Original instructions

Orion1 Extended

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 Extended 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

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 Extended 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 get in touch, even accidentally, with moving parts.

The Orion1 Extended 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/A5:2013	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 connections are made through a M12 connector located in the lower side of the profile.

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 (see paragraph 9 “Diagnostic functions”).

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	Type 4
R = 30 mm	Hand protection	Type 4

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

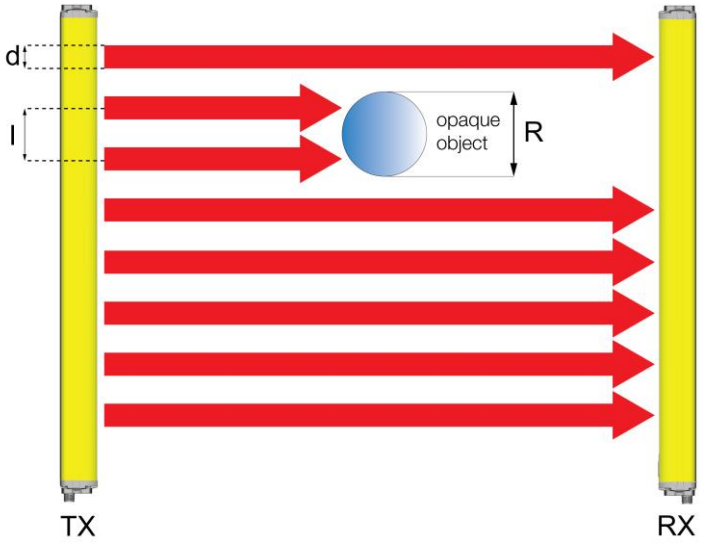


Figure 1 – Resolution

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 13 – “Model overview” for the resolution of each model.

2.3 Protected height

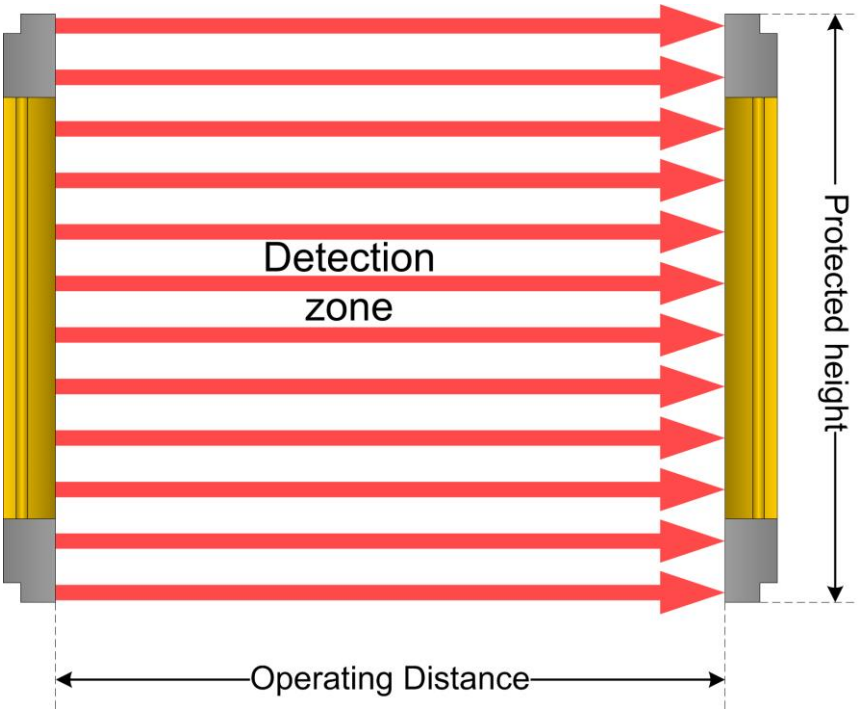


Figure 2 – Protected height

The height protected by the Orion1 Extended is the whole height of the AOPD. Referring to the figure above the protected height is reported in the table here below.

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

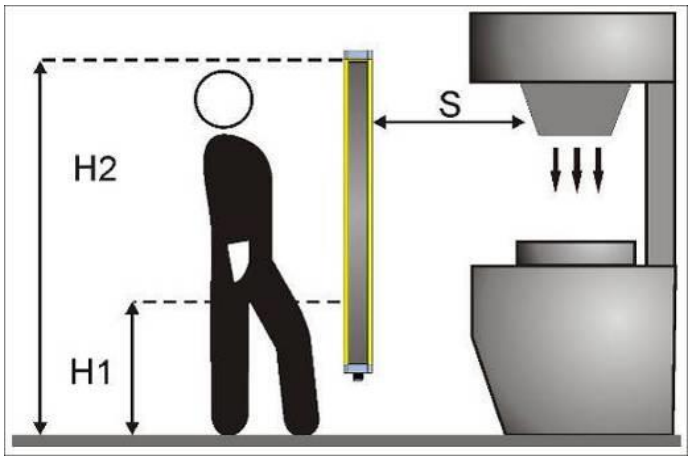


Figure 3 – Minimum distance for a vertically assembled AOPD

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.

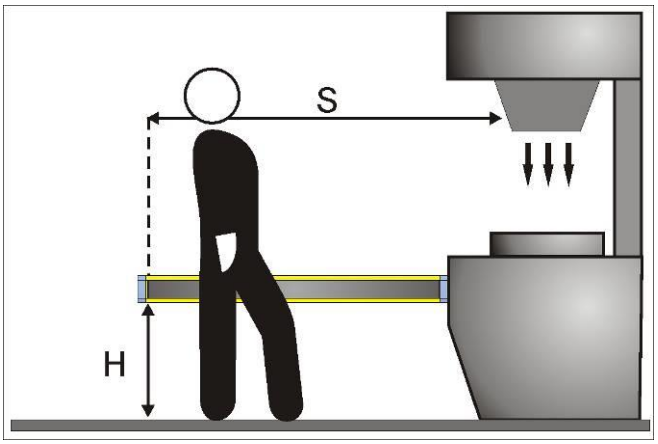
b) $S_{RO} = (K \times T) + C_{RO}$

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-E	**Orion1-4-30-060-E**
T1, response time of AOPD (see paragraph 13 – “Model overview”)	0.019 s	0.015 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	796 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	637 mm	759 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 Extended 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 (refer to 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 paragraphs 3, 4)
- 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.

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

- Use only matched pair with same serial number.
- 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 12 “Technical data”.
- Do not place the AOPD near strong and/or flashing light sources or similar devices.
- Strong electromagnetic interferences can jeopardise 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 jeopardise the function.

3.2 General Information on positioning the AOPD

The AOPD should 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).

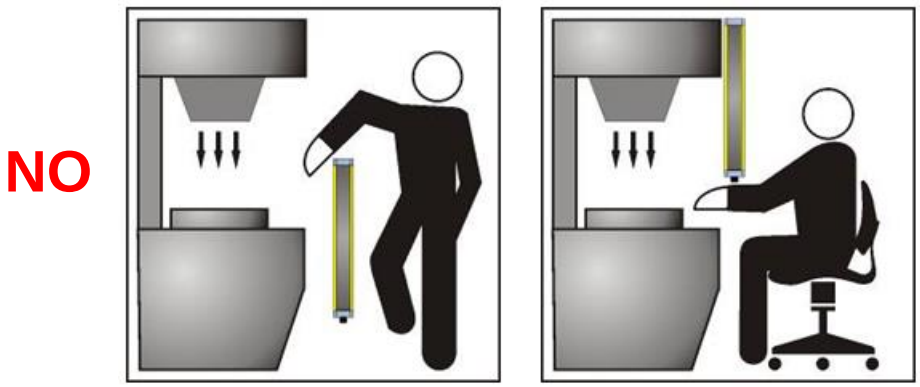


Figure 5 – Incorrect device positioning

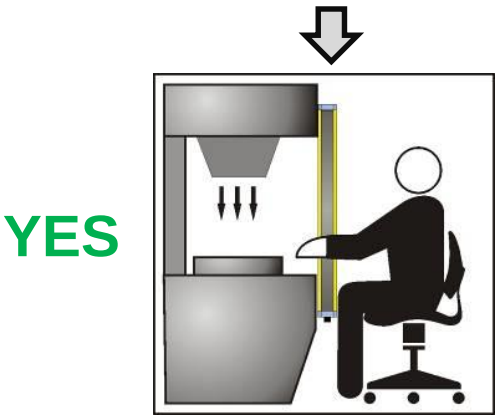


Figure 6 – Correct device positioning

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 very near 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 in the hazard zone, an additional mechanical protection must be mounted to prevent the access.

NO

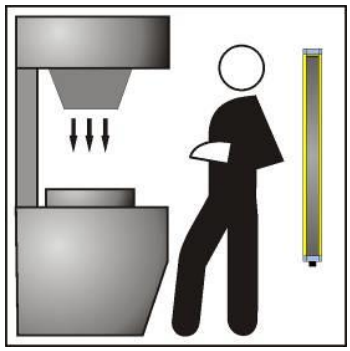


Figure 7 – Incorrect installation

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.

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.

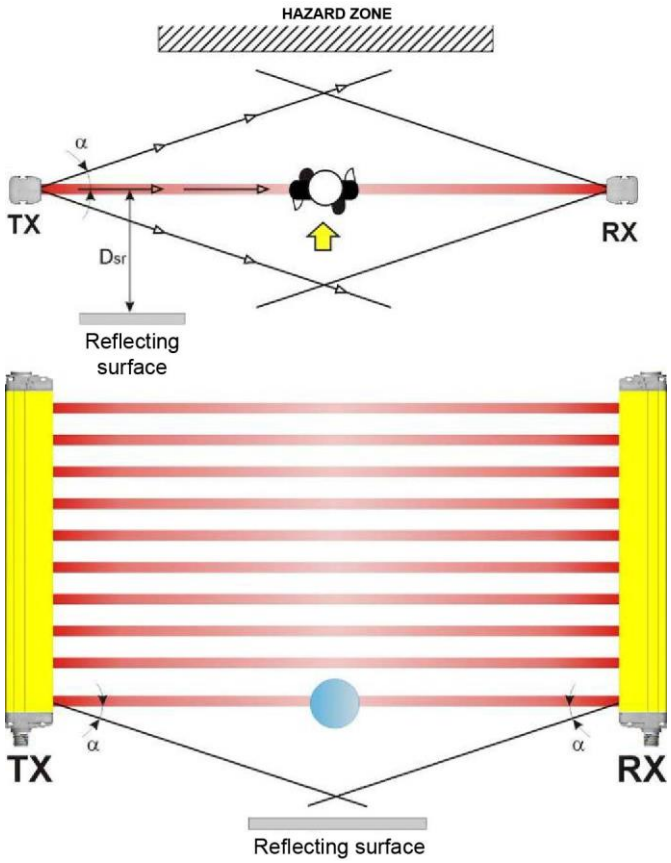


Figure 9 – Distance to reflecting surfaces

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° (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:

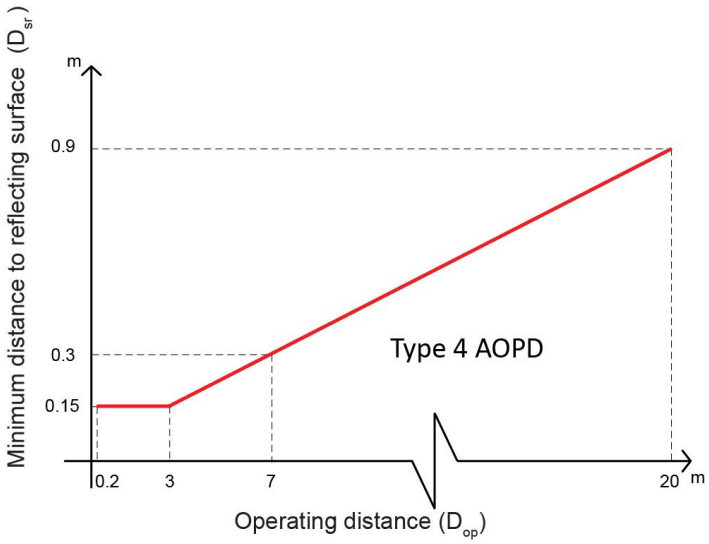


Figure 10 – Distance to a reflective surface as a function of the operating distance

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

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

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

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.

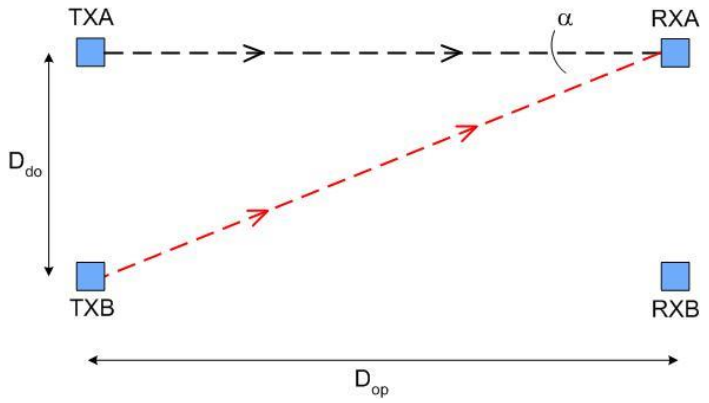


Figure 11 – Distance between adjacent devices

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.

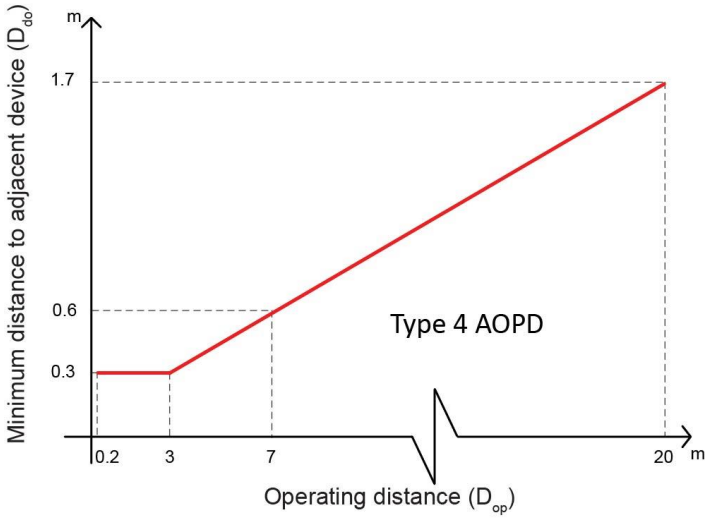


Figure 12 – Minimum distance to an adjacent device as a function of the operating distance

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 devices

When several AOPDs have to 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.

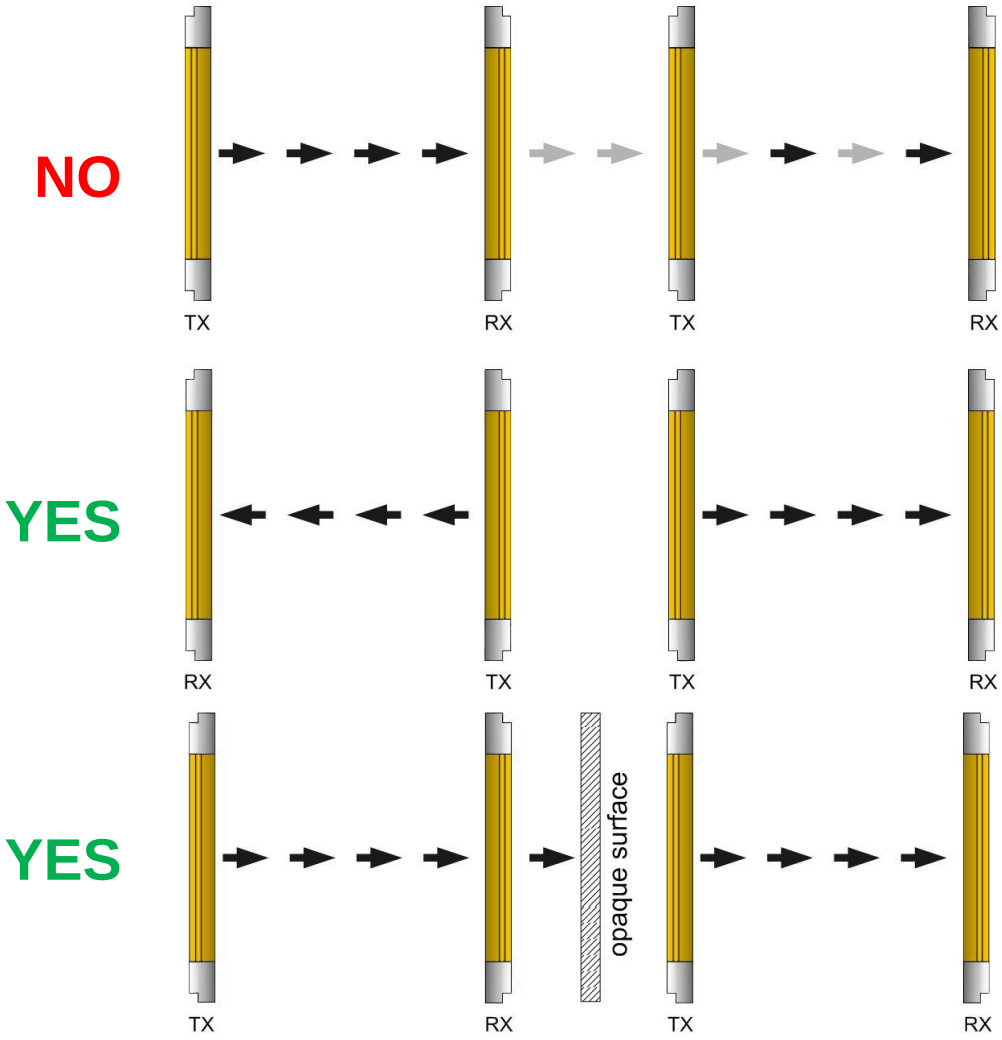


Figure 13 – Installation of several devices close to each other

If two AOPDs have to be mounted close to each other as in the first example of Figure 13, the coding function can be a solution (refer to paragraph 8.10 “Coding function”).

3.2.5 Transmitter and receiver orientation

The two units shall be assembled parallel to each other, with the beams arranged 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.

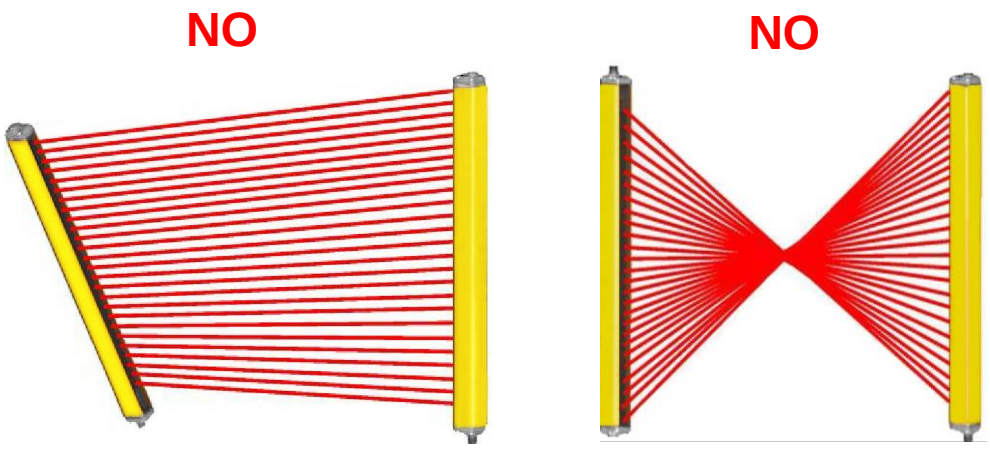


Figure 14 – Incorrect orientation

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.

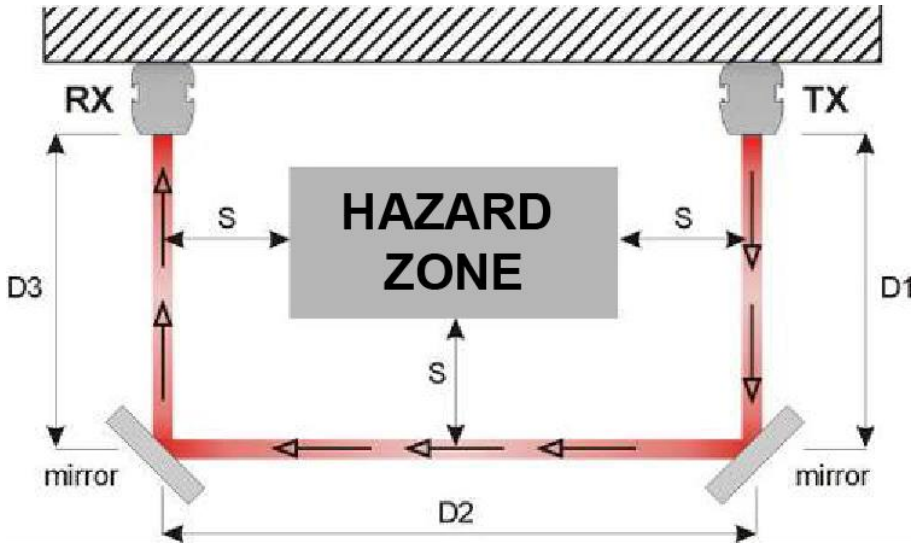


Figure 15 – Use of deviating mirrors

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 Orion laser pointer (available as accessory) is recommended in these conditions.
- The minimum 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)
0	7 m	20 m
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:

- AOPD remains in OSSD OFF state during beam interruption along the entire detection zone, using the suitable “Test piece” according to 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.

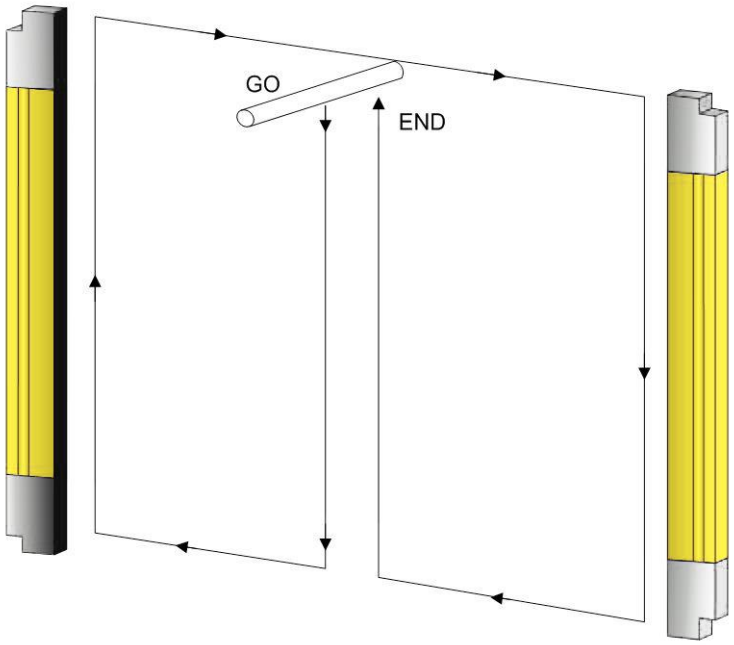


Figure 16 – Scheme for checking the function

- The AOPD is correctly aligned: press slightly the product side in both directions and check that the red LED (named OSSD on the receiver) does not turn on.
- The OSSD outputs switch off (red LED “OSSD” on the receiver turns on and the controlled machine stops) when the Test function (on the transmitter) 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 must be included within the operating range of the model used (see paragraph 12 “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 Extended models.

To mount the AOPD, insert the supplied threaded pins into the dedicated location in the end cap, see figure below. Then let the pins slide towards the metallic groove. Fix the bracket against the profile by tightening the M5 hexagonal nuts.

Loosen the nuts to slide the bracket group along the groove and tighten them to fix it again.

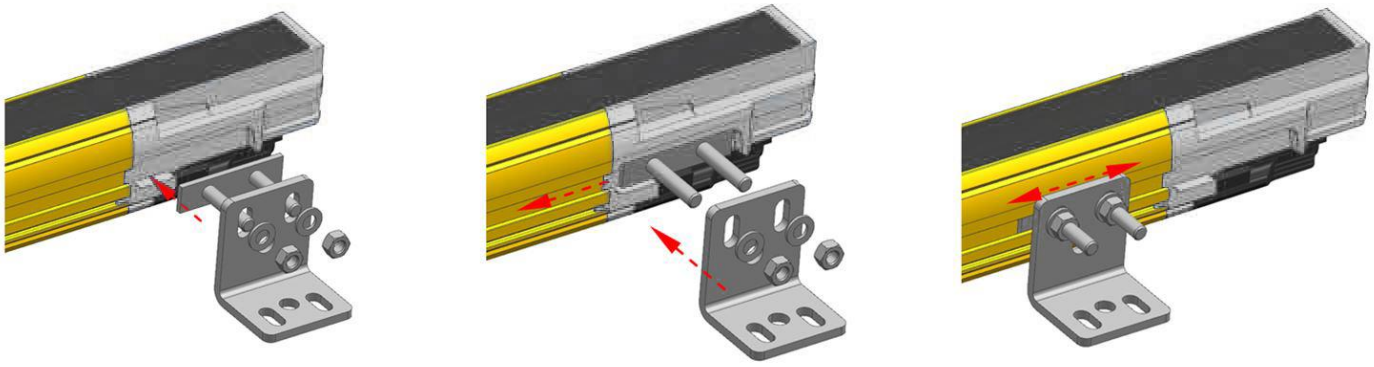


Figure 17 – Mounting the angled fixing bracket

5 Electrical connections

All electrical connections to the transmitter and receiver are made through specific cables with a rectangular 18 pin connector on the AOPD side and M12 male connector(s) on the other side.

There is only one type of cable for the transmitter, but two different ones for the receiver, one for the muting function and one for the blanking function. See the cable description below.

The cables must be connected on the display side of the AOPD after removing the white cap.

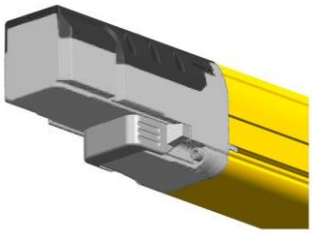


Figure 18 – Connection of the cables on the display side of the AOPD

Make sure the terminator cap is in place on the other side. If missing, master and slave units go in critical communication failure.

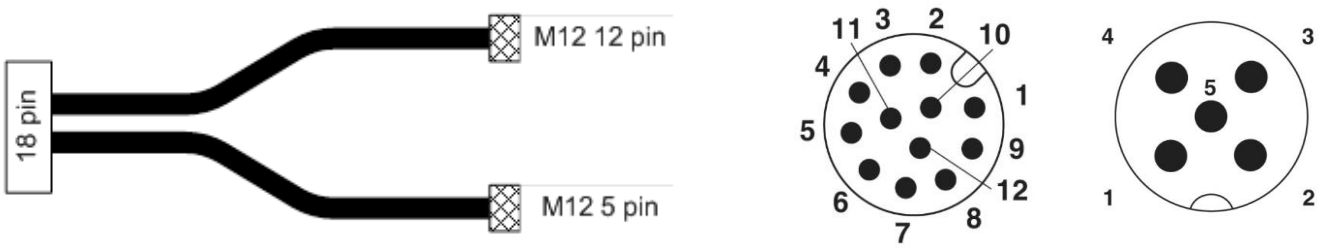
NB: Since the RX connections are different for the M12-12-poles connector of the muting cable and the M12-12-poles connector of the blanking cable, it is important to use the correct cable for each configuration (cable with two M12 connector for the muting function and cable with one M12connector for the blanking function).

5.1 Transmitter, cable M12-C02PT2T

Pin	Wire[1]	Function	Connection to	Refer to
1	Brown	Supply	+24 VDC	
2	White	TEST	NO contact to +24 VDC	8.2
3	Blue	Supply	0 V	
4	Black	EARTH	Earth	
5	Grey	Not used	-	

[1]Colours according to ABB Jokab Safety standard cables

5.2 Receiver, cable for muting, M12-C02PT62RM



5.2.1 Receiver cable for muting, M12-12 connector

Pin	Wire[1]	Function		Connection to	Refer to
1	Brown	Supply		+24 VDC	
2	Blue	Supply		0 V	
3	White	RESET/ ACKNOWLEDGE/ ALIGN	Auto. Reset with no function	Not connected	8.1 8.3 6
			Auto. Reset with Acknowledge function or Alignment mode	NO contact to +24 VDC	
			Manual Reset	NO contact to +24 VDC	
4	Green	OVERRIDE1		NO contact to +24 VDC	8.7
5	Pink	OSSD2	.	Safety control module for ex	
6	Yellow	EDM	Function used/activated	NC contact of a force guided relay	8.4
			Function not used/deactivated	Not connected	
7	Black	MUTING SELECTION	Possibility to disable the Muting function during operation	NO contact to +24 VDC	8.6
			No possibility to disable the Muting function during operation	Not connected	
8	Grey	OSSD1		Safety control module for ex.	
9	Red	OVERRIDE2		NO contact to 0 V	8.7
10	Violet	MUTING LAMP		Lamp between output and +24 VDC - ON when Muting activated - Flashing during override	
11	Grey-pink	OVERRIDE STATUS		Lamp, PLC input, HMI, etc. - High when Override active - Low when Override inactive NB: this output can fluctuate at start-up independently of the Override function.	
12	Red-blue	EARTH		Earth	

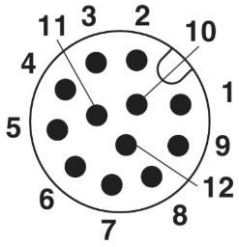
[1]Colours according to ABB Jokab Safety standard cables

5.2.2 Receiver cable for muting, M12-5 connector

Pin	Wire[1]	Function	Connection to	Refer to
1	Brown	Supply	24 VDC	
2	White	MUTING2	Muting sensor Shall be high in presence of object	8.6
3	Blue	Supply	0 V	
4	Black	MUTING1	Muting sensor Shall be high in presence of object	8.6
5	Grey	Not used	-	

[1]Colours according to ABB Jokab Safety standard cables

5.3 Receiver, cable for blanking, M12-C02PT6RB



Pin	Wire[1]	Function		Connection to	Refer to
1	Brown	Supply		+24 VDC	
2	Blue	Supply		0 V	
3	White	RESET/ ACKNOWLEDGE/ ALIGN	Auto. Reset with no function	Not connected	8.1 8.3 6
			Auto. Reset with Acknowledge function or Alignment mode	NO contact to +24 VDC	
			Manual Reset	NO contact to +24 VDC	
4	Green	TEACH IN	If "Teach-in" of blanking zone is to be used	NO contact to +24 VDC	8.8.2.1
5	Pink	OSSD 2		Safety control module for ex.	
6	Yellow	EDM	Function used/activated	NC contact of a force guided relay	8.4
			Function not used/deactivated	Not connected	
7	Black	*Not used*			
8	Grey	OSSD 1		Safety control module for ex.	
9	Red	TOLERANCE	Activate the "Tolerance of fixed blanking" function	NO contact to +24 VDC	8.8.2.2
10	Violet	LAMP		Lamp between output and +24 VDC - ON when Blanking activated - Flashing when Blanking error like one more beam blanked than configured for example.	
11	Grey-pink	*Not used*			
12	Red-blue	EARTH		Earth	

[1]Colours according to ABB Jokab Safety standard cables

5.4 Important notes on connections

For the correct functioning of the Orion1 Extended 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 cable 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 push-button must be a NO contact connected to +24 VDC.

⚠ **Warning!** The TEST button must be located in such a way that the operator can check the entire hazard zone during any test.

⚠ **Warning!** The ACKNOWLEDGE/RESET/ALIGN button must be located in such a way that the operator can check the entire hazard zone during any reset operation.

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

5.5 Connection examples

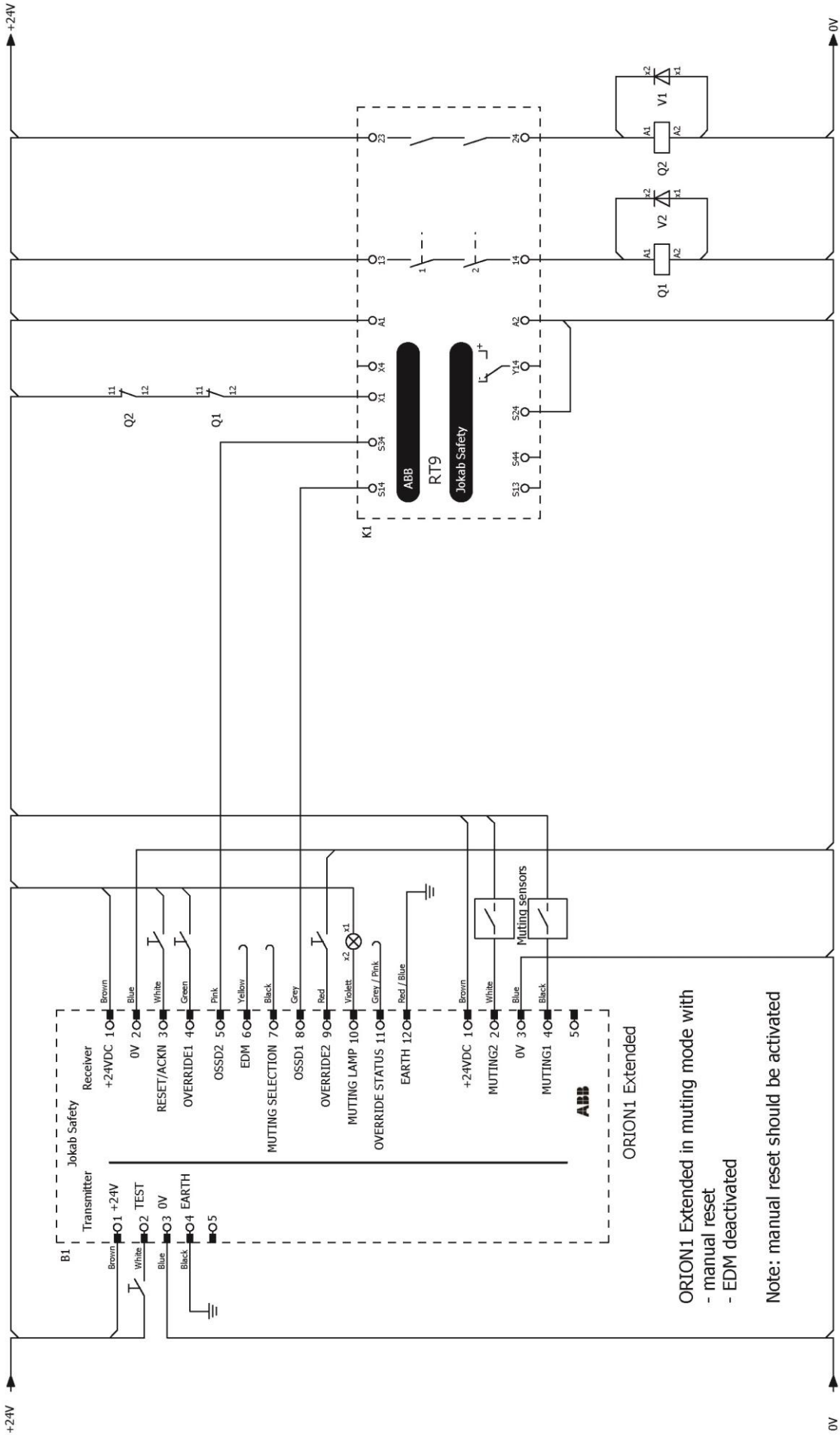


Figure 19 – Connection to a RT9 safety relay

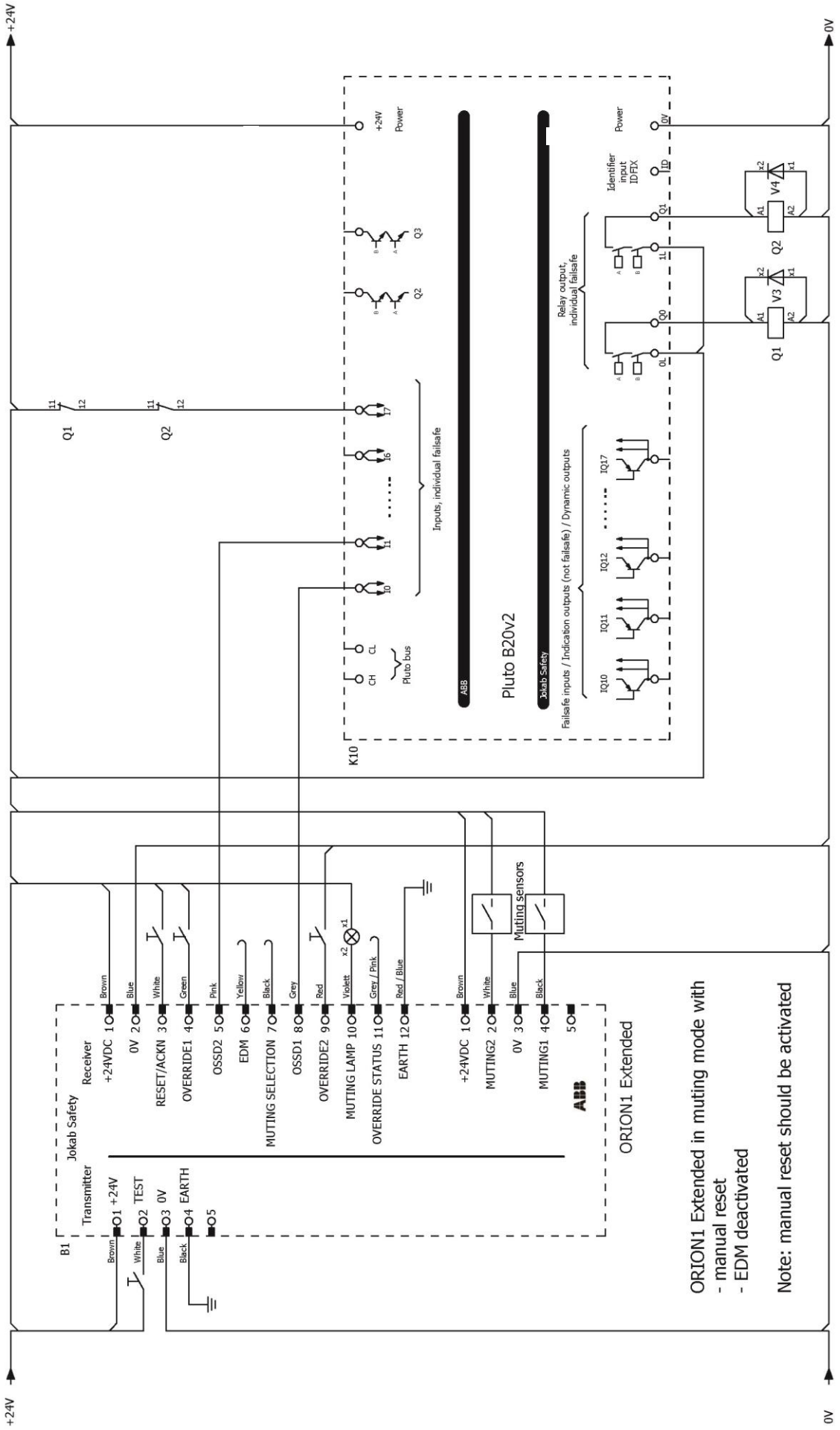


Figure 20 – Connection to a Pluto B20 Safety PLC

The figures show the connection between Orion1 Extended 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 conforming to the safety requirements of the plant.

If one of these configurations is erroneously used, the device enters the OSSD error mode (see paragraph 9 – “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

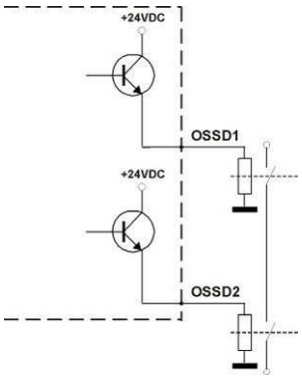
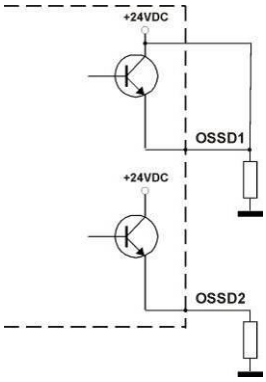
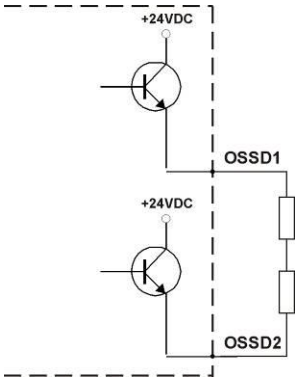


Figure 21 – Correct connection of OSSD outputs

NO



NO



NO

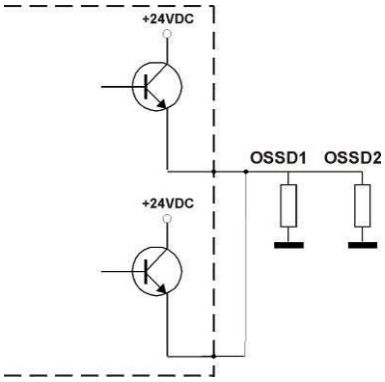


Figure 22 – Incorrect connection of OSSD outputs

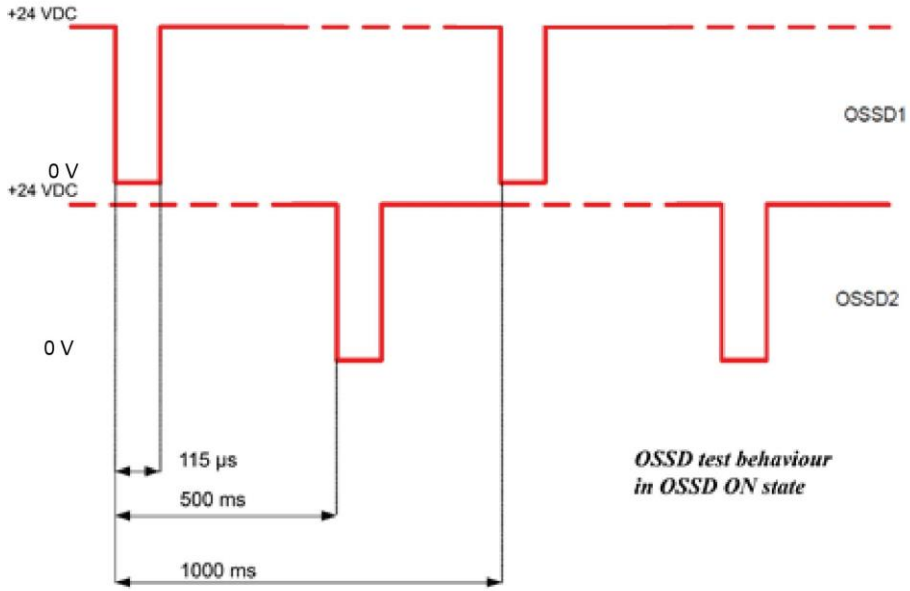


Figure 23 – Time chart of the OSSD outputs

6 Alignment procedure

The alignment between the 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 figure shows that the first beam is located at the bottom of the AOPD, near the display. The last beam is on the opposite side, near the terminator cap. These two beams are also used as synchronization beams.

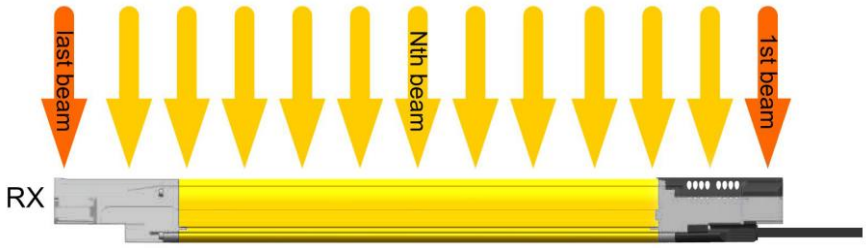


Figure 24 – First and last beams

6.1 Alignment mode

The Alignment mode is activated by pushing the external NO contact (ACKNOWLEDGE/RESET/ALIGN push-button, pin 3 of the M12-12 pole connector on the receiver) at power on until the second LED (red) begins to flash indicating the activation of the Alignment mode, as shown in the following time chart.

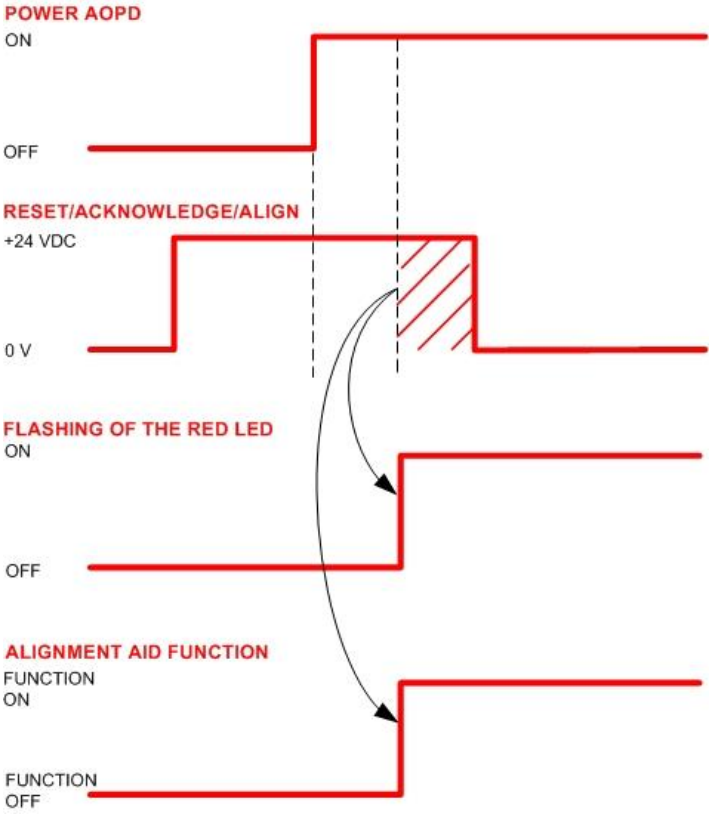


Figure 25 – Time chart of the Alignment aid function

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

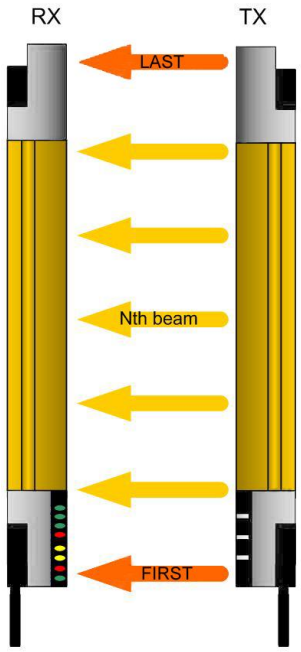
NB: The OSSD outputs are off in alignment mode.

6.2 Correct alignment procedure

The alignment is performed after having completed the mechanical installation and the electrical connections as described above.

Enter Alignment mode as described above.

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



Indication	Display on receiver	Alignment Status	Output status when Normal Op. mode
No Synchronization, check FIRST		NONE	OSSD OFF
FIRST aligned		NONE	OSSD OFF
LAST aligned		NONE	OSSD OFF
One or more intermediate beams not aligned		NONE	OSSD OFF
All beams aligned		BAD	OSSD ON
All beams aligned			OSSD ON
All beams aligned			OSSD ON
All beams aligned		EXCELLENT	OSSD ON

A. Keep the receiver in a steady position and adjust the transmitter until the third LED (yellow) turns off. This condition shows the alignment of the first synchronisation beam.

B. Rotate the transmitter, pivoting around the lower optics axis, until the fourth LED (yellow) turns off. This condition shows the alignment of the last synchronisation beam.

C. Slightly turn both units both ways to find the limits of the area of maximum alignment level ( ). Place both units in the centre of this area.

D. Fix the two units firmly using brackets.

   Check that the alignment level on the receiver is maximum when the beams are not interrupted. Then check that all level LEDs turn off 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”).

E. Switch the device off and on to normal operating mode.

The alignment level is also monitored during normal operation mode and visualized on the same display (see paragraph 9.1 – “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).

7 Function setting

The configuration of the functions and the parameters of the AOPD can be performed with the help of push-buttons and LED display (available on both receivers and transmitters).

A display consisting of 8 LEDs and 3 protected push-buttons is used for the basic configuration. The LEDs are also used in normal operation mode for status information. A special tool, provided with the device (see paragraph 14.4 – “Tool for BCM configuration”), must be used to activate the push-buttons. This prevents accidental access to the safety configuration.

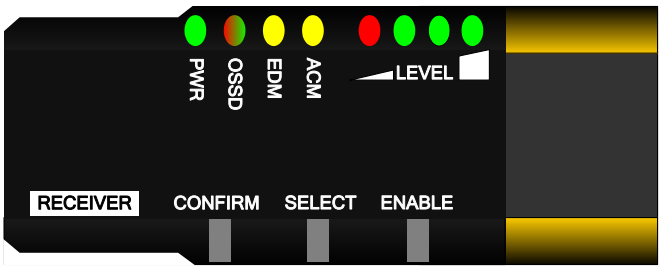


Figure 26 – Display on the receiver

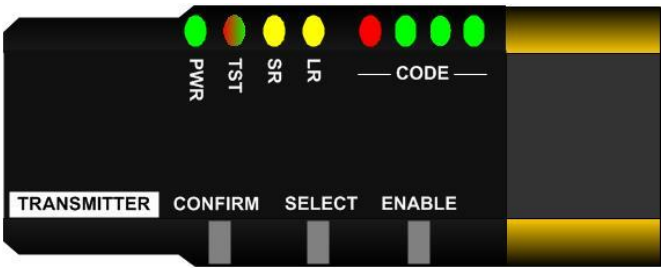


Figure 27 – Display on the transmitter

7.1 Basic Configuration Mode (BCM)

On the right side of the display on transmitter and receiver, 3 push-buttons allow the user to configure the AOPD.

The three push-buttons are the:

- CONFIRM push-button to enter the BCM and to confirm the selected configuration,
- SELECT push-button to roll between different functions,
- ENABLE push-button to activate/deactivate the current function,

BCM configuration:

1. Keep the CONFIRM button pressed to enter the Basic Configuration Mode.
2. Check that you are in BCM: all the LEDs are lit in sequence from 2 to 8 informing you of the current configuration.
3. Select the function to configure with the SELECT push-button; the corresponding LED flashes.
4. Activate the selected function with the ENABLE push-button (switch LED on/off).
5. Repeat steps 3 and 4 until the desired configuration is visualized.
6. Keep the CONFIRM push-button pressed to activate the new configuration.

7.2 Reset to factory configuration

The user can also reset the AOPD back to the factory configuration settings as follows:

- Press the CONFIRM button and keep it pressed for at least 9 s but less than 30 s, otherwise the AOPD goes in Error mode.
- The LEDs flash for a while, then the AOPD is reset.
- After reset, the AOPD returns to normal operation mode with the factory configuration.

7.3 Function list

Orion1 Extended has two main operating modes: Blanking and Muting. LEDs 5 to 8 have different functions in Muting mode and Blanking mode.

NB: The default configuration is indicated in bold characters.

NB: The last 3 LEDs don't change status when changing from Muting mode to Blanking mode (and vice versa). Since these 3 LEDs have different meanings depending on the mode, the user has to pay attention to the configuration settings before changing mode.

7.3.1 Function list on the receiver in Muting mode (LED 3 ON Yellow)

Function	LED number	Setting[1]	LED Status PWR OSSD EDM ACM LEVEL 1 2 3 4 5 6 7 8
Coding	2	Code 1	○ ● ○ ○ ○ ○ ○ ○
		Code 2	○ ● ○ ○ ○ ○ ○ ○
		No Code	○ ● ○ ○ ○ ○ ○ ○
Muting/Blanking selection	3	**Muting**	○ ○ ● ○ ○ ○ ○ ○
		Blanking	○ ○ ● ○ ○ ○ ○ ○
EDM[2]	4	**Enabled**	○ ○ ○ ● ○ ○ ○ ○
		Disabled	○ ○ ○ ● ○ ○ ○ ○
Reset function	5	**Auto**	○ ○ ○ ○ ● ○ ○ ○
		Manual	○ ○ ○ ○ ● ○ ○ ○
Muting direction	6	**T/X (bidirectional)**	○ ○ ○ ○ ○ ● ○ ○
		L (monodirectional)	○ ○ ○ ○ ○ ● ○ ○
Muting timeout	7	**10 min**	○ ○ ○ ○ ○ ○ ● ○
		Infinite	○ ○ ○ ○ ○ ○ ● ○
Override trigger	8	**Level**	○ ○ ○ ○ ○ ○ ○ ●
		Edge	○ ○ ○ ○ ○ ○ ○ ●

[1] The default configuration (at delivery) is indicated in bold characters.

[2] Please look at the 4th LED, and not the one called "EDM".

7.3.2 Function list on the receiver in Blanking mode (LED 3 OFF)

Function	LED number	Setting[1]	LED Status PWR OSSD EDM ACM LEVEL 1 2 3 4 5 6 7 8
Coding	2	Code 1	○ ● ○ ○ ○ ○ ○ ○
		Code 2	○ ● ○ ○ ○ ○ ○ ○
		No Code	○ ● ○ ○ ○ ○ ○ ○
Muting/Blanking selection	3	**Muting**	○ ○ ● ○ ○ ○ ○ ○
		Blanking	○ ○ ● ○ ○ ○ ○ ○
EDM[2]	4	**Enabled**	○ ○ ○ ● ○ ○ ○ ○
		Disabled	○ ○ ○ ● ○ ○ ○ ○
Reset function	5	**Auto**	○ ○ ○ ○ ● ○ ○ ○
		Manual	○ ○ ○ ○ ● ○ ○ ○
Floating blanking selection	6-7	**Floating blanking disabled**	○ ○ ○ ○ ○ ● ● ○
		Floating blanking 1 beam	○ ○ ○ ○ ○ ● ● ○
		Floating blanking 2 beams	○ ○ ○ ○ ○ ● ● ○
		Reduced Res. 4 beams	○ ○ ○ ○ ○ ● ● ○
Fixed blanking selection	8	**1 Fixed blanking zone**	○ ○ ○ ○ ○ ○ ○ ●
		2 Fixed blanking zones	○ ○ ○ ○ ○ ○ ○ ●

[1] The default configuration (at delivery) is indicated in bold characters.
[2] Please look at the 4th LED, and not the one called “EDM”.

7.3.3 Function list on the transmitter

Function	LED number	Setting[1]	LED Status PWR TST SR LR CODE 1 2 3 4 5 6 7 8
Coding	2	Code 1	○ ● ○ ○ ○ ○ ○ ○
		Code 2	○ ● ○ ○ ○ ○ ○ ○
		No Code	○ ● ○ ○ ○ ○ ○ ○
Range selection	3	**Long**	○ ○ ● ○ ○ ○ ○ ○
		Short	○ ○ ● ○ ○ ○ ○ ○

[1] The default configuration (at delivery) is indicated in bold characters.

8 Functions

8.1 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 in two different ways.

Automatic reset is the default setting. The Reset function can be configured, see 8.1.3.

8.1.1 Automatic Reset

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

The response time is the time between the introduction of the object in the detection zone and the OSSD outputs being off. The recovery time is the time between the removal of the object from the detection zone and the OSSD outputs being on.

These times depend on the height of the AOPD. See paragraph 13 – “Model overview” for further details.

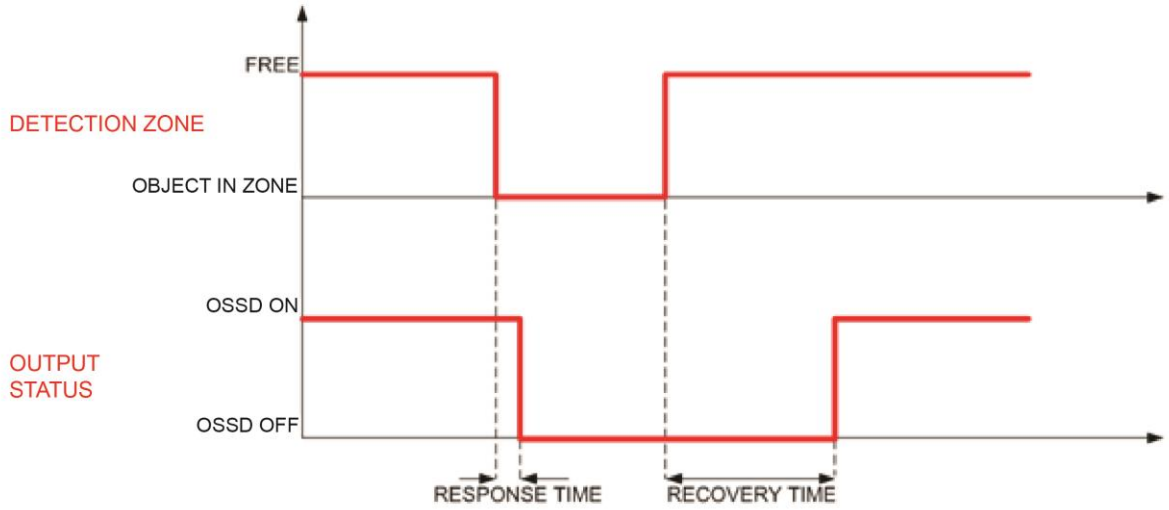


Figure 28 – Time chart of the Automatic Reset function

In Automatic Reset, the Acknowledge/Reset/Align input (pin 3 of the M12-12 pole connector on the receiver) has to be left floating (or connected to a NO push-button for ALIGN/ACKNOWLEDGE).

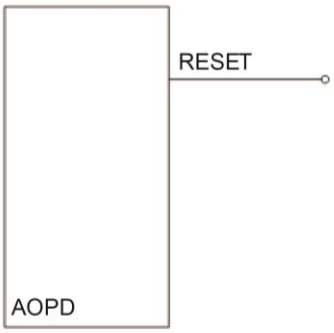


Figure 29 – Automatic Reset connection

8.1.2 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 RESET push-button must be kept pressed for at least 500 ms but less than 5 s, otherwise the AOPD goes in Error mode.

When the RESET push-button is released, the OSSD outputs switch on.

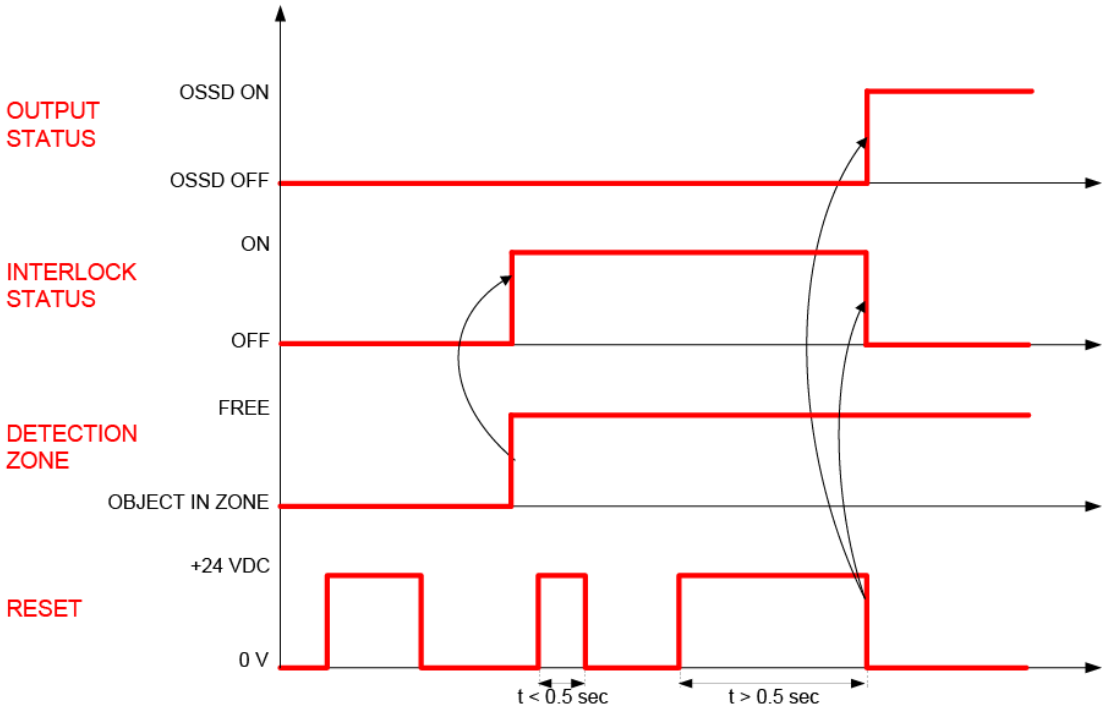


Figure 30 – Time chart of the Manual Reset function

In Manual Reset, the Acknowledge/Reset/Align input (pin 3 of the M12-12 pole connector on the receiver) has to be connected to +24 VDC though a normally open contact.

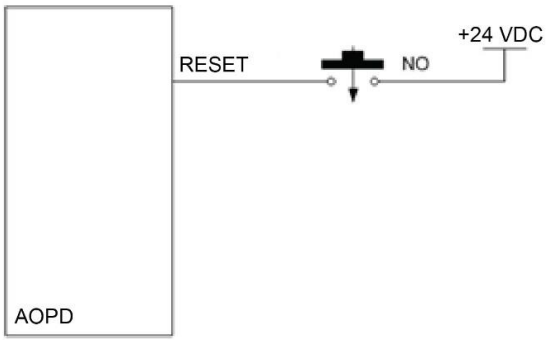


Figure 31 – Manual Reset connection

⚠ **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 5.4 – “Important notes on connections”).

8.1.3 Configuration of the Reset function

Configuration of the Reset function		
		PWR OSSD EDM ACM LEVEL 1 2 3 4 5 6 7 8
Auto	LED 5 ON Red	
Manual	LED 5 OFF	

8.2 Test function

The Test function is activated by pressing an external NO contact (TEST push-button, pin 2 of the M12-5 pole connector on the transmitter) for at least 0.5 s.

The Test stops the emission, the receiver sees all beams being interrupted and the OSSD outputs switch off within the response time. As shown in the time chart below, the OSSD outputs switch off after more than 500 ms.

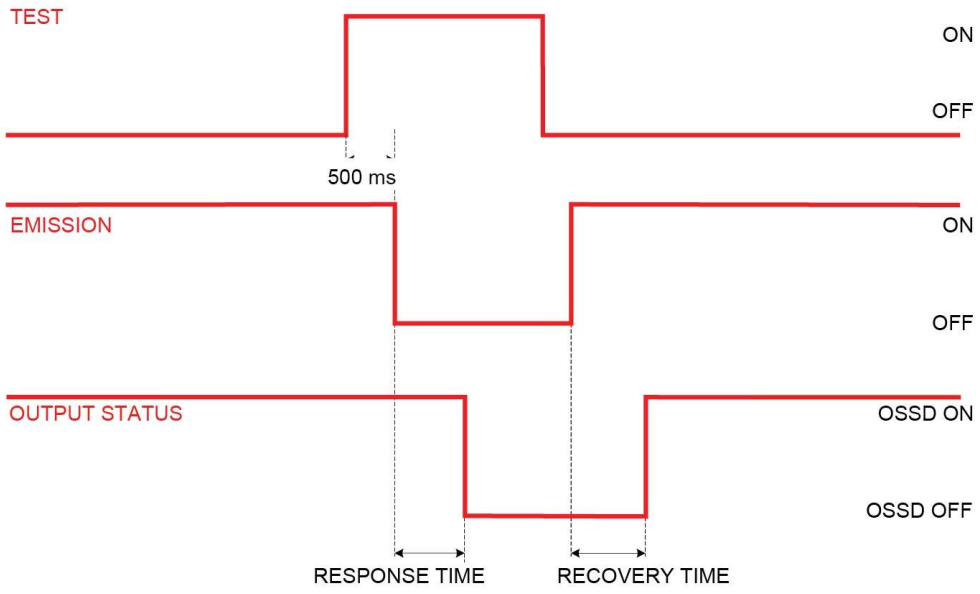


Figure 32 – Time chart of the Test function

8.3 Acknowledge function

The Acknowledge function is used in presence of an internal non-critical error.

The Acknowledge function is activated by pressing an external NO contact (ACKNOWLEDGE/RESET/ALIGN push-button, pin 3 of the M12-12 pole connector on the receiver) for at least 5 s. The AOPD then returns to normal operation mode.

For all critical errors, like a microprocessor failure for ex., a power cycle is necessary.

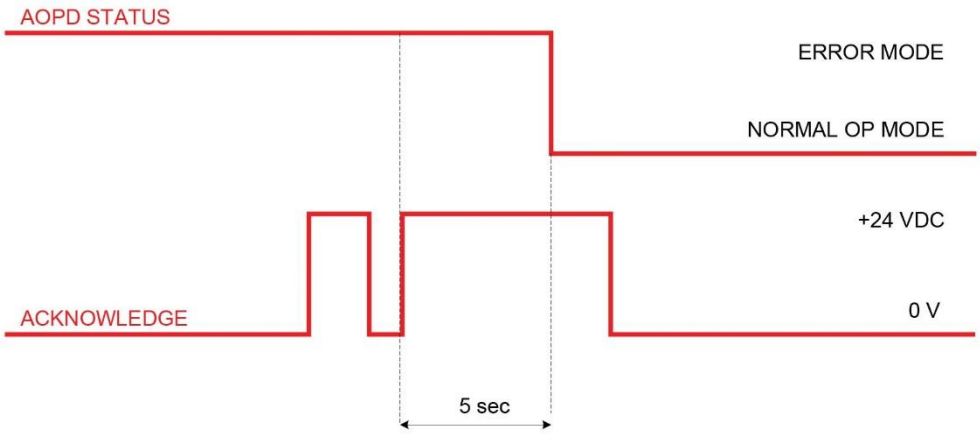


Figure 33 – Time chart of the Acknowledge function

8.4 EDM

The AOPD has a function for monitoring the actuation of external devices (EDM). This function can be activated or deactivated, see paragraph 8.4.3.

8.4.1 EDM activated

When the EDM function is activated, connect the EDM input (pin 6 of M12-12 pole connector on the receiver) to +24 VDC through the normally closed contacts of the devices to be monitored.

NB: In Normal operation mode, the third LED on the display is on when the function is activated.

The figure below shows how to connect the EDM input.

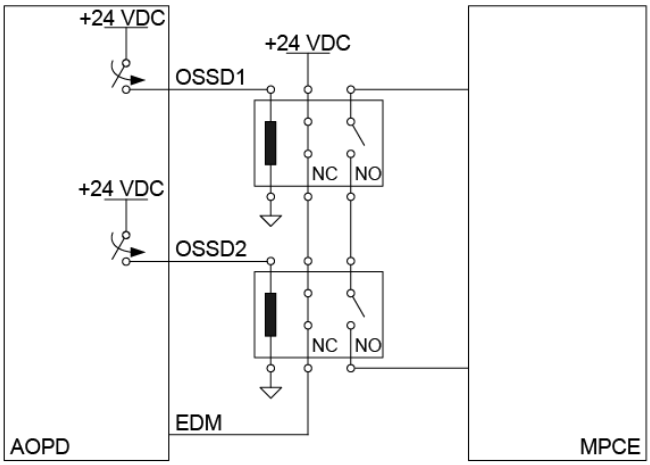


Figure 34 – EDM connection

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

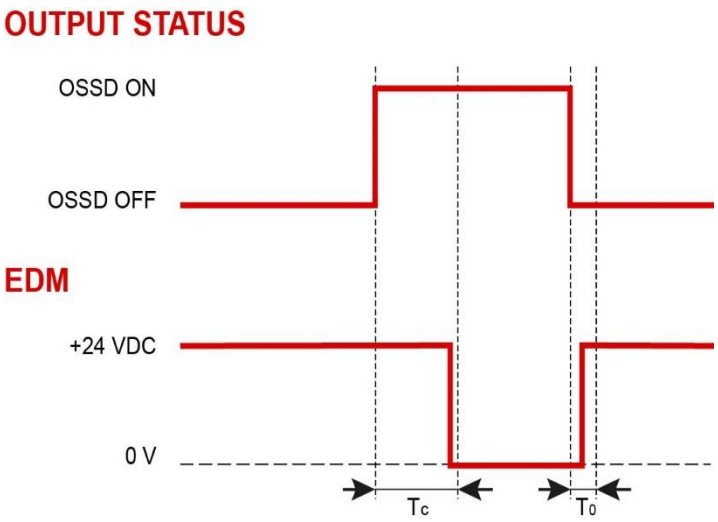


Figure 35 – Time chart of the EDM function

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.

8.4.2 EDM deactivated

When the EDM is deactivated, it is necessary to leave the EDM input floating.

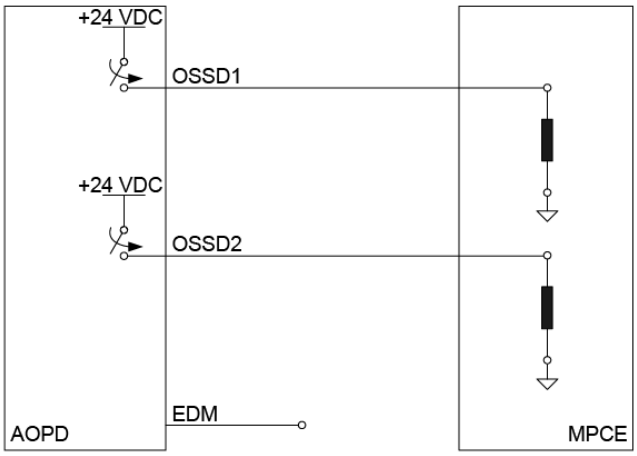


Figure 36 – EDM connection when deactivated

8.4.3 Configuration of the EDM function

This function allows the user to activate or deactivate the monitoring of the external switching devices.

Configuration of the EDM function								
		PWR	OSSD	EDM	ACM	LEVEL		
Activated	LED 4 ON Yellow	●	○	○	●	○	○	○	○
Deactivated	LED 4 OFF	●	○	○	●	○	○	○	○

To increase the level of safety, the AOPD checks that the EDM input is floating at start-up when the EDM function is deactivated.

8.5 Range reduction

This function allows the user to select the maximum operating distance of the AOPD.

A shorter range is preferable when several AOPDs have to be mounted near to each other and no code is used.

Short/Long range should be chosen for the transmitter (TX) which gives different maximum operating distances as follows:

	Models with a 30 mm resolution
TX in Long Range	20 m
TX in Short range	12 m

	Models with a 14 mm resolution
TX in Long Range	7 m
TX in Short range	4 m

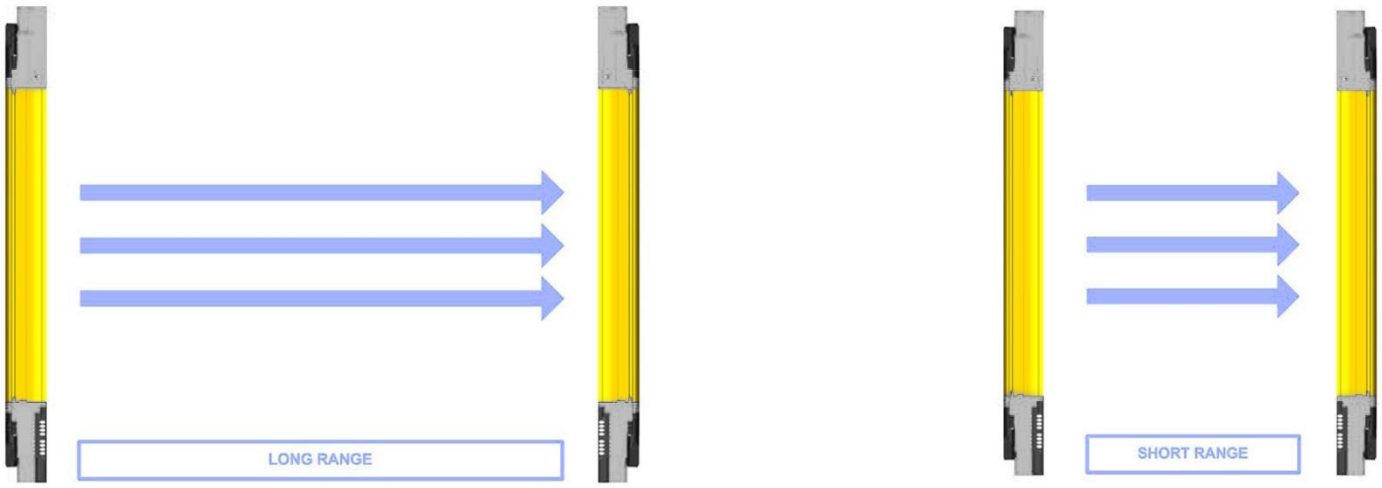


Figure 37– Reduction of range

8.5.1 Configuration of the Range selection function

Configuration of the Reduction of range function on the transmitter											
		PWR	TST	SR	LR	CODE					
		1	2	3	4	5	6	7	8		
Long	LED 3 ON Yellow	●	○	●	○	○	○	○	○		
Short	LED 3 OFF	●	○	●	○	○	○	○	○		

8.6 Muting

The Muting function allows automatic bypassing of the safety function on the whole or part of the protected height in order to carry out specific operations without stopping the machine.

The most common application is in and out feeding of material. The muting sensors must be able to recognize the passing material (pallets, vehicles, etc.) and their placement will depend on the length and speed of the material. In case of different transport speeds in the muting area, their effect on the total muting duration must be considered.

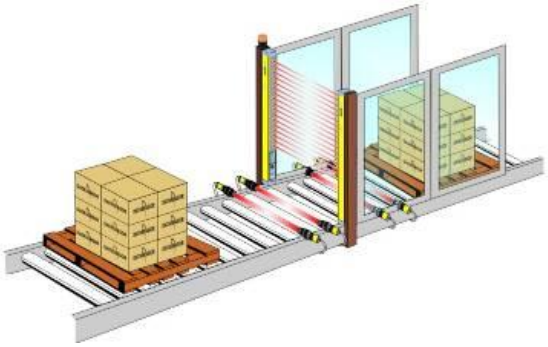


Figure 38 – Example of muting application

- The AOPD has two inputs (MUTING1 and MUTING2) for the activation of this function, according to the current standards.
- This function is particularly suitable when an object, but not a person, has to pass through the hazard zone, under certain conditions.
- It is important to remember that the Muting function represents a forced condition of the system and therefore has to be used with the necessary precautions.
- If MUTING1 and MUTING2 inputs are activated by two muting sensors or actuators, these should be correctly connected and positioned in order to avoid undesired muting or potentially dangerous conditions for the operator.
- MUTING1 and MUTING2 cannot be activated simultaneously.
- The activation of the Muting function is signalled by an external muting lamp connected to pin 10 of the M12-12 pole connector and by LEDs on the display. When the Muting function is on, the lamp and the LEDs start flashing.
- The lamp should be as visible as possible.
- If the muting lamp is broken and/or not connected, the muting request causes the AOPD to enter Error mode and the OSSD outputs to switch off. The corresponding error is indicated.
- If both the first and the last beams are interrupted by the passing material, the AOPD recovery time may be longer. A material moving faster than 1 m/s could cause the OSSD outputs to switch off at the end of the muting sequence.

Warning! Select the configuration carefully: an incorrect configuration can cause a reduction of the SIL/PL reached by the system. For a correct use of the muting, please refer to the relevant standards.

Warning! The muting sensors must be positioned in such a way that the Muting function cannot be activated by the accidental passing of a person. Particular attention must be paid to the use of the one-way L-muting mode: the muting sensors must be positioned to allow the passage of the material coming out of the hazard zone protected by the AOPD.

8.6.1 Enabling of the Muting function

The Muting function is enabled by default (at delivery). It can be dynamically enabled and disabled during the operation of Orion1 Extended. When disabled, no valid muting request on the MUTING inputs is accepted and the safety function is never bypassed.

The user can disable the Muting function during runtime by setting a high level on the MUTING SELECTION input (pin 7 of the M12-12 pole connector of the receiver muting cable).

8.6.2 Muting indicators

In order to use the Muting function, a dedicated indicator (lamp) must be connected to the AOPD; without it, the AOPD goes in Error mode.

Both incandescent and LED lamps can be used. When using a LED lamp, make sure to respect the polarity.

The lamp is tested cyclically when it is on in order to detect a lack of functionality. If a lamp break is detected, the AOPD goes in Error mode (Lamp failure) and shows the corresponding message on the display (see paragraph 12 – “Technical data” for information about the lamp).

8.6.3 Typical muting application and connection of the AOPD

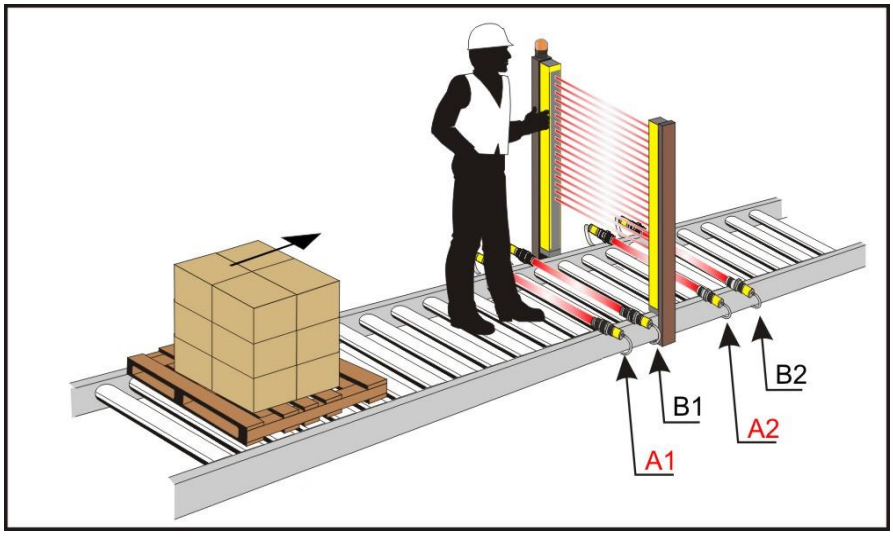


Figure 39 – Typical muting application

The figure above shows a typical muting application: the box on the conveyor may go through the AOPD without stopping the machine but not the worker. Following a correct activation sequence of the A1, B1, A2 and B2 sensors, the AOPD is temporarily bypassed.

The output of the muting sensors (A1, B1, A2 and B2) should be high when the object is detected. The muting sensors can be optical sensors, mechanical sensors, proximity sensors, etc.

8.6.4 Muting direction

The AOPD can be used with

- T/X-muting when the “boxes” can move in both directions. This is the default setting.
  T-muting demands four muting sensors and X-muting only two.
- L-muting when the “boxes” move in one direction only. L-muting demands two sensors.

The muting direction can be chosen, see paragraph 8.6.4.3

8.6.4.1 T and X muting

With a T-muting, four sensors are used, A1, B1, A2 and B2.

With a X-muting, two sensors are used, A1 and B2.

The sensors named A1/A2 are connected to MUTING1 and the sensors named B1/B2 are connected to MUTING2. The sensors that end with “1” are on the same side of the AOPD and are on the opposite side of the sensors that end with “2”.’

See the figure below.

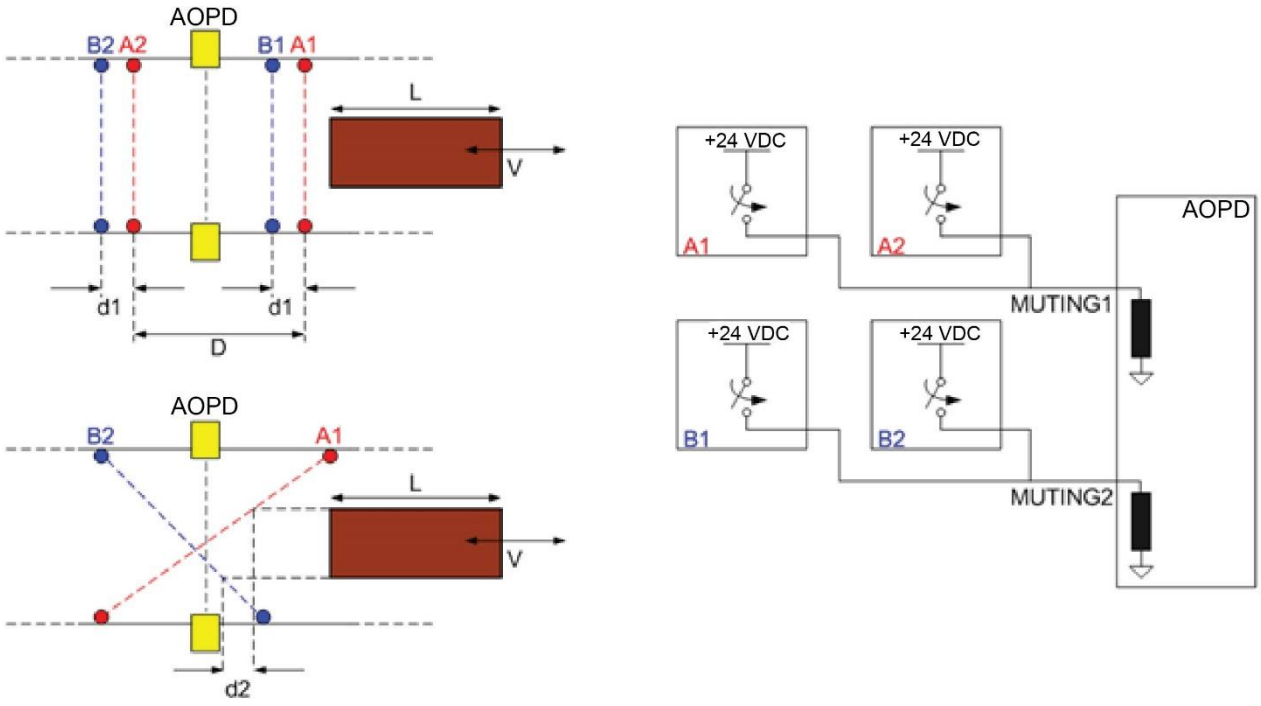


Figure 40 – Connection of T and X-muting

If

- L = The length of the “box”.
- D = The distance at which the sensors A1/A2 or B1/B2 have to be mounted. (D depends on L, see below.)
- V = The speed of the “box”.
- d1 = The maximum distance between the muting sensors. (d1 depends on V, see below.)
- d2 = The maximum distance for the muting request to be accepted. (d2 depends on V, see below.)
- T12max = The maximum activation delay allowed between MUTING1 and MUTING2.

Then

D must be less than L, D < L

d1max [cm] = V [m/s] × T12max [s] × 100

d2max [cm] = V [m/s] × T12max [s] × 100

In T/X-muting, the Muting function is activated when either the signal on MUTING2 goes high within a fixed T12max time after the rise of the signal on MUTING1 or vice versa. After this time (T12max), in order to activate the muting function, one of the muting input should go low and the sequence should start from the beginning.

The Muting function is deactivated a specific time (Tdelay) after one of the signals on MUTING1 or MUTING2 goes low.

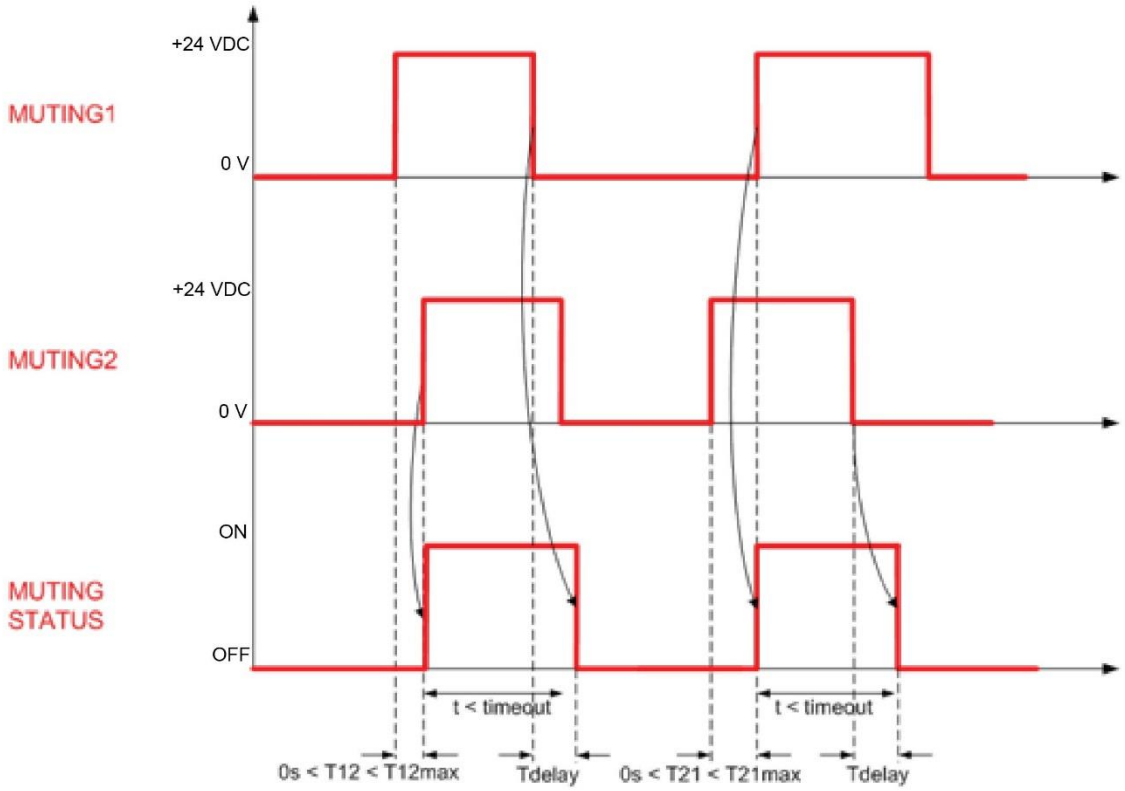


Figure 41 – Time chart of T and X-muting

	T and X-muting
T12max	4 s
Tdelay	0
End of muting	As soon as A or B goes low
Muting timeout see paragraph 8.6.5	10 min or infinite

8.6.4.2 L-muting

The sensor named A is the farthest from the AOPD and must be activated first. If the sensor named B is activated first, the Muting function is not activated. In the following figure, this means that the “box” has to move from the right to the left.

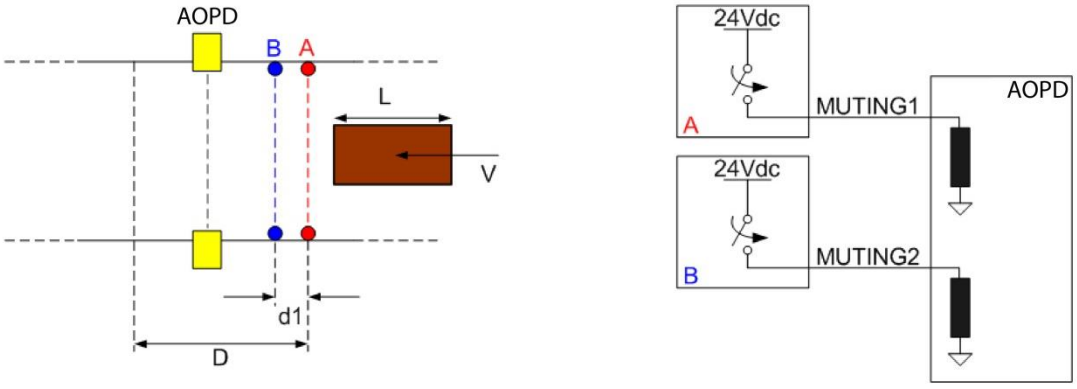


Figure 42 – L muting connection

If

- L = The length of the “box”.
- V = The speed of the “box”.
- d1 = The maximum distance between the muting sensors. (d1 depends on V, see below.)
- T12max = The maximum activation delay allowed between MUTING1 and MUTING2.

Then

d1max [cm] = V [m/s] × T12max [s] × 100

In L-muting mode, the Muting function is activated when the signal on MUTING2 goes high within a fixed T12max time after the rise of the signal on MUTING1. After this time (T12max), in order to activate the muting function, one of the muting input should go low and the sequence should start from the beginning.

NB: MUTING1 has to go high first. If MUTING2 goes high before MUTING1, the Muting function is not activated. The Muting function ends after a time that is a multiple of the activation delay between the two sensors (m × T12).

⚠ **Warning!** L-muting must be used exclusively for materials going out of the hazard zone.

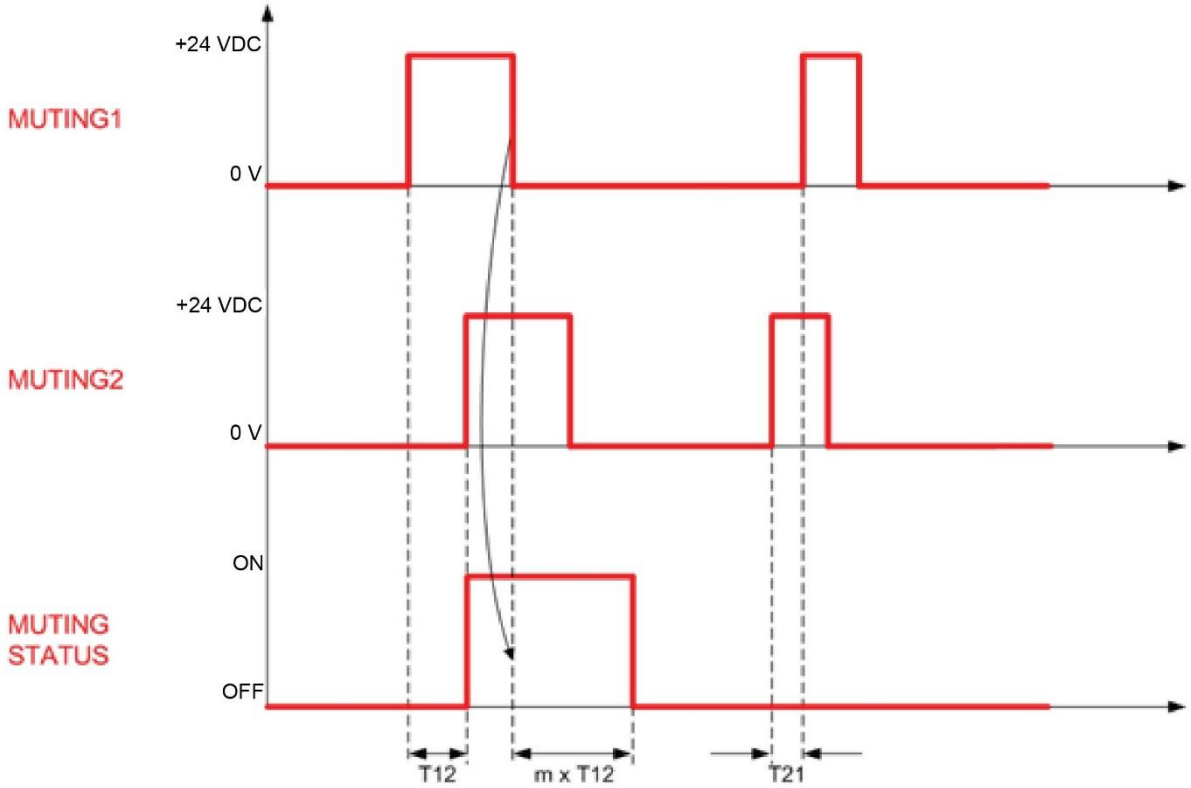


Figure 43 – Time chart of L-muting

	L-muting
T12max	4 s
Tdelay	0
End of muting[1] after deactivation of MUTING1	After 2 × T12
Muting timeout, see paragraph 8.6.5	10 min or infinite

[1] T12 is the actual activation time between MUTING1 and MUTING2.

8.6.4.3 Configuration of the Muting direction

Configuration of the Muting Direction									
		PWR	OSSD	EDM	ACM		LEVEL		
		1	2	3	4	5	6	7	8
T and X (two directions)	LED 6 ON Green	●	○	○	○	○	●	○	○
L (one direction)	LED 6 OFF	●	○	○	○	○	●	○	○

8.6.5 Muting timeout

The muting timeout defines the maximum duration of the Muting function; after the timeout the muting ends.

This time can be set.

The user can select a timeout of 10 minutes or infinite; “infinite” means that the muting could never end: the Muting function is activated as long as the muting conditions persist.

⚠ **Warning!** An infinite muting is not compliant with EN 61496-1/AC:2010.

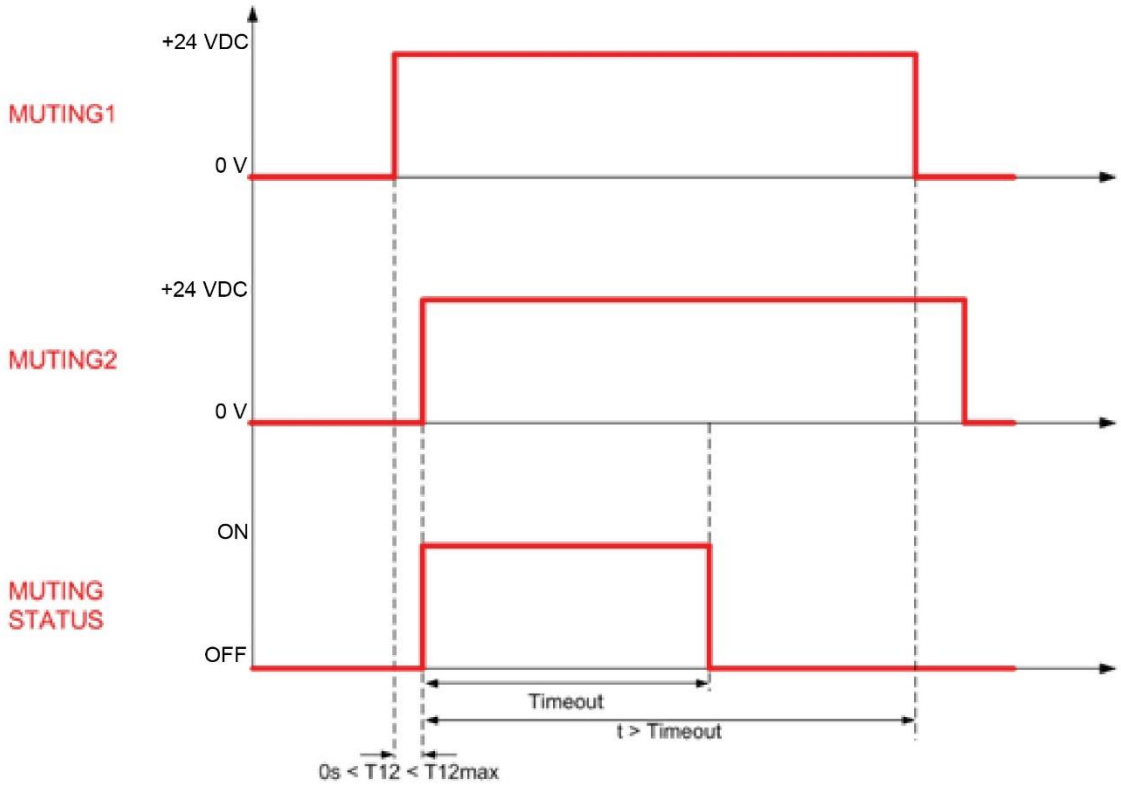


Figure 44 – Timeout of the Muting function

8.6.5.1 Configuration of the Muting Timeout

Configuration of the Muting Timeout			
		PWR 1 · OSSD 2 · EDM 3 · ACM 4 · LEVEL 5 6 7 8	
10 min	LED 7 ON Green	● ○ ○ ○ ○ ○ ● ○	
infinite	LED 7 OFF	● ○ ○ ○ ○ ○ ● ○	

⚠ **Warning!** An infinite muting is not compliant with EN 61496-1:2013

8.7 Override

The override function is used to bypass the AOPD completely and switch on the OSSD outputs when it is necessary to start the machine despite one or more beams of the AOPD being interrupted. The purpose is usually to clear the detection zone and move a “box” that has stopped there because of a cycle anomaly.

The two OVERRIDE inputs have to be connected, OVERRIDE1 (pin 4 of the M12-12 pole connector on the receiver) to +24 VDC through a NO contact and OVERRIDE2 (pin 9 of the M12-12 pole connector on the receiver) to 0 V through a NO contact.

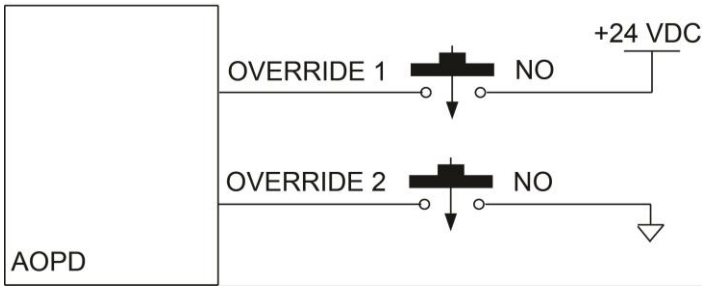
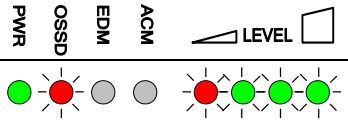


Figure 45 – Connection of the OVERRIDE inputs

The following conditions are necessary for the override request to be accepted:

- The AOPD is in OSSD OFF state,
- At least one muting sensor is activated,
- A working lamp is connected.

When the first two conditions are true, the display shows the “override attention status” with both the red OSSD LED and the red alignment LED flashing.

Override attention status


The Override function will automatically end when one of the following conditions is present:

- In T/X-muting, all the muting sensors are deactivated,
  In L-muting, all the muting sensors are deactivated AND no beam is interrupted.
- The pre-determined time limit has expired.
- The requirements for the activation are not met anymore (for example, one OVERRIDE input is deactivated).

See below for the time charts of the Override function.

8.7.1 Override trigger

It is possible to choose the trigger of the OVERRIDE inputs, Level or Edge, see paragraph 8.7.1.3 – “Configuration of the Override trigger”.

As illustrated by the diagrams below, two types of override trigger sequence are accepted on the OVERRIDE inputs.

8.7.1.1 Override - Level trigger

The Override function is activated when both contacts are closed AND at least one muting sensor is activated.

OVERRIDE STATUS is an output signal that is high when the OVERRIDE inputs are active and the override conditions true.

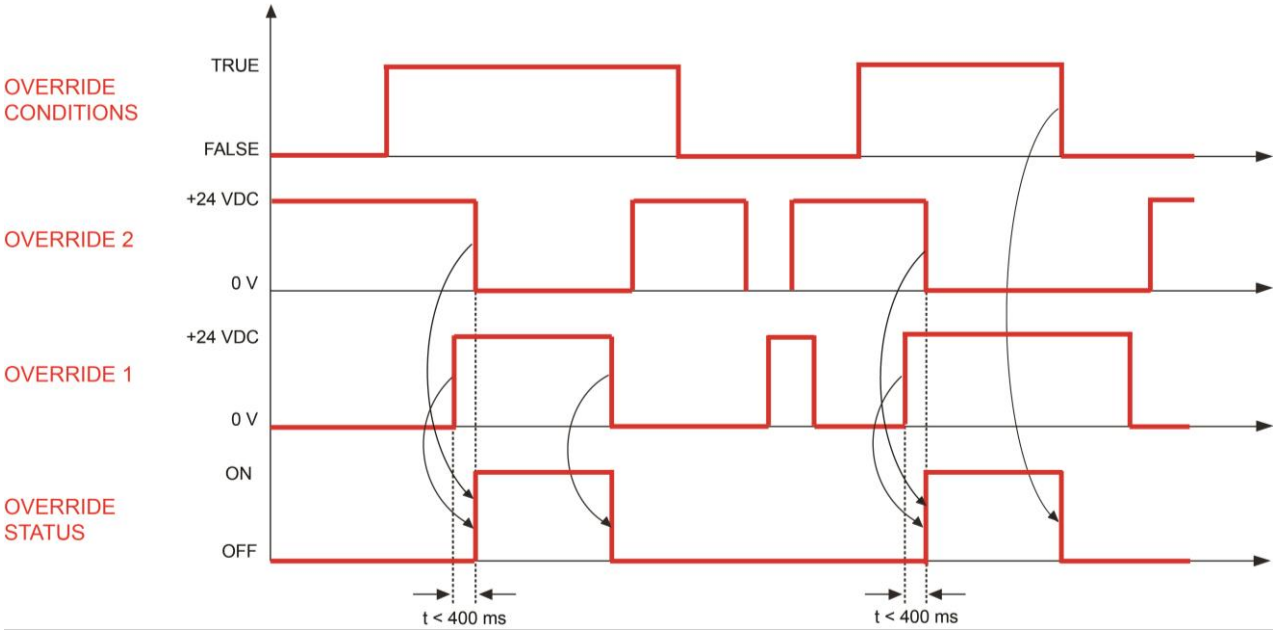


Figure 46 – Time chart of the Override function with level trigger

8.7.1.2 Override - Edge trigger

The Override function is activated by the closing of the override contacts when at least one muting sensor is activated. In this case, the Override function remains activated when the override contacts are released. The function is deactivated when one of the following events happens:

- the muting sensors are deactivated (T-muting) or the muting sensors are deactivated AND no beams are interrupted (L-muting),
- the timeout expires.

OVERRIDE STATUS is an output signal that is high when the OVERRIDE inputs are active and the override conditions true.

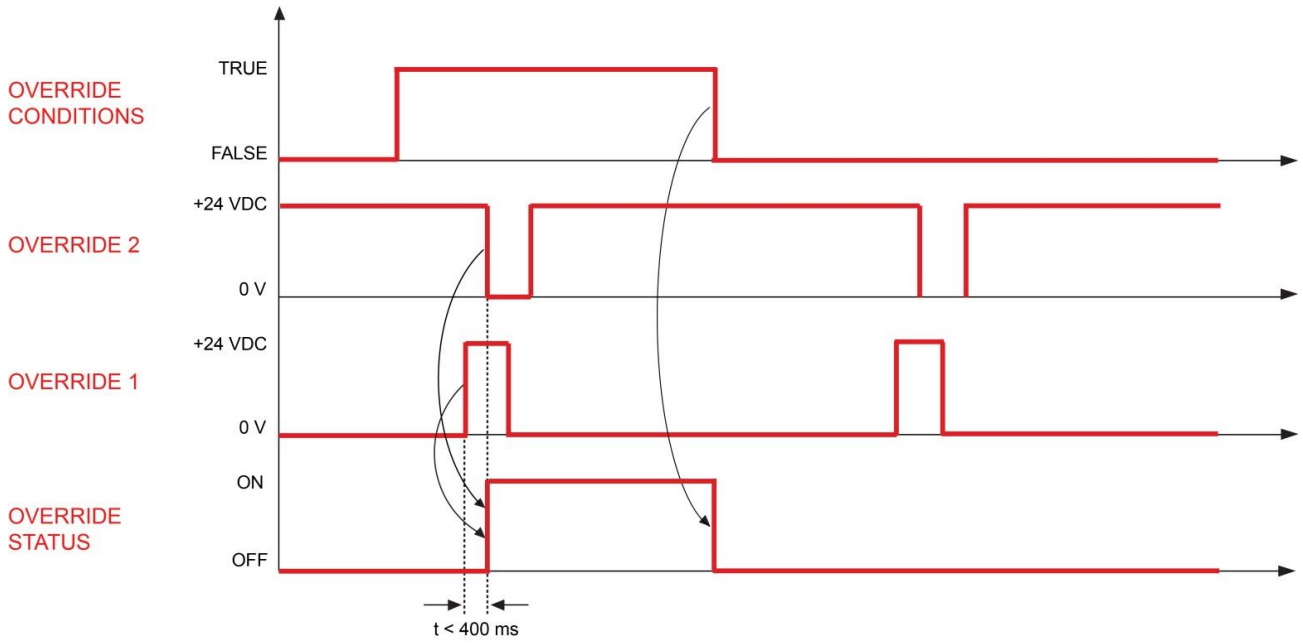


Figure 47 – Time chart of the Override function with edge trigger

⚠ **Warning!** Edge trigger of the override is not compliant with EN 61496-1:2013.

8.7.1.3 Configuration of the Override trigger

Configuration of the Override trigger									
		PWR	OSSD	EDM	ACM	LEVEL			
Level	LED 8 ON Green	●	○	○	○	○	○	○	●
Edge	LED 8 OFF	●	○	○	○	○	○	○	●

8.7.2 Override timeout

The override timeout is the maximum duration of the override.

The override timeout is 120 s with both level and edge trigger: the Override function is deactivated after a maximum of 120 s even if the override conditions are still true and both override contacts are still closed (this condition only with Level trigger).

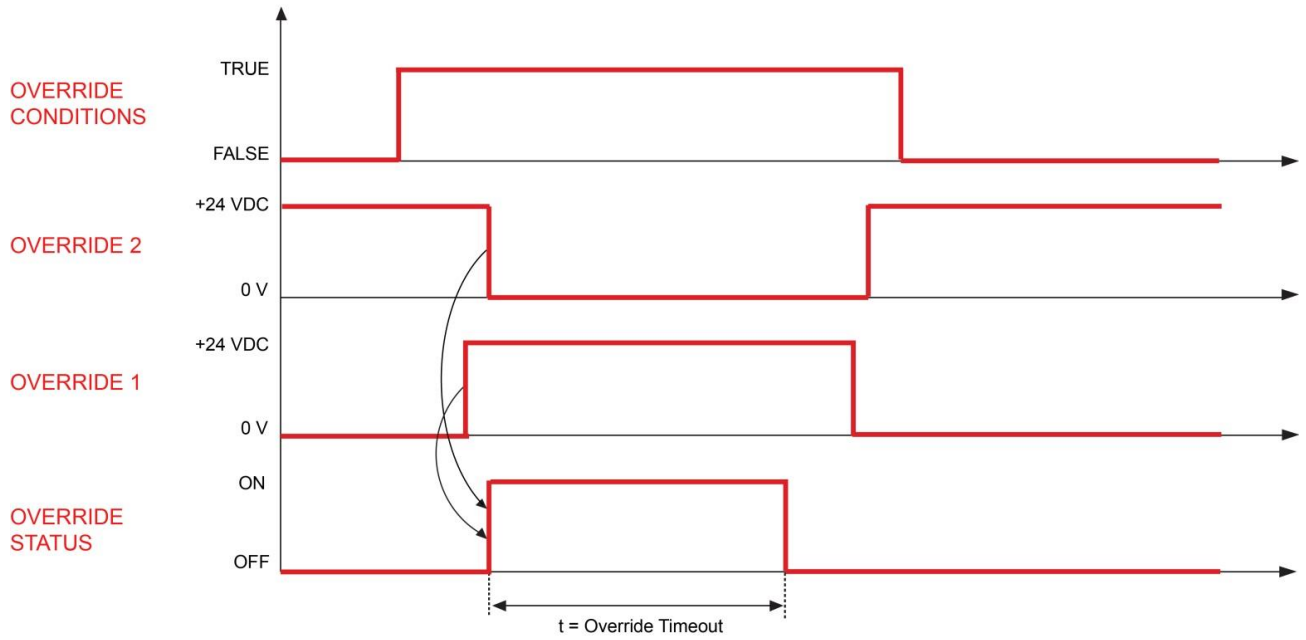


Figure 48 – Timeout of the Override function

8.7.3 Override reset

The ACKNOWLEDGE/RESET/ALIGN input (pin 3 of the M12-12 pole connector on the receiver) should be connected to +24 VDC through a normally open contact.

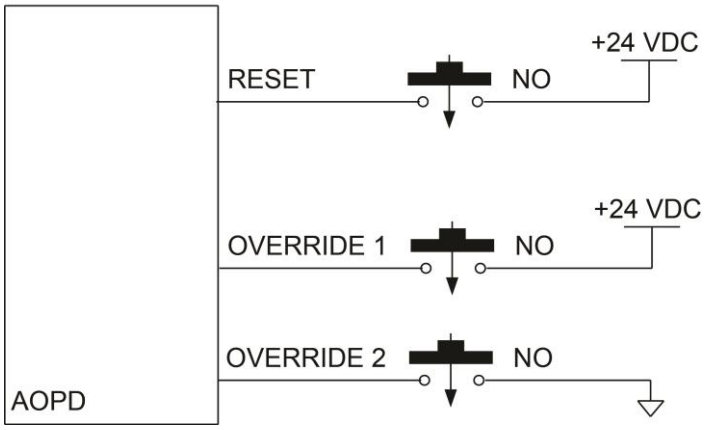


Figure 49 – Connection of the override reset

When override ends, the OSSD outputs switch off and a reset is required to switch them on.

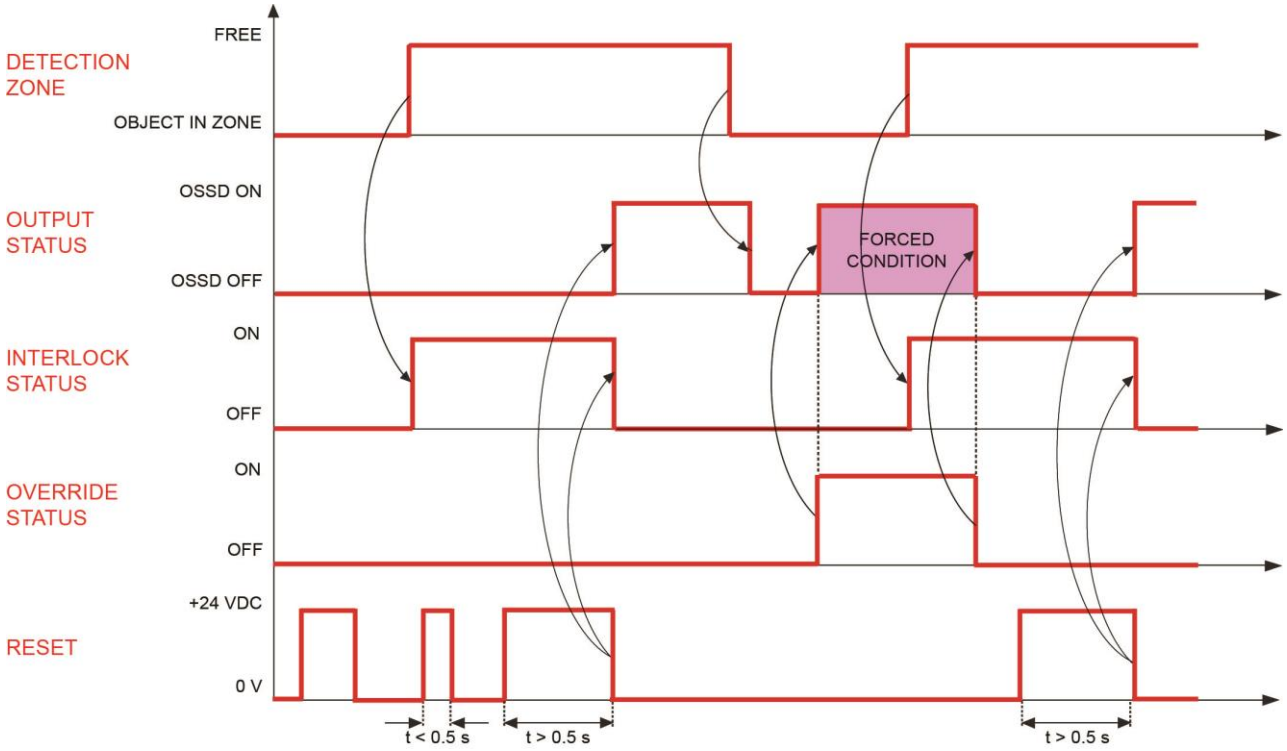


Figure 50 – Time chart of the override reset

8.8 Blanking

The Blanking function allows the OSSD outputs of the AOPD to remain on and the machine to work, even if a pre-determined number of beams within the detection zone is being interrupted. The Blanking function is usually used when the detection zone of the AOPD is interrupted by the material being processed or by a fixed or mobile part of the machine.

Blanking shall only be possible in presence of determined safety conditions. For example, the use of the Blanking function changes the resolution of the AOPD and may increase the minimum installation distance. An additional fixed guard may also be necessary.

A lamp (see characteristics in paragraph 12 – “Technical data”) can be connected to indicate that the Blanking function is active. The use of the lamp is not mandatory. The lamp starts to flash in the following cases:

- the AOPD is in any Fixed blanking mode and the object is removed from the blanked zone,
- the AOPD is in Floating mode with total surveillance and the dimension of the taught object changes or the object is removed from the blanked zone.

There are two types of Blanking functions: Fixed blanking and Floating blanking. These two functions can be activated individually or simultaneously.

8.8.1 Activation of the Blanking function

Muting/Blanking selection											
		PWR	OSSD	EDM	ACM	LEVEL					
		1	2	3	4	5	6	7	8		
Muting	LED 3 ON YELLOW	●	○	●	○	○	○	○	○		
Blanking	LED 3 OFF	●	○	■	○	○	○	○	○		

8.8.2 Fixed blanking

Fixed blanking allows a fixed portion of the detection zone (i.e. a fixed set of beams) to be occupied, while all the other beams operate normally.

In Fixed blanking, the beams of the blanked zone have to remain interrupted, otherwise the OSSD outputs of the AOPD switch off.

Fixed blanking can be combined with Floating blanking; at least one synchronization beam must be free.

Up to two zones can be set as blanking zones.

Configuration: Fixed blanking											
		PWR	OSSD	EDM	ACM	LEVEL					
		1	2	3	4	5	6	7	8		
1 Fixed blanking zone	LED 8 ON Green	●	○	■	○	○	○	○	●		
2 Fixed blanking zones	LED 8 OFF	●	○	■	○	○	○	○	■		

- 1 Fixed blanking zone: Only 1 zone can be configured as blanking zone.
- 2 Fixed blanking zones: 2 zones can be configured as blanking zones.

8.8.2.1 Fixed blanking – Teach-in

The blanking zone is defined through a Teach-in operation: the user keeps the TEACH IN normally open contact (pin 4 of the M12-12 pole connector on the receiver) pressed for at least 3 s while the object(s) that should be allowed to be in the detection zone is/are present in the zone to be blanked. The blanking zone becomes active when the TEACH IN contact is released.

If the TEACH IN contact is kept pressed for a time greater than 1 minute, the AOPD enters Error mode.

The Teach-In configuration is kept until the next Teach-In, even if the AOPD is switched off or Reset. To erase a Teach-In configuration, perform a new Teach-in operation with the detection zone free from object.

In case of a Blanking error, the Teach-in configuration is erased after Acknowledge.

If the user changes mode from blanking to muting and then blanking again, all Teach-in zones learnt at the beginning are lost.

8.8.2.2 Fixed blanking – Tolerance

When the Tolerance function is active, the object can move 1 beam above or below the blanking zone. If the object moves more than 1 beam out of the blanking zone, the AOPD enters Error mode (Blanking error).

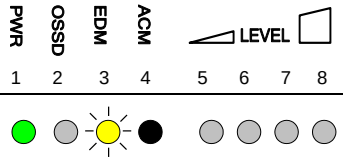
The Tolerance function is useful when there is a risk that the object slightly moves from its initial position.

The Tolerance function can be activated by keeping the normally open TOLERANCE contact (pin 9 of the M12-12 pole connector on the receiver) pressed at start-up.

If the AOPD is switched off, the Tolerance function is deactivated and should be reactivated as described above.

When the Tolerance function is active, at least two not blanked beams must separate two blanking zones.

The activation of the tolerance is indicated by the flashing of a LED on the display, see below.

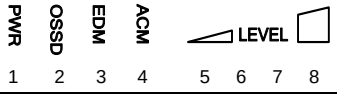
Tolerance indication		
		
Tolerance active	LED 3 flashing YELLOW	

Warning! Tolerance affects the effective resolution of the AOPD. Take the new resolution into account when calculating the minimum installation distance.

8.8.3 Floating blanking

Floating blanking allows the object to move freely inside the detection zone of the AOPD.

Floating blanking is deactivated by default and should be activated.

Configuration of Floating blanking		
		
Floating blanking deactivated	**LED 6 ON Green** **LED 7 ON Green**	
Floating blanking 1 beam (with partial surveillance)	LED 6 ON Green LED 7 OFF	
Floating blanking 2 beams (with partial surveillance)	LED 6 OFF LED 7 ON Green	

- Floating blanking deactivated: No Floating blanking allowed.
- Floating blanking 1 beam: AOPD remains in OSSD ON state if 0 or 1 beam is interrupted.
- Floating blanking 2 beams: AOPD remains in OSSD ON state if 0, 1 or 2 adjacent beams are interrupted.

“Partial surveillance” means that the object may be removed from the detection zone without causing the OSSD outputs to switch off.

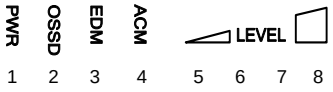
8.8.3.1 Reduced resolution

Reduced resolution is a particular kind of floating blanking where more than one object can interrupt each a specific number of beams with the AOPD remaining in OSSD ON state.

4 adjacent beams can be interrupted by the object while the AOPD remains in OSSD ON state. The object may interrupt 0, 1, 2, 3 or 4 beams while the AOPD remains in OSSD ON state.

The effective resolution of the AOPD changes. The minimum installation distance must be calculated using the effective resolution.

Number of beams in “Reduced resolution”	AOPD with 14 mm resolution Effective resolution when reduced	AOPD with 30 mm resolution Effective resolution when reduced
4	51 mm	105 mm

Reduced resolution		
		
Reduced resolution 4*	LED 6 OFF LED 7 OFF	

* Reduced resolution 4: AOPD switches to OSSD OFF state if more than 4 adjacent beams are interrupted.

8.9 Cascade

Up to three units, a master and two slaves, can be connected in a cascade configuration. The device connected to the power supply is the master (first device). Transmitter is connected to transmitter and receiver to receiver; the top of the device is connected to the bottom of the next device (the bottom is the display side).

- The maximum number of beams is 160 beams for 30 mm resolution models and 320 beams for 14 mm resolution models.
- The maximum length of the master unit is 1800 mm and the maximum length of each slave is 1200 mm.
- For the correct connection of the units, specific cables should be used, see paragraph 14.5 – ”Connection cables“.

Though the devices usually are close to each other, it is not necessary to use coding since the beams of the connected devices are scanned one after the other. The response time is therefore longer, see paragraph 13 – “Model overview”.

BCM is possible on the master only. Blanking applies to the master only and all other functions to master and slaves.

A dedicated bus provides the connection between master and slave units.

A proprietary communication protocol is used to communicate safety related information and status to the slaves.

The OSSD outputs are physically connected to the master unit only; only the master unit can control their status.

In case of communication error due to a stuck-at fault or signal degradation, master and slave units enter Error mode.

A safe auto-recognition procedure is implemented at start up. It automatically detects the topology of the cascade connection and correctly addressed units. In order to allow auto-recognition, the supplied termination caps must be mounted on the tail connector of the last cascade unit, on both transmitter and receiver units. If missing, master and slave units enter Error mode (critical communication error).

8.10 Coding function

This function is useful when two AOPDs have to be installed at a distance that is shorter than the minimum allowed distance with both receivers on the same side, see paragraph 3.2.3 – “Minimum distance between adjacent devices”. The two AOPDs are then configured with two different codes so that they don’t disturb each other-

8.10.1 No code

When no code is selected, the AOPD has to be installed at a certain distance from other AOPDs with no code, in order to avoid possible interferences that can lead to a dangerous situation. See paragraph 3.2.3.

If two AOPDs have to be installed at a distance that is shorter than the minimum allowed distance, the transmitter of the first AOPD should be installed on the same side as the receiver of the second AOPD.

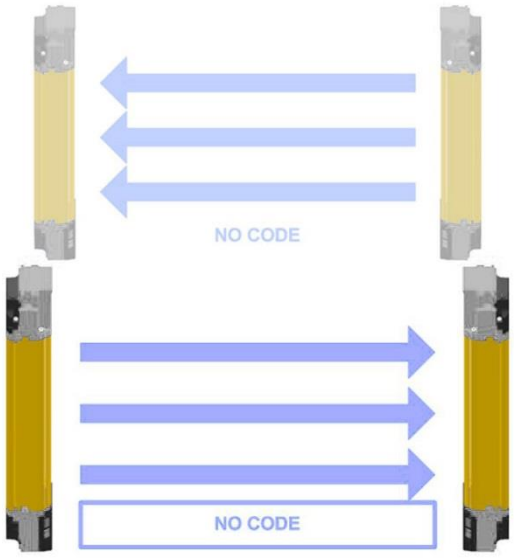


Figure 51 – No code

8.10.2 Code 1 or Code 2

AOPDs that are installed closer to each other than the minimum distance for adjacent devices and have their receivers on the same side might disturb each other and must be configured with different codes.

The transmitter must be configured with the same code as the receiver.

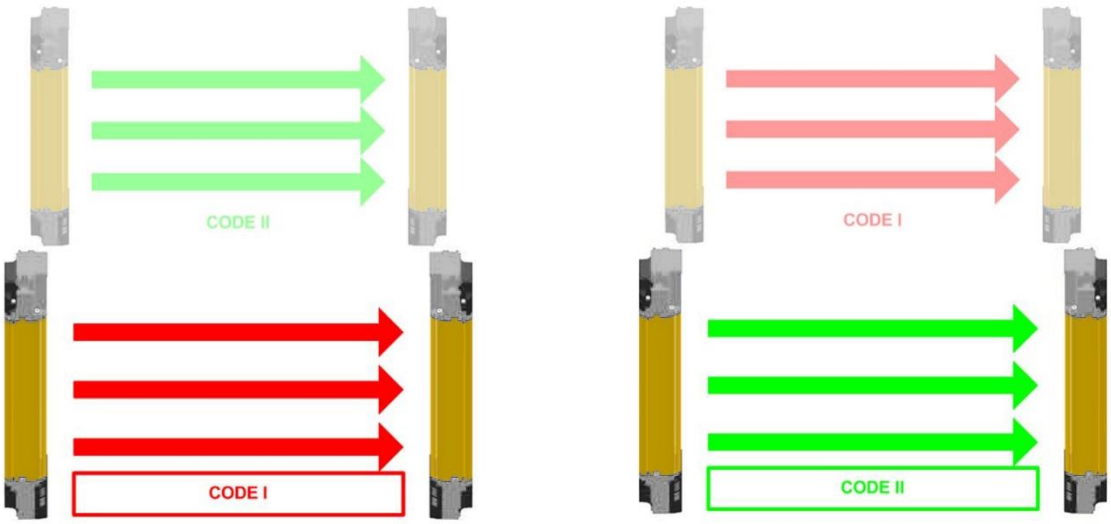


Figure 52 – Code 1 and code 2

The type of coding chosen can be visualized on the display when the beams are interrupted:

Normal operation mode – Display on the receiver when a beam is interrupted		PWR 1	OSSD 2	EDM 3	ACM 4	LEVEL 5	6	7	8
No Code	LED 5 and 6 OFF								
Code 1	LED 5 ON Red, LED 6 OFF								
Code 2	LED 5 OFF, LED 6 ON Green								

Normal operation mode – Display on the transmitter when a beam is interrupted		PWR 1	TST 2	SR 3	LR 4	CODE 5	6	7	8
No Code	LED 5 and 6 OFF								
Code 1	LED 5 ON Red, LED 6 OFF								
Code 2	LED 5 OFF, LED 6 ON Green								

8.10.2.1 Configuration of the codes

Two codes are available, code 1 and code 2. An AOPD with no code can be disturbed by any other AOPD.

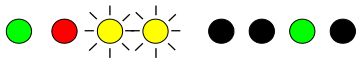
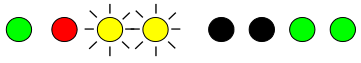
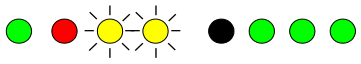
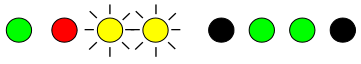
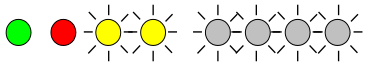
Configuration of the codes – Transmitter and receiver		PWR / PWR 1	OSSD / TST 2	EDM / SR 3	ACM / LR 4	LEVEL / CODE 5	6	7	8
No Code	LED 2 OFF								
Code 1	LED 2 ON Red								
Code 2	LED 2 ON Green								

9 Diagnostic functions

9.1 Display

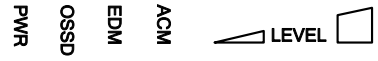
On the display on both receiver and transmitter, 8 LEDs help the user to control and check the state of the AOPD, in Alignment mode, Normal operation mode and Error mode. The display also informs the user of the configuration set with the push-buttons.

9.1.1 Transmitter

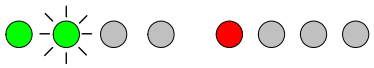
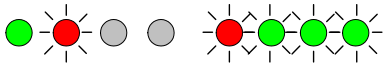
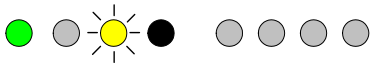
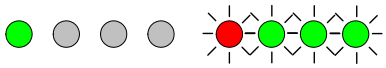
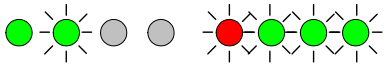
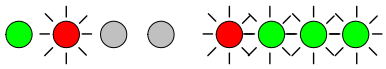
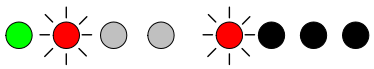
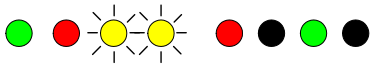
		LED configuration PWR TST SR LR —— CODE —— Off On Flashing Indifferent	Action
Normal operation	Short range emission		
	Long range emission		
	No code		
	Code 1		
	Code 2		
	Test		If undesired test, check the wiring and connections of the test input.
	Emission		
Error	Microprocessor error		Acknowledge. If the error persists, contact your ABB Jokab Safety representative.
	Optical error		Acknowledge. If the error persists, contact your ABB Jokab Safety representative.
	BCM configuration error		Perform a new BCM configuration. If the error persists, contact your ABB Jokab Safety representative.
	Communication error		Check the cascade connection and the presence of the terminator caps. Acknowledge.
	Critical error		Switch the AOPD off and on. If the error persists, contact your ABB Jokab Safety representative

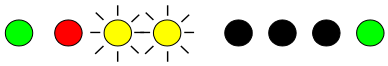
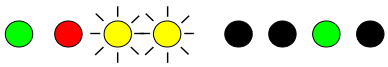
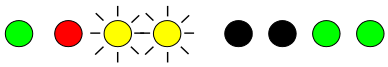
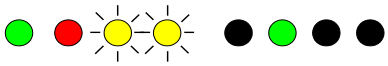
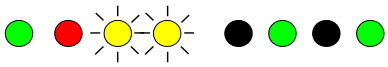
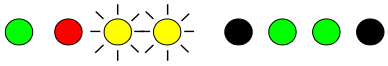
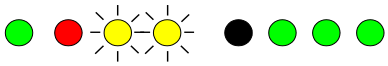
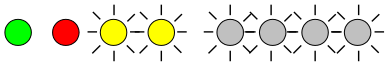
It is not possible to acknowledge a critical error. The device must be switched off and on. If the error persists, contact your ABB Jokab Safety representative.

9.1.2 Receiver



AOPD mode	Status	LED configuration Off On Flashing Indifferent	Action
Alignment	Not aligned		See paragraph 6 – “Alignment procedure”.
	FIRST aligned		See paragraph 6 – “Alignment procedure”.
	LAST aligned		See paragraph 6 – “Alignment procedure”.
	Minimum alignment signal level		See paragraph 6 – “Alignment procedure”.
	Maximum alignment signal level		See paragraph 6 – “Alignment procedure”.
Normal operation Manual Reset Only	Interlock Free beams		AOPD waiting for Reset. Push the RESET button.
	Interlock Interrupted beams		Free the detection zone and push the RESET button.
Normal operation	OSSD ON (maximum alignment)		
	OSSD OFF Code 1		
	OSSD OFF Code 2		
	OSSD OFF No code		
	Signal level on the beams	None Insufficient Low Good Best	
	EDM activated		

AOPD mode	Status	LED configuration Off On Flashing Indifferent	Action
Normal operation Blanking only	Valid Blanking (OSSDs ON)		
	Invalid blanking (OSSDs OFF)		Blanking zones not respected. Reconfigure blanking (teach-in).
	BCM tolerance active		Check the effective resolution of the AOPD and if the tolerance function should be activated.
Normal operation Muting only	Muting Active		If unexpected OSSD OFF with muting active, check the configuration of partial muting.
	Override Active		OSSD ON, muting lamp flashing.
	Override attention status		Push the OVERRIDE button to force the OSSD outputs on.
	Override timing error		Check and repeat the override activation sequence. Check the connections and the wiring the override function.
	Lamp error		Check the connections and the wiring of the lamp and/or if the lamp is broken.

AOPD mode	Status	LED configuration Off On Flashing Indifferent	Action
Error	OSSD error		Check the wiring and connections of the OSSD outputs. Make sure that there is no short-circuit between them or with the power supply. Then Acknowledge. If the error persists, contact your ABB Jokab Safety representative.
	Microprocessor error		Acknowledge. If the error persists, contact your ABB Jokab Safety representative.
	Optical error		Acknowledge. If the error persists, contact your ABB Jokab Safety representative.
	EDM error		Check the connections and the wiring of the EDM function, inclusive EDM selection. Check the time sequence (see the Time chart Figure 35). Acknowledge.
	Reset error		Check the connections and the wiring of the Reset function. Acknowledge.
	Communication error		Check the cascade connection and the presence of the terminator caps. Acknowledge.
	BCM configuration error		Perform a new BCM configuration. If the error persists, contact your ABB Jokab Safety representative.
	Critical error		Switch the AOPD off and on. If the error persists, contact your ABB Jokab Safety representative
	Power supply error		Check the connections and wiring of the power supply Connection. 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. If the error persists, contact your ABB Jokab Safety representative.

10 Periodical checks

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

Check that:

- AOPD remains in OSSD OFF state during beam interruption along the entire detection zone, using the suitable “Test piece” according to the Figure 16 scheme (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 (named OSSD on the receiver) does not turn on.
- The OSSD outputs switch off (red LED “OSSD” on the receiver 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 and the external electrical connections are not damaged.
- 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.

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

11 Device maintenance

Orion1 Extended 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

12 Technical data

Manufacturer	
Address	ABB JOKAB SAFETY Varlabergsvägen 11 SE-434 39 Kungsbacka, Sweden
Electrical data	
Power supply (Vdd):	+24 VDC ± 20 %
Unit current draw (TX):	3 W max
Unit current draw (RX):	5 W max (without load)
Outputs:	2 PNP
Short-circuit protection:	1.4 A max
Output current:	0.5 A max / each output
Output voltage – status ON:	Vdd –1 V min
Output voltage – status OFF:	0.2 V max
Capacitive load	2.2 µF @ +24 VDC max
Response times:	See table below
Recovery time:	Typically 100 ms – Recovery Time may be longer if both first and last beams are interrupted.
Protected height:	300..1800 mm
Electrical protection:	Class III - use SELV/PELV
Current for External Lamp:	20 mA min; 300 mA max
Connections:	RX (muting models): M12 12-poles male connector + M12 5-poles male connector RX (blanking models): M12 12-poles male connector TX (for both models): M12 5-poles male connector
Cables length (for power supply):	50 m. max
Optical data	
Emitting light (λ):	Infrared, LED (950 nm)
Resolution:	14 - 30 mm
Operating distance:	0.2…20 m for 30 mm 0.2…7 m for 14 mm
Ambient light rejection:	According to IEC-61496-2:2013
Mechanical and environmental data	
Operating temperature:	0…+ 50 °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 sweep per axis, 1octave/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 side material:	PMMA
Caps material:	PBT Valox 508 (pantone 072C)
Cover material:	PC LEXAN
Weight:	1.35 kg per linear meter for single unit

Functional safety data		
EN 61496-1:2013	Type 4	
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

13 Model overview

Model	Article number	Protected height (mm)	Number of beams	Response time no code (ms)	Response time with code (ms)	Resolution (mm)
Orion1-4-14-030-E	2TLA022301R0100	300	32	15	20	14
Orion1-4-14-045-E	2TLA022301R0200	450	48	17	25	14
Orion1-4-14-060-E	2TLA022301R0300	600	64	19	29	14
Orion1-4-14-075-E	2TLA022301R0400	750	80	20	34	14
Orion1-4-14-090-E	2TLA022301R0500	900	96	22	38	14
Orion1-4-14-105-E	2TLA022301R0600	1050	112	24	43	14
Orion1-4-14-120-E	2TLA022301R0700	1200	128	26	47	14
Orion1-4-14-135-E	2TLA022301R0800	1350	144	27	52	14
Orion1-4-14-150-E	2TLA022301R0900	1500	160	29	56	14
Orion1-4-14-165-E	2TLA022301R1000	1650	176	31	61	14
Orion1-4-14-180-E	2TLA022301R1100	1800	192	33	65	14
Orion1-4-30-030-E	2TLA022303R0100	300	16	13	16	30
Orion1-4-30-045-E	2TLA022303R0200	450	24	14	18	30
Orion1-4-30-060-E	2TLA022303R0300	600	32	15	20	30
Orion1-4-30-075-E	2TLA022303R0400	750	40	16	23	30
Orion1-4-30-090-E	2TLA022303R0500	900	48	17	25	30
Orion1-4-30-105-E	2TLA022303R0600	1050	56	18	27	30
Orion1-4-30-120-E	2TLA022303R0700	1200	64	19	29	30
Orion1-4-30-135-E	2TLA022303R0800	1350	72	19	32	30
Orion1-4-30-150-E	2TLA022303R0900	1500	80	20	34	30
Orion1-4-30-165-E	2TLA022303R1000	1650	88	21	36	30
Orion1-4-30-180-E	2TLA022303R1100	1800	96	22	38	30

For the response times of cascade solutions, see next page.

The user can calculate the response time of whatever cascade he creates with the following formulas referring to the response times given in the following tables:

No code	$T_{cascade}$ [ms] = T_{master} + T_{slave1} + T_{slave2} + 7,5
With code	$T_{cascade}$ [ms] = $T_{master\ code}$ + $T_{slave1\ code}$ + $T_{slave2\ code}$ + 7,5

Model	Master response time no code (ms) T_{master}	Slave response time no code (ms) T_{slave}	Master response time with code (ms) $T_{master\ code}$	Slave response time with code (ms) $T_{slave\ code}$
Orion1-4-14-030-E	13.7	13.7	19.1	19.1
Orion1-4-14-045-E	15.4	15.4	23.6	23.6
Orion1-4-14-060-E	17.2	17.2	28.1	28.1
Orion1-4-14-075-E	18.9	18.9	32.6	32.6
Orion1-4-14-090-E	20.7	20.7	37.1	37.1
Orion1-4-14-105-E	22.4	22.4	41.6	41.6
Orion1-4-14-120-E	24.2	24.2	46.0	46
Orion1-4-14-135-E	26.0	-	50.5	-
Orion1-4-14-150-E	27.7	-	55.0	-
Orion1-4-14-165-E	29.5	-	59.5	-
Orion1-4-14-180-E	31.2	-	64.0	-
Orion1-4-30-030-E	11.9	11.9	14.6	15
Orion1-4-30-045-E	12.8	12.8	16.8	17
Orion1-4-30-060-E	13.7	13.7	19.1	19
Orion1-4-30-075-E	14.5	14.5	21.3	21
Orion1-4-30-090-E	15.4	15.4	23.6	24
Orion1-4-30-105-E	16.3	16.3	25.8	26
Orion1-4-30-120-E	17.2	17.2	28.1	28
Orion1-4-30-135-E	18.0	-	30.3	-
Orion1-4-30-150-E	18.9	-	32.6	-
Orion1-4-30-165-E	19.8	-	34.8	-
Orion1-4-30-180-E	20.7	-	37.1	-

14 Dimensions

14.1 Profiles

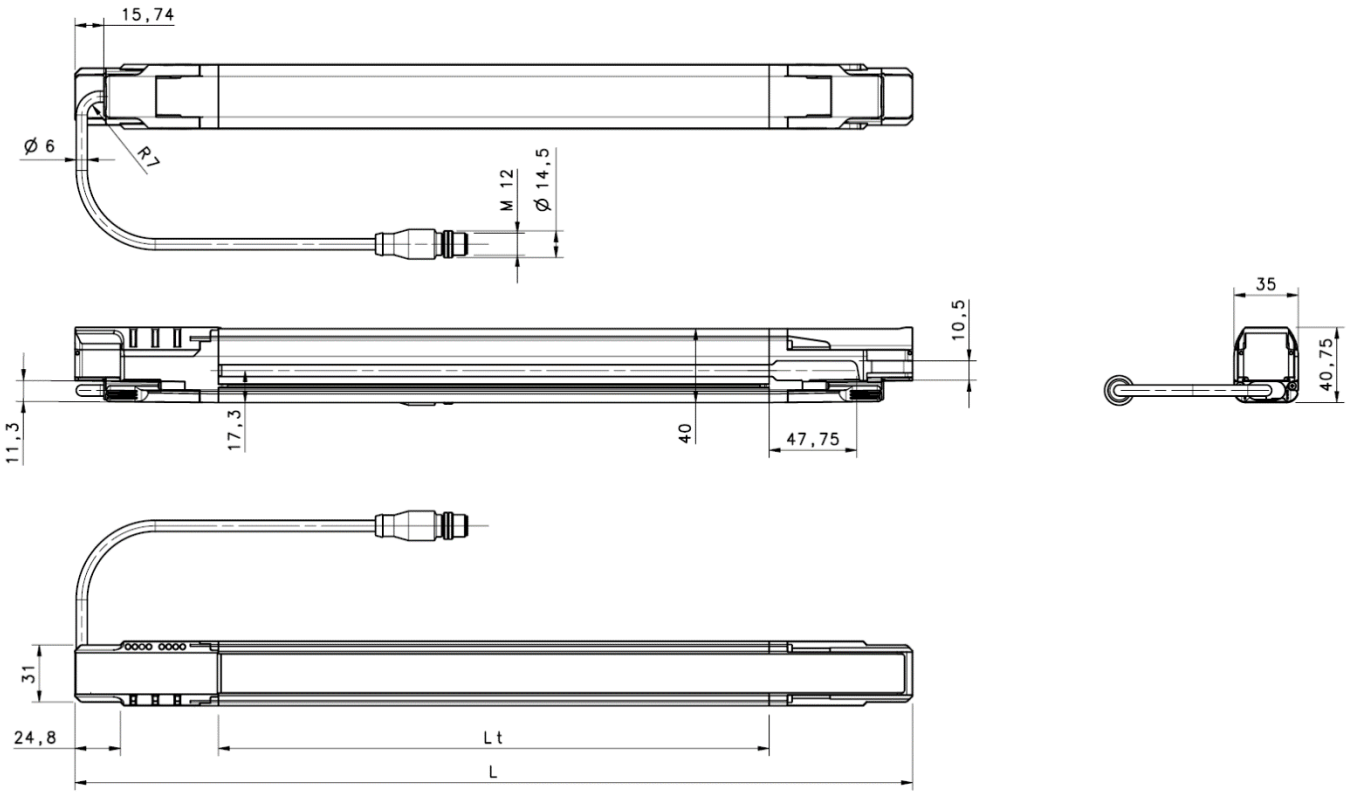


Figure 53 – Dimensions of the profiles

NB: All dimensions in millimetres.

Model	L_t (mm)	L (mm)
Orion1-4-xx-030-E	150	306.3
Orion1-4-xx-045-E	300	456.3
Orion1-4-xx-060-E	450	606.3
Orion1-4-xx-075-E	600	756.3
Orion1-4-xx-090-E	750	906.3
Orion1-4-xx-105-E	900	1056.3
Orion1-4-xx-120-E	1050	1206.3
Orion1-4-xx-135-E	1200	1356.3
Orion1-4-xx-150-E	1350	1506.3
Orion1-4-xx-165-E	1500	1656.3
Orion1-4-xx-180-E	1650	1806.3

xx = Resolution (14mm - 30mm)

14.2 Angled fixing bracket

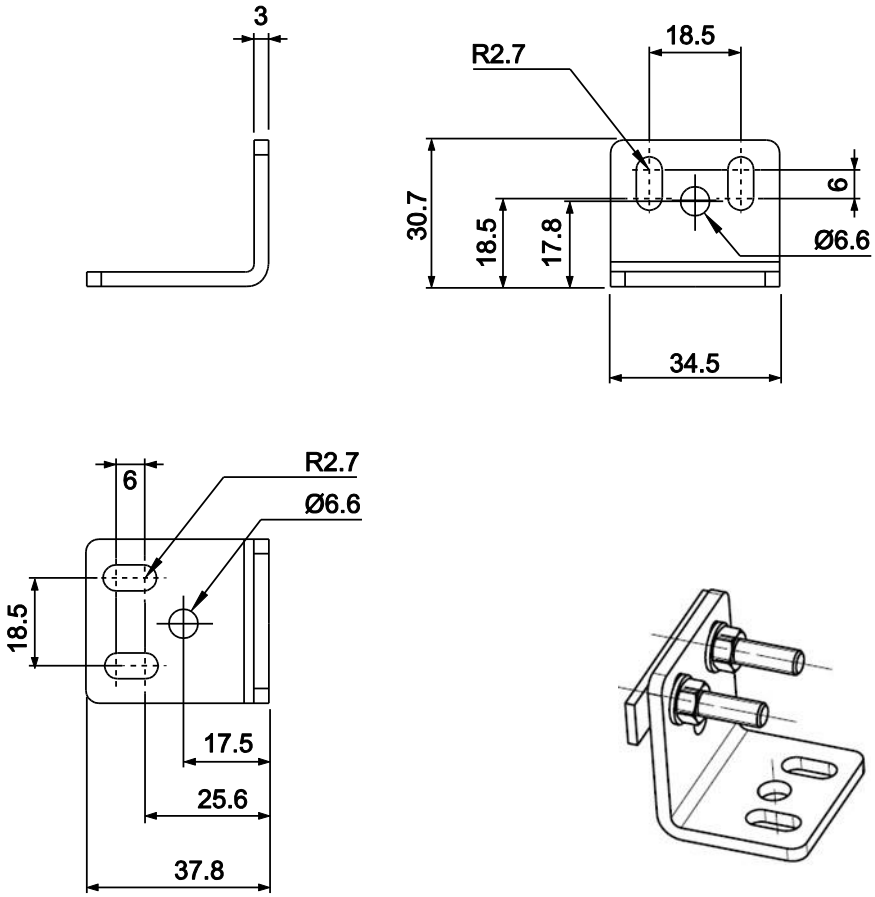


Figure 54 – Dimensions of the angled fixing bracket

14.3 Fixing bracket with profile

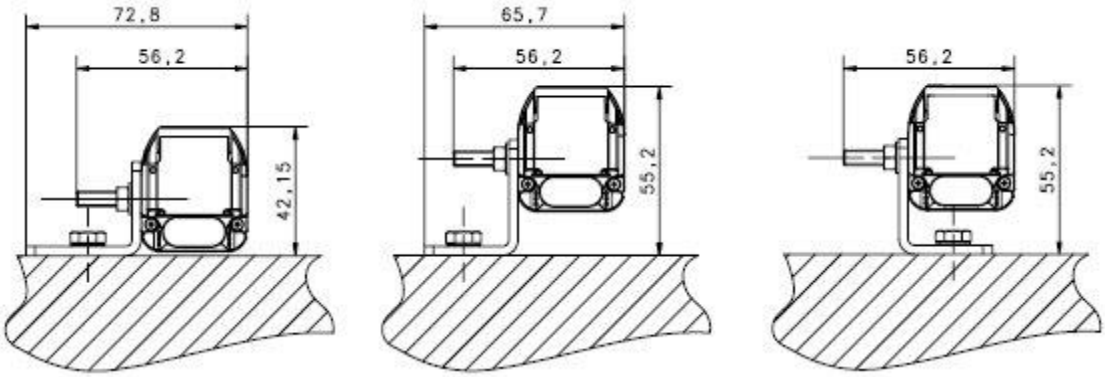


Figure 55 – Angled fixing bracket

14.4 Tool for BCM configuration

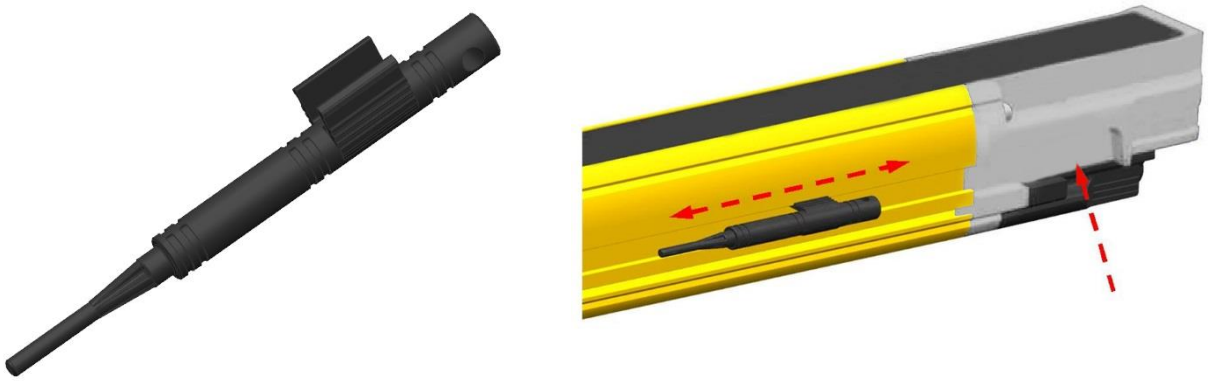


Figure 56 – Tool for BCM configuration

When not used, the tool for BCM configuration can be inserted in the profile groove by inserting it from the top of the AOPD.

14.5 Connection cables

14.5.1 Transmitter cable

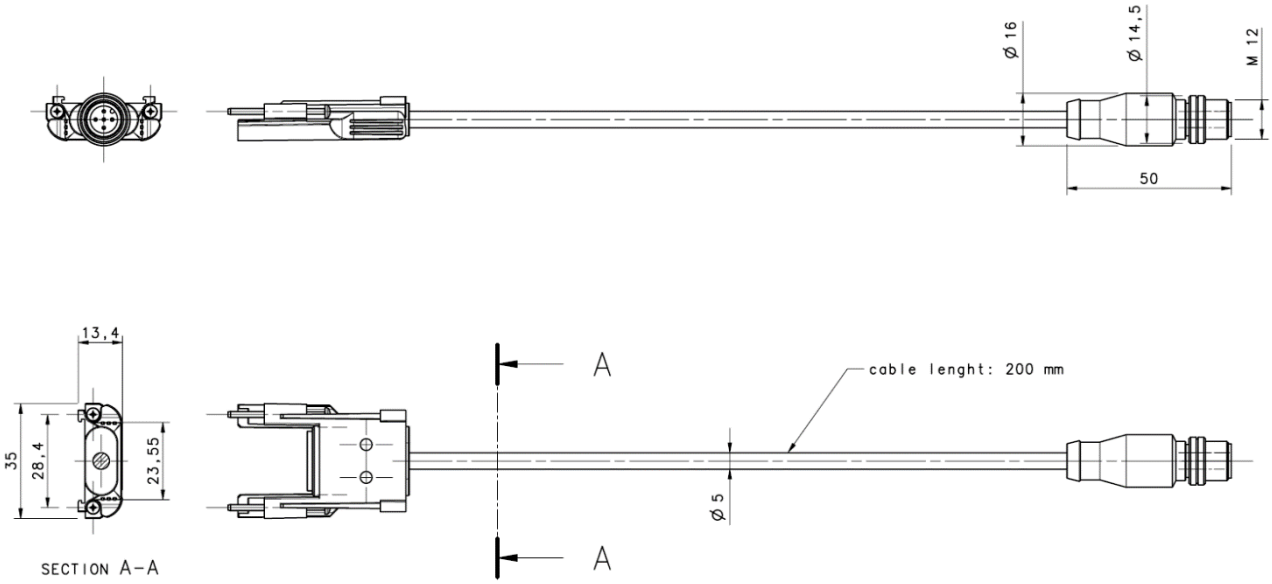


Figure 57 – Transmitter cable

This cable must always be used with an Orion1 Extended transmitter. It has an 18 pole connector on one side and a M12-5 pole male connector on the other side.

Model	Description	Article number
M12-C02PT2T	Orion1 Extended TX 0.2m	2TLA022315R0100

14.5.2 Receiver blanking cable

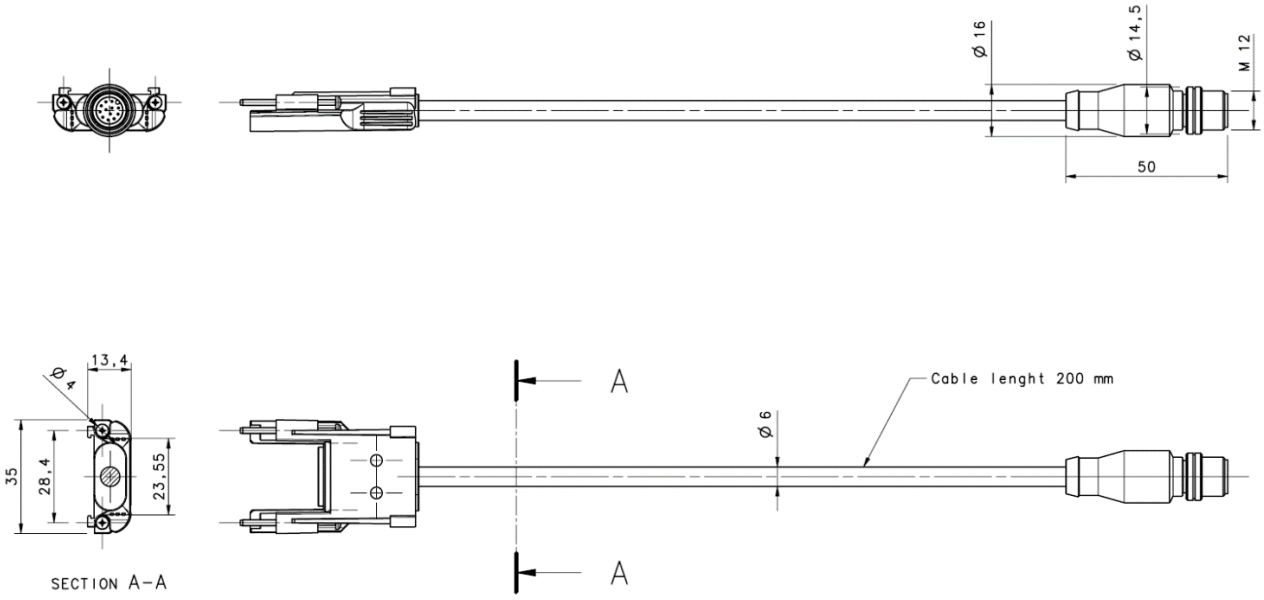


Figure 58 – Receiver blanking cable

This cable must be used with an Orion1 Extended receiver configured in Blanking mode. It has an 18 pole connector on one side and a M12-12 pole male connector on the other side.

Model	Description	Article number
M12-C02PT6RB	Orion1 Extended RX Blanking cable 0.2m	2TLA022315R0200

14.5.3 Receiver muting cable

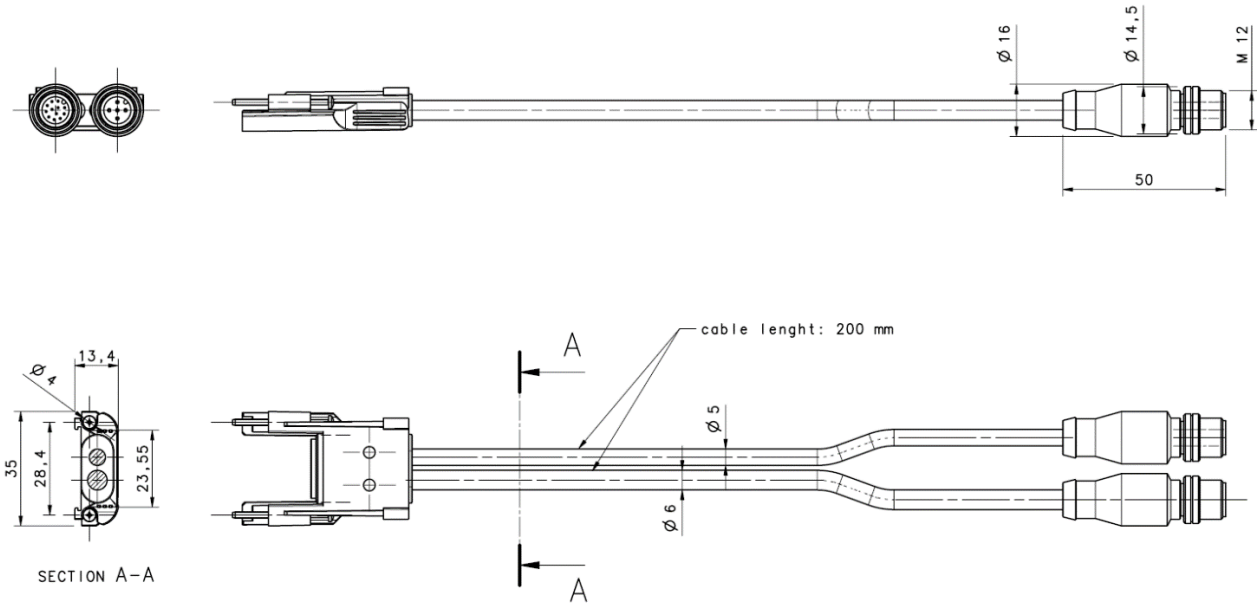


Figure 59 – Receiver muting cable

This cable must always be used with an Orion1 Extended receiver configured in Muting mode. It has an 18 pole connector on one side and two M12 male connectors on the other side, one M12-5 pole and one M12-12 pole.

Model	Description	Article number
M12-C02PT62RM	Orion1 Extended RX Muting cable 0.2m	2TLA022315R0300

15 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