle[2)]	6.67 %						5 %
Peak wavelength							
Blue	468 nm						
Green	519 nm						
Lime (neon green)	544 nm						
Red	632 nm						
Infrared	856 nm						
White	None (Entire visible spectrum present)						
Spectral half width							
Blue	20 nm						
Green	35 nm						
Lime (neon green)	100 nm						
Red	17 nm						
Infrared	35 nm						
White	None (Entire visible spectrum present)						
Risk group per EN 62471:2008[3)]	RG0: Red, Green, Lime (Neon green), Infrared RG1: Blue, White RG2: -						
Adjustable beam angle	0° to 135°						
Adjustment cycles	max. 20,000						
LED lens							
Type 1 - Wide beam	Yes (74°)						
Type 2 - Standard	Yes (37°)						

Order number	VSLL11xx0.67xP-000	VSLL12xx0.67xP-000	VSLL13xx0.67xP-000	VSLL14xx0.67xP-000	VSLLR4xx0.67xP-000	VSLLR6xx0.67xP-000	VSLLR8xx0.67xP-000
Type 3 - Narrow beam	Yes (23°)						
Front glass (cover)	Plastic without anti-reflective coating						
Operating conditions							
Mounting orientation							
Horizontal	Yes						
Vertical	Yes						
Face-up	Yes						
Installation elevation above sea level							
0 to 2000 m	No limitations						
>2000 m	Reduction of ambient temperature by 0.5 °C per 100 m (Maximum 5000 m possible)						
Pollution degree per EN 60664-1	2						
Overvoltage category per EN 60664-1	II						
Degree of protection per EN 60529	IP65						
Ambient conditions							
Temperature[4)]							
Operation	-25 °C to +50 °C						
Storage	-40 °C to +85 °C						
Transport	-40 °C to +85 °C						
Relative humidity							
Operation	5 to 95 % condensing						
Storage	5 to 95 % condensing						
Transport	5 to 95 % condensing						
Mechanical properties							
Note	Size 1x1	Size 1x2	Size 1x3	Size 1x4	Size R4	Size R6	Size R8
Dimensions							
Width	120 mm	320 mm	480 mm	640 mm	280 mm	350 mm	430 mm
Height	86.2 mm	95.2 mm			127.7 mm		
Depth	66.7 mm	80 mm			280 mm	350 mm	430 mm

1) The maximum cycle time should not exceed 10 ms.
2) Pulse length in comparison to the sum of pulse length and pause duration (e.g. for flash operation)
3) For a working distance of 200 mm, pulse length of 10 ms, and a 6.67% duty cycle.
4) All mounting orientations

4.2.1 Product label

Light Bar



1	Smart Light - Order number (Example)	**2**	MAC address
3	Standards and certifications	**4**	Serial number (barcode type 128 and hexadecimal)
5	Production date: Year and calendar week (yyww)	**6**	Interface name

4.3 Operating and connection elements

4.3.1 Dimensioned drawing

Dimensions in mm.

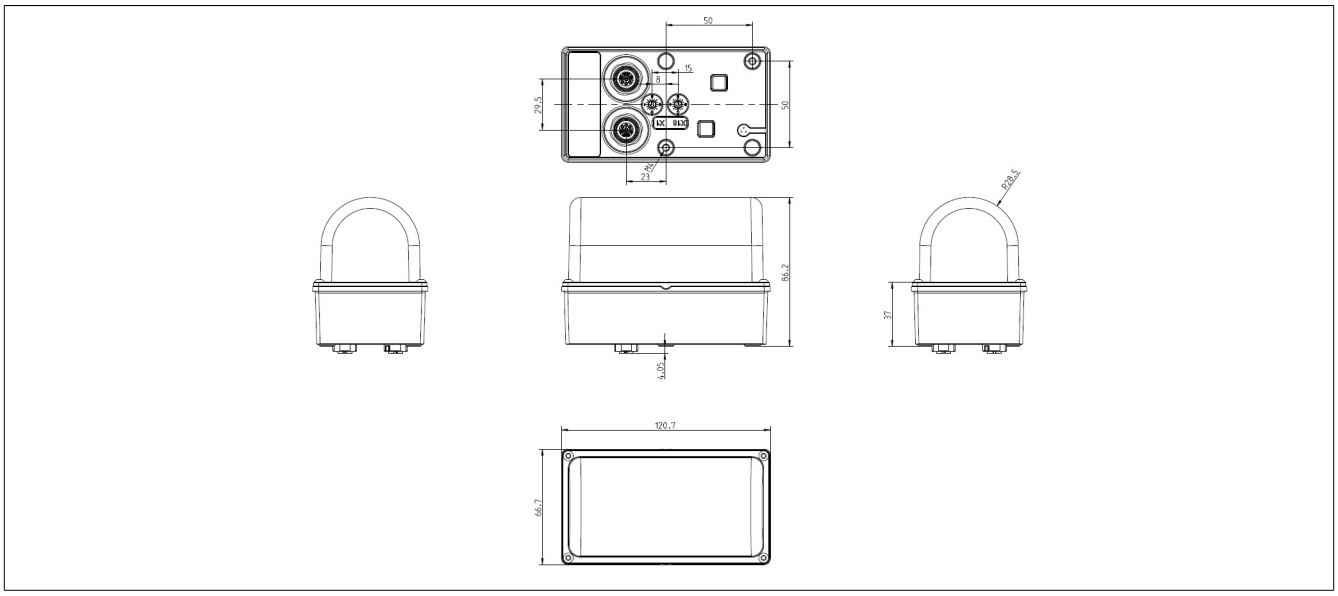


Figure 8: 1x1 Light bar

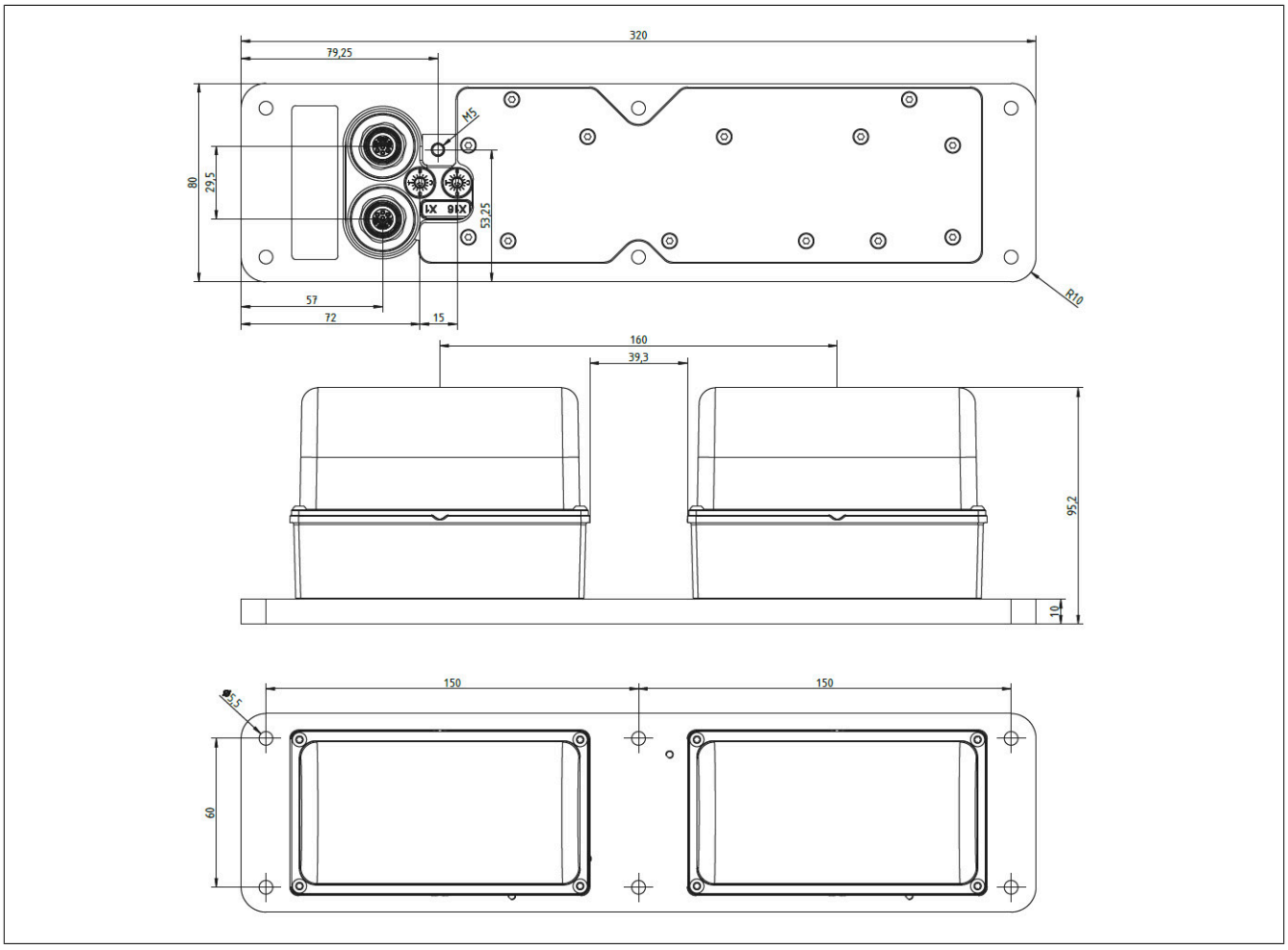


Figure 9: 1x2 Light Bar

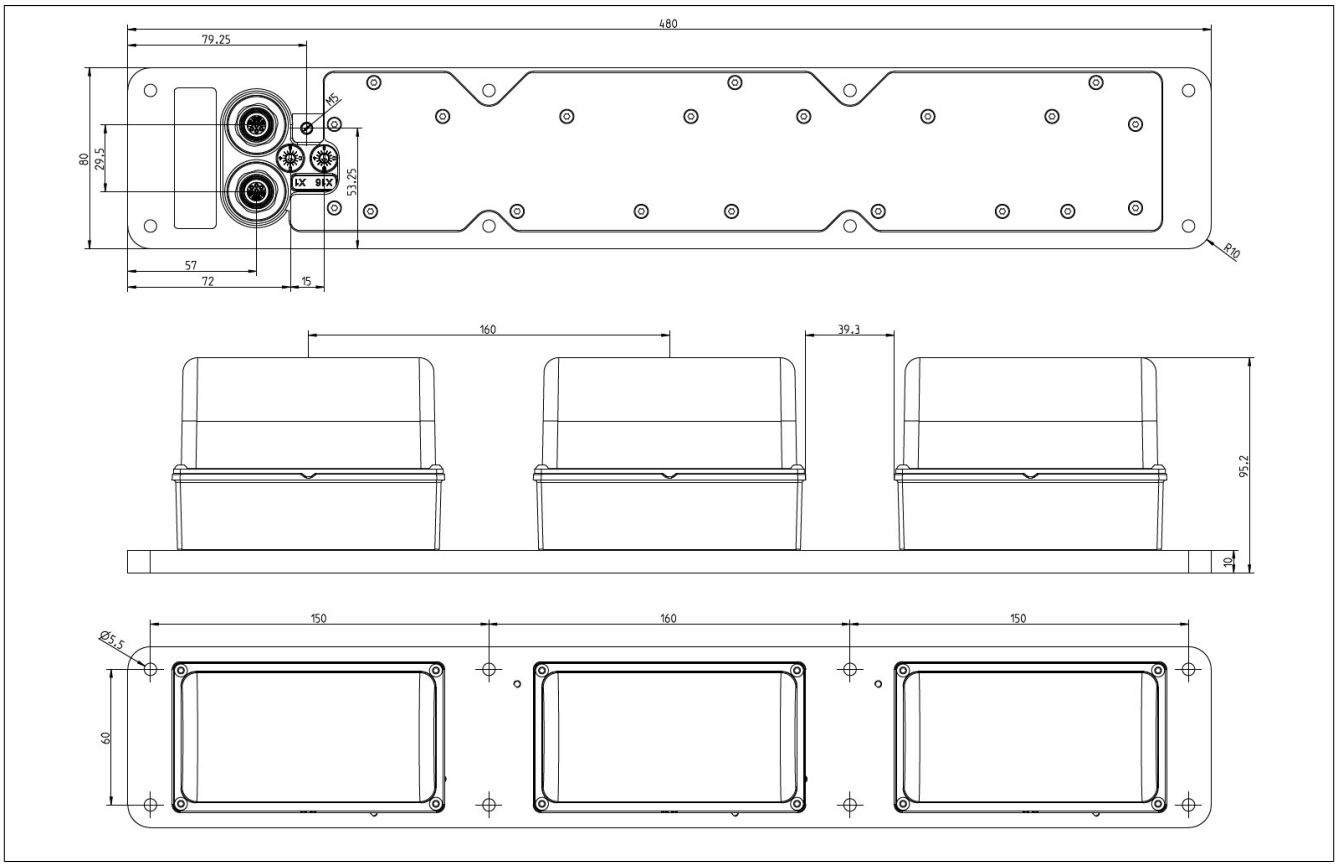


Figure 10: 1x3 Light Bar

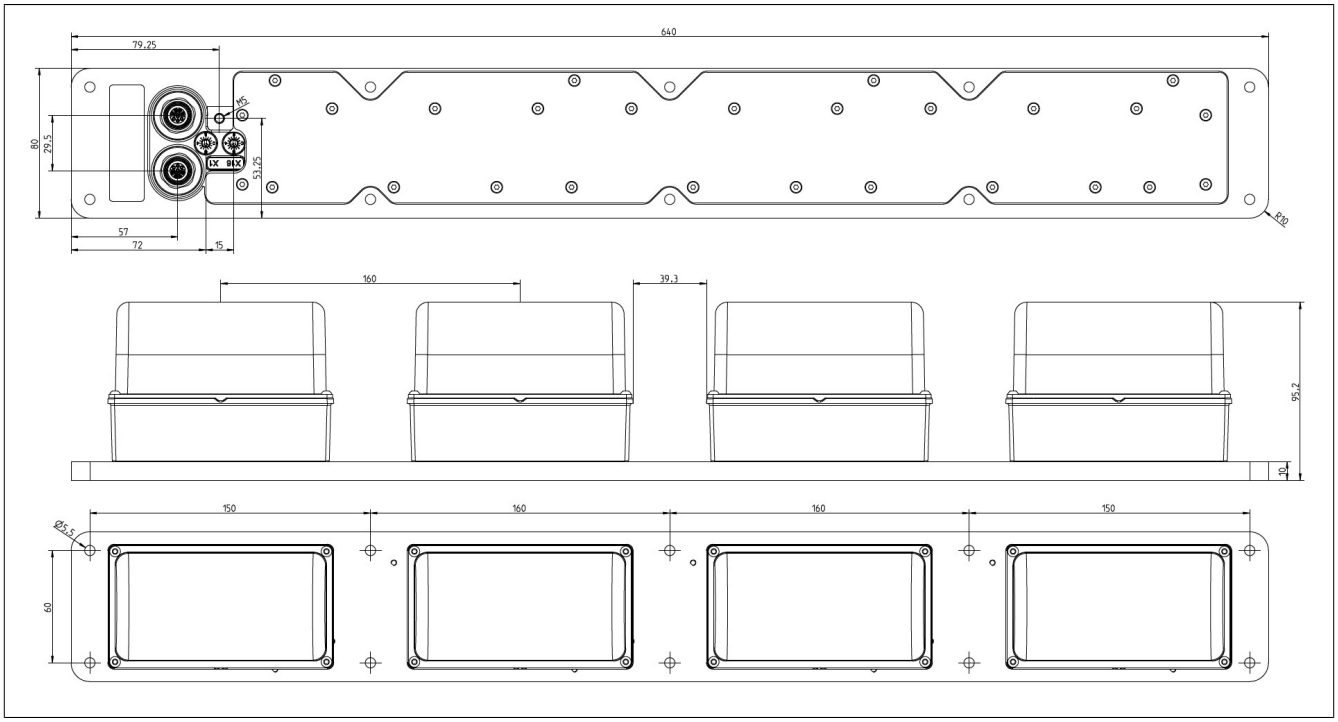


Figure 11: 1x4 Light Bar

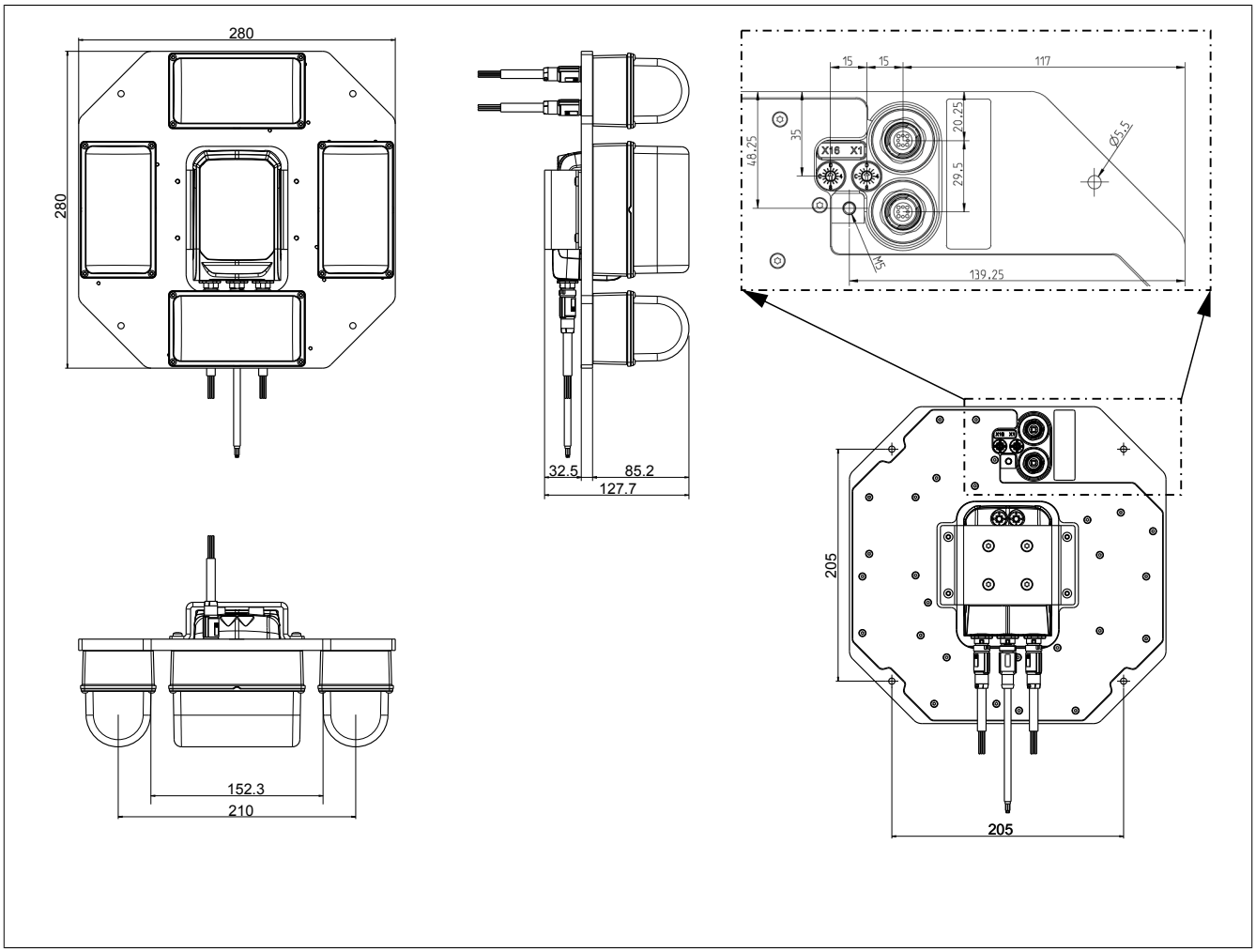


Figure 12: R4 Light Bar

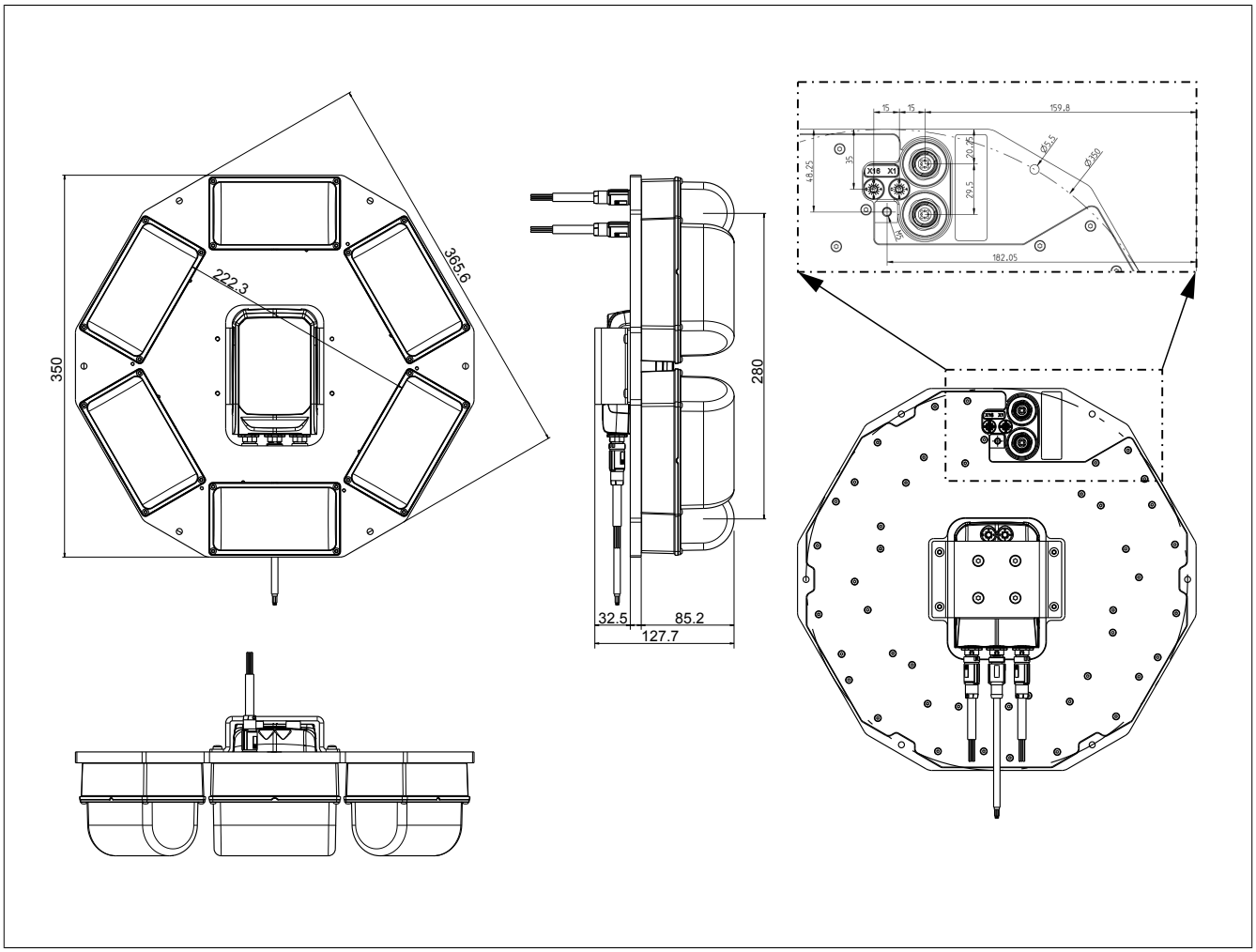


Figure 13: R6 Light Bar

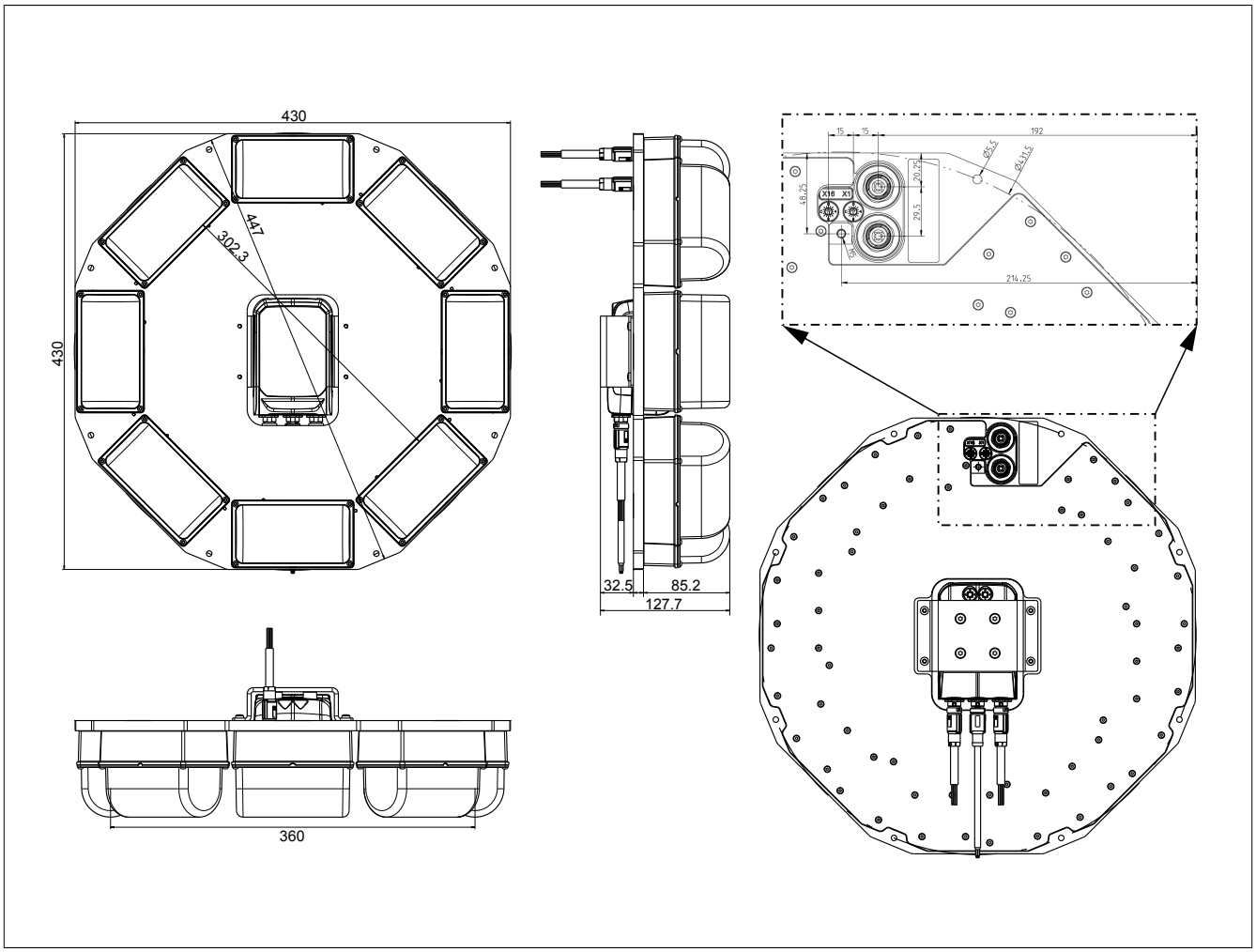


Figure 14: R8 Light Bar

4.3.2 LED status indicators

Light bar
The LED status indicators are located under the front glass cover on the printed circuit board.

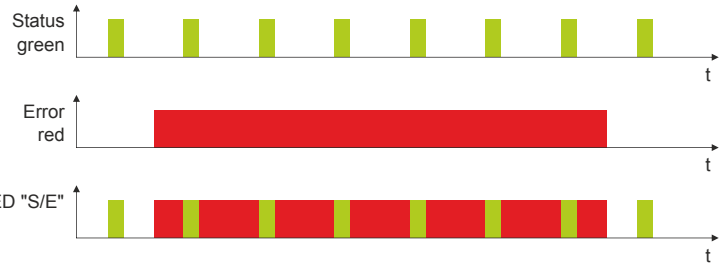
1	STATUS Status LED of the POWERLINK interface	**2**	ERROR Error LED of the POWERLINK interface
3	L/A IF1 POWERLINK Link/Activity LED of IF1	**4**	L/A IF2 POWERLINK Link/Activity LED of IF2

During Smart Light startup, the LED behavior corresponds to the behavior described in section POWERLINK V2 mode.

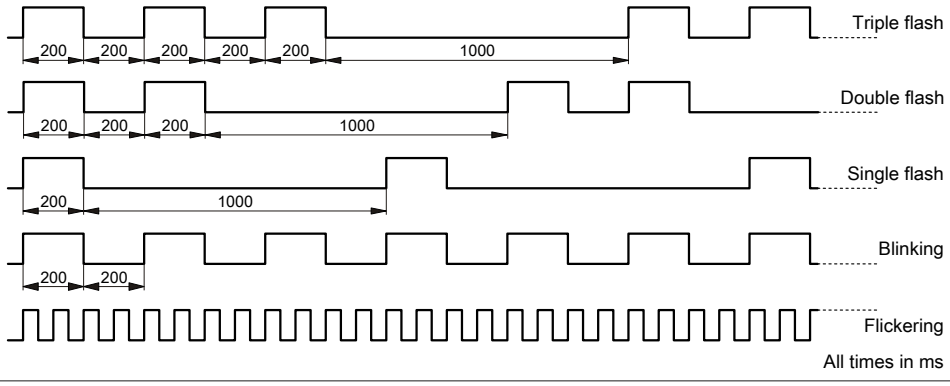
Information:

In contrast to Smart Camera modules, the LED status indicators are not switched off with Smart Light modules during flashing. Possible interference with the actual lighting is negligible.

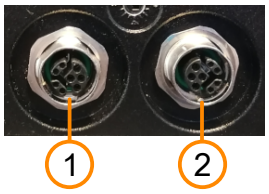
4.3.2.1 POWERLINK V2 mode

LED	Color	Status	Description
STATUS	Green	Off	No power supply or mode NOT_ACTIVE. The controlled node (CN) is either not supplied with power or it is in state NOT_ACTIVE. The CN waits in this state for about 5 s after a restart. Communication is not possible with the CN. If no POWERLINK communication is detected during these 5 s, the CN changes to state BASIC_ETHERNET (flickering). If POWERLINK communication is detected before this time expires, however, the CN immediately changes to state PRE_OPERATIONAL_1.
		Flickering	Mode BASIC_ETHERNET. The CN has not detected any POWERLINK communication. In this state, it is possible to communicate directly with the CN (e.g. with UDP, IP). If POWERLINK communication is detected in this state, the CN changes to state PRE_OPERATIONAL_1.
		Single flash	Mode PRE_OPERATIONAL_1. When operated on a POWERLINK V2 manager, the CN waits until an SoC frame is received and then switches to the PRE_OPERATIONAL_2 state.
		Double flash	Mode PRE_OPERATIONAL_2. The CN is normally configured by the manager in this state. It is then switched to state READY_TO_OPERATE by command (POWERLINK V2).
		Triple flash	Mode READY_TO_OPERATE. In a POWERLINK V2 network, the manager switches to the OPERATIONAL state by issuing a command.
		On	Mode OPERATIONAL. PDO mapping is active, and cyclic data is evaluated.
		Blinking	Mode STOPPED. Output data is not being output, and no input data is being provided. It is only possible to switch to or leave this state after the manager has given the appropriate command.
Error	Red	On	The controlled node (CN) is in an error state (failed Ethernet frames, increased number of collisions on the network, etc.). If an error occurs in the following states, the red LED is superimposed by the green flashing LED: • PRE_OPERATIONAL_1 • PRE_OPERATIONAL_2 • READY_TO_OPERATE  Note: • Several red blinking signals are displayed immediately after the device is switched on. This is not an error, however. • The LED is lit red for CNs with configured physical node number 0 but that have not yet been assigned a node number via dynamic node allocation (DNA).
L/A IFx	Green	On	The link to the remote station is established.
		Blinking	The link to the remote station is established, and Ethernet activity is taking place on the bus.

LED status indicators - Blink times



4.3.3 Connection elements



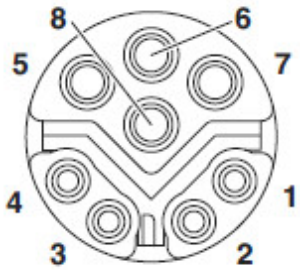
1	IF1: 24 VDC module power supply and POWERLINK 1	2	IF2: 24 VDC module power supply and POWERLINK 2

4.3.3.1 POWERLINK interface including 24 VDC module power supply

The POWERLINK interface with integrated 2-port hub connects to the fieldbus system for machine automation. The interface is designed for 100BASE-TX, and the two circular connectors also contain the 24 VDC module power supply.

The two hex address switches for setting the POWERLINK node number are located on the back of the device.

Pinout



Pin	Pinout	Explanation
1	TXD	PLK transmit signal
2	TXD\	PLK transmit signal inverted
3	RXD	PLK receive signal
4	RXD\	PLK receive signal inverted
5	GND	Supply line 1 (max. 3 A)
6	GND	Supply line 2 (max. 3 A)
7	+24 VDC	Supply line 2 (max. 3 A)
8	+24 VDC	Supply line 1 (max. 3 A)

POWERLINK node number

The node number for the POWERLINK node is set using the two number switches.

Switch position	Description
0x00	Only permitted when operating the POWERLINK node in DNA mode.
0x01 - 0xEF	Node number of the POWERLINK node. Operation as a controlled node (CN).
0xF0 - 0xFF	Reserved, switch position not permitted.

4.3.3.1.1 Dynamic node allocation (DNA)

Most POWERLINK bus controllers have the ability to dynamically assign node numbers. This has the following advantages:

- No setting of the node number switch
- Easier installation
- Reduced error sources

For information regarding configuration as well as an example, see Automation Help → Communication → POWERLINK → General information → Dynamic node allocation (DNA)

4.4 Function description

4.4.1 Daisy-chain wiring

The POWERLINK interface is designed as a 2-port hub and equipped with two circular connectors that are also located in the 24 V module power supply. Thanks to this interface, it is possible for several Smart Lights to be quickly and easily connected in series in terms of power supply and bus cabling (see "POWERLINK interface including 24 VDC module power supply" on page 44).

4.4.2 Monochrome lighting

> **Caution!**
>
> **Possible eye injuries due to optical radiation!**
>
> **The device corresponds to risk group 1 as described in EN 62471:2008 (with a working distance of 20 cm, pulse length of 10 ms and a 10% duty cycle).**
>
> - **Do not look directly into the lighting during operation.**
> - **Workstations must maintain the minimum distance to the device specified in the standard.**

The use of colored lighting is of great importance in industrial image processing in connection with colored objects. Different light colors represent different wavelengths, regardless of whether it is the light from lighting or the reflected light of an object.

If the lighting color and the color of the object are approximately the same (i.e. their wavelengths are approximately the same), the object in the acquired image is displayed as very bright to completely white (since the object reflects this wavelength particularly well in incident light or absorbs it particularly badly in transmitted light). Conversely, with a complementary color (opposing color in the color circle), the object can be displayed very dark to completely black.

The right lighting color (in relation to the object color) can improve contrast and help highlight or hide structures.

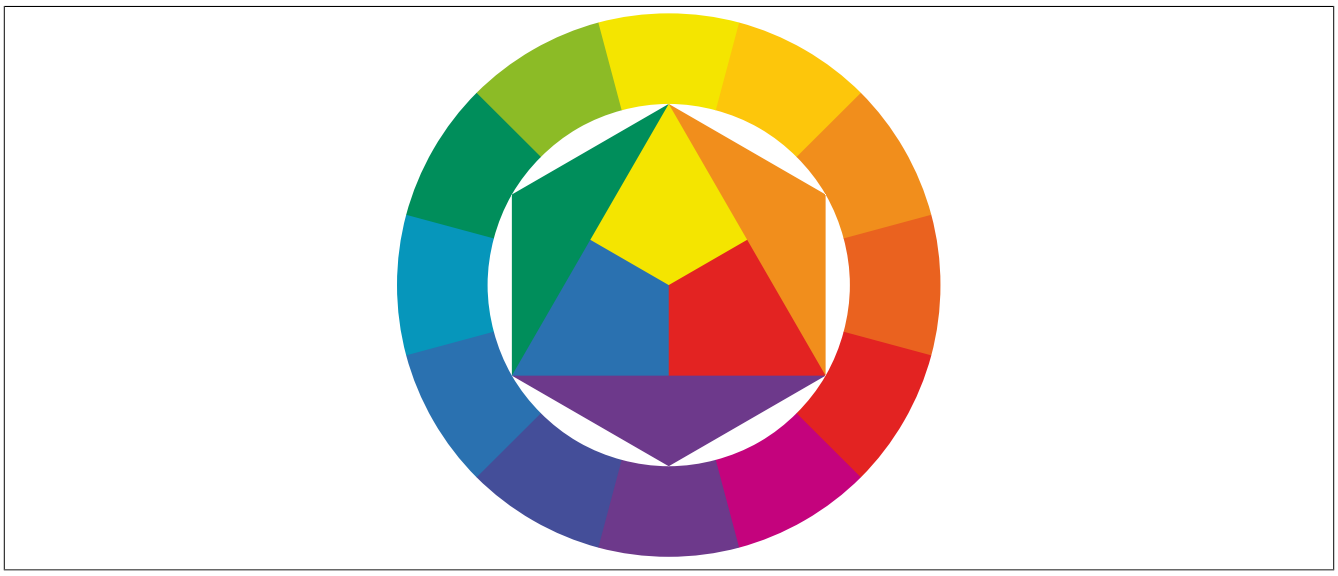
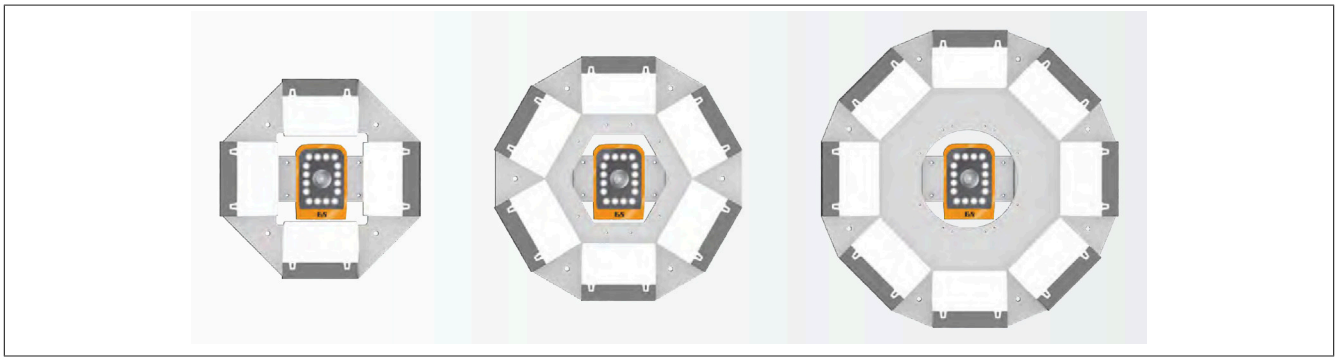


Figure 15: Color circle per Johannes Itten, 1961, in the public domain

4.4.3 Modular arrangements

Light bars can be arranged modularly thanks to their flexible design. They are available in a row of up to 4 light bars.

The flexible light bars are also available as four-, six- and eight-color ring lights (using a daisy-chain arrangement with POWERLINK).

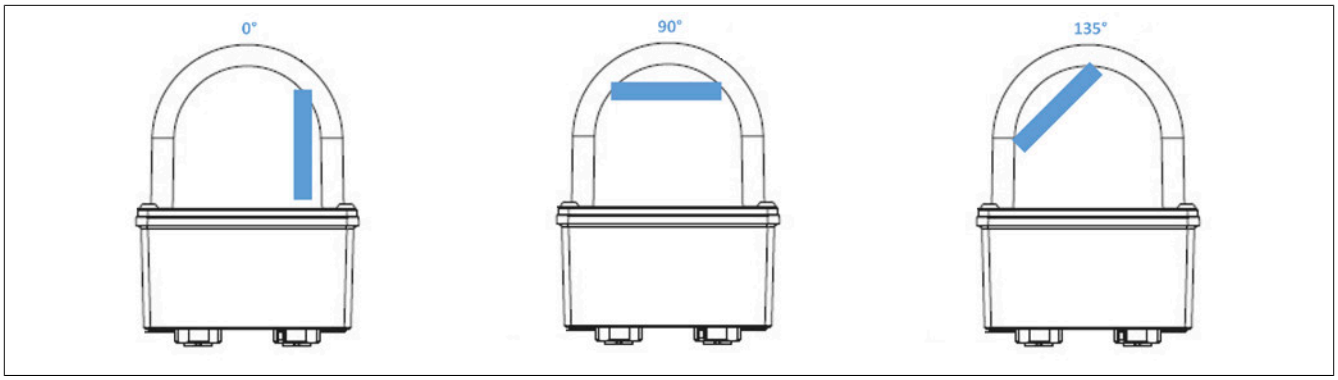


Information:

All modular arrangements can be ordered separately as finished configurations, see Smart Lights - Order number key

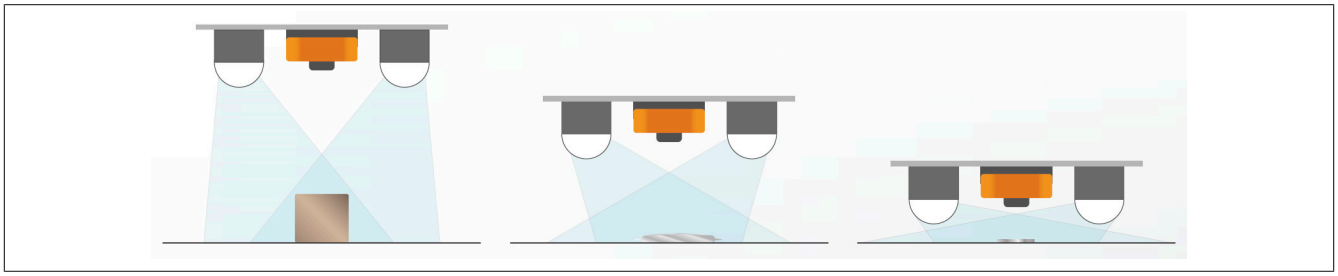
4.4.4 Adjustable beam angle

The beam angle of the light bar can be set in an angular range from 0° to +135° using stepper motor control.



The very precise alignment of the light source makes it easier to achieve good results for a variety of applications with different directional lighting situations.

Object-specific requirements such as bright-field or dark-field illumination can be implemented simply by setting a parameter.



4.5 Commissioning

Information:

A Smart Light module must be operated directly on the Smart Camera (without any further hub level). This is necessary so that there is no delay between light and image acquisition.

4.5.1 Factory alignment

Smart Light products from B&R are aligned during production. This "factory alignment" includes the following aspects, which can be enabled in the application if required:

- Adjustment of LED temperature drift, see parameter LEDTempDriftCorrection.

4.5.2 Photobiological safety - User information

The standard EN 62471 "Photobiological safety of lamps and lamp systems" divides lighting sources into a series of risk groups:

- Risk group (RG) 0 = Harmless / no photobiological hazard, even with continuous, unrestricted use
- Risk group (RG) 1 = Low risk / no danger due to normal constraints of behaviour
- Risk group (RG) 2 = Moderate risk / does not present a hazard due to aversion reactions of bright light sources or thermal discomfort
- Risk group (RG) 3 = High risk / danger even for volatile or short-term irradiation

Notice!

Possible injuries to eyes and skin due to optical radiation!

The device corresponds to risk group 1 according to IEC 62471:2006 (at working distance 20 cm, pulse length 10 ms, duty cycle 6.67%, or duty cycle 5% for size R8).

- **Do not look directly into the lighting during operation.**
- **Workstations must maintain the minimum distance to the device specified in the standard.**
- **The risk related to the observer depends on the installation and use of the device**

Information:

Depending on the activated color of a multiple LED, different risk groups can arise with the same output power.

For further information on photobiological safety see "Photobiological safety" on page 68.

4.5.2.1 Protection measures

Technical protection measures

- Protection of adjacent workplaces against the light cone of an LED lighting
- Enclosures preventing access to the danger zone
- Reduction of the intensity (limitation of the duty cycle of the LEDs) Organisational protective measures

Organisational protective measures

- Limitation of the residence time in the vicinity of the LED illumination (compliance with the maximum exposure time)
- Hazard-related labelling of risk groups
- Marking of the danger area

Personal protection measures

- Avoid staring directly into an LED illumination, regardless of the light colour used and the duration of the light pulse.
- When staying in the immediate vicinity of LED lighting, appropriate safety goggles or protective clothing (UV) must be used!

4.5.3 Installation and wiring

4.5.3.1 Installation

When mounting machine vision modules, it must be ensured that the modules are mounted on a sufficiently large, thermally conductive, flat surface on the machine side that is free of contamination. The maximum operating temperature specified in the technical data and the protection class must be observed during installation (see "Technical data VSLL" on page 36).

The **Smart Light** module must be attached using the 4 fixing points on the rear of the housing with a thermal and electrically conductive material, see "Dimensioned drawing".

For mounting and heat dissipation, the mounting points specified in the dimensioned drawing must lie on the entire surface of the mounting surface! Fixing on uneven mounting surfaces can lead to impairment of the the heat dissipation of machine vision modules.

Furthermore, it is essential that a free space is provided above and below the machine vision modules to ensure sufficient heat dissipation through air circulation. The products must be protected against impermissible contamination.

The use of the installation accessories, that can be ordered, is strongly recommended for mounting, see "Installation accessories".

4.5.3.2 Wiring

Only the available cables (see "Cables" on page 73) and the available cable accessories (see "Cable accessories" on page 81) are intended for wiring.

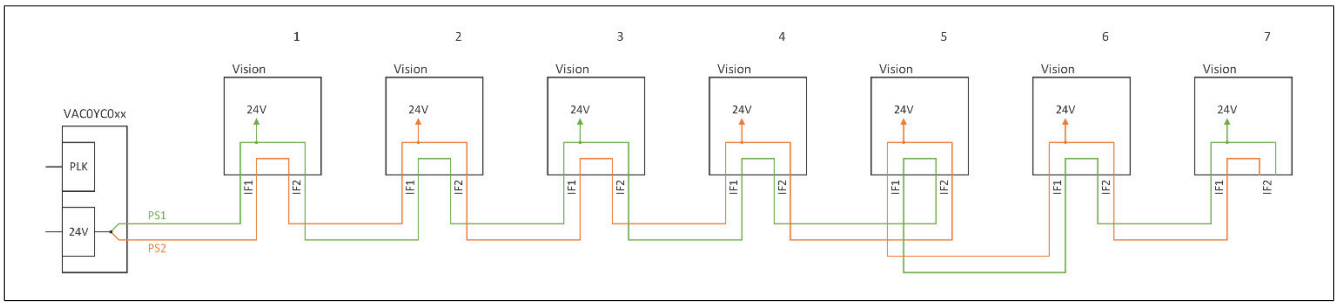
4.5.3.3 Vision modules supply concept

All vision modules (both **Smart Camera** and **Smart Light** modules) must be supplied with 24 V SELV / PELV. The voltage range at the input of 20.4 VDC to 28.8 VDC must be observed for correct function.

Power is supplied via the Vision POWERLINK hybrid cables. Each cable has 2 separate supply lines. The voltage is fed into the hybrid distributor and then split into the 2 supply lines PS1 and PS2. The energy for supplying the first vision module is taken from line PS1 from interface IF1. The line PS2 is only looped through. Both lines are crossed out on the circuit board. The maximum nominal current for the Smart Light is 3 A per line (2 supply lines per cable), so a section can be loaded with a maximum of 3 A.

Series connection example of vision modules:

As shown in the following illustration, the choice of the supply line (PS1 or PS2) for supplying the vision product depends on the position and the choice of the interface (IF1 or IF2) facing the hybrid distributor. With the vision module in position 5, IF2 was assigned to the hybrid distributor. So it is supplied with PS2. If IF1 were assigned to the hybrid distributor in position 5, as with the other positions, then the vision product in position 5 would be supplied with PS1.



However, a POWERLINK line can not only consist of Vision modules, but can also be continued with a POWERLINK hybrid distributor. In principle, no separate power supply is required for this second POWERLINK hybrid distributor, since the power supply can be provided via the line. However, if a separate power supply is provided for the second POWERLINK hybrid distributor, the power supply source of the first distributor box must be used.

Both distribution boxes must therefore be supplied from a single voltage supply source (they must have the same reference potential)!

4.5.4 Overtemperature behavior

The module has an internal overtemperature shutoff that triggers at the internal temperature sensors at 105/110 °C and above (this is indicated in Automation Studio by a logger message) and switches off the module.
The hysteresis for the restart temperature is 5 °C.

Information:

The environmental conditions specified in the technical data must be adhered to independently of a temperature monitoring system.

Cooling measures

The corresponding requirements of mechanical assembly must be observed to ensure heat dissipation.

On the application side, the internal temperature sensors can be read out with the `SensorTemperatureControllerBoard`, `SensorTemperatureLedBoard` data point in order to implement a user overtemperature shutdown. For example, if the internal temperature exceeds a specified threshold (e.g. 80 °C), the pulse-pause ratio can be increased to reduce the power consumption.

4.6 Maintenance

Notice!

Possible damage to the device due to improper handling!

- **Carry out maintenance work only when the power is switched off.**
- **Make sure that all modules and components are handled carefully.**

4.6.1 Cleaning the Smart Light

The characteristics of the Smart Light can be affected by dirt (reduced cooling power due to dust, poor light quality due to dirty glass cover, etc.) or condensation (e.g. water drops on the glass front). The Smart Light must therefore be kept clean or cleaned regularly. To clean the device, proceed as follows:

- Use a clean synthetic microfiber wipe to clean the device.
- Moisten the wipe with IPA (isopropanol) or a mixture of distilled water and IPA. A mixing ratio in the range of 30/70 to 70/30 is recommended.
- Do not spray the cleaning agent directly onto the device, but first onto the wipe.

Notice!

Possible damage to the device due to incorrect cleaning!

Never use aggressive solvents, chemicals, abrasives, compressed air or steam jets.

4.7 Register descriptions

The default configuration of a lighting unit is set using the registers described. The registers can be accessed in Automation Studio as follows:

- Cyclic parameters and general data points are accessible via the I/O mapping of the lighting unit. They can be modified at runtime.
- Acyclic camera parameters are accessible via the lighting unit configuration. They cannot be modified at runtime.

For all Light Bar with multiple light segments (i.e. all sizes larger than 1x1), each segment of a lighting unit can be controlled individually.

4.7.1 General data points

The module has the following general data points that provide access to general module information:

4.7.1.1 ModuleOK

Status bit that indicates whether the module is physically present and configured. Detection takes place via the fieldbus connection.

Data type	Values	Information
BOOL	0	Module not ready for operation
	1	Module present and configured

4.7.1.2 SerialNumber

The module's unique serial number can be read from this register. This 7-digit serial number is printed in decimal form on the module's housing.

Data type	Values
UDINT	0 to 4,294,967,295

Information:

Module serial number

The complete module serial number is made up of the 4-digit ModuleID and subsequent 7-digit SerialNumber.

Example:

- **ModuleID = 0xE908**
- **SerialNumber = 0x0001234**
- **Serial number printed on the module = 0xE9080001234**

4.7.1.3 ModuleID

The module hardware ID used to determine the type of device can be read from this register. This is also listed in the respective technical data as the "B&R ID code". In addition, a serial number is printed on each module; the module hardware ID corresponds to the first four positions of this serial number.

Data type	Values	Information
UDINT	0 to 65535	Module hardware ID. 4-digit hexadecimal number
	65536 to 4,294,967,295	Reserve

4.7.1.4 HardwareVariant

The hardware variant of the module can be read from this data point.

Data type	Values	Information
UDINT	0 to 65535	Hardware variant
	65536 to 4,294,967,295	Reserve

4.7.1.5 FirmwareVersion

The firmware version of the module can be read from this data point.

The last two positions correspond to the number after the decimal point.

Example: 345 corresponds to version 3.45.

Data type	Values	Information
UDINT	1 to 99	Release version of older modules or developmental versions of new modules
	100 to 29999	Release version
	30,000 to 59999	Test version
	60000 to 4,294,967,295	Reserve

4.7.2 Overview of registers

Parameter	Type	Range of values	Description	Cyclic	Acyclic
Ready	BOOL	0 or 1	Lighting unit availability status	R	
Status	UDINT	0x00000000 to 0xFFFFFFFF	This parameter specifies the status of the lighting unit.	R	
AcceptedFlashCnt	USINT	0 to 255	Counter for accepted lighting jobs	R	
CompletedFlashCnt	USINT	0 to 255	Counter for executed lighting jobs	R	
FailedFlashCnt	USINT	0 to 255	Counter for failed lighting jobs	R	
LightWarningCnt	USINT	0 to 255	Counter for errors or warnings that have occurred related to lighting.	R	
SensorTemperatureControllerBoard	SINT	-128 to +127	Current temperature at the controller board of the lighting unit in °C	R	
SensorTemperatureLedBoard	SINT	-128 to +127	Current temperature at the LED board of the lighting unit in °C	R	
FlashTrigger	BOOL	0 or 1	Enables/Disables the trigger for the lighting job	W	
ResetFlashTrigger	BOOL	0 or 1	Canceling an lighting job triggered by NetTime	W	
Nettime(n)	DINT	-2.147.483.648 to 2.147.483.647	Sets the NetTime for the trigger in µs	W	
ExposureTime(n)	UDINT	1 to 16.777.216	Sets the exposure time in µs	W	
FlashSegment(n)	USINT	0 to 0x0F	Enables/Disables LED segments	W	
FlashColor(n)	USINT	0 to 255	Select LED colors of the LED lighting	W	
SetAngleTotal	USINT	0 to 135	Position of stepper motor in degree.	W	
CyclicLineScanNettime	DINT	-2.147.483.648 to 2.147.483.647	Specifies the NetTime for dynamic line sensor mode.	W	
CyclicLineScanPeriod	UDINT	0 to 4.294.967.295	Time between 2 flashes in dynamic line sensor mode.	W	
LEDTempDriftCorrection	BOOL	0 or 1	Enables/Disables LED temperature drift correction		W
LineSensorModeFlashCount	UINT	1 to 4096	After a flash of light has been triggered, this process can be repeated with a certain interval.		W
LineSensorModeTimeDelay	UDINT	0 to 4.294.967.295	Time between flashes [nsec]		W
UseDynamicLineScan	BOOL	0 or 1	Switches the line sensor mode		W
MultiCaptureCount	USINT	1 to 10	Number of lighting jobs during a multiple image acquisition.		W

4.7.2.1 Smart Light data (cyclic read)

Information:

The parameters specified in this section are part of the I/O mapping of the hardware module that can be accessed via Automation Studio.

4.7.2.1.1 Ready

The status bit indicates whether the lighting unit is ready for image processing (Ready) or busy (Busy).

It also indicates whether the stepper motor has already reached its position.

Also during startup and initialization the lighting unit is busy and therefore the status bit **Ready** = 0.

Data type	Values	Information
BOOL	0	Busy. Module is busy with other tasks.
	1	Ready. Module is ready for lighting.

Information:

As long as the lighting unit is busy, neither a trigger nor new jobs can be started.

4.7.2.1.2 Status

This parameter specifies the status of the lighting unit

This parameter must be checked for 0 in the application during operation.

Values	Information
Bit 0	**FlashTrigger** is active.
Bit 1	**FlashTrigger** is waiting for a trigger of the set **NetTime**.
Bit 3 to Bit 5	Reserve
Bit 6	Software reset **ResetFlashTrigger** is currently still being executed.
Bit 7	The stepper motor has not yet moved to the position set via **SetAngle**.
Bit 8 to Bit 11	Reserve
Bit 12	HW error. Not all segments were found.
Bit 13	Operating temperature too high
-	-

Information:

During startup, a check is carried out to determine whether all segments are present, otherwise the power supply for the LEDs is not enabled. In this case, bit 12 is set in the Status parameter.

4.7.2.1.3 AcceptedFlashCnt

Counter for accepted lighting jobs.

Data type	Values	Information
USINT	0 to 255	Counter for accepted lighting jobs.

Information:

When evaluating the counter, a potential value overflow must be taken into account!

4.7.2.1.4 CompletedFlashCnt

Counter for executed lighting jobs.

Data type	Values	Information
USINT	0 to 255	Counter for executed lighting jobs.

Information:

When evaluating the counter, a potential value overflow must be taken into account!

4.7.2.1.5 FailedFlashCnt

Counter for failed or invalid lighting jobs, for example jobs with incorrect timing. **CompletedFlashCnt** can still count up.

Data type	Values	Information
USINT	0 to 255	Counter for failed or invalid lighting jobs.

Information:

When evaluating the counter, a potential value overflow must be taken into account!

4.7.2.1.6 LightWarningCnt

Counter for errors or warnings that have occurred related to lighting. The value of this parameter is incremented in the following cases:

- If the exposure was too long.
- If there is not enough power available.
- If the sampling behavior is not correct.

Data type	Values	Information
USINT	0 to 255	Counter for errors or warnings that have occurred related to lighting.

Information:

When evaluating the counter, a potential value overflow must be taken into account!

4.7.2.1.7 SensorTemperatureControllerBoard

Current temperature of the vision module in °C.

Data type	Values	Information
SINT	-128 to 127	Current measured temperature at the temperature sensor on the controller board in the vision module in °C.

4.7.2.1.8 SensorTemperatureLedBoard

Current temperature of the vision module in °C.

Data type	Values	Information
SINT	-128 to 127	Current measured temperature at the temperature sensor on the LED board in the vision module in °C.

4.7.2.2 Smart Light parameters (cyclic write)

Information:

The parameters specified in this section are part of the I/O mapping of the hardware module that can be accessed via Automation Studio.

4.7.2.2.1 FlashTrigger

Trigger to enable the lighting job. A positive edge of this parameter enables the lighting job (The positive edge is only accepted with **Ready** =1). Nettime (n), ExposureTime (n) and FlashColor (n) are returned.

In order to enable additional lighting job, this value must be reset to 0 so that another lighting job is possible.

Data type	Values	Information
BOOL	0	Do not start a job (default value).
	1	Lighting job enabled.

4.7.2.2.2 ResetFlashTrigger

A positive edge, cancels all pending future jobs or not yet executed ones using NetTime. A lighting job in progress is not aborted.

Data type	Values	Information
BOOL	0	Trigger abort off (default value).
	1	Cancel trigger.

4.7.2.2.3 Nettime(n)

Delay time (the set NetTime) for the trigger.

If multiple images are acquired due to a trigger event (MultiCapture >1), the delay is always based on the actual trigger event and not the last acquisition.

Information:

Triggering takes place immediately if the Nettime is in the past. In this case, both FailedFlashCnt and CompletedFlashCnt are increased.

Data type	Values	Information
DINT	-2.147.483.648 to 2.147.483.647	32-bit value for set NetTime from 1 µs to 4294 s in increments of 1 µs (absolute NetTime).

Information:

Depending on the calculated value of parameter MultiCapture, this parameter (with indices 01, 02, etc.) occurs n times.

4.7.2.2.4 ExposureTime(n)

Illumination duration of the LED lighting.

Data type	Values	Information
UDINT	1 to 16.777.216	24-bit value for an integration time of 1 µs to 16.8 s in increments of 1 µs.

Information:

Depending on the calculated value of parameter MultiCapture, this parameter (with indices 01, 02, etc.) occurs n times.

4.7.2.2.5 FlashSegment(n)

This parameter specifies which LED segments should be used for the image acquisition. The various LED segments can be switched in combinations as required and are addressed as bit patterns.

Information:

The parameter is available only for Light Bar with a size larger than 1x1.

Data type	Values	Information
USINT	Bit 0	LED segment 1 on/off
	Bit 1	LED segment 2 on/off
	Bit 2	LED segment 3 on/off
	Bit 3	LED segment 4 on/off
	Bit 4	LED segment 5 on/off
	Bit 5	LED segment 6 on/off
	Bit 6	LED segment 7 on/off
	Bit 7	LED segment 8 on/off

Information:

Depending on the calculated value of parameter MultiCapture, this parameter (with indices 01, 02, etc.) occurs n times.

4.7.2.2.6 FlashColor(n)

This parameter specifies which LED color should be used during a lighting job. For a lighting variant with a single LED color, this parameter must only be set once at the beginning. For lighting variants with multiple LED colors, these can consequently be switched during application depending on the requirements.

If an LED color is set that the lighting unitdoes not have, no light is used during the lighting job!

Data type	Values	Information
USINT	0	No light (default value)
	1	Red
	2	Green
	3	Blue
	4	Lime
	99	White
	100	Infrared
	Rest	Invalid

Information:

Depending on the calculated value of parameter MultiCapture, this parameter (with indices 01, 02, etc.) occurs n times.

4.7.2.2.7 SetAngleTotal

Parameter to set the adjustable beam angle of the LEDs to an absolute position.

Data type	Values	Information
UINT	0 to 135	Position of stepper motor in degree.

Information:

To minimize the slip of the mechanics, all positions are approached in positive direction. If a position is to be approached which is smaller than the current position (negative direction), additional steps are moved in the negative direction and then the actual position is approached in the positive direction.

4.7.2.2.8 CyclicLineScanNettime

Parameter **CyclicLineScanNettime** is only active if **UseDynamicLineScan** is set to 1 (cyclic/dynamic line sensor)

CyclicLineScanPeriod is valid from this Nettime on.

Data type	Values	Information
DINT	-2.147.483.648 to 2.147.483.647	Specifies the NetTime for dynamic line sensor mode.

4.7.2.2.9 CyclicLineScanPeriod

Parameter **CyclicLineScanPeriod** is only active if **UseDynamicLineScan** is set to 1 (cyclic/dynamic line sensor).

Data type	Values	Information
UDINT	0 to 4.294.967.295	Time between 2 flashes in line sensor mode from 0 to 4.29 s in increments of 1 ns.

4.7.2.3 Smart Light configuration (acyclic write)

Information:

The parameters specified in this section are part of the hardware module configuration that can be accessed via Automation Studio.

4.7.2.3.1 LEDTempDriftCorrection

This parameter can be used to enable an automatic correction of the temperature drift of the LED lighting.

The intensity of the LEDs is adjusted to each other. Slightly less light output is therefore available with **LEDTempDriftCorrection** enabled. Subsequently, the exposure time increases.

Data type	Values	Information
BOOL	0	No correction of the LED temperature drift (default value).
	1	LED temperature drift correction enabled.

4.7.2.3.2 LineSensorModeFlashCount

Number of flashes in static line sensor mode.

Data type	Values	Information
UINT	1 to 4096	Number of flashes in line sensor mode. The default value is 1.

4.7.2.3.3 LineSensorModeTimeDelay

The length of time between triggered flashes configured via **LineSensorModeFlashCount** in static line sensor mode.

Data type	Values	Information
UDINT	1 to 4.294.967.295	Time between two flashes in line sensor mode from 1 ns to 4.29 s in increments of 1 ns.

4.7.2.3.4 UseDynamicLineScan

Parameter to switch the operating mode (mode) between static and dynamic line sensors. The value of this parameter must always be set in relation to a **Smart Camera**.

Information:

For further information on the line sensor operation of a Smart Camera, see the chapter "mapp Vision" in the Automation Help.

Data type	Values	Information
BOOL	0	Static line sensor (LineSensorModeFlashCount, LineSensorModeTimeDelay)
	1	Dynamic (cyclic) line sensor (CyclicLineScanNettime, CyclicLineScanPeriod)

4.7.2.3.5 MultiCaptureCount

Parameter for multiple lighting of the lights during multiple image acquisitions of the camera. Specifies the number of flashes within a cycle.

Information:

For correct operation, the value of MultiCaptureCount of the Smart Light must be equal to the value of AcquisitionCount of the ahead camera.

As long as parameter **MultiCaptureCount** = 1, the parameters with index 01 are used. Otherwise, the parameter sets are processed one after the other until the value of **MultiCaptureCount** valid at the time of the trigger edge is reached.

Data type	Values	Information
USINT	1 to 10	Number of flashes. Default = 1

4.8 International and national certifications

Machine vision devices meet the requirements of the listed certifications and their relevant standards. We are committed to ensuring the reliability of our products in industrial environments.

Information:

Certifications applicable to the respective module are available at the following locations:

- **Section "General information > Certifications in section "Technical data" in the data sheet**
- **On the website www.br-automation.com in section "Technical data" for the individual products (possible to search using model number).**
- **On the product label of the module.**

Changes and new certifications are promptly made available in electronic form on the B&R website at www.br-automation.com.

4.8.1 Overview of certifications

Mark	Explanation	Certificate authority	Region
CE	CE marking	Notified bodies	Europe (EU)

4.8.2 EU directives and standards (CE)

CE marking

CE

The respective product complies with all applicable EU directives and relevant harmonized standards.

Certification of these products is performed in cooperation with accredited testing laboratories.

Validity: Europe (EU)

EMC Directive 2014/30/EU

Il devices satisfy the protection requirements of the "EMC Directive" and are designed for industrial use:

Applicable standards from this directive:

EN 61131-2	Programmable logic controllers - Part 2: Equipment requirements and tests
EN 61000-6-2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments
EN 61000-6-4	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emissions standard for industrial environments

The corresponding declaration of conformity is available for download from the B&R website.
For information about the versions of applicable standards, see the declaration of conformity.

Declaration of conformity

Declarations of conformity

4.8.2.1 Overview of standards

Standard	Description
EN 50581	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances
EN 55011 (CISPR 11)	Industrial, scientific and medical equipment - Radio frequency disturbance characteristics - Limits and methods of measurement
EN 55016-2-1 (CISPR 16-2-1)	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-1: Methods of measurement of disturbances and immunity - Conducted disturbance measurements
EN 55016-2-3 (CISPR 16-2-3)	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity - Radiated disturbance measurements
EN 55022 (CISPR 22)	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
EN 60068-2-6	Environmental testing - Part 2-6: Procedures - Test Fc: Vibration (sinusoidal)
EN 60068-2-27	Environmental testing - Part 2-27: Test procedure - Test Ea and guidance: Shock
EN 60068-2-31[1)]	Environmental testing - Part 2-31: Test procedure - Test Ec: Rough handling shocks, mainly for devices
EN 60529	Degrees of protection provided by enclosures (IP code)
EN 60664-1	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests
EN 60721-3-2	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 2: Transport and handling
EN 60721-3-3	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 3: Stationary use at weather-protected locations
EN 61000-4-2	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test
EN 61000-4-3	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test
EN 61000-4-4	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test
EN 61000-4-5	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measuring techniques - Surge immunity test
EN 61000-4-6	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
EN 61000-4-8	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measuring techniques - Power frequency magnetic field immunity test
EN 61000-4-11	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measuring techniques - Voltage dips, short interruptions and voltage variations
EN 61000-4-29	Electromagnetic compatibility (EMC) - Part 4-29: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests
EN 61000-6-2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments
EN 61000-6-4	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
EN 61131-2	Programmable logic controllers - Part 2: Guidance for inspection and routine testing
EN 62471	Photobiological safety of lamps and lamp systems

1) Replacement for EN 60068-2-32

4.8.2.2 Requirements for immunity to disturbances

Immunity	Testing performed per standard:	Requirements per standard:	
		EN 61131-2 [1]	EN 61000-6-2 [2]
Electrostatic discharge (ESD)	EN 61000-4-2	✓	✓
High-frequency electromagnetic fields (HF field)	EN 61000-4-3	✓	✓
High-speed transient electrical disturbances (Burst)	EN 61000-4-4	✓	✓
Surge voltages (Surge)	EN 61000-4-5	✓	✓
Conducted disturbances	EN 61000-4-6	✓	✓
Magnetic fields with electrical frequencies	EN 61000-4-8	✓	✓
Voltage dips (AC) Short-term interruptions (AC) Voltage fluctuations (AC)	EN 61000-4-11	✓	✓
Short-term interruptions (DC) Voltage fluctuations (DC)	EN 61000-4-29	✓	-

1) EN 61131-2: Product standard - Programmable logic controllers
2) EN 61000-6-2: Generic standard - Immunity for industrial environments

Criteria to prove the performance of a PLC system against EMC disturbances

Criteria	During test	After test
A	The PLC system shall continue to operate as intended. No loss of function or performance.	The PLC system shall continue to operate as intended.
B	Degradation of performance accepted. The operating mode is not permitted to change. Irreversible loss of stored data is not permitted.	The PLC system shall continue to operate as intended. Temporary degradation of performance must be self-recoverable.
C	Loss of functions accepted, but no destruction of hardware or software (program or data).	The PLC system shall continue to operate as intended automatically, after manual restart or power off / power on.
D	Degradation or failure of functionality that can no longer be restored.	PLC system permanently damaged or destroyed.

Electrostatic discharge (ESD)

Testing performed per standard: EN 61000-4-2	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
Contact discharge (CD) On conductive accessible parts	±4 kV Criteria B	
Air discharge (AD) On insulating accessible parts	±8 kV Criteria B	

High-frequency electromagnetic fields (HF field)

Testing performed per standard: EN 61000-4-3	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
Housing, completely wired	80 MHz to 1 GHz, 10 V/m 1.4 to 2 GHz, 3 V/m 2 to 2.7 GHz, 1 V/m Criteria A	

High-speed transient electrical disturbances (Burst)

Testing performed per standard: EN 61000-4-4	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
AC power inputs	±2 kV / 5 kHz Criteria B	
AC power outputs	±2 kV / 5 kHz [1] Criteria B	±2 kV / 5 kHz Criteria B
Other AC I/O	±2 kV / 5 kHz [1] Criteria B	-
DC mains inputs/outputs	±2 kV / 5 kHz [1] Criteria B	
Other I/Os and interfaces	±1 kV / 5 kHz [1] Criteria B	

1) Only for connections with a permitted cable length greater than 3 m.

Surge voltages (Surge)

Testing performed per standard: EN 61000-4-5	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
AC mains inputs/outputs Line / line	±1 kV Criteria B	
AC mains inputs/outputs Line / ground	±2 kV Criteria B	
DC mains inputs/outputs Line / line	±0.5 kV 1) Criteria B	±0.5 kV Criteria B
DC power inputs Line / ground	±0.5 kV 1) Criteria B	±0.5 kV Criteria B
DC power outputs Line / ground	±0.5 kV 1) Criteria B	±0.5 kV Criteria B
Signal connections, unshielded Line / ground	±1 kV 1) Criteria B	
All shielded cables Line / ground	±1 kV 1) Criteria B	-

1) Only for connections with a permitted cable length greater than 30 m.

Conducted disturbances

Testing performed per standard: EN 61000-4-6	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
AC mains inputs/outputs	10 V 150 kHz to 80 MHz 80% AM (1 kHz) Criteria A	
DC mains inputs/outputs	10 V 150 kHz to 80 MHz 80% AM (1 kHz) Criteria A	
Other I/Os and interfaces	10 V 1) 150 kHz to 80 MHz 80% AM (1 kHz) Criteria A	

1) Only for connections with a permitted cable length greater than 3 m.

Magnetic fields with electrical frequencies

Testing performed per standard: EN 61000-4-8	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
Housing, completely wired	30 A/m 3 axes (x, y, z) 50/60 Hz 1) Criteria A	

1) Mains frequency per manufacturer data

Voltage dips

Testing performed per standard: EN 61000-4-11	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
AC power inputs	0% residual voltage 250/300 periods (50/60 Hz) 1) 20 attempts Criteria C	
	40% residual voltage 10/12 periods (50/60 Hz) 1) 20 attempts Criteria C	
	70% residual voltage 25/30 periods (50/60 Hz) 1) 20 attempts Criteria C	

1) Mains frequency per manufacturer data

Short-term interruptions

Testing performed per standard: EN 61000-4-11 / EN 61000-4-29	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
AC power inputs	0% residual voltage 0.5 periods (50/60 Hz) 1) 20 attempts Criteria A	0% residual voltage 1 period (50/60 Hz) 1) 3 attempts Criteria B
DC power inputs	0% residual voltage ≥10 ms (PS2) 2) 20 attempts Criteria A	-

1) Mains frequency per manufacturer data
2) Use of a B&R power supply guarantees that these requirements are met.

Voltage fluctuations

Testing performed per standard: EN 61000-4-11 / EN 61000-4-29	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN 61000-6-2
AC power inputs	-15% / +10% Test duration per 30 minutes Criteria A	-
DC power inputs	-15% / +20% Test duration per 30 minutes Criteria A	-

4.8.2.3 Emission requirements

Phenomenon	Testing performed per standard:	Limit values per standard:	
		EN 61131-2 [1]	EN 61000-6-4 [2]
Emissions related to lines	EN 55011 / EN 55022 EN 55016-2-1	✓	✓
Radiated emissions	EN 55011 / EN 55022 EN 55016-2-3	✓	✓

1) EN 61131-2: Product standard - Programmable logic controllers
2) EN 61000-6-4: Generic standards - Emission standard for industrial environments

Emissions related to lines

Testing performed per standard: EN 55011 / EN 55022 / EN 55016-2-1	Limit values per standard: EN 61131-2 / Zone B	Limit values per standard: EN 61000-6-4
AC mains connection 150 kHz to 30 MHz	150 to 500 kHz 79 dB (µV) quasi-peak value 66 dB (µV) average value	
	500 kHz to 30 MHz 73 dB (µV) quasi-peak value 60 dB (µV) average value	
Telecommunications / network connection 150 kHz to 30 MHz	-	150 to 500 kHz 97 to 87 dB (µV) quasi-peak value 53 to 40 dB (µA) quasi-peak value 84 to 74 dB (µV) average value 40 to 30 dB (µA) average value
	-	500 kHz to 30 MHz 87 dB (µV) quasi-peak value 43 dB (µA) quasi-peak value 74 dB (µV) average value 30 dB (µA) average value

Radiated emissions

Testing performed per standard: EN 55011 / EN 55022 / EN 55016-2-3	Limit values per standard: EN 61131-2 / Zone B	Limit values per standard: EN 61000-6-4
Electric field / Measured from 10 m 30 MHz to 1 GHz	30 to 230 MHz 40 dB (µV/m) quasi-peak value	
	230 MHz to 1 GHz 47 dB (µV/m) quasi-peak value	
Electric field / Measured from 3 m 1 to 6 GHz [1]	-	1 to 3 GHz 76 dB (µV/m) peak value 56 dB (µV/m) average value
	-	3 to 6 GHz 80 dB (µV/m) peak value 60 dB (µV/m) average value

1) Depends on the highest internal frequency

4.8.2.4 Mechanical conditions

Testing	Testing performed per standard:	Requirements per standard:				
		EN 61131-2 [1]	EN 60721-3-2 Class 2M1	EN 60721-3-2 Class 2M2	EN 60721-3-2 Class 2M3	EN 60721-3-3 Class 3M4
Vibration (sinusoidal) / Operation	EN 60068-2-6	✓	-	-	-	✓
Shock / Operation	EN 60068-2-27	✓	-	-	-	✓
Vibration (sinusoidal) / Transport (packaged)	EN 60068-2-6	-	✓	✓	✓	-
Shock / Transport (packaged)	EN 60068-2-27	-	✓	✓	-	-
Free fall / Transport (packaged)	EN 60068-2-31 [2]	✓	✓	-	-	-
Toppling / Transport (packaged)	EN 60068-2-31	-	✓	✓	✓	-

1) EN 61131-2: Product standard - Programmable logic controllers
2) Replacement for EN 60068-2-32

Vibration (sinusoidal) / Operation

Testing performed per standard: EN 60068-2-6	Requirements per standard: EN 61131-2		Requirements per standard: EN 60721-3-3 / Class 3M4	
Vibration (sinusoidal) [1] Operation	Frequency	Amplitude	Frequency	Amplitude
	5 to 8.4 Hz	Deflection 3.5 mm	2 to 9 Hz	Deflection 3 mm
	8.4 to 150 Hz	Acceleration 1 g [2]	9 to 200 Hz	Acceleration 1 g [2]
	20 sweeps for each axis [3]			

1) Uninterrupted duty with movable frequency in all 3 axes (x, y, z); 1 octave per minute
2) 1 g = 10 m/s²
3) 2 sweeps = 1 frequency cycle ($f_{min} \rightarrow f_{max} \rightarrow f_{min}$)

Shock / Operation

Testing performed per standard: EN 60068-2-27	Requirements per standard: EN 61131-2	Requirements per standard: EN 60721-3-3 / Class 3M4
Shock [1] Operation	Acceleration 15 g Duration 11 ms 18 shocks	Acceleration 10 g Duration 11 ms 18 shocks

1) Pulse (half-sine) stress in all 3 axes (x, y, z), 1 octave per minute

Vibration (sinusoidal) / Transport (packaged)

Testing performed per standard: EN 60068-2-6	Requirements per standard: EN 60721-3-2 / Class 2M1		Requirements per standard: EN 60721-3-2 / Class 2M2		Requirements per standard: EN 60721-3-2 / Class 2M3	
Vibration (sinusoidal) [1] Transport (packaged)	Frequency	Amplitude	Frequency	Amplitude	Frequency	Amplitude
	2 to 9 Hz	Deflection 3.5 mm	2 to 9 Hz	Deflection 3.5 mm	2 to 8 Hz	Deflection 7.5 mm
	9 to 200 Hz	Acceleration 1 g [2]	9 to 200 Hz	Acceleration 1 g [2]	8 to 200 Hz	Acceleration 2 g [2]
	200 to 500 Hz	Acceleration 1.5 g [2]	200 to 500 Hz	Acceleration 1.5 g [2]	200 to 500 Hz	Acceleration 4 g [2]
	20 sweeps for each axis[3]					

1) Uninterrupted duty with movable frequency in all 3 axes (x, y, z); 1 octave per minute
2) 1 g = 10 m/s²
3) 2 sweeps = 1 frequency cycle ($f_{min} \rightarrow f_{max} \rightarrow f_{min}$)

Shock / Transport (packaged)

Testing performed per standard: EN 60068-2-27	Requirements per standard: EN 60721-3-2 / Class 2M1	Requirements per standard: EN 60721-3-2 / Class 2M2
Shock [1] Transport (packaged)	Type I Acceleration 10 g Duration 11 ms 18 shocks	
	Type II -	Type II Acceleration 30 g Duration 6 ms 18 shocks

1) Pulse (half-sine) stress in all 3 axes (x, y, z)

Free fall / Transport (packaged)

Testing performed per standard: EN 60068-2-31 [1]	Requirements per standard: EN 61131-2 with shipping packaging		Requirements per standard: EN 61131-2 with product packaging		Requirements per standard: EN 60721-3-2 / Class 2M1	
Free fall Transport (packaged)	Weight	Height	Weight	Height	Weight	Height
	<10 kg	1.0 m	<10 kg	0.3 m	<20 kg	0.25 m
	10 to 40 kg	0.5 m	10 to 40 kg	0.3 m	20 to 100 kg	0.25 m
	>40 kg	0.25 m	>40 kg	0.25 m	>100 kg	0.1 m
	5 attempts					

1) Replacement for EN 60068-2-32

Toppling / Transport (packaged)

Testing performed per standard: EN 60068-2-31	Requirements per standard: EN 60721-3-2 / Class 2M1		Requirements per standard: EN 60721-3-2 / Class 2M2		Requirements per standard: EN 60721-3-2 / Class 2M3	
Toppling Transport (packaged)	**Weight**	**Required**	**Weight**	**Required**	**Weight**	**Required**
	<20 kg	Yes	<20 kg	Yes	<20 kg	Yes
	20 to 100 kg	-	20 to 100 kg	Yes	20 to 100 kg	Yes
	>100 kg	-	>100 kg	-	>100 kg	Yes
	Topple on all edges		Topple on all edges		Topple on all edges	

4.8.2.5 Electrical safety

Overvoltage category

Requirement per standard: EN 61131-2	Explanation per standard: EN 60664-1
Overvoltage category II	Equipment of "overvoltage category II" is energy-consuming equipment to be supplied from the fixed installation.

Pollution degree

Requirement per standard: EN 61131-2	Explanation per standard: EN 60664-1
Pollution degree 2	Only non-conductive pollution occurs. Temporary conductivity caused by condensation must occasionally be expected, however.

Protection rating provided by enclosure (IP code)

Requirement per EN 61131-2	Meaning of codes per EN 60529	Meaning for the protection of equipment	Meaning for the protection of personnel
≥IP20	First number IP**2**x	Protected against solid foreign bodies with a diameter ≥12.5 mm.	Protected against touching dangerous parts with fingers.
	Second number IPx**0**	Not protected.	-

Requirement per manufacturer	Meaning of codes per EN 60529	Meaning for the protection of equipment	Meaning for the protection of personnel
IP54	First number IP**5**x	Dust protected.	Protected against touching dangerous parts with conductor.
	Second number IPx**4**	Protected against splash water.	

Requirement per manufacturer	Meaning of codes per EN 60529	Meaning for the protection of equipment	Meaning for the protection of personnel
IP65	First number IP**6**x	Dust-proof	Protected against touching dangerous parts with conductor.
	Second number IPx**5**	Protected against water jets.	

4.8.2.6 Photobiological safety

4.8.2.6.1 Risk group classification

The following table shows the result of the risk group classification according to IEC 62471:2006 at a distance of 20 cm in front of the LEDs.

Light Bar		LED colors						
		Red (1)	Green (2)	Blue (3)	Lime (4)	White (99)	Infrared (100)	UV (210)
LED lens	Lens 1	RG0	RG0	RG0	RG0	RG0	RG0	RG0
	Lens 2	RG0	RG0	RG1	RG0	RG0	RG0	RG0
	Lens 3	RG0	RG0	RG1	RG0	RG1	RG0	RG1

LED lens 2 – Color Blue (3)

Classification RG1 due to the blue light hazard.

LED lens 3 – Color Blue (3)

Classification RG1 due to the blue light hazard.

LED lens 3 – Color White (99)

Classification RG1 due to the blue light hazard.

LED lens 3 – Color UV (210)

Classification RG1 based on the actinic ultraviolet hazard (skin and eye).
Classification RG1 due to the near UV hazard (eye).

4.8.2.6.2 Marking on plant/machine

According to the IEC TR 62471-2 standard and the risk group classification carried out, a hazard-related marking of the risk groups is required on the plant/machine.

The markings should be permanently attached, legible and clearly visible during normal operation and during maintenance and service work. Markings should be affixed in such a way that they can be read without the need to expose oneself to optical radiation exceeding the applicable exposure limit value (ELV). Text and borders should appear black on a yellow background.

Appropriate safety marking is shown in the following illustrations for each RG.

4.8.2.6.3 Exposure hazard value (EHV)

The hazard value of exposure (EHV) indicates the relationship between the actual measured value of exposure (exposure level) at a distance of 20 cm and the exposure limit value.

EHV = exposure level / exposure limit value

If the exposure level (measured value of exposure at a distance of 20 cm) exceeds the exposure limit value, EHV is greater than 1. A list of hazard values per risk group is given in the following tables.

Machine Vision	Photobiological safety	Exposure hazard value (EHV)		
		RG0	RG1	RG2
LED-lens 3 - Blue (3)	Blue light	7.3300	1.5398	-

Machine Vision	Photobiological safety	Exposure hazard value (EHV)		
		RG0	RG1	RG2
LED-lens 2 - Blue (3)	Blue light	1.6400	0.7482	-

Machine Vision	Photobiological safety	Exposure hazard value (EHV)		
		RG0	RG1	RG2
LED-lens 3 - White (99)	Blue light	1.8100	0.2005	-

Machine Vision	Photobiological safety	Exposure hazard value (EHV)		
		RG0	RG1	RG2
LED-lens 3 - UV (210)	Actinic UV	1.3400	0.4467	-
	Near UV	2.9400	0.8909	-

4.8.2.6.4 Maximum permissible exposure time

The maximum duration of exposure that can be exposed without exceeding the exposure limit value. The duration of exposure thus has an influence on the limit value. The maximum exposure duration must be calculated over a whole day.

In worst case operation with 10 ms pulse length and 10% duty cycle, one can be exposed to the exposure at a distance of 20 cm for a total of 64.9 s per day without exceeding the limit value. In addition, the exposure limit value is exceeded.

The following tables show the maximum permissible exposure time (accumulated over one day) at a distance of 20 cm and operation with 10 ms pulse length and 10% duty cycle, where the exposure limit value is observed.

Machine Vision	Photobiological safety	Maximum permissible exposure time
LED-lens 3 - Blue (3)	Blue light	64.9 s

Machine Vision	Photobiological safety	Maximum permissible exposure time
LED-lens 2 - Blue (3)	Blue light	133.6 s

Machine Vision	Photobiological safety	Maximum permissible exposure time
LED-lens 3 - White (99)	Blue light	498.7 s

Machine Vision	Photobiological safety	Maximum permissible exposure time
LED-lens 3 – UV (210)	Actinic UV	22388 s
	Near UV	340 s

4.8.2.6.5 Hazard distances (HD)

The hazardous distance (HD) indicates the distance from the LEDs at which the exposure limit value is maintained when operating with 10 ms pulse length and 6.67% duty cycle (5% for size R8).

Machine Vision	Photobiological safety	Hazard distances (HD)		
		RG0	RG1	RG2
LED-Lens 3 - Blue (3)	Blue light	1.33 m	0.35 m	0.20 m

Machine Vision	Photobiological safety	Hazard distances (HD)		
		RG0	RG1	RG2
LED-lens 2 - Blue (3)	Blue light	0.82 m	0.20 m	0.20 m

Machine Vision	Photobiological safety	Hazard distances (HD)		
		RG0	RG1	RG2
LED-lens 3 - White (99)	Blue light	0.82 m	0.20 m	0.20 m

Machine Vision	Photobiological safety	Hazard distances (HD)		
		RG0	RG1	RG2
LED-lens 3 - UV (210)	Actinic UV	0.24 m	0.20 m	0.20 m
	Near UV	0.35 m	0.20 m	0.20 m

4.8.2.6.6 Duty cycle LEDs

The duty cycle of the LEDs depends on the pulse duration and the pause duration:

Duty cycle = pulse duration / (pause duration + pulse duration)

For example, if a pulse duration of 1.4 ms and a pause duration of 98.6 ms is selected (resulting in a duty cycle of 1.4%), the limit value of RG0 is maintained at a distance of 20 cm.

In the following tables, the reduction in the intensity of the LEDs (duty cycle) is listed for which the limit value of the corresponding risk group is observed at a distance of 20 cm.

Machine Vision	Photobiological safety	Duty cycle LEDs		
		RG0	RG1	RG2
LED-lens 3 - Blue (3)	Blue light	1.4%	6.67%	6.67%

Machine Vision	Photobiological safety	Duty cycle LEDs		
		RG0	RG1	RG2
LED-lens 2 - Blue (3)	Blue light	4.5%	6.67%	6.67%

Machine Vision	Photobiological safety	Duty cycle LEDs		
		RG0	RG1	RG2
LED-lens 3 - White (99)	Blue light	6.29%	6.67%	6.67%

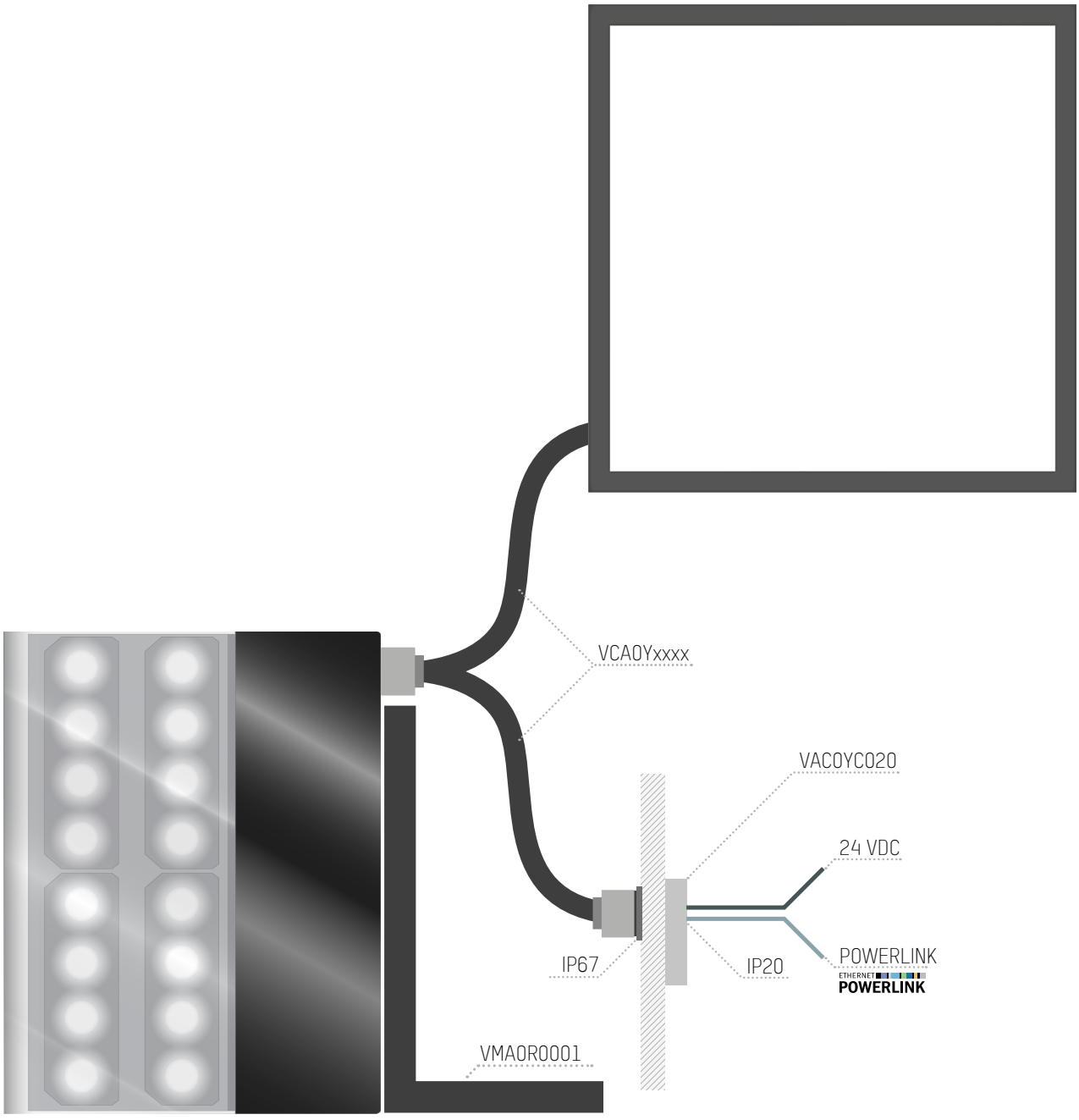
Machine Vision	Photobiological safety	Duty cycle LEDs		
		RG0	RG1	RG2
LED-lens 3 - UV (210)	Actinic UV	6.67%	6.67%	6.67%
	Near UV	3.4%	6.67%	6.67%

5 Machine vision accessories

Overview and use of B&R machine vision accessories for Smart Camera and Smart Light products:

- **VMA0R0001**: Vision mounting bracket 80 mm x 100 mm
- **VCA0Yxxxx**: POWERLINK M12 Y-coded hybrid cable, various lengths
- **VAC0YC020**: IP20 POWERLINK hybrid distributor for control cabinet installation

Smart Light



Information:

Additionally to the exclusive Machine Vision accessories, a POWERLINK connection cable is required for operating machine vision hardware components.
A 3-pin terminal block is required for the machine-side connection of the POWERLINK hybrid distributor.
M12 sensor cables are available for optional connection of the input/output interface.

5.1 Accessories - Order number key

Cables

Product area											
V											Integrated machine vision
	Product group										
	C	A									Cables
			Variant								
			0								Standard variant
				Connector type							
				Y							Y-coded
					Length in 0.1 m steps						
					0	1	.	0	0	0	5	Y-hybrid cable 0.5 m M12 to M12, straight
					0	1	.	0	0	1	0	Y-hybrid cable 1.0 m M12 to M12, straight
					0	1	.	0	0	2	0	Y-hybrid cable 2.0 m M12 to M12, straight
					0	1	.	0	0	5	0	Y-hybrid cable 5.0 m M12 to M12, straight
					0	1	.	0	1	0	0	Y-hybrid cable 10.0 m M12 to M12, straight
					0	1	.	0	1	5	0	Y-hybrid cable 15.0 m M12 to M12, straight
					0	1	.	0	2	0	0	Y-hybrid cable 20.0 m M12 to M12, straight
					0	1	.	0	3	0	0	Y-hybrid cable 30.0 m M12 to M12, straight

Cable accessories

Product area									
V									Integrated machine vision
	Product group								
	A	C							Accessories for cables
			Variant						
			0						Standard variant
				Connector type					
				Y					Y-coded
					Accessory type				
					C	0	2	0	Y-distributor / IP20 power supply box, suitable for control cabinet installation

Installation accessories

Product area									
V									Integrated machine vision
	Product group								
	M	A							Installation accessories
			Variant						
			0						Standard variant
				Mounting type					
				R					Mounting bracket
					Accessory type				
					0	0	0	1	Type 1

5.2 Cables

The following cables are available for integrated machine vision.

5.2.1 VCA0Yxx.xxxx - POWERLINK hybrid cable M12, 8-pin, Y-coded

B&R offers hybrid cables with M12 screw connectors for connecting Smart Camera and Smart Light products to each other or to a POWERLINK hybrid distributor in the following lengths:

5.2.1.1 Order data

Order number	Short description	Figure
VCA0Y01.0005	POWERLINK hybrid cable M12, Y-coded, 0.5m str.	
VCA0Y01.0010	POWERLINK hybrid cable M12, Y-coded, 1.0m str.	
VCA0Y01.0020	POWERLINK hybrid cable M12, Y-coded, 2.0m str.	
VCA0Y01.0050	POWERLINK hybrid cable M12, Y-coded, 5.0m str.	
VCA0Y01.0100	POWERLINK hybrid cable M12 Y-coded, 10.0m str.	
VCA0Y01.0150	POWERLINK hybrid cable M12 Y-coded, 15.0m str.	
VCA0Y01.0200	POWERLINK hybrid cable M12 Y-coded, 20.0m str.	
VCA0Y01.0300	POWERLINK hybrid cable M12 Y-coded, 30.0m str.	

Table 1: VCA0Y01.0005, VCA0Y01.0010, VCA0Y01.0020, VCA0Y01.0050, VCA0Y01.0100, VCA0Y01.0150, VCA0Y01.0200, VCAY01.0300 - Order data

5.2.1.2 Technical data

Product ID	VCA0Y01. 0005	VCA0Y01. 0010	VCA0Y01. 0020	VCA0Y01. 0050	VCA0Y01. 0100	VCA0Y01. 0150	VCA0Y01. 0200	VCA0Y01. 0300
Short description								
Accessories	POWERLINK hybrid cable, M12, Y-coded, straight							
General information								
Durability	Flame-retardant per UL 1581, section 1060 / 1061 and UL 2556, section 9.3 Oil resistance per IEC 60811-2-1 and VDE 0282 part 10							
Certifications								
CE	Yes							
Cable construction								
Supply lines								
Quantity	4							
Wire insulation	PP							
Variant	CuZn contact with Ni/Au contact surface							
Cross section	0.85 mm²							
Signal line								
Quantity	4							
Wire insulation	PP							
Variant	CuZn contact with Ni/Au contact surface							
Cross section	0.15 mm²							
Cable stranding	Yes							
Cable shield	Tinned copper wire braiding							
Outer jacket								
Material	PUR (halogen-free, low-adhesive)							
Color	Black RAL 9005							
Connector								
Type	2x M12 SPEEDCON, Y-coded, male, straight							
Mating cycles	At least 100							
Contacts	8 (4 power supply and 4 signal contacts)							
Electrical properties								
Nominal voltage	Max. 50 VDC (peak value)							
Nominal current	6 A power supply line 0.5 A signal line							
Test voltage								
Wire - Wire	2000 V (50 Hz, 1 min.)							
Wire - Shield	2000 V (50 Hz, 1 min.)							
Transfer properties	Ethernet hybrid Cat 5 (IEC 11801), 100 Mbit/s							
Transfer rate	100 Mbit/s							

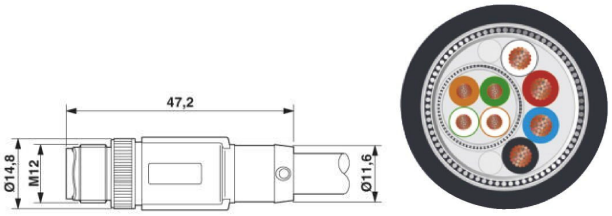
Table 2: VCA0Y01.0005, VCA0Y01.0010, VCA0Y01.0020, VCA0Y01.0050, VCA0Y01.0100, VCA0Y01.0150, VCA0Y01.0200, VCA0Y01.0300 - Technical data

Product ID	VCA0Y01.0005	VCA0Y01.0010	VCA0Y01.0020	VCA0Y01.0050	VCA0Y01.0100	VCA0Y01.0150	VCA0Y01.0200	VCA0Y01.0300
Conductor resistance								
Supply lines	at 25 °C: <22.5 Ω/km at 90 °C: <28.4 Ω/km							
Signal line	<280.0 Ω/km							
Insulation resistance	≥5 GΩ/km							
Operating conditions								
Degree of protection per EN 60529								
Cables	IP65/IP67							
Male M12 connector	IP65/IP67 (connected and screwed in)							
Ambient conditions								
Temperature								
Fixed installation	-25 to 90°C (male M12 connector) -40 to 80°C (cable)							
Flexible installation	-25 to 90°C (male M12 connector) -30 to 70°C (cable)							
Mechanical properties								
Dimensions								
Length	0.5 m	1.0 m	2.0 m	5.0 m	10.0 m	15.0 m	20.0 m	30.0 m
Diameter	8.8 ±0.2 mm							
Bend radius								
Fixed installation	Min. 4 outer diameter							
Flexible installation	Min. 8 outer diameter							
Drag chain data								
Acceleration	Max. 3 m/s²							
Flex cycles	Min. 2 million							
Velocity	Max. 3 m/s							
Weight	112 g	167 g	275 g	606 g	1159 g	1705 g	2267 g	3160 g

Table 2: VCA0Y01.0005, VCA0Y01.0010, VCA0Y01.0020, VCA0Y01.0050, VCA0Y01.0100, VCA0Y01.0150, VCA0Y01.0200, VCA0Y01.0300 - Technical data

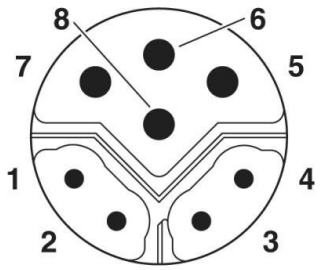
5.2.1.3 Wiring

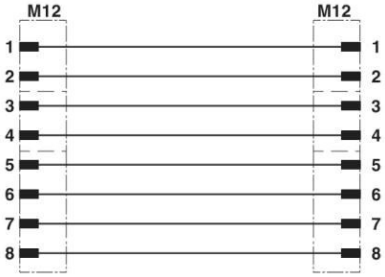
Dimensions and design



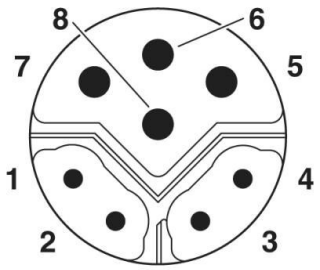
Pinout

M12 connector





M12 connector



5.2.1.3.1 Pinout

Pin	Pinout	Explanation
1	TXD	PLK transmit signal
2	TXD\	PLK transmit signal inverted
3	RXD	PLK receive signal
4	RXD\	PLK receive signal inverted
5	GND	Supply line 1 (max. 4 A)
6	GND	Supply line 2 (max. 4 A)
7	+24 VDC	Supply line 2 (max. 4 A)
8	+24 VDC	Supply line 1 (max. 4 A)

5.2.2 X20CAxE61.xxxx(x) - POWERLINK connection cable RJ45

B&R offers POWERLINK connection cables with RJ45 connectors in the following lengths that can be used to connect a POWERLINK hybrid distributor to a POWERLINK network:

5.2.2.1 Order data overview

Length	X20CAxE61.xxxx	X20CA0E61.xxxxx
0.2 m		X20CA0E61.00020
0.25 m		X20CA0E61.00025
0.3 m		X20CA0E61.00030
0.35 m		X20CA0E61.00035
0.4 m		X20CA0E61.00040
0.5 m		X20CA0E61.00050
1 m		X20CA0E61.00100
1.5 m		X20CA0E61.00150
2 m		X20CA0E61.00200
3 m		X20CA0E61.00300
4 m		X20CA0E61.00400
5 m		X20CA0E61.00500
6 m		X20CA0E61.00600
8 m		X20CA0E61.00800
9 m		X20CA0E61.00900
10 m	X20CA3E61.0100	X20CA0E61.01000
11 m		X20CA0E61.01100
12 m		X20CA0E61.01200
13 m		X20CA0E61.01300
14 m		X20CA0E61.01400
15 m	X20CA3E61.0150	X20CA0E61.01500
16 m		X20CA0E61.01600
17 m		X20CA0E61.01700
19 m		X20CA0E61.01900
20 m	X20CA0E61.0200 X20CA3E61.0200	X20CA0E61.02000
25 m	X20CA0E61.0250	
30 m	X20CA0E61.0300	
35 m	X20CA0E61.0350	
40 m	X20CA0E61.0400	
50 m	X20CA0E61.0500	
60 m	X20CA0E61.0600	
100 m	X20CA0E61.1000	
		

Length	Tolerances for cable lengths
X20CAxE61.xxxx	
10 to 100 m	+2% of the length
X20CA0E61.xxxxx	
0.2 to 0.5 m	+0.01 m
1 to 5 m	+0.04 m
6 to 20 m	+1% of the length

5.2.2.2 Technical data

Product ID	X20CA0E61.xxxx	X20CA3E61.xxxx	X20CA0E61.xxxxx
General information			
Durability	Oil resistance per VED 0473 part 811-2-1 (EN 60811-2-1) Flame-retardant per IEC 60332-1-2 UV-resistant		Flame-retardant per IEC 60332-3-24 ROHS 2002/95/EC Can be used in industrial buildings and outdoors
Short description	POWERLINK connection cable RJ45 to RJ45		
Type	Connection cables		
Cable cross section			
AWG	4x 22 AWG		4x 2x 26 AWG
mm²	4x 0.34 mm²		4x 2x 0.14 mm²
Cable construction			
Inner jacket	-		Halogen-free, flame-retardant
Outer jacket			
Material	Polyurethane (PUR) GN		PVC
Properties	Halogen-free		-
Color	Green		Black (RAL 9005)
Labeling	B&R X67CA0Exx.xxxx and X20CA0Exx.xxxx	X20CA3E61.xxxx	B&R X20CA0E61.xxxxx
Wires			
Wire insulation	Polyethylene (PE)		
Wire colors	White, yellow, blue, orange	Red, white, yellow, blue	Blue-white, blue, orange-white, orange, green-white, green, brown-white, brown
Shield	Aluminum foil and braided wire shield composed of tinned copper wires	Overlapping aluminum-clad foil, tinned copper braiding, 85% coverage	Aluminum foil and braided wire shield composed of tinned copper wires
Type	Stranded wire 0.34 mm² (22 AWG), tinned	Tinned copper strand 22/7 AWG	Stranded wire 26 AWG, tinned 4x 2x 26 AWG
Stranding	4-wire twisted pair	Yellow with yellow, orange with orange, white with white, blue with blue	Blue-white with blue, orange-white with orange, green-white with green, brown-white with brown
Electrical properties			
Operating voltage	-		Max. 125 V
Test voltage			
Wire - Wire	-		1000 V
Conductor resistance	≤120 Ω/km at 20°C		≤145 Ω/km at 20°C
Transfer properties	Category 5 / Class D up to 100 MHz per ISO/IEC 11801 (EN 50173-1), ISO/IEC 24702 (EN 50173-3)		Category 5 per EN 50288-2-2 (2004) / IEC 61156-6 (2002)
Transfer rate	10/100 Mbit/s		
Insulation resistance	≥500 MΩ/km at 20°C		≥5 GΩ/km at 20°C
Operating conditions			
Degree of protection per EN 60529			
Cables	IP67		
RJ45 connector	IP20, only when properly connected		
Ambient conditions			
Temperature			
Transport	-50 to 70°C		-
Fixed installation	-25 to 60°C		-40 to 80°C
Flexible installation	-20 to 60°C		-10 to 60°C
Mechanical properties			
Dimensions			
Length	Various		
Diameter	6.5 mm ±0.2 mm		6.7 mm ±0.2 mm
Bend radius			
After installation	≥7x outer diameter		≥4x outer diameter
During installation	≥3x outer diameter		≥8x outer diameter
Drag chain data			
Acceleration	-	4 m/s²	-
Flex cycles	-	Min. 3 million	-
Velocity	-	4 m/s	-
Weight	0.061 kg/m		0.058 kg/m

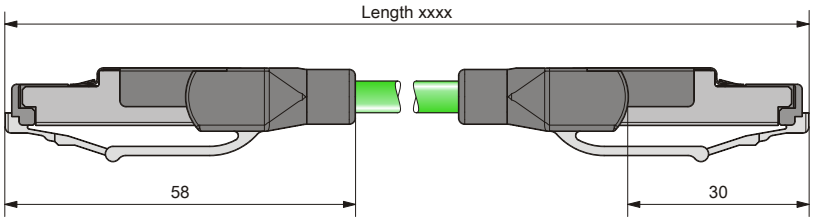
Table 3: X20CA0E61.xxxx, X20CA3E61.xxxx, X20CA0E61.xxxxx - Technical data

5.2.2.3 X20CA0E61.xxxx and X20CA3E61.xxxx

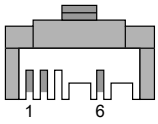
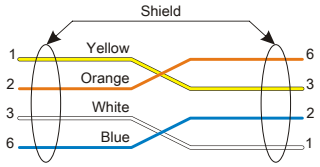
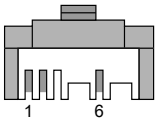
This cable is offered in 2 variants:

- X20CA0E61: Standard design
- X20CA3E61: Can be used in cable drag chains

Dimensions

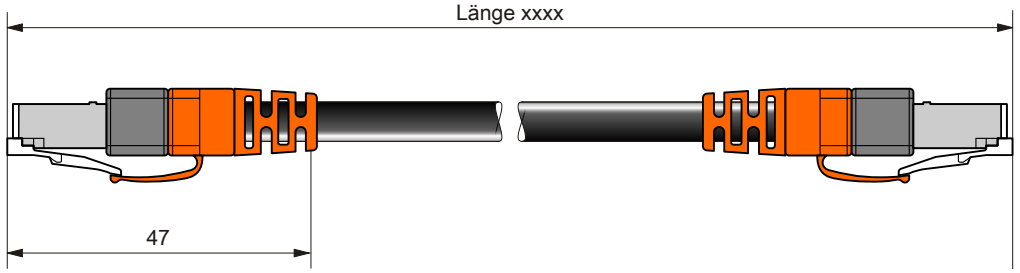


Pinout

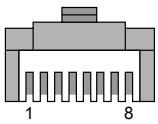
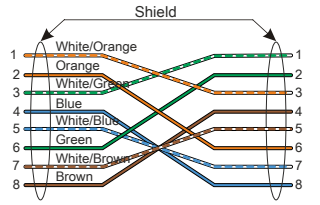
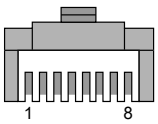
Male RJ45 connector	Pin	Name	Diagram	Male RJ45 connector
	1 - 3	TXD		
	2 - 6	TXD\		
	3 - 1	RXD		
	6 - 2	RXD\		

5.2.2.4 X20CA0E61.xxxxx

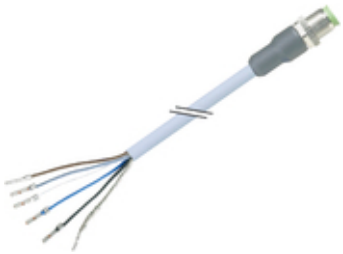
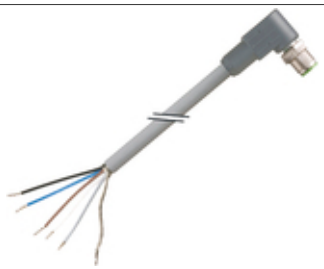
Dimensions



Pinout

Male RJ45 connector	Pin	Name	Diagram	Male RJ45 connector
	1 - 3	TXD		
	2 - 6	TXD\		
	4 - 8	RXD		
	6 - 2	RXD\		

5.2.3 M12 sensor cables

	Short description	
Length	M12 sensor cables	
2 m	X67CA0A41.0020	X67CA0A51.0020
5 m	X67CA0A41.0050	X67CA0A51.0050
10 m	X67CA0A41.0100	X67CA0A51.0100
15 m	X67CA0A41.0150	X67CA0A51.0150
20 m	X67CA0A41.0200	X67CA0A51.0200
		

Length	Tolerances for cable lengths
0 to <1 m	+2 cm
1 m to <10 m	+5 cm
10 m to xx m	+10 cm

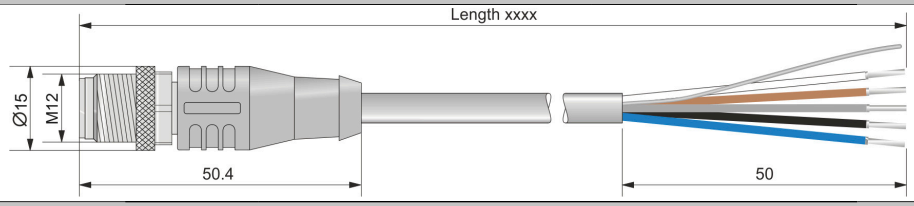
5.2.3.1 Technical data

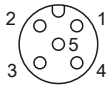
Product ID	X67CA0A41	X67CA0A51
General information		
Note	PVC- and silicone-free LABS- (PWIS-) and halogen-free	
Durability	Good chemical and oil resistance Flame resistant Good UV and ozone resistance	
Connection	M12, 5-pin, straight	M12, 5-pin, angled
Type	Attachment cables	
Cable cross section		
AWG	5x 22 AWG	
mm²	5x 0.34 mm²	
Cable construction		
Complete shielding	Tinned copper braiding, coverage 84%, 0.25 mm² with filler	
Outer sheathing		
Material	Polyurethane (PUR) UL	
Color	Gray	
Labeling	B&R X67CA0Axx.xxxx Rev. G0 ESCHA FC[1)]	
Lines		
Wire insulation	Polypropylene (PP) 9Y	
Wire colors	Brown, black, blue, white, gray	
Type	Uncoated copper ETP1 Fine stranded wire (42x 0.1 mm / 42x 38 AWG), class 5	
Stranding	5 wires stranded using filler	
Electrical characteristics		
Nominal current	Max. 4 A / contact at 40°C	
Operating voltage	Max. 60 V	
Degree of insulation	Category II in accordance with IEC 61076-2	
Conductor resistance	≤57 Ω/km	
Insulation resistance	≥100 MΩ	
Operating conditions		
EN 60529 protection		
Connector/Coupling	IP67, only when screwed in	
Environmental conditions		
Temperature		
Transport	-40 to 90°C	
Fixed installation	-30 to 90°C	
Flexible installation[2)]	-25 to 60°C	
Mechanical characteristics		
Dimensions		
Length	Various	
Diameter	5.6 mm ±0.2 mm	
Bend radius	≥12x outer diameter	
Drag chain data		
Acceleration	Max. 5m/s²	
Flex cycles	2 million	
Speed	Max. 1.6 m/s	

Table 4: X67CA0Axx - Technical data

1) xx.xxxx: Group number and cable length.
2) In cable drag chain operation.

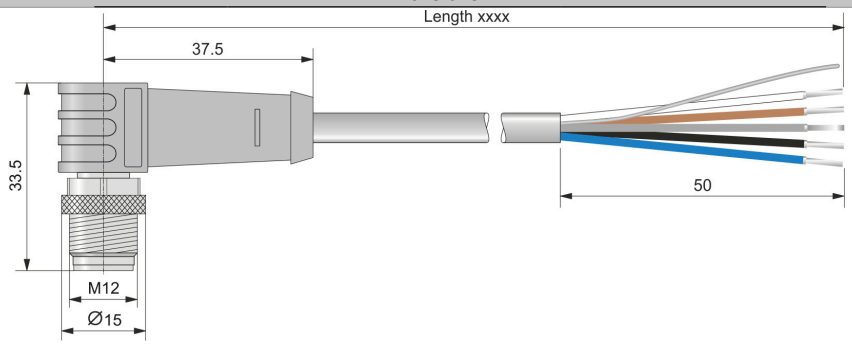
5.2.3.2 X67CA0A41.xxxx

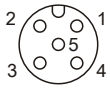
Dimensions


Pinout				
Male connector	**Pin**	**Name**	**Wire colors**	**Open**
 A-keyed	1	Pinout, see module description	Brown	For custom wiring
	2		White	
	3		Blue	
	4		Black	
	5 [1]		Gray	
	M12 [2]	SHLD	-	

1) Do not use the gray connecting line in connection with X67 modules for which pin 5 is used as a shield connection. The cable shield for this cable is connected using a union nut.
2) Shield on M12 knurled-head screw in 360° design

5.2.3.3 X67CA0A51.xxxx

Dimensions


Pinout				
Male connector	**Pin**	**Name**	**Wire colors**	**Open**
 A-keyed	1	Pinout, see module description	Brown	For custom wiring
	2		White	
	3		Blue	
	4		Black	
	5 [1]		Gray	
	M12 [2]	SHLD	-	

1) Do not use the gray connecting line in connection with X67 modules for which pin 5 is used as a shield connection. The cable shield for this cable is connected using a union nut.
2) Shield on M12 knurled-head screw in 360° design

5.3 Cable accessories

The following hybrid distributor boxes are available for integrated machine vision.

5.3.1 VAC0YC020 - POWERLINK hybrid distributor, M12, Y-coded

A POWERLINK hybrid distributor divides the lines (power supply and data) of a POWERLINK hybrid cable. For this purpose, the pins of the 8-pin M12 connector are divided between an RJ45 connector (POWERLINK data) and a 3-pin power connection.

In addition, an IP67 compliant connection to the control cabinet is possible.

5.3.1.1 Order data

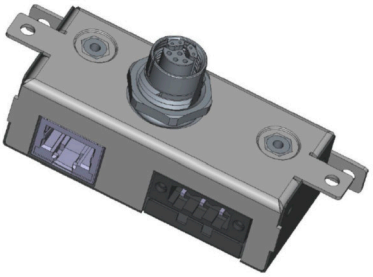
Order number	Short description	Figure
	Accessories	
VAC0YC020	IP20 POWERLINK M12 hybrid distributor	
	Optional accessories	
0TB103.9	Connector, 24 V, 5.08 3-pin screw clamp terminal block	
0TB103.91	Connector, 24 V, 5.08 3-pin cage clamp terminal block	
X20CAxE61.xxxx	PLK connection cable, RJ45-RJ45, drag chain	
X20CAxE61.xxxxx	PLK connection cable RJ45 to RJ45	

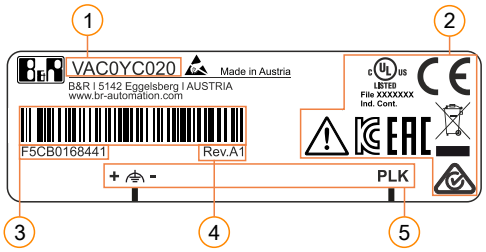
Table 5: VAC0YC020 - Order data

5.3.1.2 Technical data

Order number	VAC0YC020
Short description	
Accessories	IP20 POWERLINK M12 hybrid distributor
General information	
Certifications	
CE	Yes
Connector	
Type	1x M12, 8-pin, female 1x female RJ45 connector 1x 3-pin power supply
Internal connector	In the control cabinet: 1x female RJ45 connector and 1x 3-pin power supply
Additional connectors	Through the control cabinet panel: 1x M12, 8-pin, female
Electrical properties	
Nominal voltage	24 VDC -15% / +20%, SELV/PELV
Transfer properties	Category 5 / Class D up to 100 MHz per ISO/IEC 11801
Transfer rate	100 Mbit/s
Operating conditions	
Degree of protection per EN 60529	IP20 IP67 for M12 connector possible with compliant installation in the control cabinet
Ambient conditions	
Temperature	
Operation	-20°C to +45°C
Storage	-40°C to +85°C
Transport	-40°C to +85°C
Relative humidity	
Operation	5 to 100%, condensing
Storage	5 to 100%, condensing
Transport	5 to 100%, condensing
Mechanical properties	
Dimensions	
Width	88.0 mm
Length	38.6 mm
Height	30.0 mm
Weight	80 g

Table 6: VAC0YC020 - Technical data

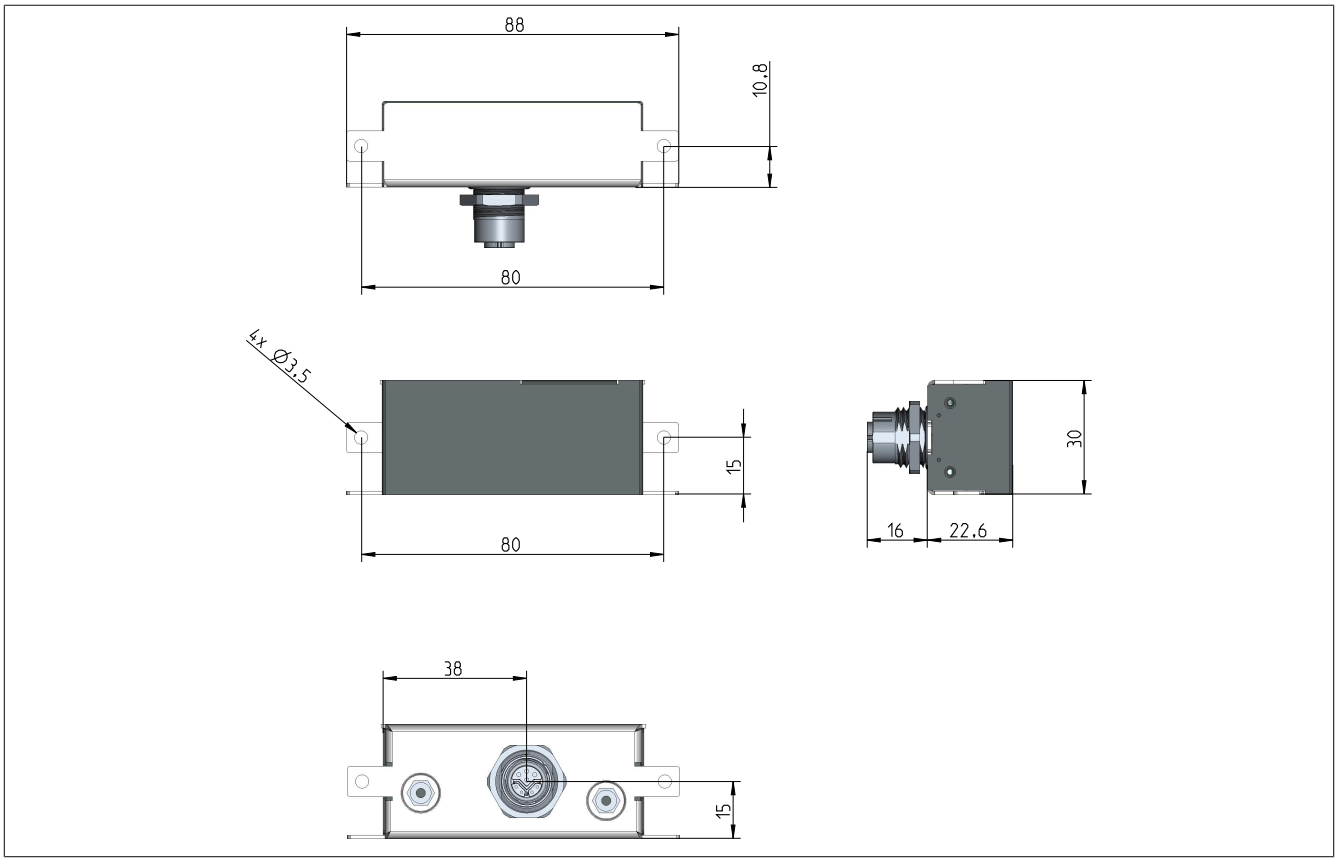
5.3.1.2.1 Product label



1	Distributor box - Order number	**2**	Certification mark and certifications
3	Serial number (barcode type 128 and hexadecimal)	**4**	Product revision
5	Interfaces: Product ID and pinout		

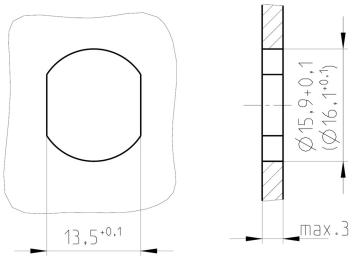
5.3.1.3 Installation

Dimensioned drawing / Drilling plan



IP67-compliant installation recommendation

1. Install the hybrid distributor with O-ring in the control cabinet.
2. Wall thickness of the control cabinet min. 2 mm and max. 3 mm.
3. Dimensions of the opening (cutout with anti-rotation protection, without chamfer):



4. Screw the M12 connector from the outside using the provided nut.
5. Tightening torque: 3 to 4 Nm.
6. The hybrid distributor can optionally be screwed to other points in the control cabinet using the side tabs.

Notice!

Failure to achieve the IP degree of protection can result in damage to the module!

- **IP67 protection of the M12 integral connector is only achieved with a correctly connected and locked male connector pair.**
- **For wall thicknesses < 2 mm, it may not be possible to achieve IP67 protection.**
- **The specified dimensions and tolerances of the opening must be strictly observed.**
- **Burrs and unevenness must be removed!**

5.3.1.4 Pinout

M12, 8-pin, Y-coded, female

Pin	Pinout	Explanation
1	TXD	PLK transmit signal
2	TXD\	PLK transmit signal inverted
3	RXD	PLK receive signal
4	RXD\	PLK receive signal inverted
5	GND	Supply line 1 (max. 4 A)
6	GND	Supply line 2 (max. 4 A)
7	+24 VDC	Supply line 2 (max. 4 A)
8	+24 VDC	Supply line 1 (max. 4 A)

Female RJ45 connector

Pin	Pinout	Explanation
1	RXD	Receive data
2	RXD\	Receive data inverted
3	TXD	Transmit data
4	Termination	-
5	Termination	-
6	TXD\	Transmit data inverted
7	Termination	-
8	Termination	-

3-pin power supply, pins

Pin	Pinout	Explanation
1	+	+24 VDC module power supply
2	Functional earth	Functional earth
3	-	Module power supply ground

5.4 Installation accessories

The following installation accessories are available for integrated machine vision.

5.4.1 VMA0Rxxxx - Mounting bracket

L-bracket with universal drill holes for direct installation of the Smart Camera and Smart Light.

5.4.1.1 Order data

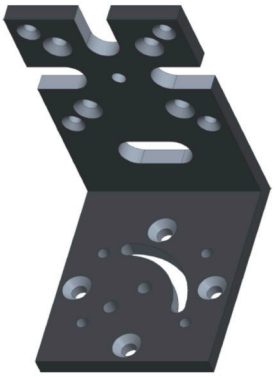
Order number	Short description	Figure
	Accessories	
VMA0R0001	Vision mounting bracket 80 mm x 100 mm 2x Torx countersunk screws DIN 965 M4x12 TORX 4.8 A2K T20 8x Torx countersunk screws DIN 965 M5x12 TORX 4.8 A2K T25 4x Torx flat-head screw ISO 14583 M5x12 70 A2 T25	

Table 7: VMA0R0001 - Order data

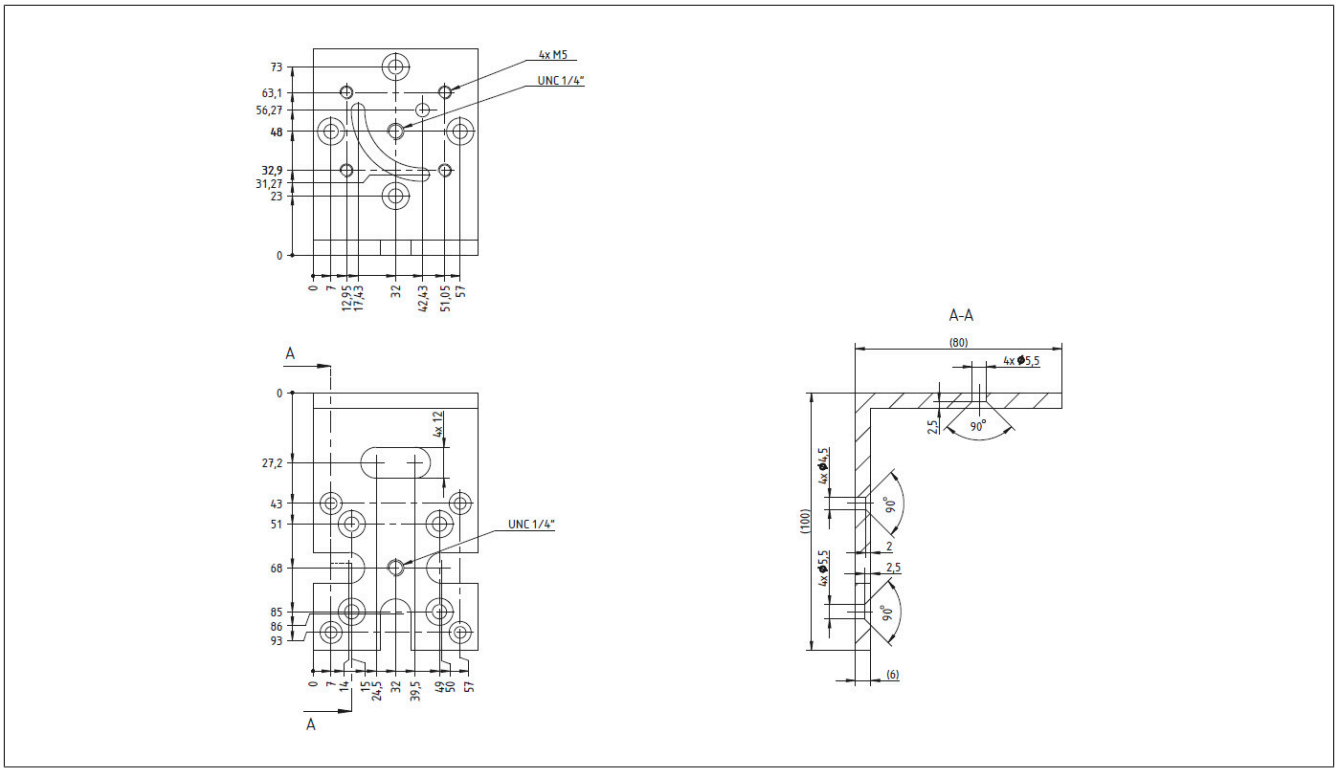
5.4.1.2 Technical data

Order number	VMA0R0001
Short description	
Accessories	Vision mounting bracket 80 mm x 100 mm
General information	
Certifications	CE
Mechanical properties	
Note	L - Bracket with universal drill holes
Material	EN AW-6060 (AlMgSi0.5)
Coating	Black, 25 µm, EPD-coated
Dimensions	
Width	64 mm
Height	100 mm
Depth	80 mm
Weight	180 g

Table 8: VMA0R0001 - Technical data

5.4.1.3 Installation

Dimensioned drawing / Drilling plan



Usage

The 100 mm long side of the mounting bracket is primarily intended for mounting a Smart Camera module or a Smart Light module. This side features 4 M5 cutouts for mounting a machine vision component, 4 additional M4 cutouts and a UNC 1/4" thread hole.

The 80 mm side of the mounting bracket is primarily intended for mounting the L-bracket on the machine. In addition to 4 M5 cutouts and a UNC 1/4" tapping hole, this side offers a curved oblong hole (90° arc) and a corresponding cutout for individual mounting.
Machine side installation can take place at any angle with two of the supplied flat-head screws.

The mounting bracket must be screwed to a thermally and electrically conductive mounting point on the machine side!

Grounding

The universal drill holes are uncoated. The mounting bracket can therefore be conductively connected to its mounting base on the machine with the mounting screws through the universal drill holes. The ground connection is thus provided if the mounting base is well connected to ground potential.

Publishing information

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