Original instructions

Orion1 Base

Safety light curtains

Type 4 Active Opto-electronic Protective Device (AOPD)

ABB Jokab Safety Varlabergsvägen 11, SE-434 39 Kungsbacka, Sweden
www.abb.com/jokabsafety

Read and understand this document

Please read and understand this document before using the products. Please consult your ABB JOKAB SAFETY representative if you have any questions or comments.

WARRANTY

ABB JOKAB SAFETY's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by ABB JOKAB SAFETY.

ABB JOKAB SAFETY MAKES NO WARRANTY OR REPRESENTATION, EXPRESSED OR IMPLIED, REGARDING NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS, ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OR THEIR INTENDED USE. ABB JOKAB SAFETY DISCLAIMS ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED.

LIMITATIONS OF LIABILITY

ABB JOKAB SAFETY SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

In no event shall responsibility of ABB JOKAB SAFETY for any act exceed the individual price of the product on which liability asserted.

IN NO EVENT SHALL ABB JOKAB SAFETY BE RESPONSIBLE FOR WARRANTY, REPAIR, OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS ABB JOKAB SAFETY'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.

SUITABILITY FOR USE

ABB JOKAB SAFETY shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the product. At the customer's request, ABB JOKAB SAFETY will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this document.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE ABB JOKAB SAFETY PRODUCT IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

PERFORMANCE DATA

While every effort has been taken to ensure the accuracy of the information contained in this manual ABB JOKAB SAFETY cannot accept responsibility for errors or omissions and reserves the right to make changes and improvements without notice. Performance data given in this document is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of ABB JOKAB SAFETY's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the ABB JOKAB SAFETY Warranty and Limitations of Liability.

Table of Contents

1 Introduction

1.1 Scope

The purpose of these instructions is to describe the Orion1 Base light curtains and to provide the necessary information required for selection, installation and operation of the safety devices.

1.2 Audience

This document is intended for authorized installation personnel.

1.3 Prerequisites

It is assumed that the reader of this document has knowledge of the following:

- Basic knowledge of ABB Jokab Safety products.
- Knowledge of machine safety.

1.4 Abbreviations

ACM: Advanced Configuration Mode

AOPD: Active Opto-electronic Protective Device

BCM: Basic Configuration Mode

EDM: External Device Monitoring

MPCE: Machine Primary Control Element

OSSD: Output Signal Switching Device (switching output)

RX: Receiver

TX: Transmitter

1.5 Special notes

Pay attention to the following special notes in the document:

⚠ **Warning!**	Danger of severe personal injury! An instruction or procedure which, if not carried out correctly, may result in injury to the operator or other personnel.
Caution!	Danger of damage to the equipment! An instruction or procedure which, if not carried out correctly, may damage the equipment.
NB:	Notes are used to provide important or explanatory information.

2 Overview

2.1 General description

The Orion1 Base light curtains are Active Opto-electronic Protective Devices (AOPDs) that are used to protect working areas that, in presence of machines, robots, and automatic systems in general, can become hazardous for operators that can get in touch, even accidentally, with moving parts.

The Orion1 Base light curtains are Type 4 intrinsic safety systems used as accident-prevention protection devices and are manufactured in accordance with the international standards in force for safety, in particular:

EN 61496-1:2013	Safety of machinery – Electro-sensitive protective equipment – Part 1: General requirements and tests
IEC 61496-2:2013	Safety of machinery – Electro-sensitive protective equipment – Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)
EN ISO 13849-1:2008	Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design
EN 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements
EN 61508-2:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems
EN 61508-3:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 3: Software requirements
EN 61508-4:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 4: Definitions and abbreviations
EN 62061:2005/A1:2013	Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems

The device, consisting of one transmitter and one receiver housed inside strong aluminium profiles, generates infrared beams and detects any opaque object interrupting a beam. The 2 units are composed by one or several transmitting and receiving modules.

The transmitter and the receiver are equipped with the command and control functions. The receiver checks the control operations and safety actions.

The synchronisation between the transmitter and the receiver takes place optically, i.e. no electrical connection between the two units is required.

The microprocessors guarantee the check and the management of the beams that are sent and received and the microprocessors inform the operator about the general conditions of the AOPD, including errors, via LEDs (see paragraph 8 – “Diagnostic functions”).

The connections are made through a M12 connector located in the lower side of the profile.

During installation, a display facilitates the alignment of both units (see paragraph 6 – “Alignment procedure”).

As soon as an object, a limb or the operator’s body accidentally interrupts one or several of the infrared beams sent by the transmitter, the OSSD outputs switch off and block the Machine Primary Control Element, MPCE (if correctly connected to the OSSD outputs).

2.2 Resolution

The resolution of the AOPD is the minimum dimension that an opaque object must have in order to interrupt at least one of the beams that constitute the detection zone.

Which resolution to choose depends on the part of the body to be protected:

R = 14mm	Finger protection	
R = 30 mm	Hand protection	

The resolution R is calculated using the following formula:

R = l + d

where:

- l Distance between the centers of two adjacent optics.
- d Diameter of the lens.

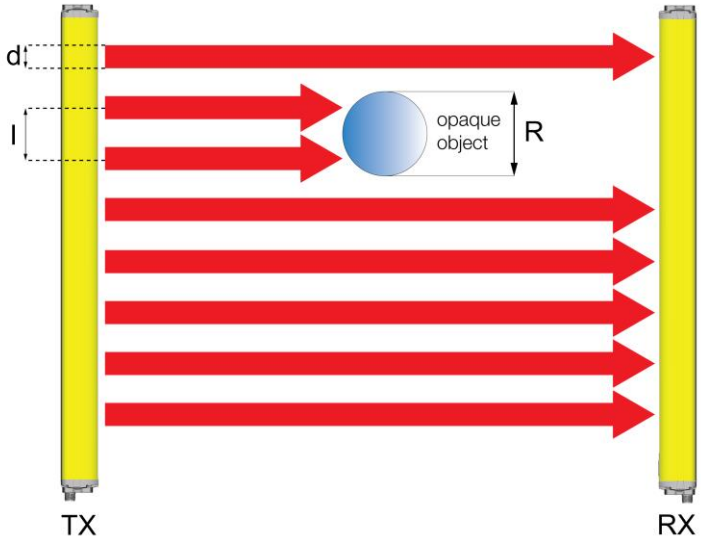


Figure 1 – Resolution

Therefore, the resolution depends only on the geometrical characteristics of the lenses, diameter and distance between centers, and is independent of any environmental and operating conditions of the AOPD.

See paragraph 12 – “Model overview” for the resolution of each model.

2.3 Protected height

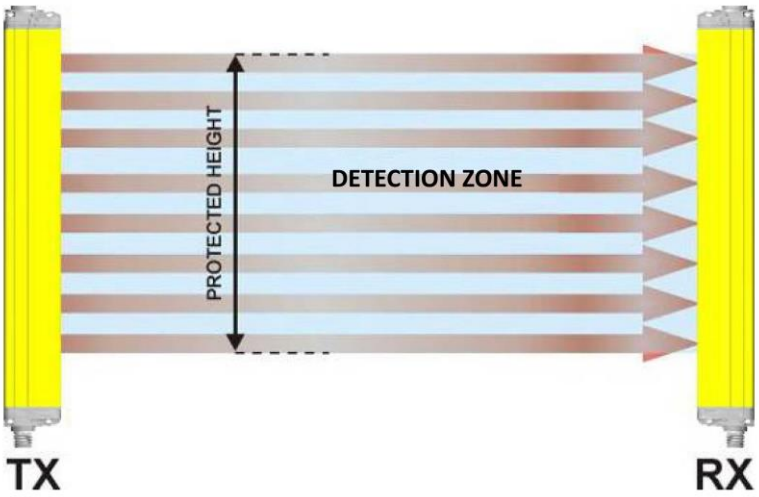
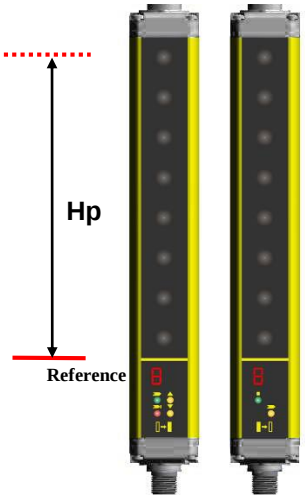


Figure 2 – Protected height

The protected height of each Orion1 Base is given in the table below. It starts from the white line engraved on the front glass:



Model	Protected height Hp (mm)
Orion1-4-xx-015-B	150
Orion1-4-xx-030-B	300
Orion1-4-xx-045-B	450
Orion1-4-xx-060-B	600
Orion1-4-xx-075-B	750
Orion1-4-xx-090-B	900
Orion1-4-xx-105-B	1050
Orion1-4-xx-120-B	1200
Orion1-4-xx-135-B	1350
Orion1-4-xx-150-B	1500
Orion1-4-xx-165-B	1650
Orion1-4-xx-180-B	1800

xx = Resolution (14 mm – 30 mm)

2.4 Minimum installation distance

⚠ **Warning!** The information given in this chapter shall be considered as an overview. For correct positioning, please refer to the latest version of the complete standard EN ISO 13855 ”Safety of machinery – Positioning of safeguards with respect to the approach speeds of parts of the human body”.

The safety device must be positioned at a distance that prevents a person or part of a person to reach the hazard zone before the hazardous motion of the machine has been stopped by the AOPD.

According to EN ISO 13855:2010, the minimum distance to the hazard zone is calculated using:

S = (K × T) + C

S Minimum distance (mm) between safeguard and hazard zone.

K Approach speed of body parts towards the hazard zone (mm/s). See below for values.

T Overall system stopping performance (s) with T = T1 + T2, where:

T1 = response time of the AOPD (s).

T2 = stopping time of the machine, including the response time of the safety control system (s).

C Intrusion distance (mm). C depends on the resolution d and the position of the detection zone. See below.

2.4.1 Vertically assembled AOPD

The minimum distance S for a vertically assembled AOPD is determined in three steps:

a) Calculation of the minimum distance for reaching through the detection zone, S_{RT}.

b) Calculation of the minimum distance for reaching over the detection zone, S_{RO}.

c) Comparison of S_{RT} and S_{RO}. The minimum distance S is the greater of the two.

NB: If access to the hazard zone by reaching over the AOPD can be excluded, e.g. by the provision of guards or other protective measures, steps b) and c) are not necessary.

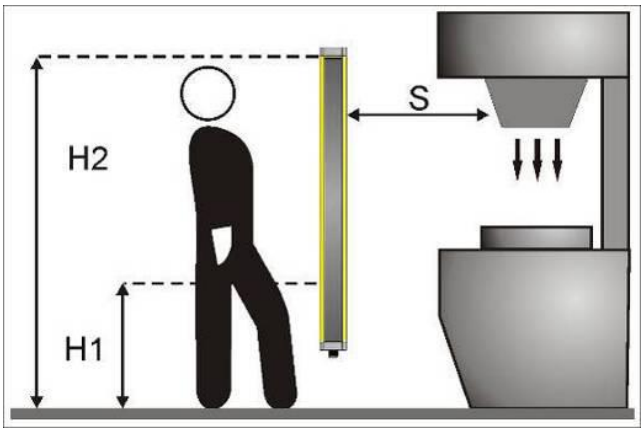


Figure 3 – Minimum distance for a vertically assembled AOPD

S = minimum distance in mm

H1 = height of the lowest beam

H2 = height of the uppermost beam

H1 ≤ 300 mm*

H2 ≥ 900 mm

* 400 mm can be used for 2 beams when the risk assessment allows it.

a) **$S_{RT} = (K \times T) + C_{RT}$**

C_{RT} = 8 × (d-14) mm for devices with a resolution d ≤ 40 mm

C_{RT} = 850 mm for devices with resolution d > 40 mm

NB: Floating blanking has an influence on the resolution. Please check the correct value.

- If the resolution is ≤ 40 mm, use first K = 2000 mm/s.
  In this case, the minimum value of S = 100 mm, except in single/double break mode with a resolution d > 14 mm when S must be > 150 mm.
- If the resolution is > 40 mm or if the previously calculated value of S is > 500 mm, use K = 1600 mm/s. In this case, the minimum value of S = 500 mm.

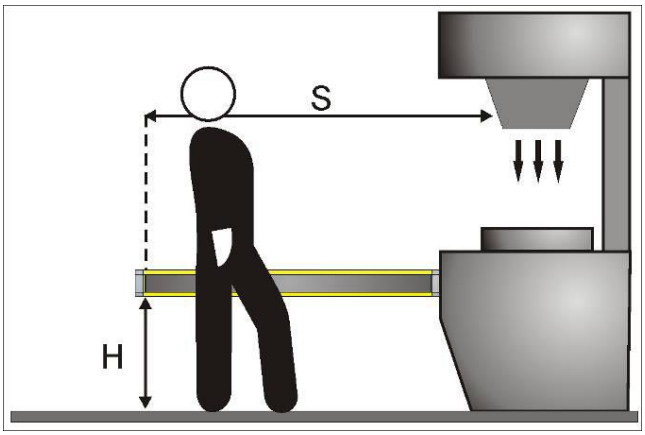
b) **$S_{RO} = (K \times T) + C_{RO}$**

K and T according to a).

C_{RO} = Intrusion distance when reaching over the AOPD towards the hazard zone prior to the actuation of the AOPD. This value depends on the height of the hazard zone and the height of the uppermost beam, see EN ISO 13855:2010.

2.4.2 Horizontally assembled AOPD

In this case, S is the minimum distance from the hazardous machinery to the farthermost beam:



S = minimum distance in mm

H = height of the detection zone. See below for calculation

Figure 4 – Minimum distance for a horizontally assembled AOPD

S = (K × T) + C

K = 1600 mm/s.

C = 1200 - 0.4 × H, where H is the height of the detection zone in mm. S Shall not be less than 850 mm.

The minimum allowed height of the detection zone above the reference plane is calculated using H = 15 × (d - 50), where d is the resolution. H shall not be less than 0 or greater than 1000.

2.4.3 Angled assembled AOPD

See the latest version of EN ISO 13855.

2.4.4 Practical examples

Let's suppose we have an Orion1-4-xx-060 in a vertical position and with no risk of reaching over it.

S = K × (T1 + T2) + 8 × (d -14)

	Orion1-4-14-060	**Orion1-4-30-060**
T1, response time of AOPD (see paragraph 12 – “Model overview”)	0.022 s	0.014 s
T2, stopping time machine + safety control system (value as ex.)	0.379 s	0.379 s
d, resolution of AOPD	14 mm	30 mm
$S_{K=2000}$, minimum distance with K = 2000 mm/s	802 mm	914 mm

In both cases, S is greater than 500 mm and can be recalculated with K = 1600 mm/s.

$S_{K=1600}$, minimum distance with K = 1600 mm/s	642 mm	757 mm

S is still greater than 500 mm and therefore OK.

2.5 Safety information

Warning!

For a correct and safe use of the Orion1 Base light curtains, the following points must be observed:

- The stopping system of the machine must be electrically controlled.
- This control system must be able to stop the hazardous movement of the machine within the total machine stopping time T as per paragraph 2.4 – “Minimum installation distance”, and during all working cycle phases.
- Mounting and connection of the AOPD must be carried out by qualified personnel only, according to the indications included in the special sections (see paragraphs 3; 4; 5; 6) and in the applicable standards.
- The AOPD must be securely placed in a particular position so that access to the hazard zone is not possible without the interruption of the beams (see paragraph 3 -”Installation”).
- The personnel operating in the hazard zone must be well trained and must have adequate knowledge of all the operating procedures of the AOPD.
- The TEST button must be located outside the hazard zone because the operator must check the hazard zone during all the test operations.
- The ACKNOWLEDGE/RESET button must be located outside the hazard zone because the operator must check the hazard zone during all acknowledge/reset operations. It must be impossible to reach the button from the hazard zone.
- If the external device monitoring (EDM) function is used, it must be activated by connecting a specific wire to the device, see paragraph 5 – “Electrical connections”.

Please carefully read the instructions for the correct functioning before powering the AOPD.

3 Installation

3.1 Precautions to observe for the choice and installation of the AOPD

- The outputs (OSSD) of the AOPD must be used as machine stopping devices and not as command devices. The machine must have its own Start command.
- The dimension of the smallest object to be detected must be larger than the resolution of the AOPD.
- The AOPD must be installed in a room complying with the technical characteristics indicated in paragraph 11 – “Technical data”.
- Do not place the AOPD near strong and/or flashing light sources or similar devices.
- Strong electromagnetic interferences can jeopardize the function of the AOPD. Please contact your ABB Jokab Safety representative for advice.
- The operating distance of the device can be reduced in presence of smog, fog or airborne dust.
- A sudden change in environment temperature, with very low minimum peaks, can generate a small condensation layer on the lenses and jeopardize the function.

3.2 General information on positioning the AOPD

The AOPD must be carefully positioned, in order to offer effective protection: access to the hazard zone must only be possible by passing through the detection zone of the AOPD.

⚠ **Warning!** Figure 5 shows some examples of possible access to the machine from the top and the bottom sides. These situations can be very hazardous and the AOPD must be installed at a correct height in order to completely cover the access to the hazard zone (Figure 6).

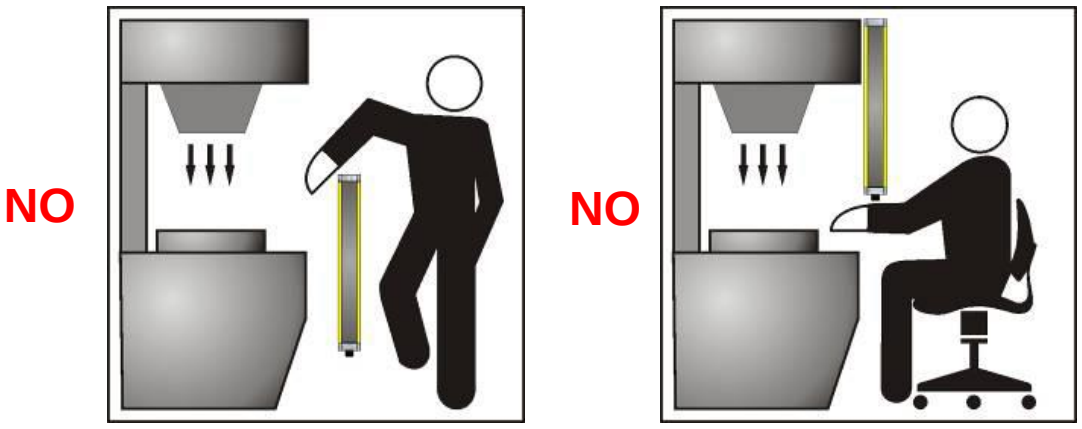


Figure 5 – Incorrect device positioning

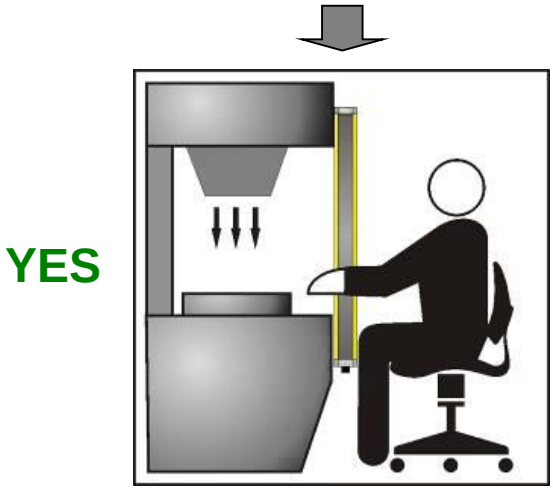


Figure 6 – Correct device positioning

Under normal operating conditions, it must be impossible to start the machine while operators are inside the hazard zone.

When the installation of the AOPD close to the hazard zone is not possible, a second AOPD must be mounted in a horizontal position in order to prevent any lateral access, see Figure 8.

⚠ **Warning!** If the operator is able to enter the hazard zone, an additional mechanical protection must be mounted to prevent the access.

NO

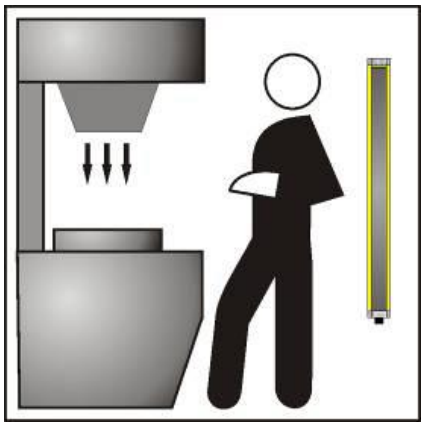


Figure 7 – Incorrect installation

YES

Figure 8 – Correct installation

3.2.1 Minimum installation distance

See paragraph 2.4 – “Minimum installation distance”.

3.2.2 Minimum distance to reflecting surfaces

Reflecting surfaces placed near the light beams of the AOPD (over, under or laterally) can cause passive reflections. These reflections can compromise the recognition of an object inside the detection zone (see Figure 9).

For example, if the receiver (RX) detects a secondary beam (reflected by the side-reflecting surface), the object might not be detected, even if the object interrupts the main beam.

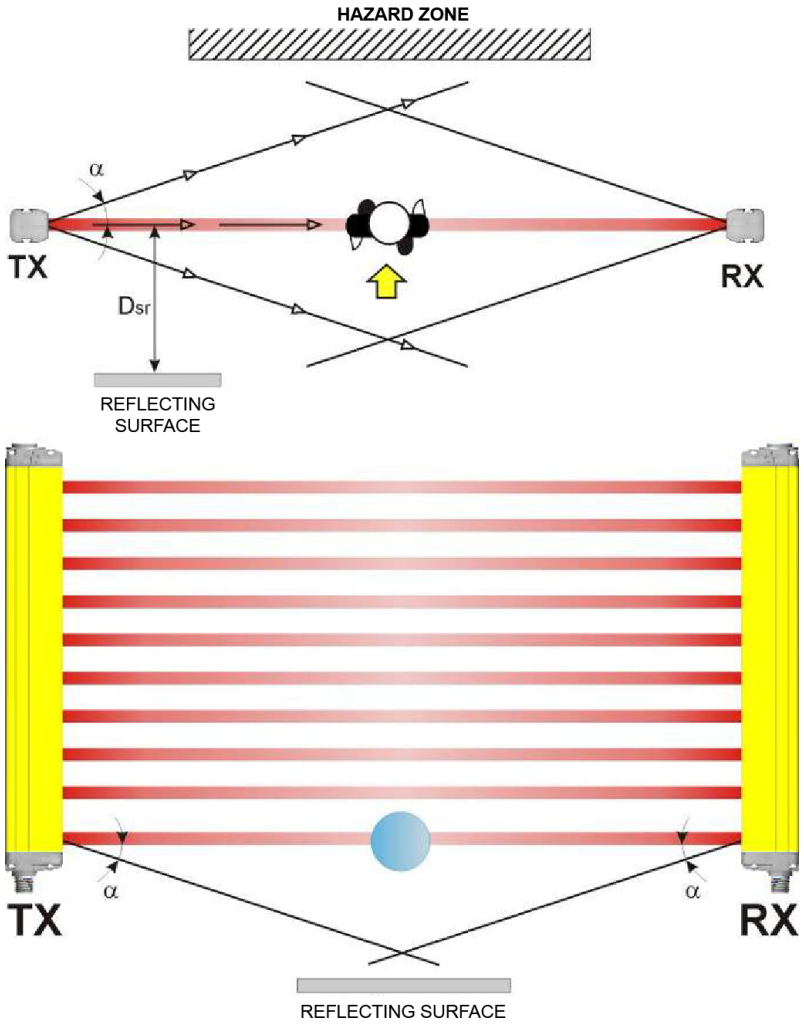


Figure 9 – Distance to reflecting surfaces

It is thus important to respect a minimum distance between the AOPD and reflecting surfaces. The minimum distance, D_{sr}, depends on the:

- operating distance between transmitter (TX) and receiver (RX),
- effective aperture angle (EAA) of the AOPD:

  For a type 4 AOPD, $EAA_{MAX} = 5°$ ($\alpha = \pm 2.5°$).

The diagram below shows the minimum distance to the reflecting surface (D_{sr}), based on the operating distance for a Type 4 AOPD:

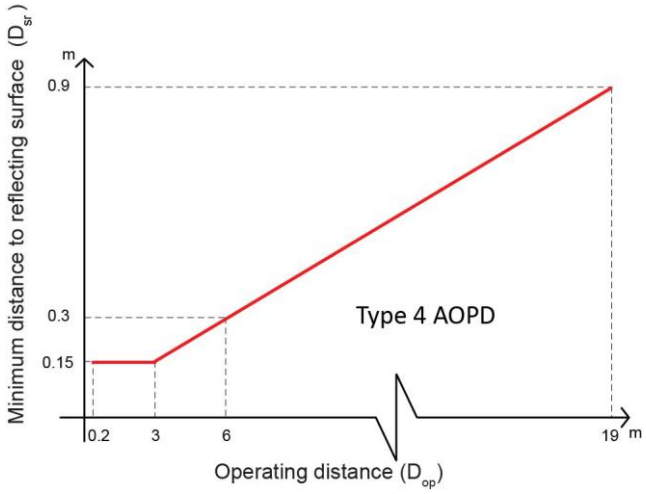


Figure 10 – Minimum distance to a reflective surface as a function of the operating distance

The formula to get D_{sr} for a Type 4 AOPD is the following:

D_{sr} (m) = 0.15 for operating distance < 3 m

D_{sr} (m) = 0.5 × operating distance (m) × tan (2α) for operating distance ≥ 3 m

⚠ **Warning!** If the reflecting surface is the floor, the calculated D_{sr} can be less than the correct height to the floor that still must be respected.

3.2.3 Minimum distance between adjacent devices

When several AOPDs must be installed close to each other, the transmitter of one device must not interfere hazardously with the receiver of the other device.

The TX_B interfering device must be positioned outside a minimum D_{do} distance from the axis of the TX_A – RX_A transmitter-receiver couple, see figure below.

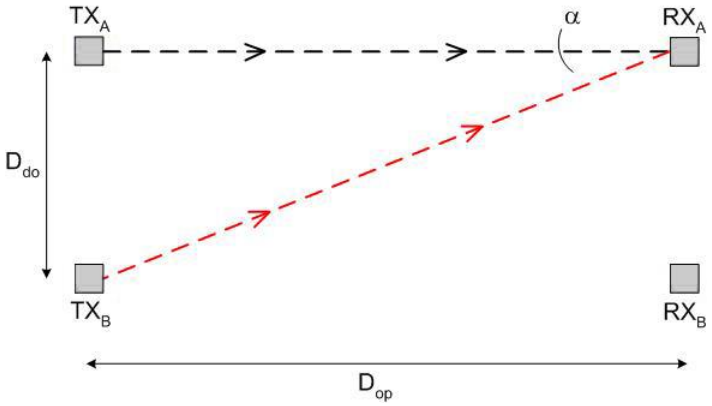


Figure 11 – Distance between adjacent devices

This minimum D_{do} distance depends on:

- the operating distance between transmitter (TX_A) and receiver (RX_A),
- the effective aperture angle of the AOPD (EAA):

  For a Type 4 AOPD, EAA_{MAX} = 5° (α = ± 2.5°).

The diagram below shows the distance to the interfering devices (D_{do}) based on the operating distance (D_{op}) of the couple (TX_A – RX_A) for a Type 4 AOPD.

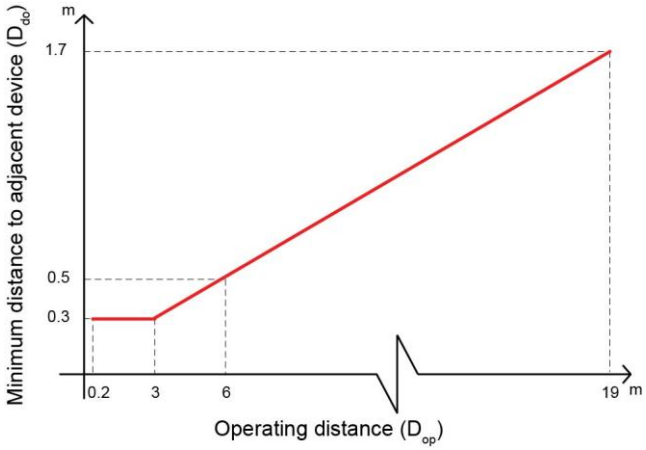


Figure 12 – Minimum distance to an adjacent device as a function of the operating distance

The formula to get D_{do} for a Type 4 AOPD is the following:

D_{do} (m) = 0.3 for operating distance < 3 m

D_{do} (m) = operating distance (m) × tan (2α) for operating distance ≥ 3 m

Warning! Please note that TX_A can interfere with RX_B in the same way as TX_B with RX_A and, if the two pairs of AOPD have different operating distances, the longest one should be used for the calculation of D_{do}.

3.2.4 Installation of several adjacent AOPDs

When several AOPDs must be installed close to each other, interferences between the transmitter of one device and the receiver of the other must be avoided.

Figure 13 provides some examples of correct and incorrect installations when it comes to interferences.

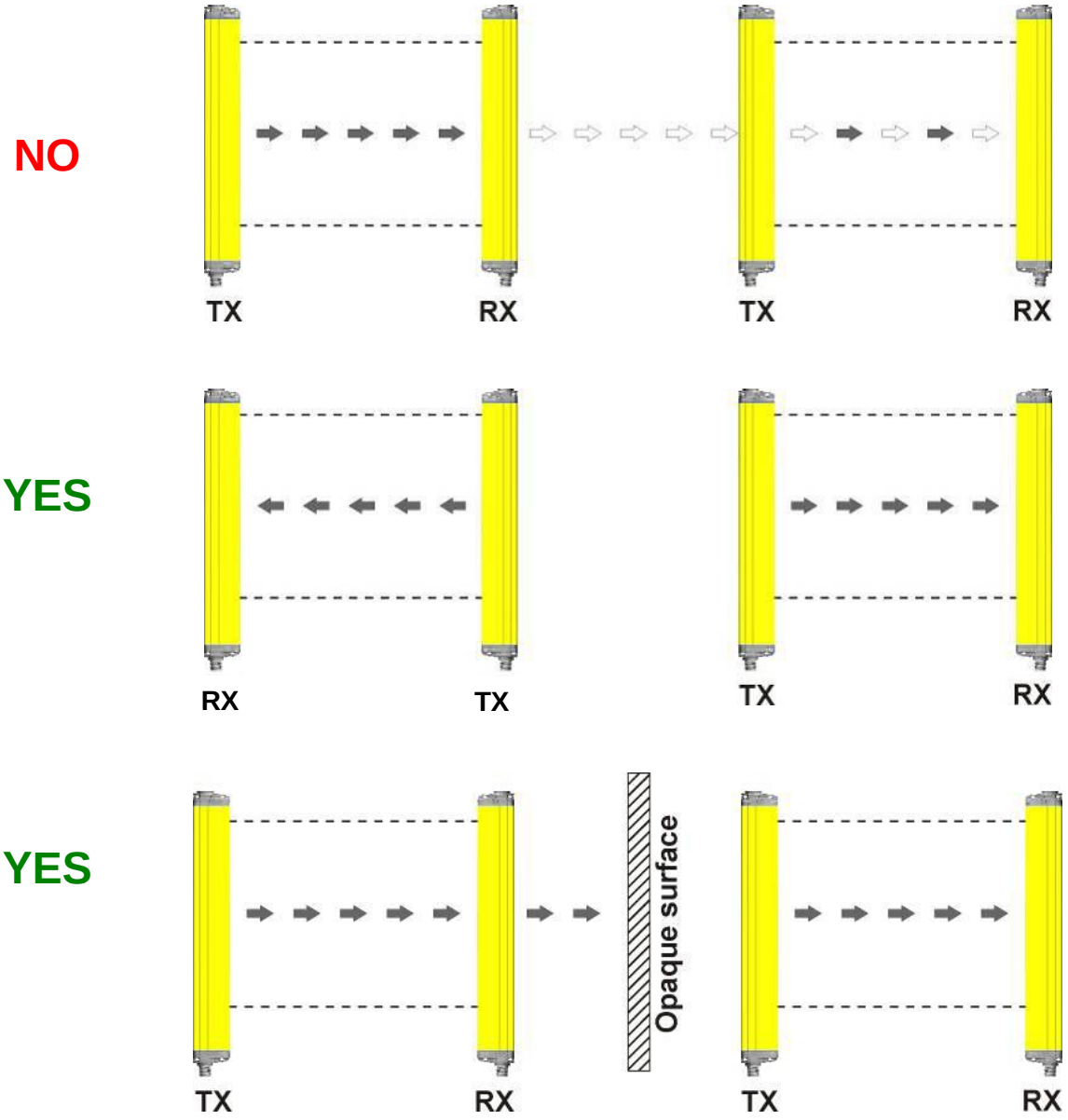


Figure 13 – Installation of several devices close to each other

3.2.5 Transmitter and receiver orientation

The two units shall be assembled parallel to each other, with the beams positioned at right angles to the transmitting and receiving surfaces, and with the connectors pointing towards the same direction.

The configurations shown in Figure 14 must be avoided.

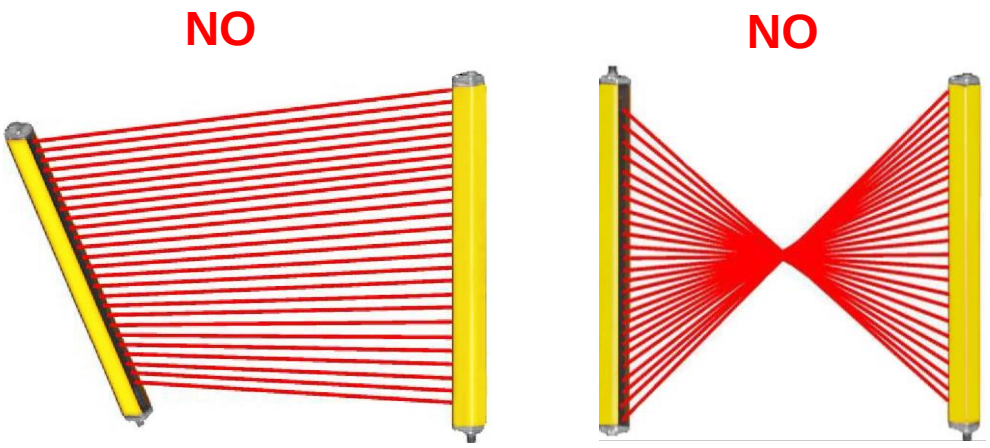


Figure 14 – Incorrect orientation

3.2.6 Use of deviating mirrors

The control of any hazard zone, with several but adjacent access sides, is possible using only one AOPD and well-positioned deviating mirrors.

Figure 15 shows a possible solution to control three different access sides, using two mirrors placed at 45° relative to the beams.

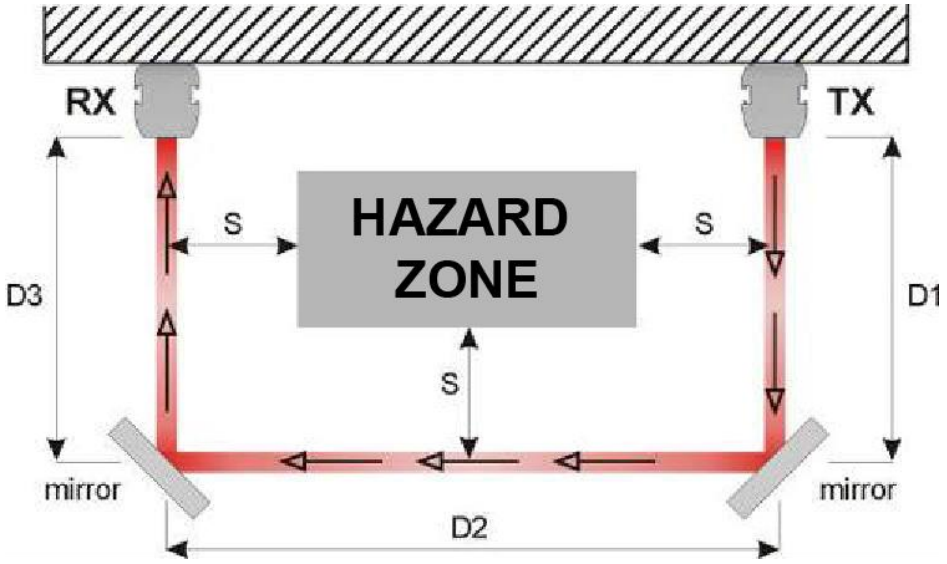


Figure 15 – Use of deviating mirrors

NB: The following precautions must be respected when using the deviating mirrors:

- The alignment of the transmitter and the receiver can be a very critical operation when deviating mirrors are used. Even a very small displacement of the mirror is enough to loose alignment. The use of an Orion laser pointer (available as accessory) is recommended in these conditions.
- The minimum installation distance (S) must be respected for each single section of the beams.
- The effective operating range decreases by about 15% by using only one deviating mirror, the percentage further decreases by using 2 or more mirrors (for more details, refer to the technical specifications of the mirrors used).
- Do not use more than three mirrors for each device.

- The presence of dust or dirt on the reflecting surface of the mirror causes a drastic reduction in the range.

The following table shows the operating distances relating to the number of mirrors used.

Number of mirrors	Operating distance (14 mm)	Operating distance (30 mm)
1	5.1 m	16.5 m
2	4.3 m	13.7 m
3	3.7 m	11.6 m

3.3 Checks after first installation

The control operations to carry-out after the first installation and before machine start-up are listed hereinafter. The controls must be carried-out by qualified personnel, either directly or under the strict supervision of the person in charge of machinery safety.

Check that:

- The AOPD remains in OSSD OFF state (▶I) during beam interruption along the entire detection zone, using the suitable “Test Piece” and following the Figure 16 scheme. The suitable “Test Piece” has one dimension identical with the resolution of the AOPD, a cylinder with a 14 mm diameter for a light curtain with a 14 mm resolution for example.

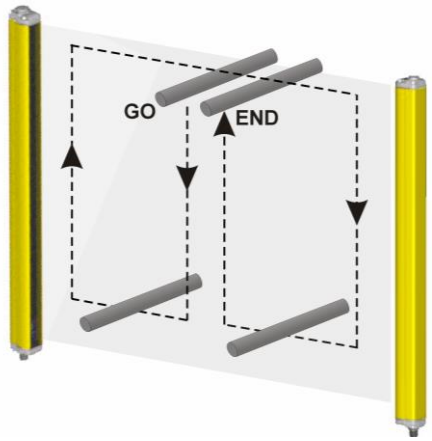


Figure 16 – Scheme for checking the function

- The AOPD is correctly aligned: press slightly the product side in both directions and check that the red LED ▶I does not turn on.
- The OSSD outputs switch off (the red LED ▶I turns on and the controlled machine stops) when the Test function is activated.
- The stopping time of the machine, including the response times of the AOPD and of the machine, is within the limits defined when calculating the minimum installation distance (refer to paragraph 2.4 – “Minimum installation distance”).
- The minimum installation distance between the hazard zone and the AOPD is in accordance with the instructions included in paragraph 2.4 – “Minimum installation distance”.
- Access of a person between the AOPD and the hazard zone of the machine is not possible, nor is it possible for him/her to stay there without being detected.
- Access to the hazard zone of the machine from any unprotected area is not possible.
- The AOPD is not disturbed by external light sources: it should remain in OSSD ON state for at least 10-15 minutes and, after placing the specific test piece in the detection zone, remain in the OSSD OFF state for the same period of time.
- All additional functions behave as expected by activating them in different operating conditions.

4 Mechanical mounting

The transmitter (TX) and receiver (RX) must be installed with the relevant sensitive surfaces facing each other. The connectors must be positioned on the same side. The distance between the two units must be within the operating range of the model used (see paragraph 11 – “Technical data”).

The two units must be aligned and as parallel as possible. The next step is the fine alignment, as shown in paragraph 6 “Alignment procedure”.

4.1 Mounting with angled fixing brackets

Angled fixing brackets are supplied with all Orion1 Base models. To mount the AOPD, insert the supplied threaded pins into the grooves on the two units (see Figure 17).

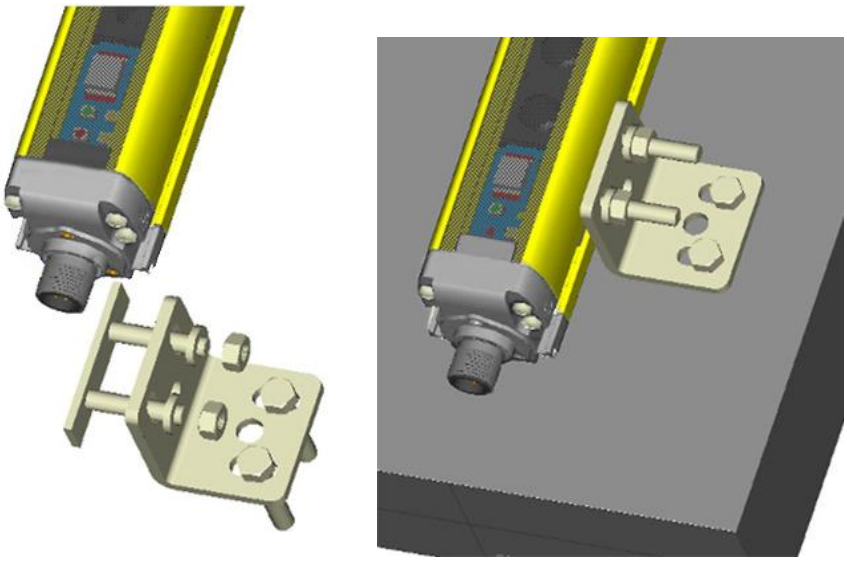
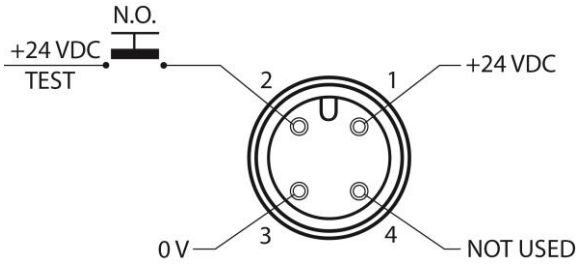


Figure 17 – Mounting with angled fixing brackets

5 Electrical connections

All electrical connections to the transmitter and the receiver are made through a male M12 connector located on the lower part of the two units, a M12 4-pole connector for the transmitter and a M12-8 pole connector for the receiver.

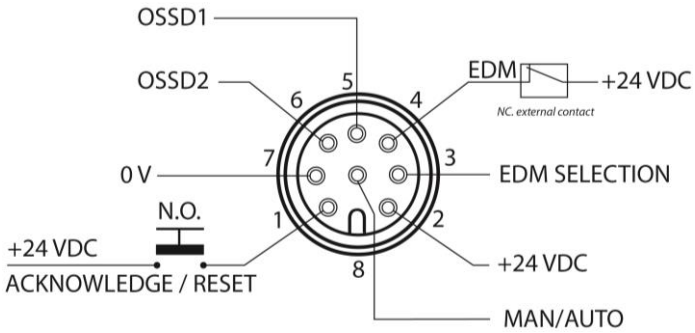
5.1 Transmitter (TX)



Pin	Wire[1]	Function	Connection to	Refer to
1	Brown	Supply	+24 VDC	
2	White	TEST	NO contact to +24 VDC if to be used	7.2
			Not connected or 0 V if not to be used	
3	Blue	Supply	0 V	
4	Black	*Not used*	-	

[1]Colors according to ABB Jokab Safety standard cables

5.2 Receiver (RX)



Pin	Wire[1]	Function		Connection to	Refer to
1	White	RESET/ ACKNOWLEDGE	Auto. Reset with no function	Not connected or 0 V	7.1, 7.3, 6.1
			Auto. Reset with Acknowledge function or Alignment mode	NO contact to +24 VDC	
			Manual Reset	NO contact to +24 VDC	
2	Brown	Supply		+24 VDC	
3	Green	EDM SELECTION	Activate EDM	Not connected or 0 V	7.4
			Deactivate EDM	+24 VDC	
4	Yellow	EDM	Function used/activated	NC contact of a force-guided relay	7.4
			Function not used/deactivated	Not connected or 0 V	
5	Grey	OSSD1		Safety control module for ex.	
6	Pink	OSSD2		Safety control module for ex.	
7	Blue	Supply		0 V	
8	Red	RESET MODE	Automatic Reset	Pin 5 (OSSD1)	7.1
			Manual Reset	Pin 6 (OSSD2)	

[1]Colors according to ABB Jokab Safety standard cables

5.3 Important notes on connections

For the correct functioning of the Orion1 Base light curtains, the following precautions regarding the electrical connections have to be respected:

- Use a suitably insulated low-voltage supply system type SELV or PELV.
- Do not place connection cables in contact with or near high-voltage cables and/or cables undergoing high current variations (e.g. motor power supplies, inverters, etc.).
- Do not connect the OSSD wires of different AOPDs in the same multi-pole cable.
- The TEST wire must be connected to the supply voltage of the AOPD through a NO push-button.
- The ACKNOWLEDGE/RESET wire must be connected through a NO push-button to the supply voltage of the Orion1 Base light curtain.

⚠ **Warning!** The TEST button must be located in such a way that the operator can check the hazard zone during any test (see paragraph 7 – “Functions”.)

⚠ **Warning!** The ACKNOWLEDGE/RESET button must be located in such a way that the operator can check the hazard zone during any reset operation (see paragraph 7 – “Functions”.)

- The device is already equipped with internal overvoltage and overcurrent suppression devices. The use of other external components is not recommended.

5.4 Connection examples

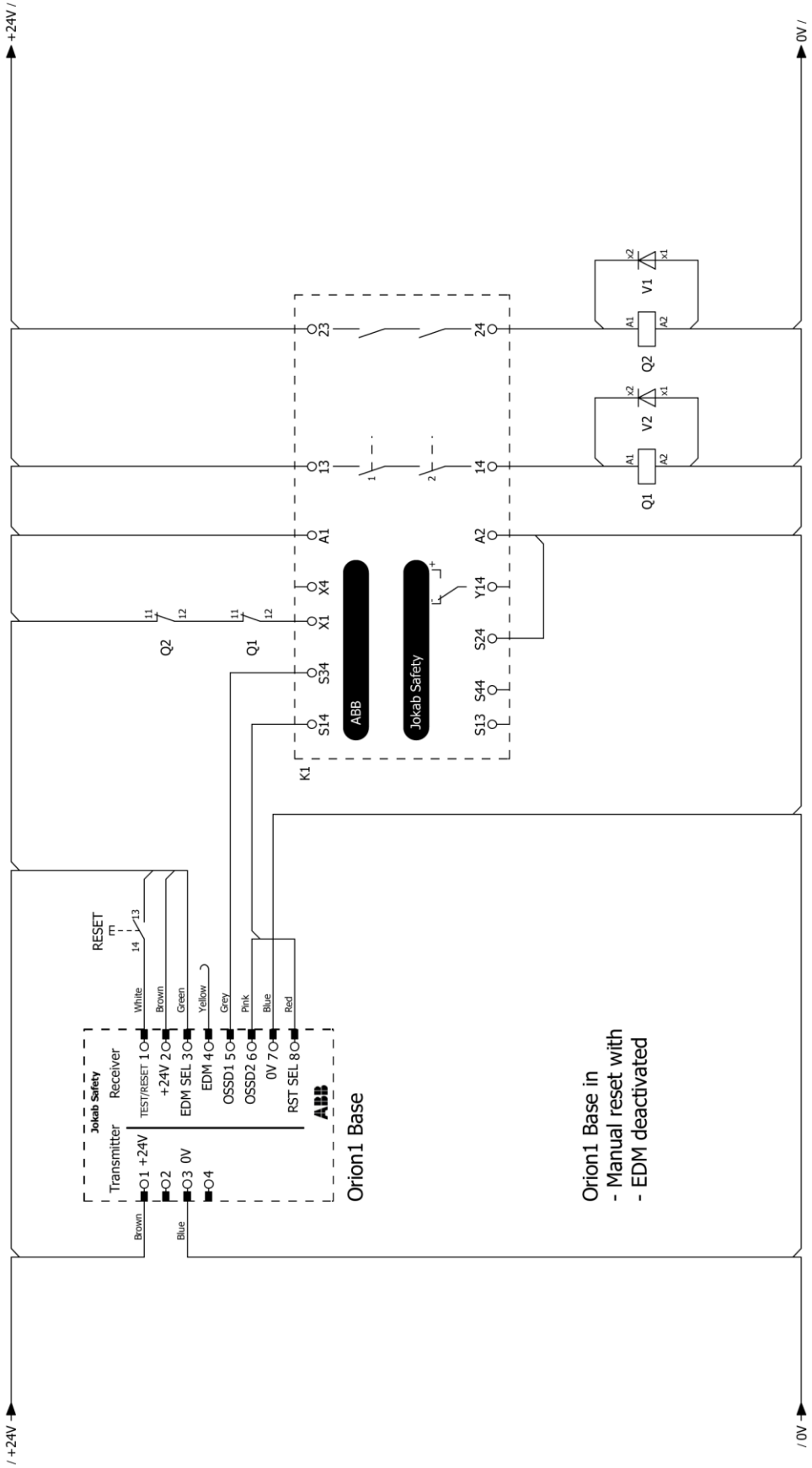


Figure 18 – Connection to a RT9 safety relay

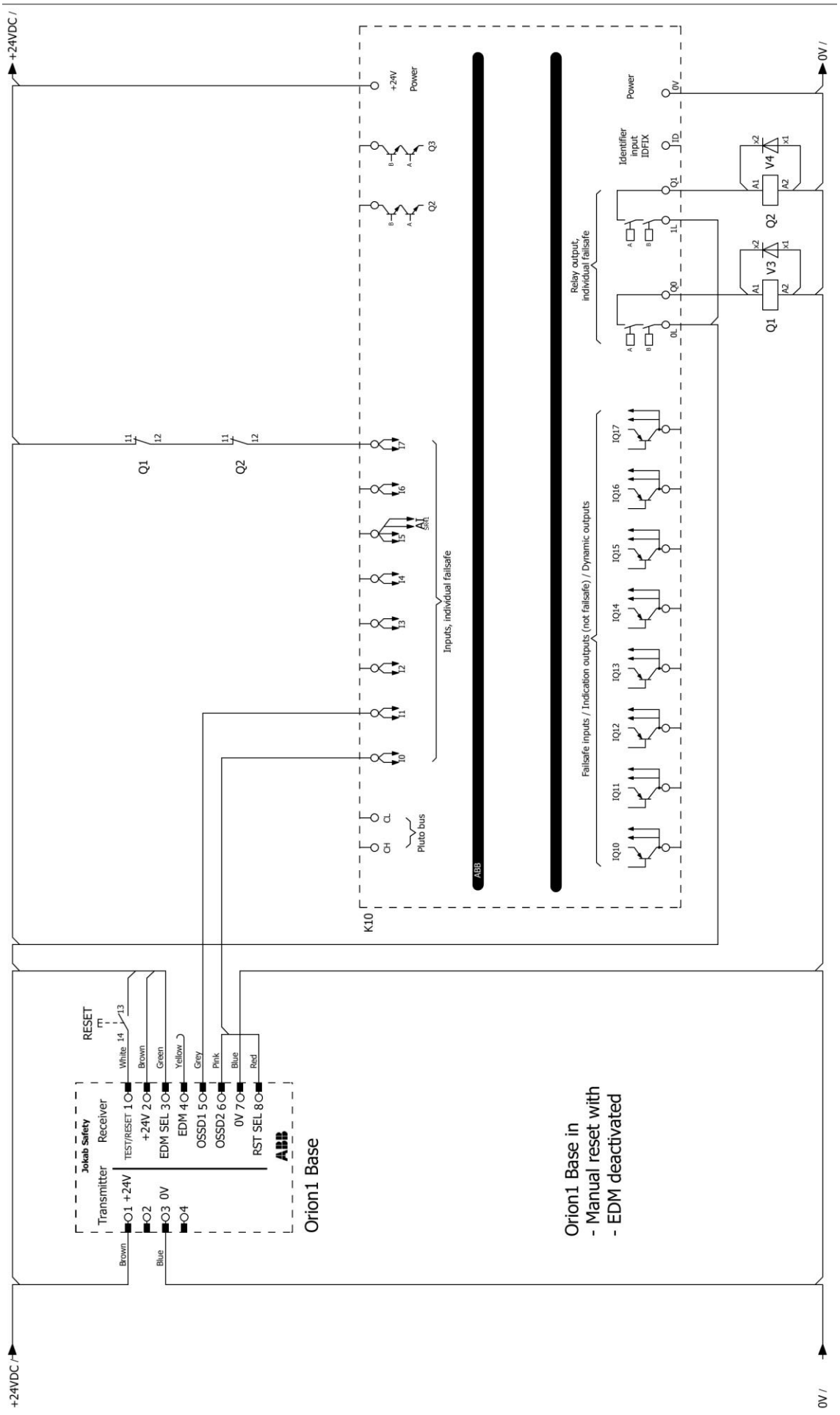


Figure 19 – Connection to a Pluto B20 Safety PLC

The figures show the connection between Orion1 Base and the RT9 safety relay/ Pluto B20 Safety PLC when the AOPD is in Manual Reset function with a reset button connected to the AOPD.

NB: Do not use varistors, RC circuits or LEDs in parallel with relay inputs or in series with OSSD outputs.

NB: The OSSD1 and OSSD2 safety contacts cannot be connected in series or in parallel, but can be used separately according to the safety requirements of the plant.

If one of these configurations is erroneously used, the device enters the OSSD Error mode (see paragraph 8 – “Diagnostic functions”).

NB: Connect both OSSD outputs to the activating device. Failure to connect an OSSD to the activating device jeopardises the SIL and/or PL of the system that the AOPD controls.

YES

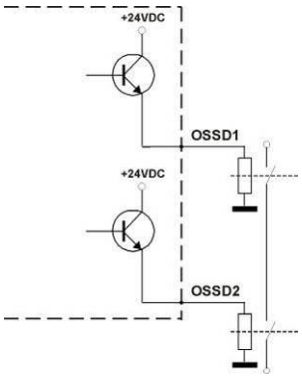
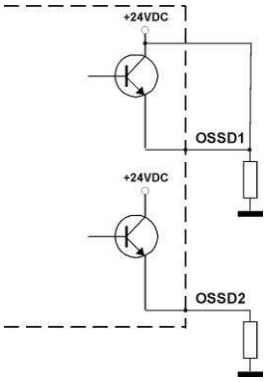
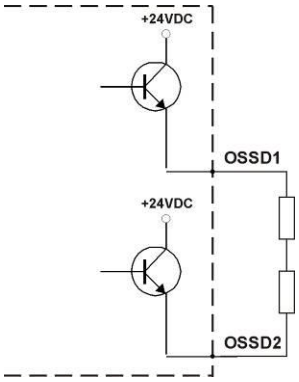


Figure 20 – Correct connection of OSSD outputs

NO



NO



NO

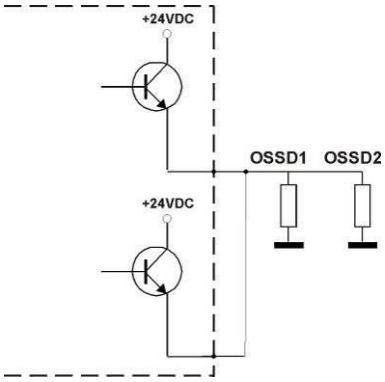


Figure 21 – Incorrect connection of OSSD outputs

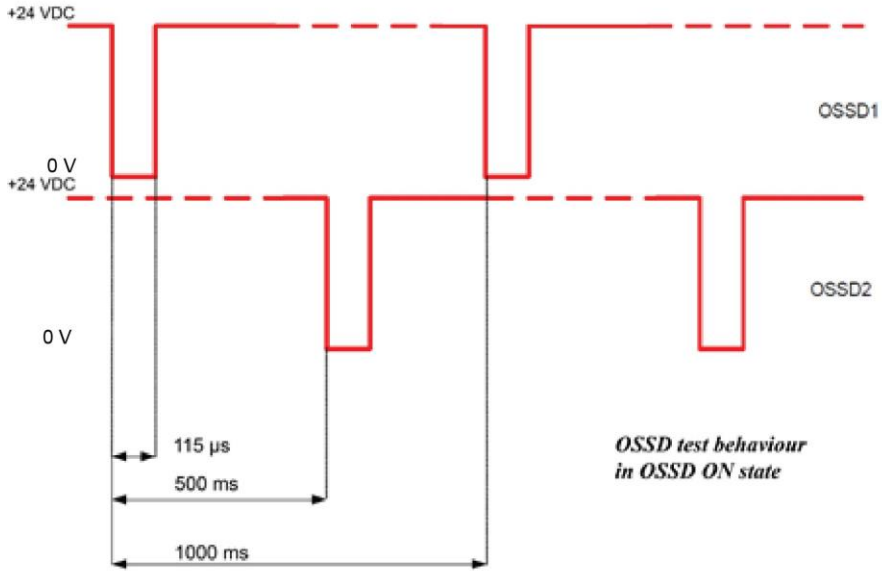


Figure 22 – Time chart of the OSSD outputs

6 Alignment procedure

The alignment between the transmitter and the receiver is necessary to obtain the correct functioning of the AOPD. A good alignment prevents outputs instability caused by dust or vibrations.

The alignment is perfect if the optical axes of the first and the last beams of the transmitter coincide with the optical axes of the corresponding elements of the receiver.

The beam used to synchronise the two units is the one closest to the connector. FIRST is the optics connected with this beam and LAST is the optics connected to the last beam when starting from FIRST.

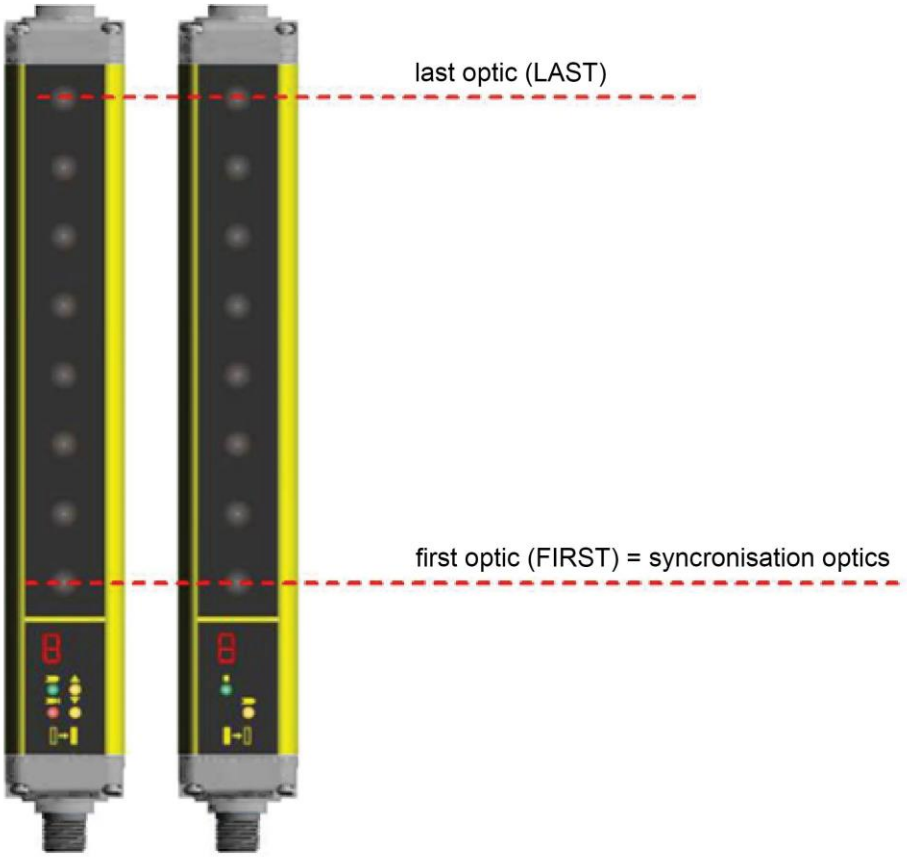


Figure 23 – LAST and FIRST optics

It is important to understand the symbols present on the display. The symbols are easily interpreted whatever the orientation of the AOPD.

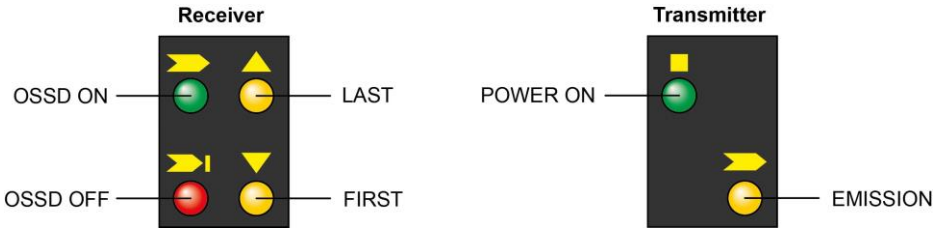


Figure 24 – Displays on transmitter and receiver

The standard installation described hereinafter is the one shown in Figure 23, i.e. with the connectors pointing down.

6.1 Alignment mode

The Alignment mode is activated by pushing the external NO contact (ACKNOWLEDGE/RESET push-button) for at least 0.5 s at power-on, see Figure 25.

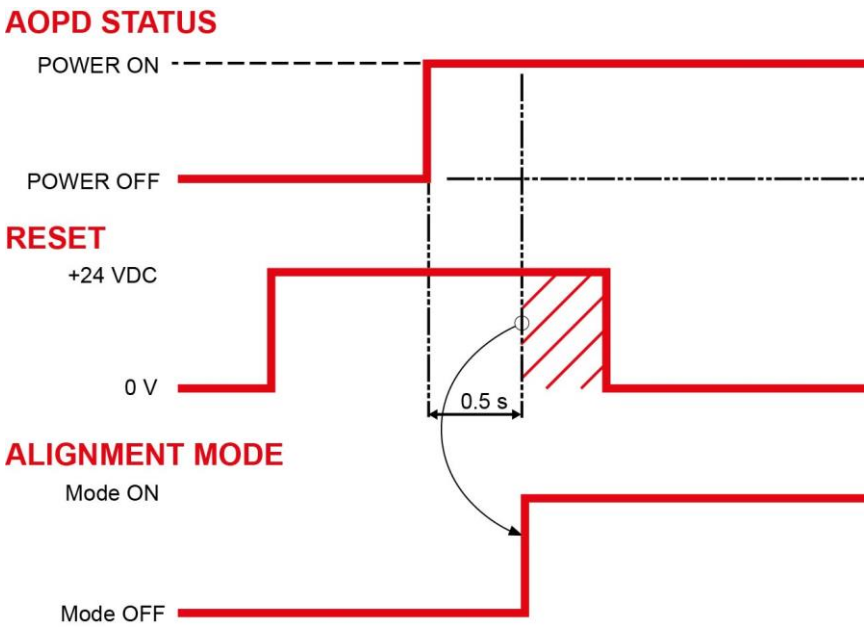


Figure 25 – Time chart of the Alignment mode

Once the optimal alignment has been reached, the device is returned to normal function by turning the receiver off and on.

NB: The alignment level is also monitored during the normal operating mode of the device via the display (see paragraph 8.2 – “Diagnostic messages”). Once the AOPD has been aligned and correctly fastened, the information on the display is used to check the alignment and detect any change in the environmental conditions (presence of dust, light disturbance and so on).

NB: The OSSD outputs are off in alignment mode.

6.2 Correct alignment procedure

The alignment is performed after having completed the mechanical installation and the electrical connections as described above. Compare alignment results with those given in the following table.

Enter the alignment mode as described above.

In alignment mode, the display informs the user of the level of alignment reached.

Display	LED ➤ OSSD ON	LED ➤I OSSD OFF	LED ▼ FIRST (yellow)	LED ▲ LAST (yellow)	Condition	Alignment status
	OFF	ON	ON	ON	First not OK Last not OK	Not aligned
			OFF	ON	First OK Last not OK	
			OFF	OFF	First OK Last OK Middle optics not OK	
	ON	OFF	OFF	OFF	Each beam is over the min. operating light reception threshold and the number of beams over the light reception threshold is between 0 and 25%	MINIMUM alignment
	ON	OFF	OFF	OFF	Each beam is over the min. operating light reception threshold and the number of beams over the light reception threshold is between 25 and 50%	
	ON	OFF	OFF	OFF	Each beam is over the min. operating light reception threshold and the number of beams over the light reception threshold is between 50 and 75%	
	ON	OFF	OFF	OFF	Each beam is over the min. operating light reception threshold and the number of beams over the light reception threshold is between 75 and 100%	MAXIMUM alignment

1) Keep the receiver in a steady position and adjust the transmitter until the yellow LED (▼ FIRST) turns off. This condition shows the alignment of the first synchronisation beam.
2) Rotate the transmitter, pivoting around the lower optics axis, until the yellow LED (▲ LAST) turns off.

   NB: Make sure that the green LED (➤) is on and steady.
3) Slightly turn both units both ways to find the limits of the area in which the green LED (➤) is steady and “4” is displayed (Maximum alignment). Place both units in the centre of this area.
4) Fix the two units firmly using brackets.

   Check that the green LED (➤) on the receiver is on when the beams are not interrupted. Then check that the red LED (➤I) turns on when one single beam is interrupted. This check shall be made with the special cylindrical “Test Piece” having a suitable size for the resolution of the device used (see paragraph 3.3 – “Checks after first installation”).
5) Switch the device off and on to normal operating mode.

The alignment level is also monitored during normal operating mode and visualized on the display (see paragraph 8.2 – “Diagnostic messages”).

Once the AOPD has been aligned and correctly fastened, the signal on the display is useful both to check the alignment and to show a change in the environmental conditions (presence of dust, light disturbance and so on).

7 Functions

7.1 Reset function

The interruption of a beam by an opaque object causes the OSSD outputs to switch off ( ) .

The AOPD can be reset to the OSSD ON state (LED on) in two different ways:

- **Automatic Reset**

  When activated, the AOPD returns to OSSD ON once the object has been removed from the detection zone.

- **Manual Reset**

  When activated, the AOPD returns to OSSD ON once the RESET button has been pushed, provided that the object has been removed from the detection zone. The condition when the object has been removed and the system is waiting for reset is called interlock and is signalled on the display (see paragraph 8.2 – “Diagnostic messages”).

⚠ **Warning!** Carefully assess risk conditions and reset modes. In applications protecting access to hazard zones, the Automatic Reset function is unsafe when the operator can stand in the hazard zone without being detected. In this case, the Manual Reset of the AOPD or the safety relay is necessary (see paragraph 5.3 – “Important notes on connections”).

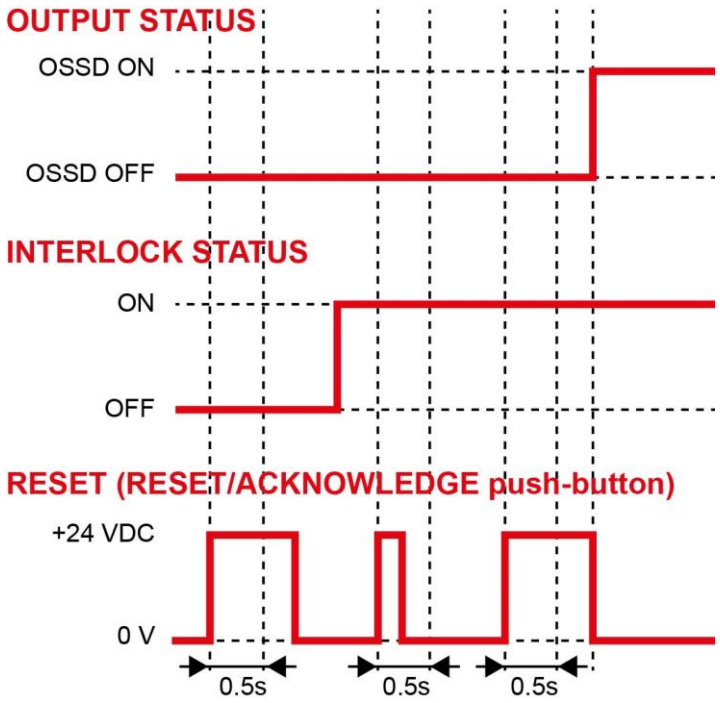


Figure 26 – Time chart of the Manual Reset function

Select either Automatic or Manual Reset by connecting pin 8 of the RX connector according to paragraph 5 – “Electrical connections”).

7.2 Test function

The Test function is activated by pressing a normally open external contact (TEST push-button) for at least 0.5 s.

The test signal is active high.

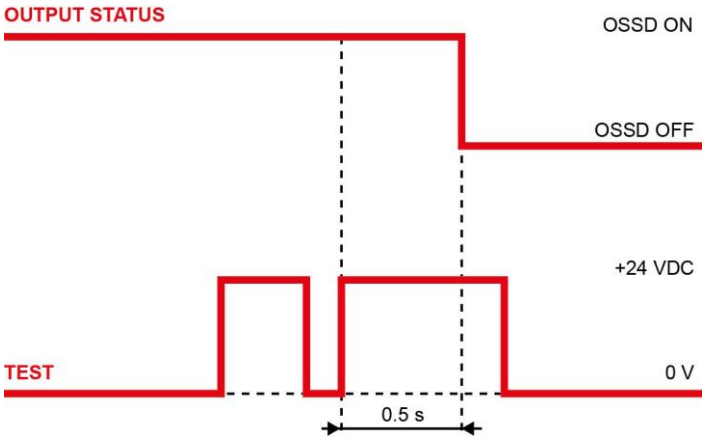


Figure 27 – Time chart of the Test function

7.3 Acknowledge function

The Acknowledge function is used in presence of an internal error like an optical error, an OSSD error or an EDM error or a selection of Manual/Automatic Reset error (see paragraph 8 – “Diagnostic functions”).

The Acknowledge function is activated by pressing an external NO contact (ACKNOWLEDGE/RESET push-button) for at least 5 s. The AOPD then returns to normal operation mode. The Acknowledge signal is active high.

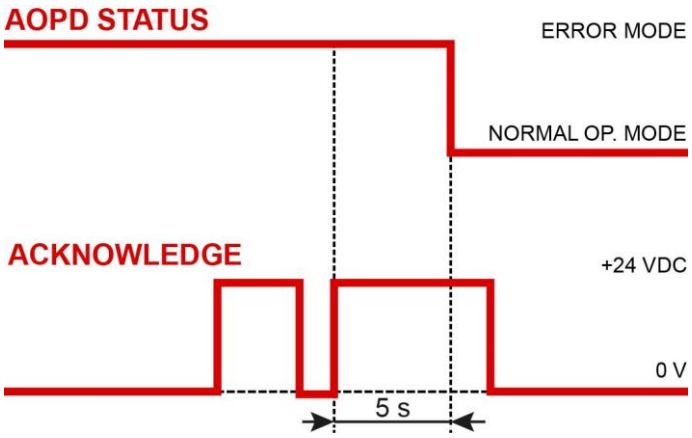


Figure 28 – Time chart of the Acknowledge function

7.4 EDM function

The AOPD has a function for monitoring the actuation of external devices (EDM). This function can be activated or deactivated (see paragraph 5 – “Electrical connections”).

EDM activated:

1) Disconnect pin 3 of the receiver or connect it to the ground (EDM selection = ON).

2) Connect the EDM input (pin 4 of M12 8-pole – RX) to +24 VDC through the normally closed contacts of the devices to be monitored.

NB: The decimal dot on the display shows that the function is activated.

EDM deactivated:

1) Connect pin 3 of the receiver to +24 VDC (EDM selection = OFF).

2) Disconnect the EDM input (pin 4 of M12 8-pole - RX) or connect it to the ground.

This function checks that the normally closed contacts switch state when the OSSD outputs change state.

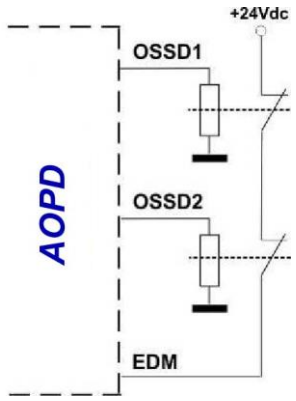


Figure 29 – Connection of EDM

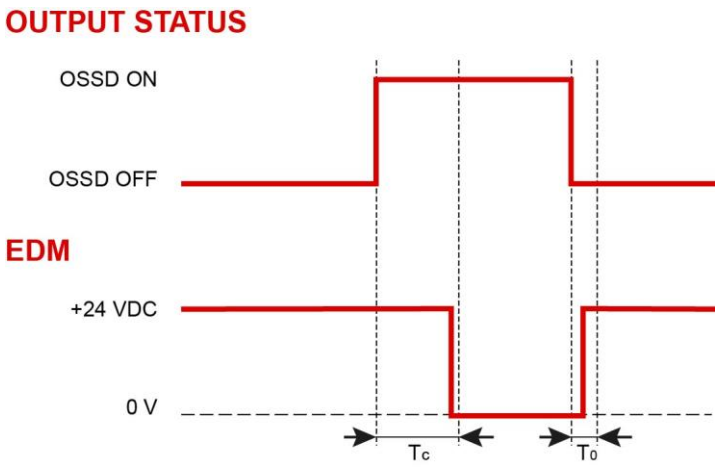


Figure 30 – Time chart of the EDM function

T_C and T_0 are the times between the change of state of the OSSD outputs and the change of state of the NC contact of the external device.

$T_C \leq 350$ ms: the external NC contacts must open within this time after the OSSD outputs have switched on.

$T_0 \leq 100$ ms: the external NC contacts must close within this time after the OSSD outputs have switched off.

8 Diagnostic functions

8.1 Visualisation of the status of the AOPD

The operator can check the status of the AOPD using a one-digit display present on both the receiver and transmitter.

Orion1 Base also has four LEDs on the receiver and two LEDs on the transmitter.

Figure 31 shows all LEDs signalling modes: OFF, ON and FLASHING.

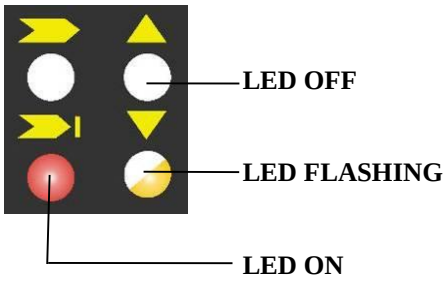


Figure 31 – Signalling modes of the LEDs

8.2 Diagnostic messages

The operator can evaluate the main causes of system stops and errors using the display and signalling LEDs.

8.2.1 Transmitter

Function	Status	Meaning	LED	DIGIT
Normal operation mode	TEST (green ON)	AOPD being tested. OSSD status on the receiver must be OFF.		
	Emission (green ON yellow ON)	AOPD in normal operating mode.		
Function	**Type**	**Check and repair**	**LED**	**DIGIT**
Error mode	Internal error (green ON)	Switch the power off and on. If the error persists, contact your ABB Jokab Safety representative.		
	Optical error (green ON)	Switch the power off and on. If the error persists, contact your ABB Jokab Safety representative.		
	No power supply (LEDs OFF)	Check the wiring, connections and value of the power supply. If the error persists, contact your ABB Jokab Safety representative.		

8.2.2 Receiver

Function	Status	Meaning	LED	DIGIT
Normal operation mode	Alignment	See paragraph 6 – “Alignment procedure”.		
	TEST (red on)	AOPD being tested. OSSD outputs off.		
	Reception (green on)	AOPD working in normal operating mode. OSSD outputs on		
	Beams interrupted (red on)	Beam(s) interrupted in Automatic Reset. OSSD outputs off.		
	Interlock Beams free (red on yellow on)	AOPD in interlock, waiting for reset. OSSD outputs off.		
	Interlock Beams interrupted (red on yellow on)	Beam(s) interrupted in Manual Reset. AOPD in interlock. OSSD outputs off.		
	Alignment level	Minimum (1 bar) Medium (2 bars) Maximum (3 bars)		
	EDM enabled	EDM function is selected.		

Function	Type	Check and repair	LED	DIGIT
Error mode	OSSD error (red on)	Check the wiring and connections of the OSSD outputs. Make sure that there is no short-circuit between them or with the supply voltage. See also 5.4 “Connection examples”. Then Acknowledge. If the error persists, contact your ABB Jokab Safety representative.		
	Internal error (red on)	Switch the power off and on. If the error persists, contact your ABB Jokab Safety representative.		
	Optical error (red on)	Acknowledge. If the error persists, contact your ABB Jokab Safety representative.		
	EDM error (red on)	Check the wiring and connections of the EDM as well as the time sequence (see the Time chart, Figure 30). If the error persists, contact your ABB Jokab Safety representative.		
	Reset selection error (red on)	Check the wiring and connections of the MAN / AUTO pin (see paragraph 5.2 – “Receiver (RX)”). If the error persists, contact your ABB Jokab Safety representative.		
	No power supply (LEDs off)	Check the wiring and the connections of the power supply. Check that its value is within the allowed range. If the error persists, contact your ABB Jokab Safety representative.		

9 Periodical checks

The following is a list of recommended checks and maintenance operations that should be periodically carried-out by qualified personnel.

Check that:

- The AOPD remains in OSSD OFF state ( ) during beam interruption along the entire detection zone, using the suitable “Test Piece” and following the Figure 16 scheme (see paragraph 3.3 Checks after first installation”).
- The AOPD is correctly aligned: press slightly the product side, in both directions, and check that the red LED does not turn on.
- The OSSD outputs switch off (the red LED turns ON and the controlled machine stops) when the Test function is activated.
- The stopping time of the machine, including the response times of the AOPD and of the machine, is within the limits defined for the calculation of the minimum installation distance (see paragraph 2.4 – “Minimum installation distance”).
- The minimum installation distance between the hazard zone and the AOPD is in accordance with the instructions included in paragraph 2.4 – “Minimum installation distance”.
- Access of a person between the AOPD and the hazard zone of the machine is not possible, nor is it possible for him/her to stay there without being detected.
- Access to the hazard zone of the machine from any unprotected area is not possible.
- The AOPD and the external electrical connections are not damaged.

The frequency of checks depends on the particular application and on the operating conditions of the AOPD.

10 Device maintenance

Orion1 Base light curtains do not require special maintenance operations.

To avoid the reduction of the operating distance, optic protective front surfaces must be cleaned at regular intervals. Use soft cotton cloths damped in water. Do not apply too much pressure on the surface in order to avoid making it opaque.

Do not use the following on plastic surfaces or on painted surfaces:

- Alcohol or solvents
- Wool or synthetic cloths
- Paper or other abrasive materials.

11 Technical data

Manufacturer	
Address	ABB JOKAB SAFETY Varlabergsvägen 11 SE-434 39 Kungsbacka Sweden
Electrical data	
Power supply (Vdd):	+24 VDC ± 20 %
Consumption (TX):	1.5 W max
Consumption (RX):	4 W max (without load)
Outputs	2 PNP
Short-circuit protection: Output current: Output voltage – ON: Output voltage – OFF: Capacitive load:	1.4 A max 0.5 A max / output Vdd -1 V min 0.2 V max 2.2 µF at +24 VDC max
Response time:	See paragraph 12 – “Model overview”
Electrical protection:	Class III – use SELV/PELV
Connections:	Transmitter: M12 4-pole male connector Receiver: M12 8-pole male connector
Cable length (for power supply):	50 m max
Optical data	
Light emission (λ):	Infrared, LED (950 nm)
Resolution:	14 – 30 mm
Protected height:	150..1800 mm. See paragraph 12 – “Model overview”
Operating distance:	0.2…19 m for 30 mm 0.2…6 m for 14 mm
Ambient light rejection:	According to IEC 61496-2:2013
Mechanical and environmental data	
Operating temperature:	0…+ 55 °C
Storage temperature:	- 25…+ 70 °C
Temperature class:	T6
Humidity:	15…95 % (no condensation)
Mechanical protection:	IP65 (EN 60529:2000)
Vibrations:	Width 0.35 mm, Frequency 10 … 55 Hz, 20 sweeps per axis, 1 octave/min (EN 60068-2-6:2008)
Shock resistance:	16 ms (10 G) 10^3 shocks per axis (EN 60068-2-29:2008)
Housing material:	Painted aluminium (yellow RAL 1003)
Front glass material:	PMMA
Cap material:	PC MAKROLON
Weight:	1.3 kg / meter for each single unit

Functional safety data		
EN ISO 13849-1:2008	PL e, Cat 4	
EN IEC 61508-1:2010 EN IEC 61508-2:2010 EN IEC 61508-3:2010 EN IEC 61508-4:2010	SIL 3	
EN IEC 62061:2005/A1:2013	SIL CL 3	
Prob. of Dangerous Failure/Hour (1/h)	PFH_d	2.64×10^{-9}
Life span (years)	T1	20
Mean Time to Dangerous Failure (years)	$MTTF_d$	444

12 Model overview

Type	Article number	Protected height (mm)	Number of beams	Response time (ms)	Resolution (mm)
Orion1-4-14-015-B	2TLA022300R0000	150	16	11	14
Orion1-4-14-030-B	2TLA022300R0100	300	32	15	14
Orion1-4-14-045-B	2TLA022300R0200	450	48	18	14
Orion1-4-14-060-B	2TLA022300R0300	600	64	22	14
Orion1-4-14-075-B	2TLA022300R0400	750	80	25	14
Orion1-4-14-090-B	2TLA022300R0500	900	96	29	14
Orion1-4-14-105-B	2TLA022300R0600	1050	112	33	14
Orion1-4-14-120-B	2TLA022300R0700	1200	128	36	14
Orion1-4-14-135-B	2TLA022300R0800	1350	144	40	14
Orion1-4-14-150-B	2TLA022300R0900	1500	160	43	14
Orion1-4-14-165-B	2TLA022300R1000	1650	176	47	14
Orion1-4-14-180-B	2TLA022300R1100	1800	192	50	14
Orion1-4-30-015-B	2TLA022302R0000	150	8	9	30
Orion1-4-30-030-B	2TLA022302R0100	300	16	11	30
Orion1-4-30-045-B	2TLA022302R0200	450	24	13	30
Orion1-4-30-060-B	2TLA022302R0300	600	32	14	30
Orion1-4-30-075-B	2TLA022302R0400	750	40	16	30
Orion1-4-30-090-B	2TLA022302R0500	900	48	18	30
Orion1-4-30-105-B	2TLA022302R0600	1050	56	19	30
Orion1-4-30-120-B	2TLA022302R0700	1200	64	21	30
Orion1-4-30-135-B	2TLA022302R0800	1350	72	23	30
Orion1-4-30-150-B	2TLA022302R0900	1500	80	25	30
Orion1-4-30-165-B	2TLA022302R1000	1650	88	26	30
Orion1-4-30-180-B	2TLA022302R1100	1800	96	28	30

13 Dimensions

13.1 Profiles

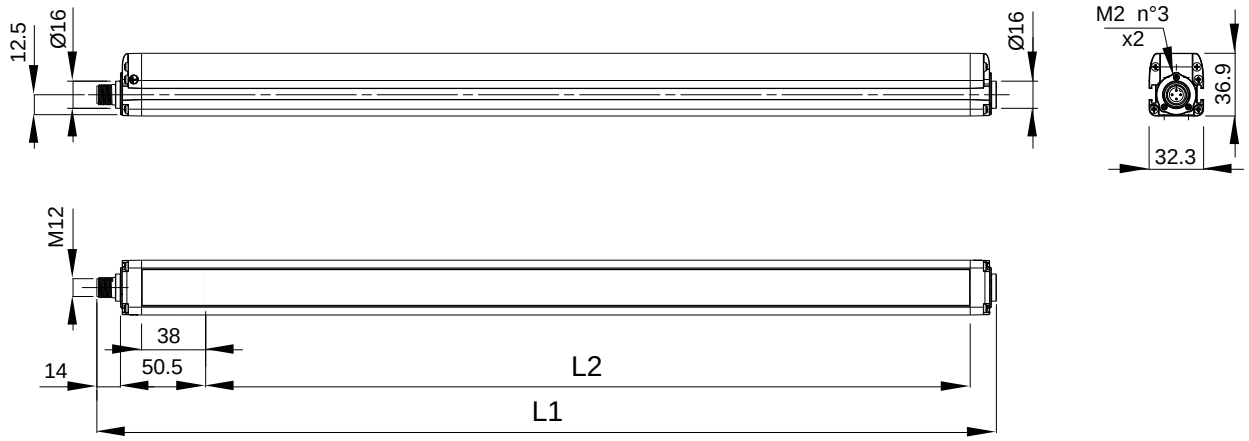


Figure 32 – Dimensions of the profiles

NB: All dimensions in millimetres.

Model	L_1	L_2
Orion1-4-xx-015-B	233.3	153.3
Orion1-4-xx-030-B	383.2	303.2
Orion1-4-xx-045-B	533.2	453.3
Orion1-4-xx-060-B	683.2	603.2
Orion1-4-xx-075-B	833.2	753.3
Orion1-4-xx-090-B	983.2	903.2
Orion1-4-xx-105-B	1133.2	1053.2
Orion1-4-xx-120-B	1283.3	1203.3
Orion1-4-xx-135-B	1433.2	1353.2
Orion1-4-xx-150-B	1583.3	1503.3
Orion1-4-xx-165-B	1733.3	1653.3
Orion1-4-xx-180-B	1883.3	1803.3

xx: resolution, 14 or 30 (mm)

13.2 Angled fixing bracket

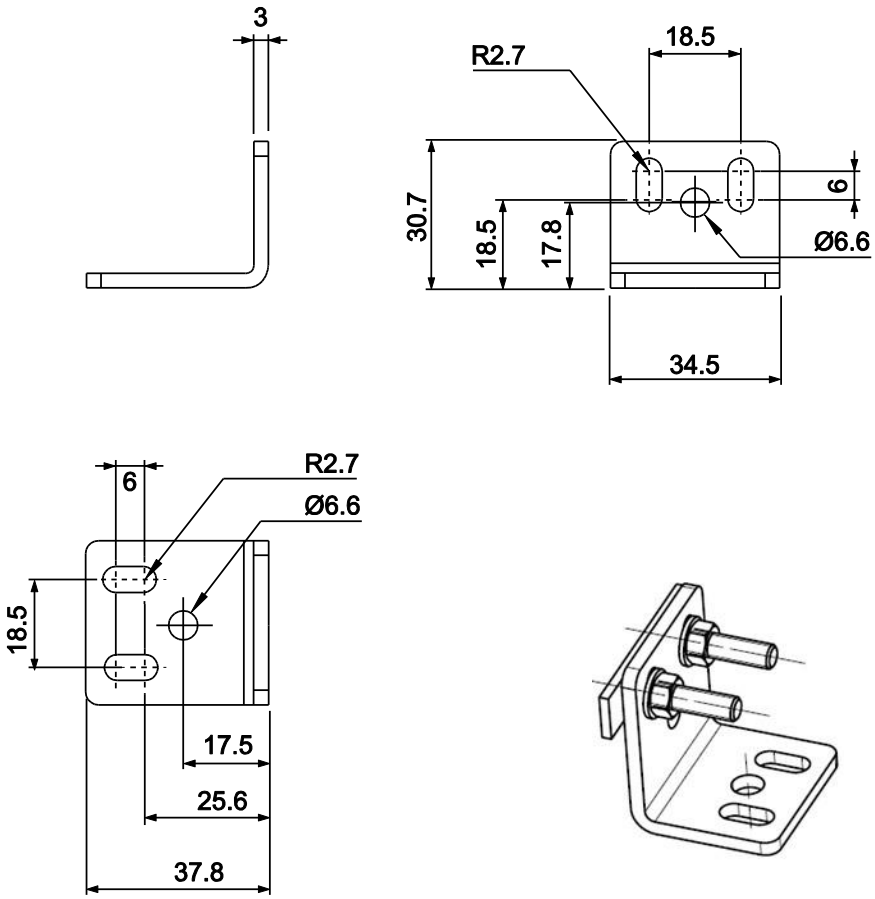


Figure 33 – Dimensions of the angled fixing bracket

NB: All dimensions in millimetres.

13.3 Fixing bracket with profile

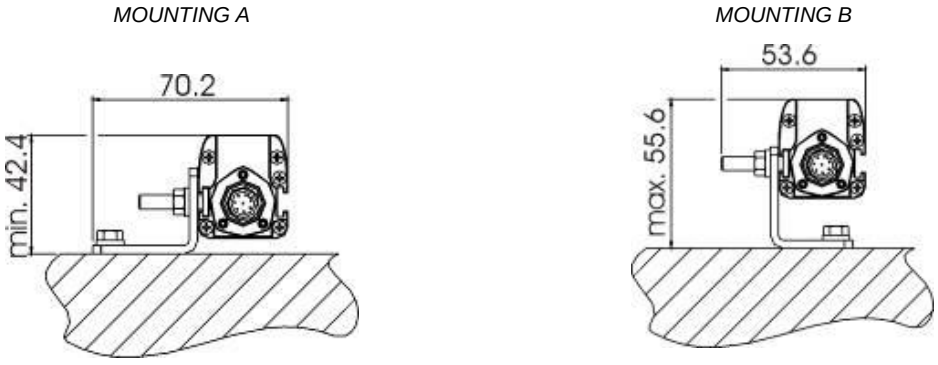


Figure 34 – Dimensions of the angled fixing bracket with a profile

NB: All dimensions in millimetres.

14 EC Declaration of conformity

EC Declaration of conformity

(according to 2006/42/EC, Annex2A)

We	ABB AB JOKAB Safety Varlabergsvägen 11 SE-434 39 Kungsbacka Sweden	declare that the safety components of ABB make with type designations and safety functions as listed below, is in conformity with the Directives 2006/42/EC 2004/108/EC
Authorised to compile the technical file		ABB AB JOKAB Safety Varlabergsvägen 11 SE-434 39 Kungsbacka Sweden
Product		**Certificate**
Light curtain/light beam Orion, all models		Z10 15 02 49833 011
Certification Body		TÜV Süd Product Service GmbH Ridlerstrasse 65 80339 München Germany
Used harmonized standards		EN 61496-1:2013, EN ISO 13849-1:2008, EN 62061:2005/A1:2013
Other used standards		EN 61496-2, EN 61508-1:2010, EN 61508-2:2010, EN 61508-3:2010, EN 61508-4:2010

Jesper Kristensson
PRU Manager
Kungsbacka 2015-03-19

www.abb.com
www.jokabsafety.com

Original