Original instructions

Orion3 Base

Safety light grids

Type 4 Active Opto-electronic Protective Device (AOPD)

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Table of Contents

1 Introduction

1.1 Scope

The purpose of these instructions is to describe the Orion3 Base light grids 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 Orion3 Base light grids 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 get in touch, even accidentally, with moving parts.

The Orion3 Base light grids are Type 4 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 active unit and one passive unit housed inside strong aluminium profiles, generates infrared beams reflected by the mirrors in the passive unit and detects an opaque object interrupting a beam. The active unit is composed by one or several emitting and receiving modules.

The active unit is equipped with the command and control functions. It checks the control operations and safety actions. The passive unit is composed of a sturdy aluminium profile containing pre-assembled and pre-aligned mirrors.

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 via a display (see paragraph 8 – “Diagnostic functions”).

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

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.

The resolution R is calculated using the following formula:

R = I + d

where:

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

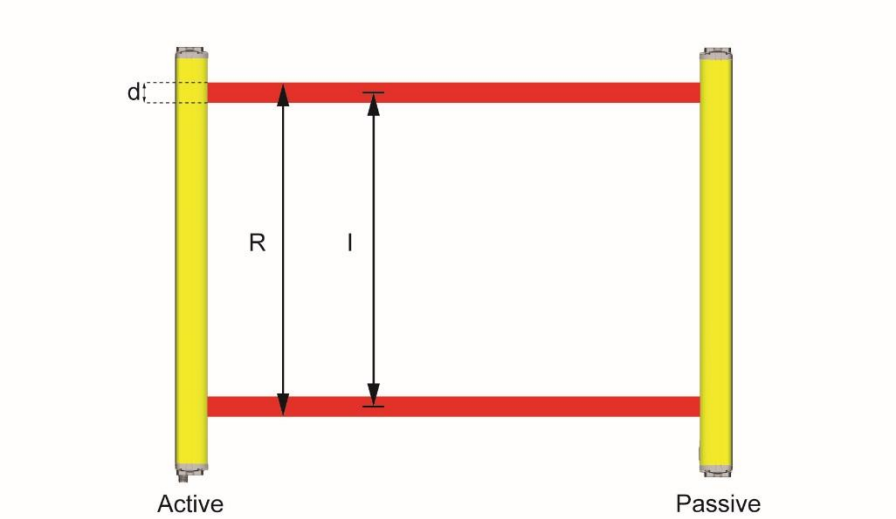


Figure 1 – Resolution

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

The following figures illustrate what is meant with protected height (Hp) for Orion3 Base.

For the values of Hp for each model, see paragraph 12 – “Model overview”.

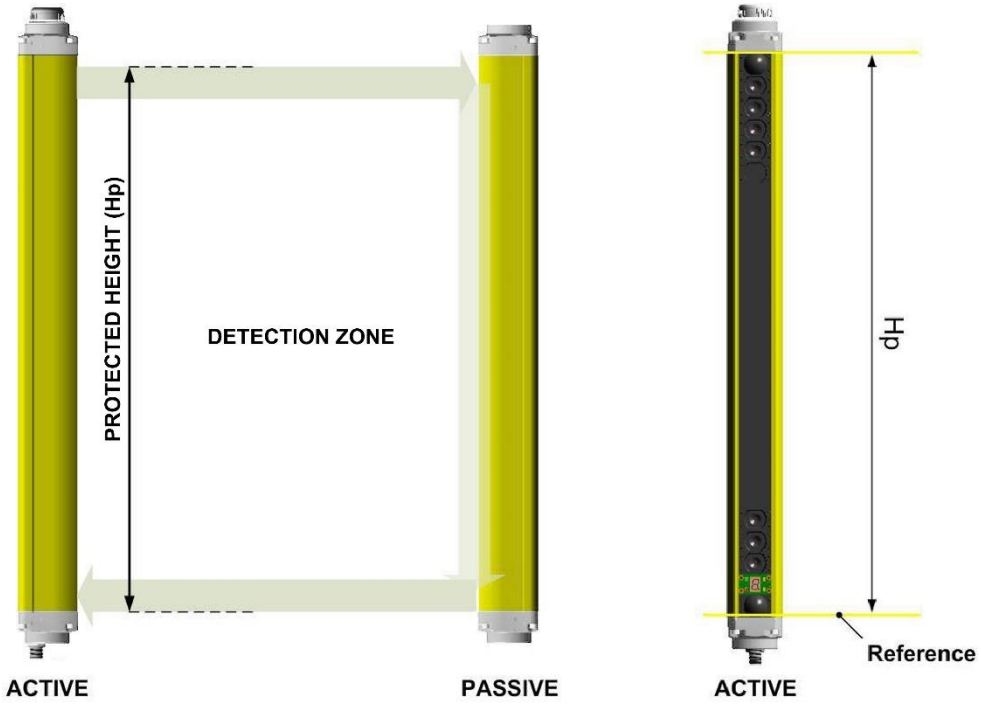


Figure 2 – Orion3 Base with 2 beams

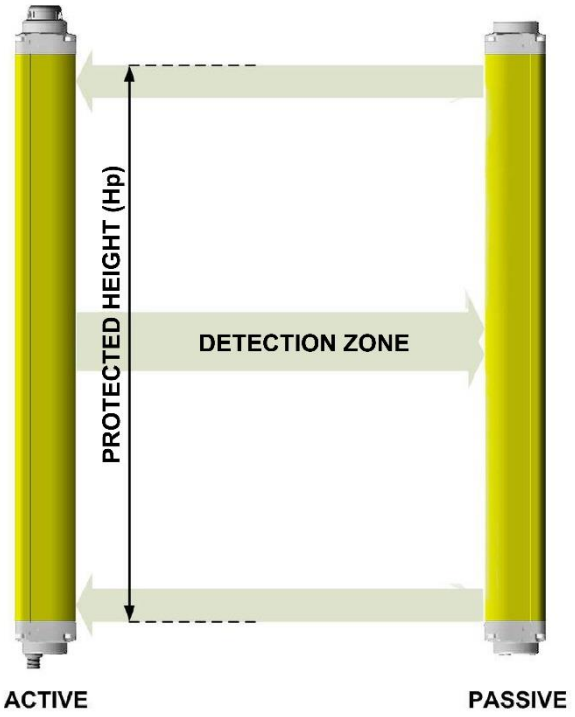


Figure 3 – Orion3 Base with 3 beams

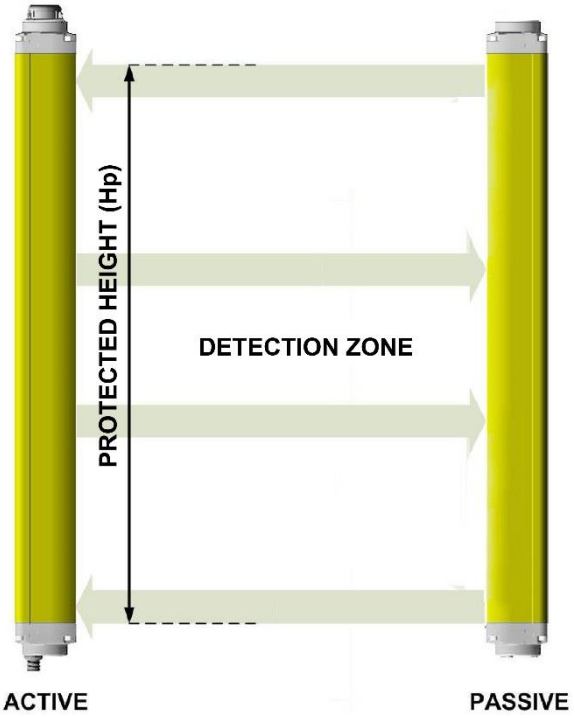
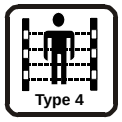
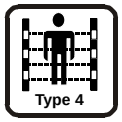
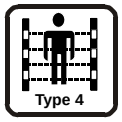
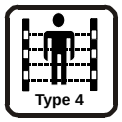


Figure 4 – Orion3 Base with 4 beams

Model	Hp [mm]	AOPD Type
Orion3-4-K1C-050-B	500	Body protection 
Orion3-4-K2C-080-B	800	Body protection 
Orion3-4-K2C-090-B	900	Body protection 
Orion3-4-K2C-120-B	1200	Body protection 

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, step b) and c) are not necessary.

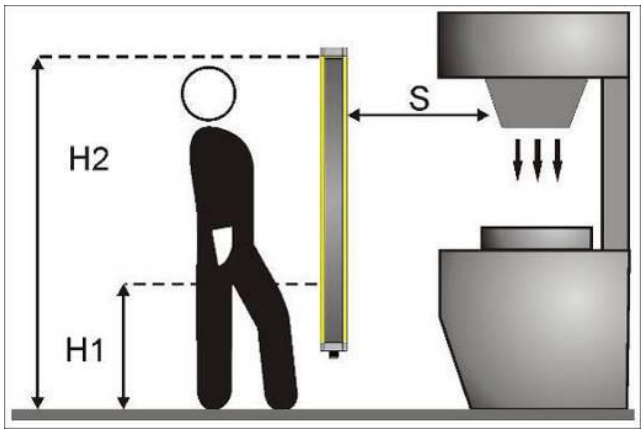


Figure 5 – Minimum distance for a vertically assembled AOPD

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} = 850 mm for devices with resolution d > 40 mm

K = 1600 mm/s for devices with resolution d > 40 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

Orion3 cannot be used horizontally.

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 Orion3 Base light grid in a vertical position and with no risk of reaching over it.

S = K × (T1 + T2) + C

	Orion3-4-K1C-050-B	Orion3-4-K2C-120-B
T1, response time of AOPD (see paragraph 12 – “Model overview”)	0.011 s	0.012 s
T2, stopping time machine + safety control system (value as ex.)	0.380 s	0.380 s
C, for AOPD with resolution > 40 mm	850 mm	850 mm
K, for AOPD with resolution > 40 mm	1600 mm/s	1600 mm/s
S, minimum installation distance	1475.6 mm	1477.2 mm

2.5 Safety information

Warning!

For a correct and safe use of the Orion3 Base light grids, 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 entire hazard zone during all the test operations.
- The RESET/ACKNOWLEDGE button must be located outside the hazard zone because the operator must check the entire hazard zone during all reset/acknowledge 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 be observed 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 so 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 6 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 (see Figure 7).

NO

Figure 6 – Incorrect device positioning

YES

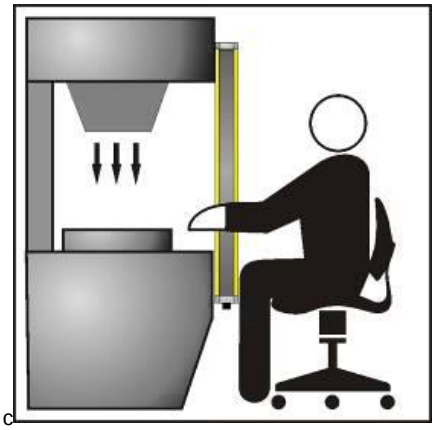


Figure 7 – Correct device positioning

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, as shown in Figure 9.

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

NO

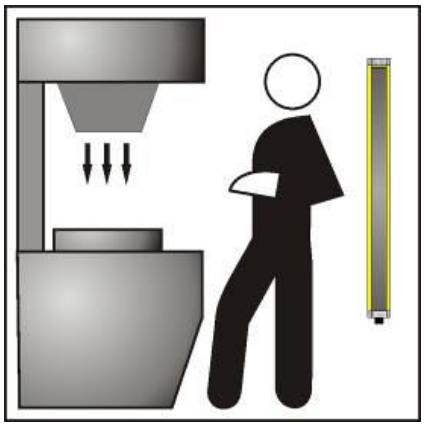


Figure 8 – Incorrect installation

YES

Figure 9 – 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 affect the recognition of an object inside the detection zone (see Figure 10).

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.

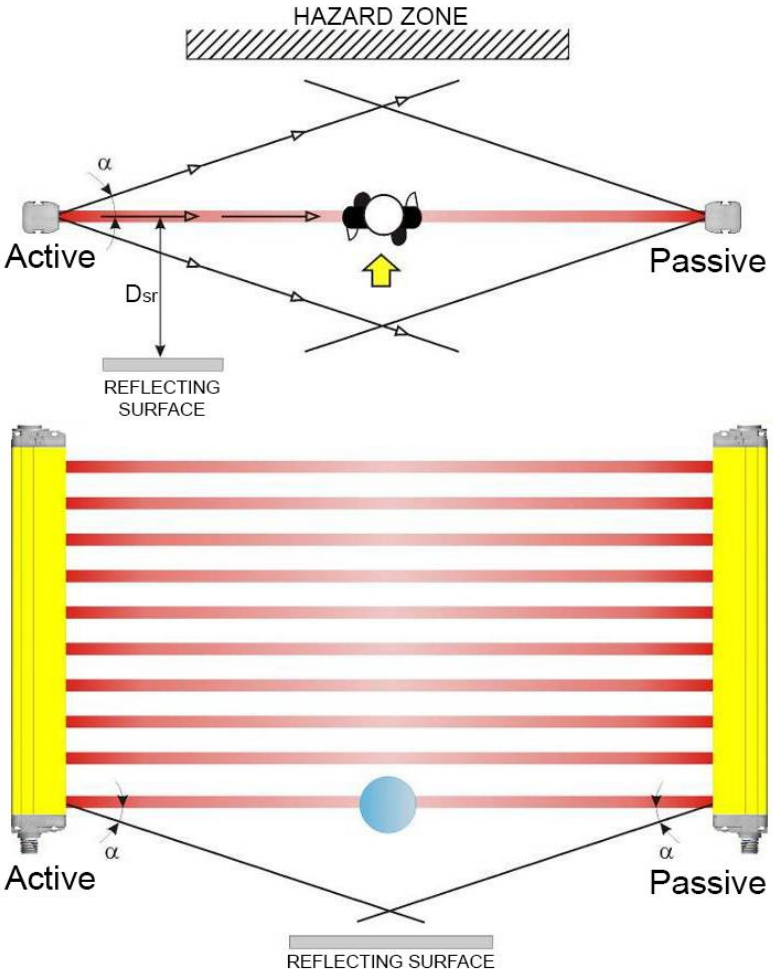


Figure 10 – Distance to reflecting surfaces

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 active and passive units,
- effective aperture angle (EAA) of the AOPD):

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

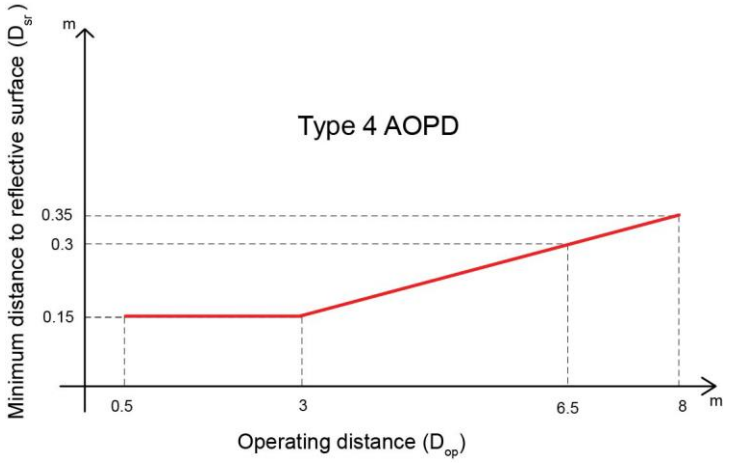


Figure 11 – Minimum distance to a reflective surface as a function of the operating distance

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.

The correct function of the AOPD is guaranteed and certified up to a maximum operating distance of 6.5 m for Orion3-4-K2C-090-B, and 8 m for Orion3-4-K1C-050-B, Orion3-4-K2C-080-B and Orion3-4-K2C-120-B. The use of the AOPD at longer distances is not recommended. Always check the correct function and that no dangerous reflections towards the receiving optics are generated by shiny objects (see Figure 12).

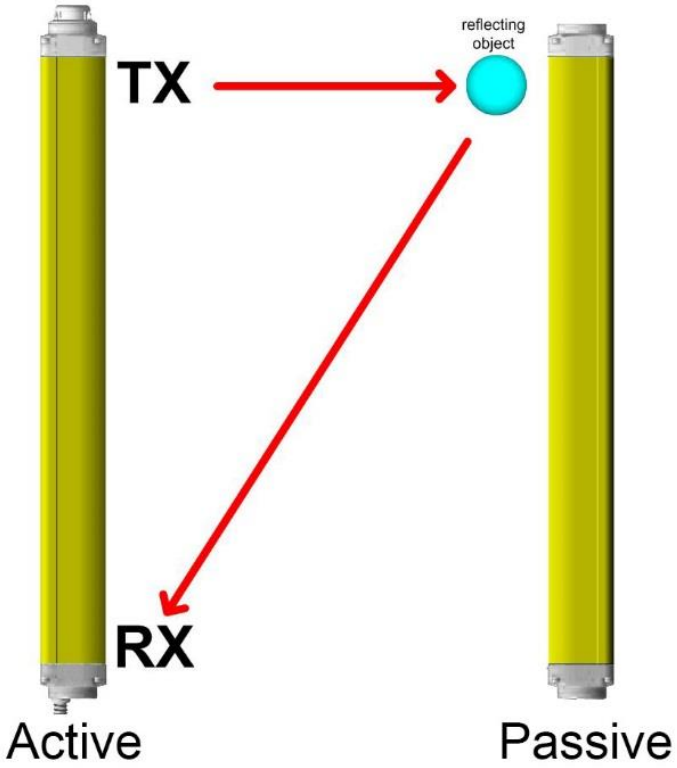


Figure 12 – Reflection by shiny objects

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.

Interfering Passive B device must be positioned outside a minimum D_{do} distance from the axis of the Active A – Passive A couple, see figure below.

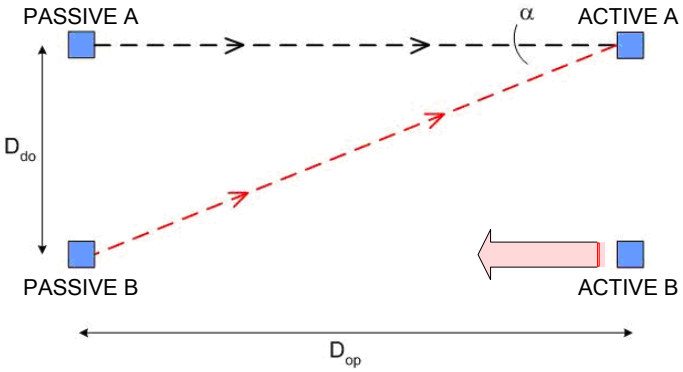


Figure 13 – Distance between adjacent devices

This minimum D_{do} distance depends on:

- the operating distance between Passive A and Active 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 minimum distance to the interfering devices (D_{do}) based on the operating distance (D_{op}) of the couple Passive A – Active A for a Type 4 AOPD.

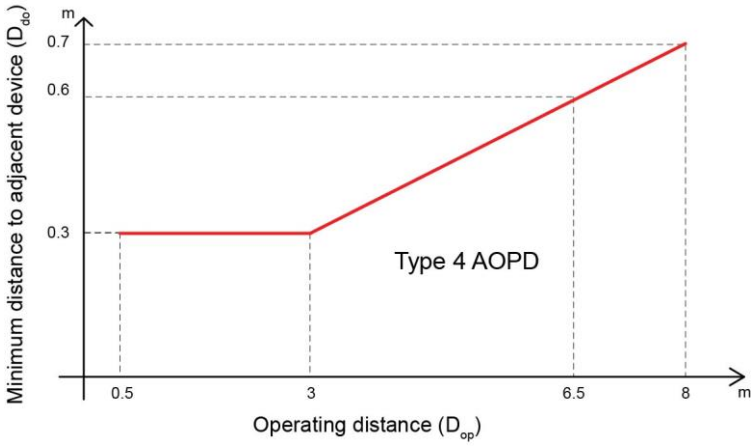


Figure 14 – Minimum distance to an adjacent device as a function of the operating distance

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 the Passive A can interfere with Active B in the same way as Passive B with Active 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 15 provides some examples of correct and incorrect installations when it comes to interferences.

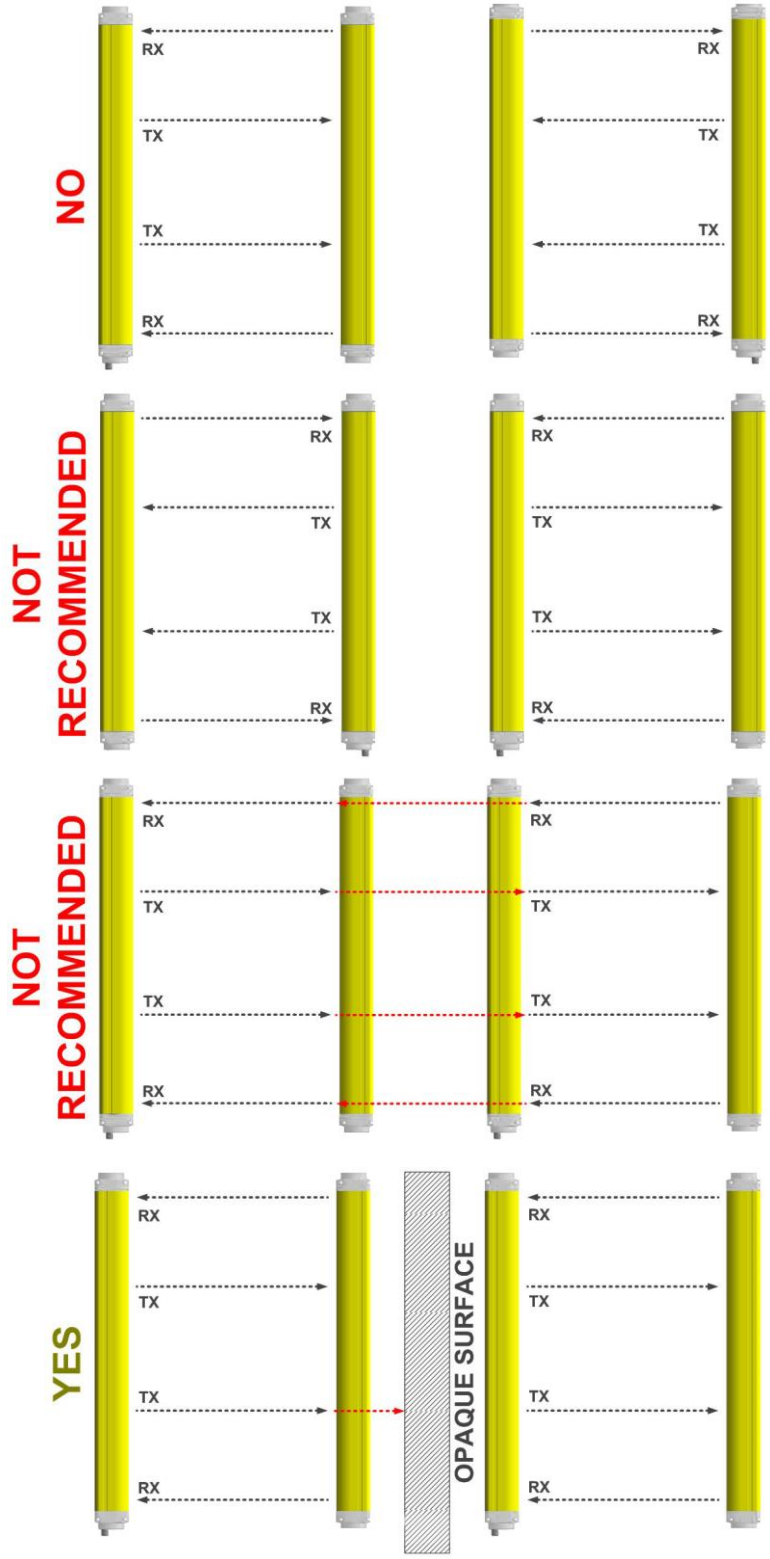


Figure 15 – Installation of several devices close to each other

3.2.5 Active and passive units orientation

The two units shall be assembled parallel to each other, and with the markings on active and passive units on the same side, both up or both down for example.

The configurations shown in Figure 16 must be avoided.

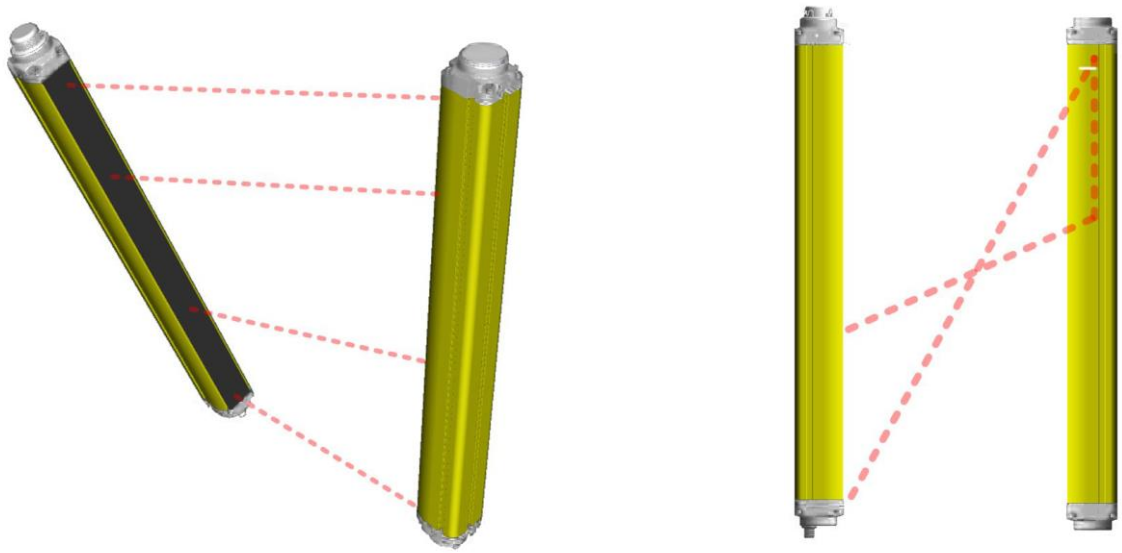


Figure 16 – Incorrect orientation

3.2.6 Use of deviating mirrors

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

- The alignment of the active and passive units can become 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.

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 17 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.

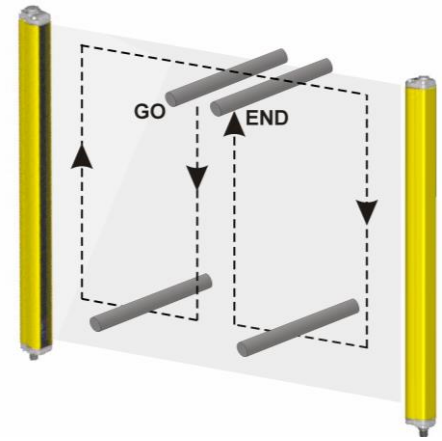


Figure 17 – Scheme for checking the function

- 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 (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 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 active and passive units must be installed with the relevant sensitive surfaces facing each other. 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 Orion3 Base models. To mount the AOPD, insert the supplied “double nut plate” (M5) into the grooves on the two units (see Figure 18).

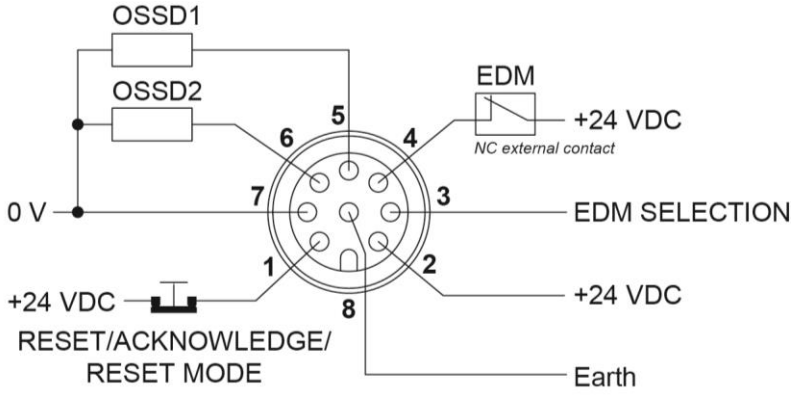
Figure 18 – Mounting with angled fixing brackets

.

5 Electrical connections

All electrical connections to the active unit are made through a male M12-8 pole connector located on the lower part of the active unit.

5.1 Active unit



Pin	Wire[1]	Function		Connection to	Refer to
1	White[2]	RESET/ ACKNOWLEDGE/ RESET MODE	Auto. Reset with no function	+24 VDC	7.1, 7.2 6.1
			Auto. Reset with Acknowledge function or Alignment mode	NC contact to +24 VDC	
			Manual Reset	NC contact to 0 V	
2	Brown	Supply		+24 VDC	
3	Green[2]	EDM SELECTION	Activate EDM	Not connected or 0 V	7.3
			Deactivate EDM	+24 VDC	
4	Yellow	EDM	Function used/activated	NC contact of force-guided relay	7.3
			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	Earth		Earth	

[1] Colors according to ABB Jokab Safety standard cables.

[2] The “RESET/ACKNOWLEDGE/RESET MODE” wire, the “EDM SELECTION” wire and the supply wires MUST be connected in order for the device to function. The other wires may be floating.

5.2 Important notes on connections

For the correct functioning of the Orion3 Base light grids, the following precautions regarding the electrical connections have to be respected:

- The Orion3 Base light grids shall be connected as protective class III equipment and the use of a SELV/PELV supply system is mandatory. A functional earth is available on pin 8 of the M12 connector (red wire). It can be connected or left floating depending on the application.
- 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 device is already equipped with internal overvoltage and overcurrent suppression devices. The use of other external components is not recommended.

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

5.3 Connection examples

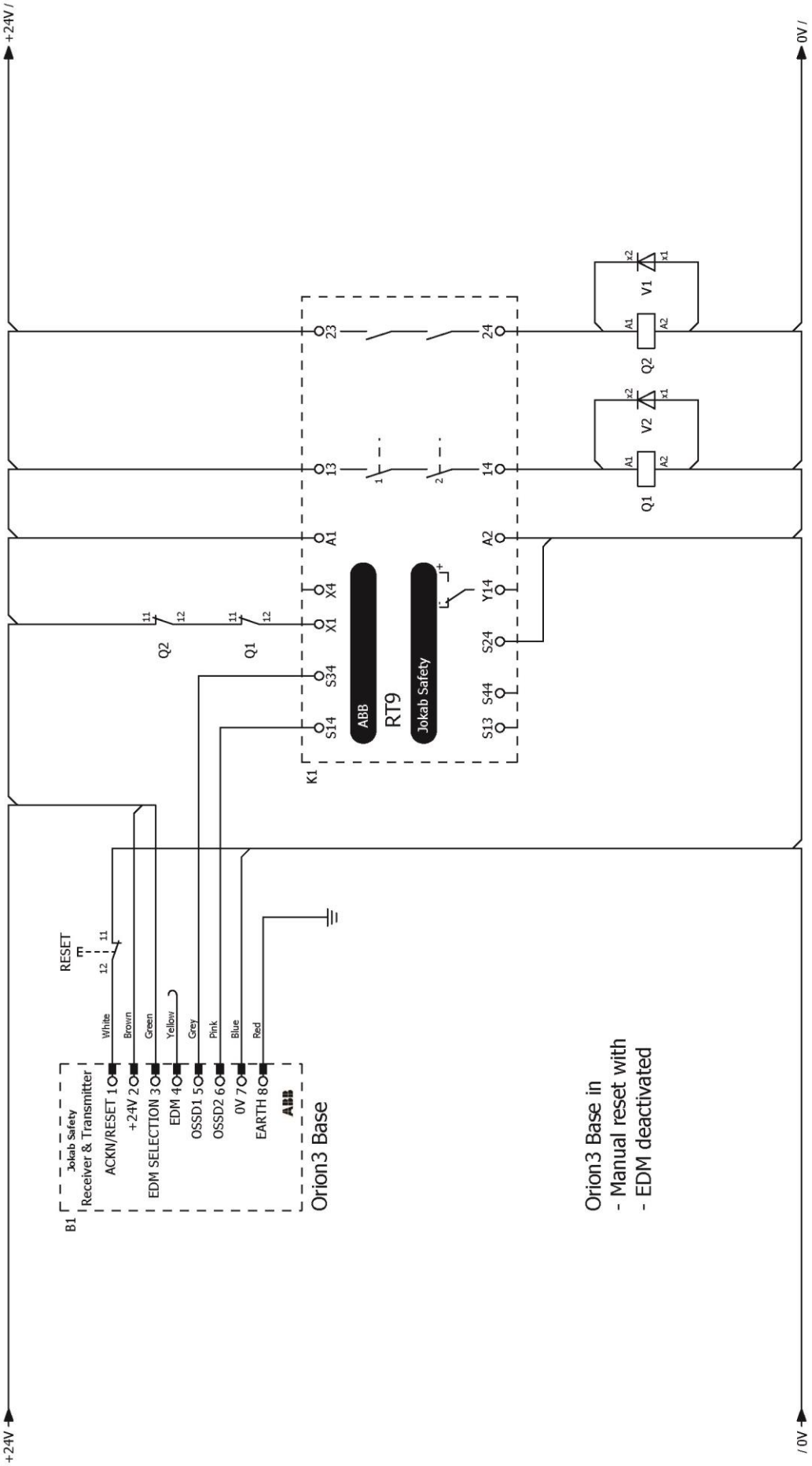


Figure 19 – Connection to a RT9 safety relay

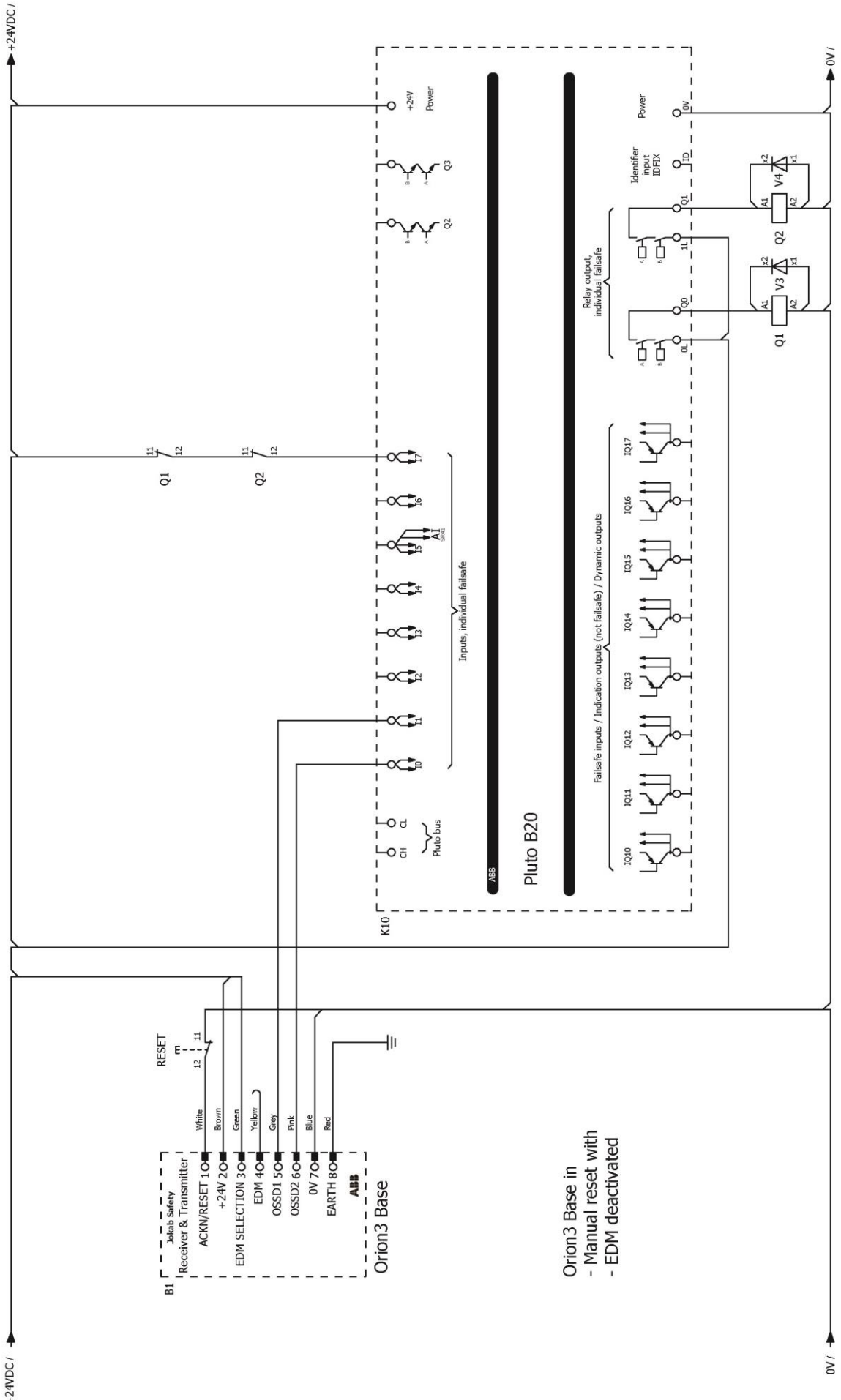


Figure 20 – Connection to a Pluto B20 safety PLC

The figures show the connection between the Orion3 Base and the RT9 safety relay/ Pluto B20 safety PLC when the AOPD is in Manual Reset mode with a reset button connected to the AOPD.

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

NB: The OSSD1 and OSSD2 safety contacts cannot be connected in series or in parallel, but must 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

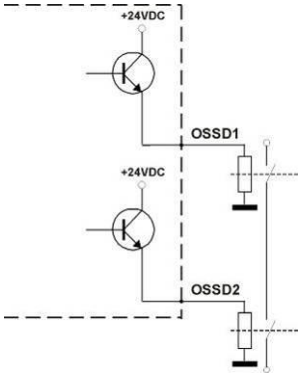
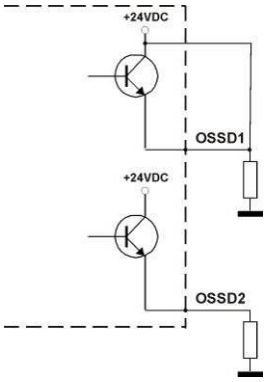
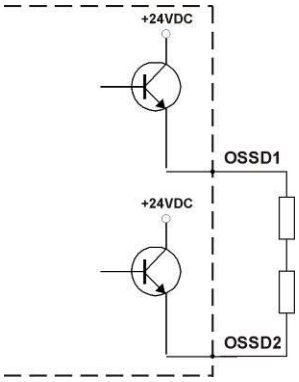


Figure 21 – Correct connection of OSSD outputs

NO



NO



NO

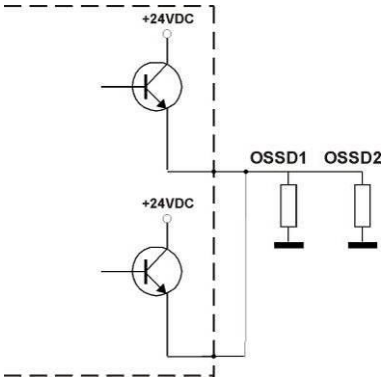


Figure 22 – Incorrect connection of OSSD outputs

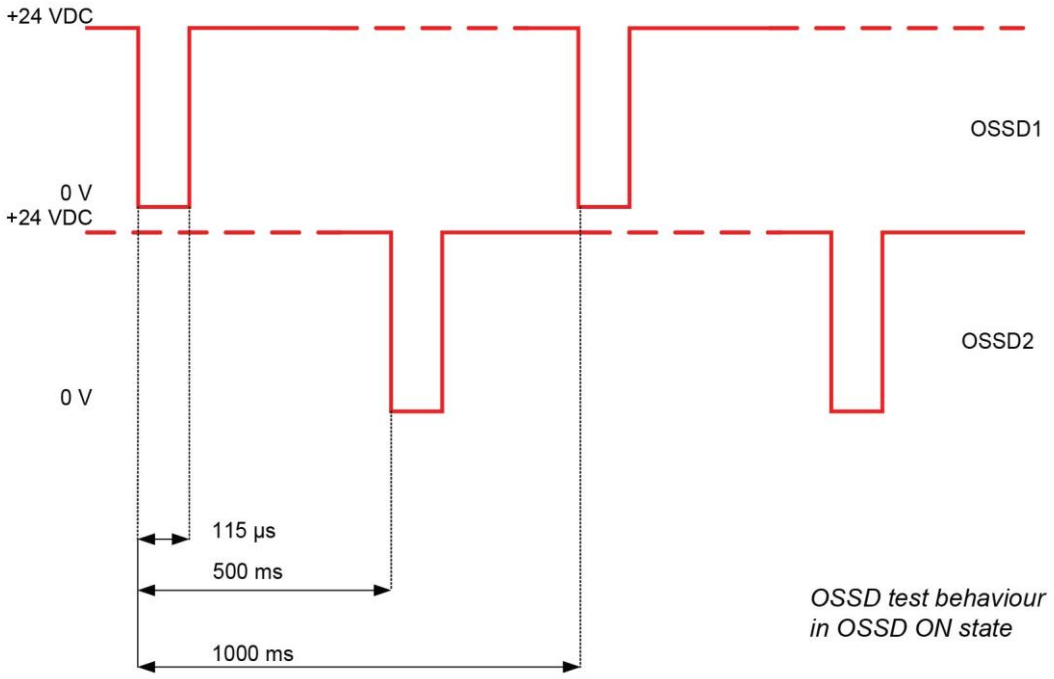


Figure 23 – Time chart of the OSSD outputs

6 Alignment procedure

The alignment between the active and the passive unit is necessary to obtain the correct functioning of the AOPD. A good alignment prevents outputs instability due to dust or vibration.

The alignment is perfect if the optical axes of the beams of the active unit coincide with the optical axes of the corresponding mirrors on the passive unit.

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

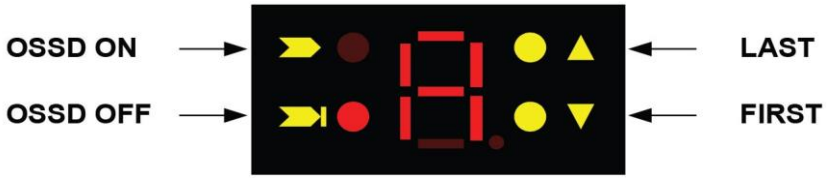


Figure 24 – Display

Each arrow is associated to a yellow LED and refers to either the first or the last transmitter/receiver couple. Figure 25 shows that the first transmitter/receiver couple is the nearest to the M12 connector and the last transmitter/receiver couple is the farthest from the M12 connector.

A 7-segment display informs the user of the level of alignment reached.

The standard installation described hereinafter is the one shown in Figure 25, i.e. with the connectors pointing down. Obviously, the first and the last couples coincide when the AOPD has only 2 beams.

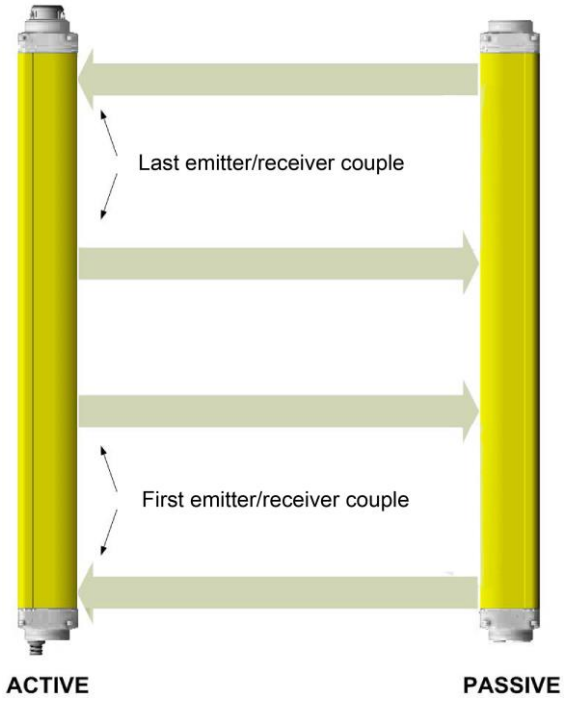


Figure 25 – First and last transmitter/receiver couple

For longer distances, the Orion laser pointer (available as accessory) can be attached to the active or the passive unit in order to obtain the best alignment (see Figure 26).

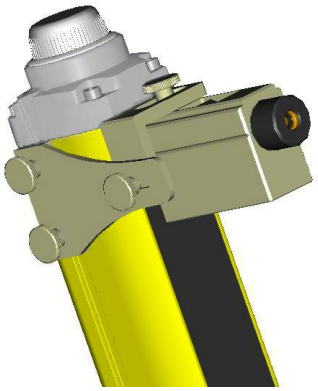


Figure 26 – Orion laser pointer

6.1 Alignment mode

The Alignment mode is activated by pushing the external NC contact (RESET/ACKNOWLDGE/RESET MODE push-button) for at least 0.5 s at power on, see Figure 27.

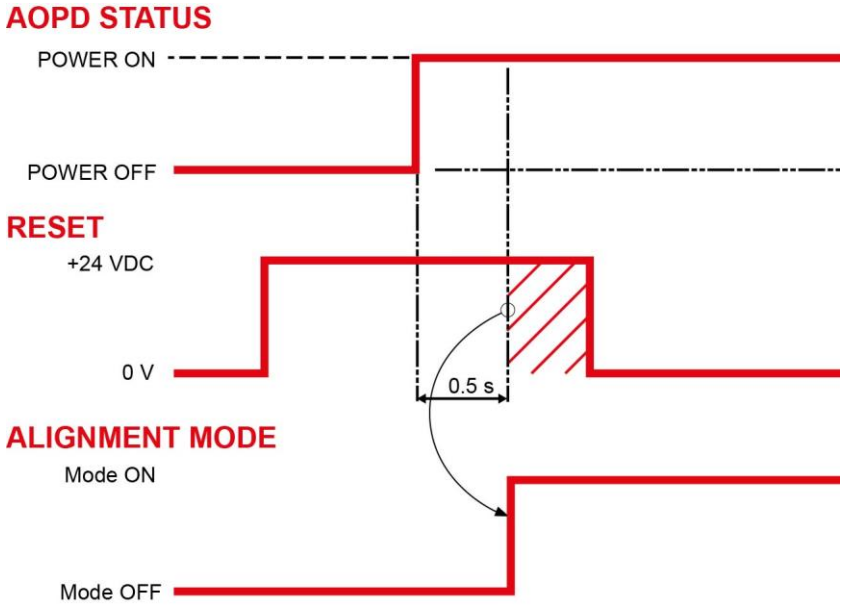


Figure 27 – Time chart of the Alignment mode

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

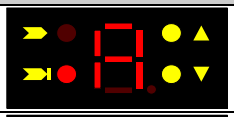
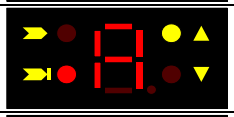
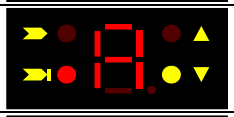
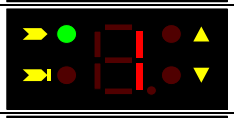
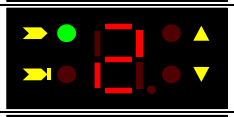
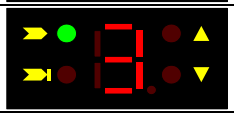
NB: The OSSD outputs are off in alignment mode.

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	Alignment status	Alignment quality	Output status when out of alignment mode
	First and last couple are not aligned	Bad	OSSD OFF
	Last couple is not aligned	Bad	OSSD OFF
	First couple is not aligned	Bad	OSSD OFF
	Every couple over the lower light reception threshold and no couple over the upper light reception threshold	Good	OSSD ON
	Every couple over the lower light reception threshold and one couple over the upper light reception threshold		OSSD ON
	Every couple over the upper light reception threshold	Excellent	OSSD ON

1) Keep the active unit in a steady position and adjust the passive unit until the yellow LED (▼ FIRST) turns off. This condition shows the alignment of the first transmitter/receiver couple.

2) Rotate the passive unit, 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 “3” is displayed (Maximum alignment). Place both units in the centre of this area.

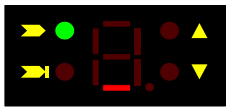
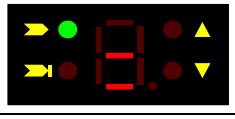
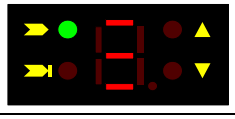
4) Fix the two units firmly using brackets.

Check that the green LED ( ) on the active unit is on when the beams are not interrupted Then check that the red LED ( ) 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.

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). The behaviour is summarized in the next table.

Display	Alignment status	Alignment quality
	Every couple over the lower light reception threshold and no couple over the upper light reception threshold	Min.
	Every couple over the lower light reception threshold and one couple over the upper light reception threshold	
	Every couple over the upper light reception threshold	Excellent

7 Functions

7.1 Acknowledge function

The Acknowledge function is used in presence of an internal error like an optical error, an OSSD error or an EDM error.

The Acknowledge function is activated by pressing an external NC contact (ACKNOWLEDGE/RESET push-button) for at least 5 s in Error mode. The AOPD then returns to normal operation mode.

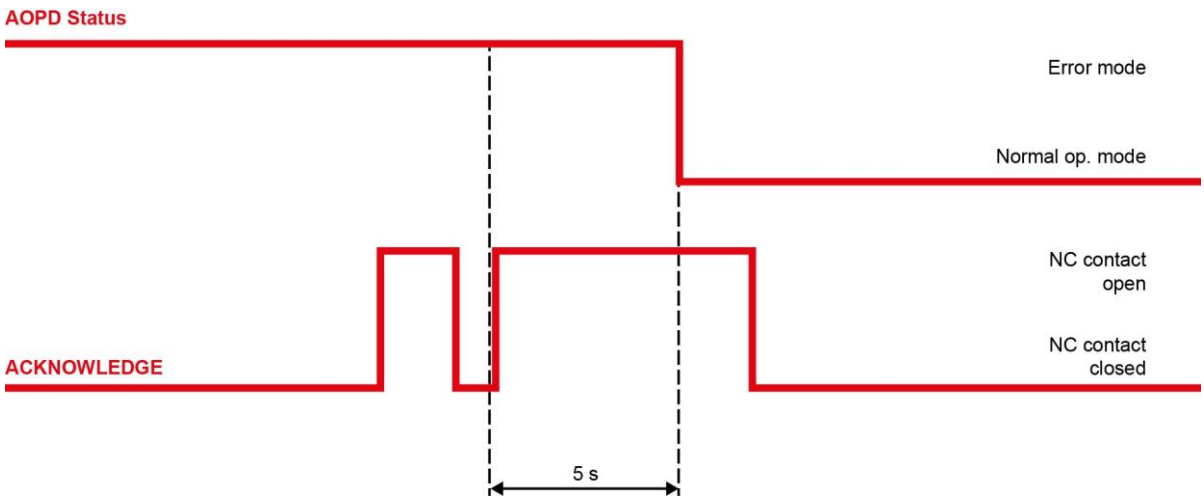


Figure 28 – Time chart of the Acknowledge function

If the error is not solved before the Acknowledge, the AOPD remains in the same error mode, whatever the error.

NB: Some errors are critical errors and the device must be turned off and on to return to normal operation mode:

- Microprocessor error
- Reset selection error

7.2 Reset function

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

The AOPD can be reset to the OSSD ON state 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 message”).

⚠ **Warning!** Carefully assess risk conditions and reset modes. In applications protecting access to hazardous 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 5.2 – “Important notes on connections”).

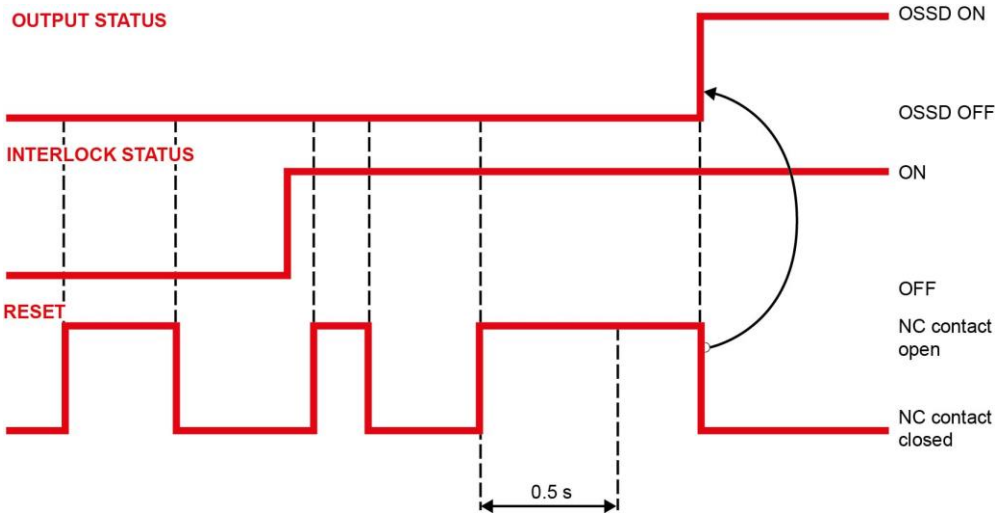


Figure 29 – Time chart for the Manual Reset function

Select either Automatic or Manual Reset by connecting pin 1 of the connector according to paragraph 5 – “Electrical connections ”.

7.3 EDM function

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

EDM activated:

1) Disconnect pin 3 of the connector or connect it to 0 V (EDM selection = ON).

2) Connect the EDM input (pin 4) to +24 VDC through the normally closed contacts of the devices to be monitored.

EDM deactivated:

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

2) Disconnect the EDM input (pin 4) or connect it to 0 V.

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

This function checks that the normally closed contact switches state when the OSSD outputs change state.

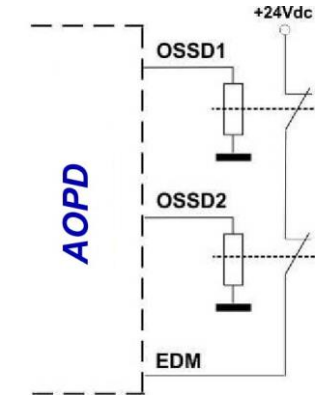


Figure 30 – Connection of EDM

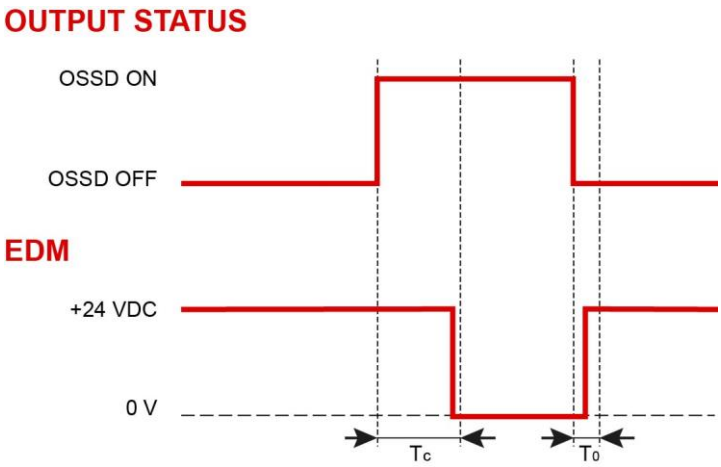


Figure 31 – Time chart of the EDM function

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

A display helps the user control and check the status of the AOPD, in Alignment mode, in normal operation mode and when troubleshooting. The display consists in four LEDs and a 7-segment display on the active unit.

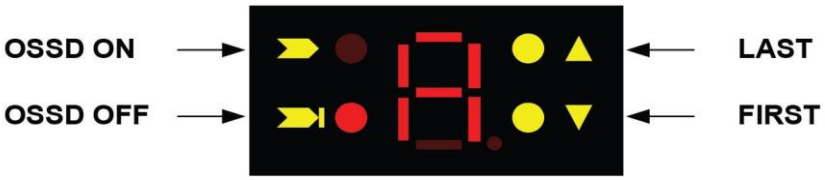
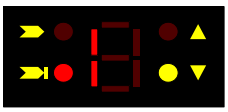
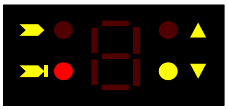
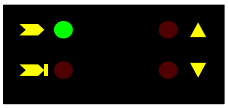
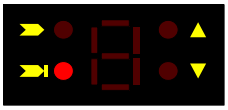
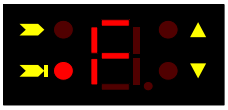
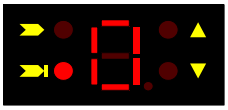


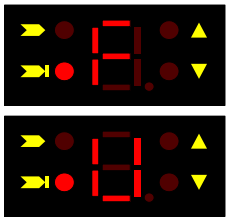
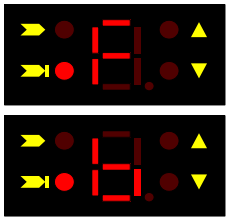
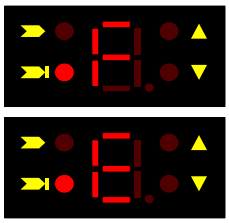
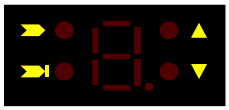
Figure 32 – LEDs on the display

8.2 Diagnostic messages

8.2.1 Active unit

All the possible cases of visualization are explained in the table below except those relative to the Alignment mode (see paragraph 6 – “Alignment procedure”).

Display	Status	Description	Action
	Interlock	Detection zone free. OSSD outputs off.	Push the RESET button to return to normal operation.
	Interlock	Beam(s) interrupted. OSSD outputs off.	Remove the object from the detection zone and push the RESET button.
	OSSD ON	OSSD outputs on.	
	OSSD OFF	OSSD outputs off.	
	Normal operation mode, OSSD OFF, interlock	EDM function activated.	
	Normal operation mode, OSSD OFF, interlock	EDM function deactivated.	
 	Error mode	OSSD error, one or both. OSSD outputs off.	Check the wiring and connections of the OSSD outputs. Make sure that there is no short-circuit between them or with the supply voltage. Then Acknowledge. If the error persists, contact your ABB Jokab Safety representative.

Display	Status	Description	Action
	Error mode (critical)	Microprocessor error. OSSD outputs off.	Turn AOPD off and on. If the error persists, contact your ABB Jokab Safety representative.
	Error mode	Optical error. OSSD outputs off.	Acknowledge the error. If the error persists, contact your ABB Jokab Safety representative.
	Error mode	EDM error. OSSD outputs off.	Check the wiring and the connections of EDM SELECTION and EDM as well as the time sequence (see the Time chart, Figure 31). Acknowledge the error. If the error persists, contact your ABB Jokab Safety representative.
	AOPD OFF	Power supply error. OSSD outputs off.	Check the wiring and connections of the power supply. Check that its value is within the allowed range. If the error persists, contact your ABB Jokab Safety representative.

It is not possible to acknowledge a critical error. The device must be switched off and on.

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 (▶I) during beam interruption along the entire detection zone, using the suitable “Test Piece” and following the Figure 17 scheme (paragraph 3.3).
- 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 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 the checks depends on the particular application and on the operating conditions of the AOPD.

10 Device maintenance

Orion3 Base light grids 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

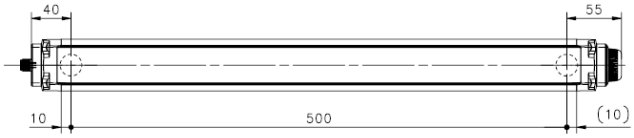
11 Technical data

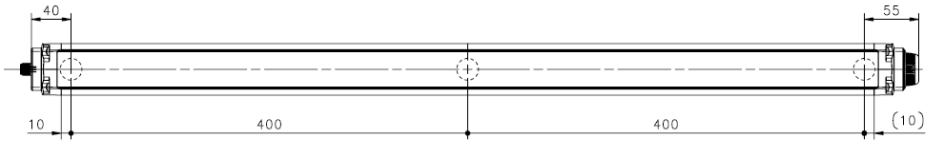
Manufacturer	
Address	ABB JOKAB SAFETY Varlabergsvägen 11 SE-434 39 Kungsbacka Sweden
Electrical Data	
Power supply:	+24 VDC ± 20%
Consumption, Active unit:	6.5 W max (without load)
Outputs	2 PNP
Short-circuit protection: Output current: Output voltage – ON: Output voltage – OFF: Capacitive load	1.4 A at 55°C 0.5 A max / output Power supply value less 1 V (min.) 0.2 V max. 2.2 µF at +24 VDC
Response time:	From 11 to 24 ms. See paragraph 12 – “Model overview”
Electrical protection:	Class III - use SELV/PELV
Connections:	M12 - 8 poles male connector
Cable length (for power supply):	70 m max.
Pollution degree:	2
Optical Data	
Light source:	Infrared LED (950 nm)
Resolution:	See paragraph 12 – “Model overview”
Protected height:	See paragraph 12 – “Model overview”
Operating distance:	From 0.5 to 6.5 m or 8 m. See paragraph 12 – “Model overview”
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)
Protection class:	IP65 (EN 60529:2000)
Vibrations:	Width 0.35 mm, Frequency,10…55 Hz 20 sweeps for each 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)
Caps material:	PBT Valox 508
Front glass material:	PMMA

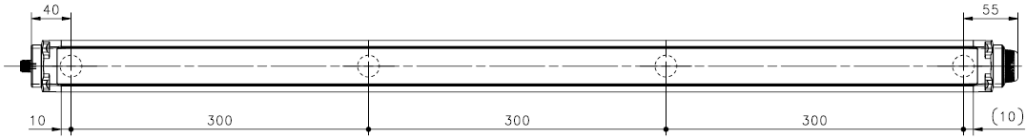
Weight, single unit without package:		
Orion3-4-K1C-050-B	1.3 Kg	
Orion3-4-K2C-080-B	1.8 Kg	
Orion3-4-K2C-090-B	2.1 Kg	
Orion3-4-K2C-120-B	2.6 Kg	
Orion3-4-M1C-050 (passive)	1.2 Kg	
Orion3-4-M2C-080 (passive)	1.7 Kg	
Orion3-4-M2C-090 (passive)	1.9 Kg	
Orion3-4-M2C-120 (passive)	2.5 Kg	
Functional safety 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	9.28×10^{-9}
Life span (years)	T1	20
Mean Time to Dangerous Failure (years)	$MTTF_d$	463

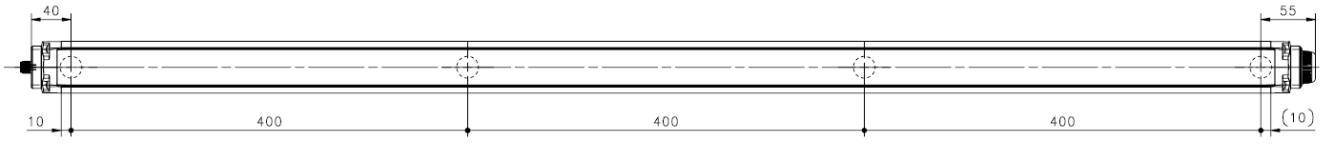
12 Model overview

Type	Article number	Protected height (mm)	Number of Beams	Resolution (mm)	Response time (ms)	Inter-axis (mm)	Operating distance (m)
Orion3-4-K1C-050-B	2TLA022306R0000	500	2	519,75	11	500	0.5..8
Orion3-4-K2C-080-B	2TLA022306R0100	800	3	399,75	12	380	0.5..8
Orion3-4-K2C-090-B	2TLA022306R0200	900	4	319,75	12	300	0.5..6.5
Orion3-4-K2C-120-B	2TLA022306R0300	1200	4	419,75	12	400	0.5..8
Orion3-4-M1C-050	2TLA022306R1000	500	-	-	-		-
Orion3-4-M2C-080	2TLA022306R1100	800	-	-	-		-
Orion3-4-M2C-090	2TLA022306R1300	900	-	-	-		-
Orion3-4-M2C-120	2TLA022306R1400	1200	-	-	-		-









13 Dimensions

13.1 Profiles

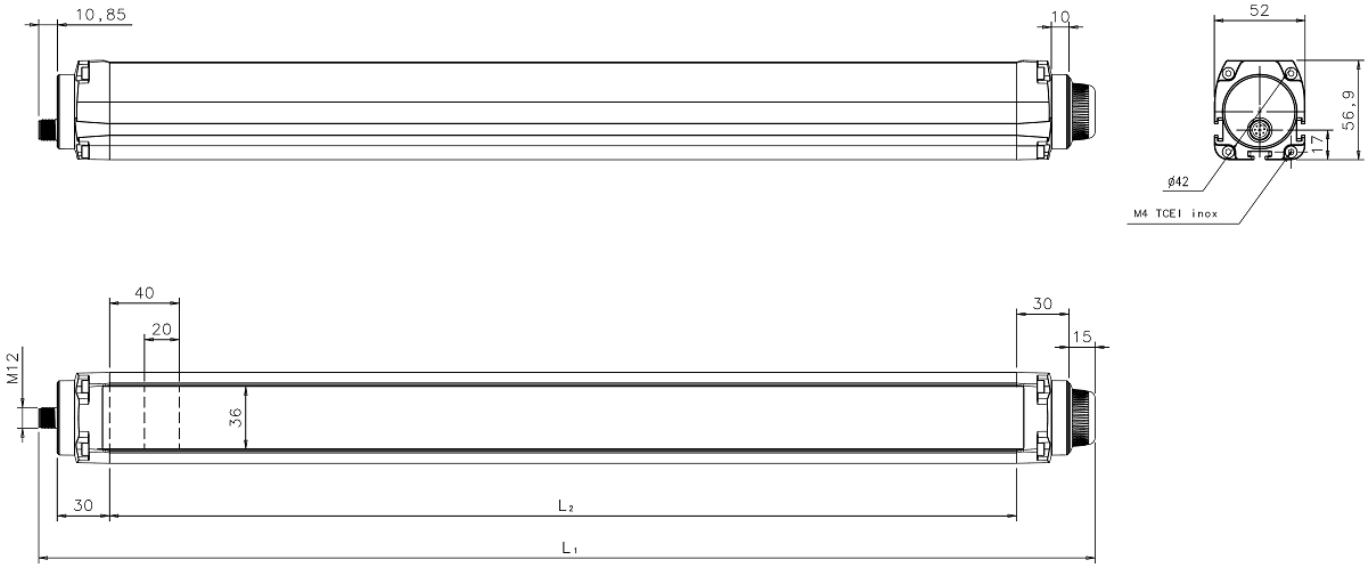


Figure 33 – Active unit

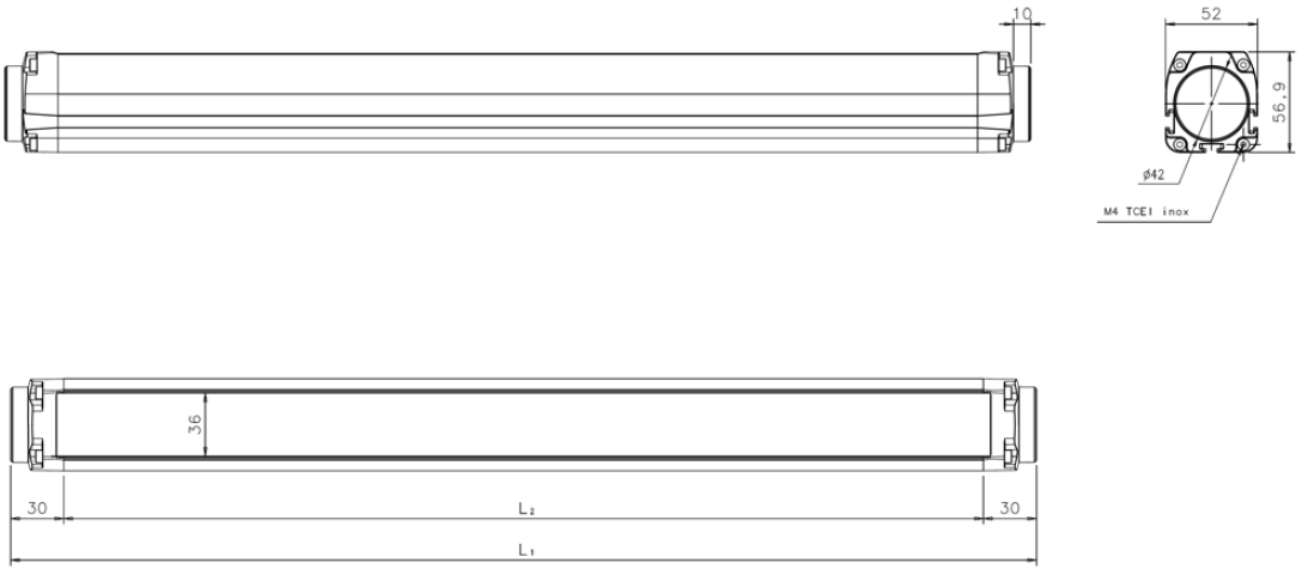


Figure 34 – Passive unit

NB: All dimensions in millimetres.

Model	L_1 [mm]	L_2 [mm]
Orion3-4-K1C-050-B (Figure 33)	606,35	520,5
Orion3-4-K2C-080-B (Figure 33)	906,35	820,5
Orion3-4-K2C-090-B (Figure 33)	1006,35	920,5
Orion3-4-K2C-120-B (Figure 33)	1306,35	1220,5
Orion3-4-M1C-050 (Figure 34)	580,5	520,5
Orion3-4-M2C-080 (Figure 34)	880,5	820,5
Orion3-4-M2C-090 (Figure 34)	980,5	920,5
Orion3-4-M2C-120 (Figure 34)	1280,5	1220,5

13.2 Angled fixing bracket

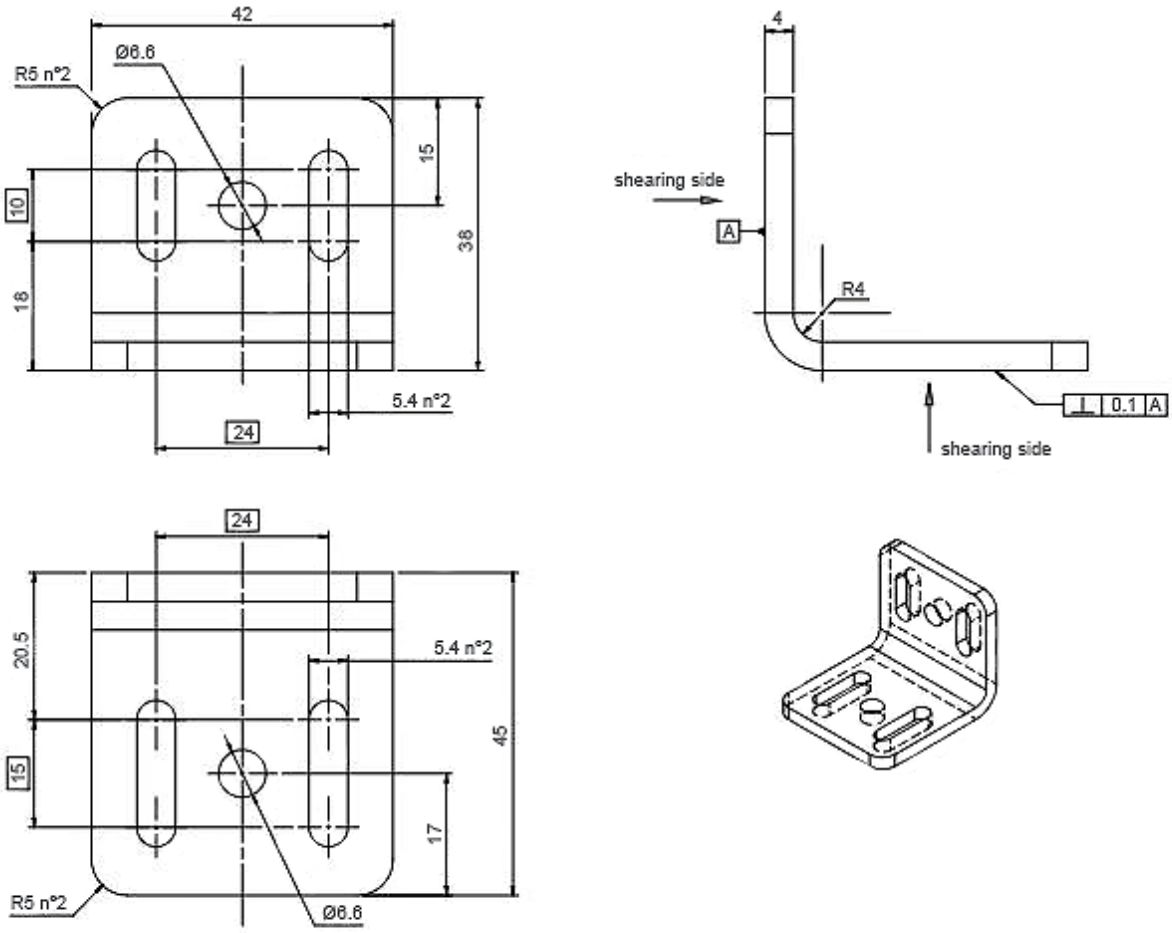


Figure 35 – Dimensions of the angled fixing bracket

NB: All dimensions in millimetres.

13.3 Fixing bracket with profile

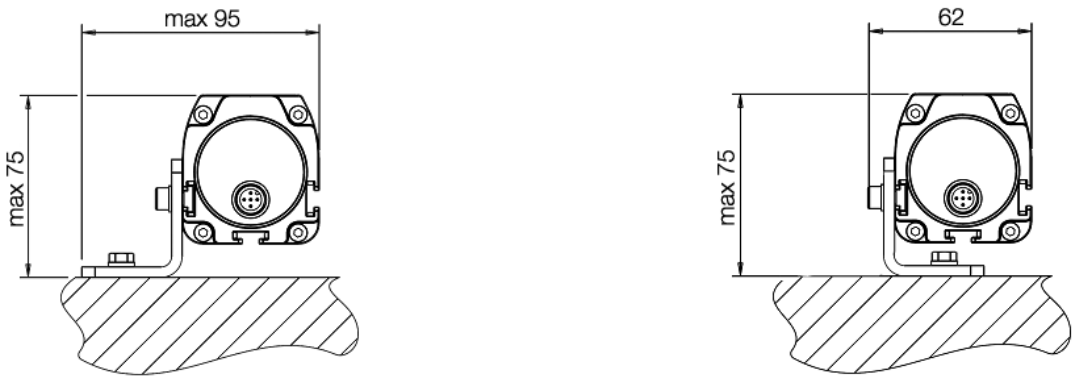


Figure 36 – Dimensions of the angled fixing bracket with a profile

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

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