

Original instructions

# Orion2 Extended

## Safety light grids

Type 4 Active Opto-electronic Protective Device (AOPD)



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# 1 Introduction

## 1.1 Scope

The purpose of these instructions is to describe the Orion2 Extended light grids and to provide the necessary information required for selection, installation and operation of the safety devices.

## 1.2 Audience

This document is intended for authorized installation personnel.

## 1.3 Prerequisites

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

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

## 1.4 Abbreviations

ACM: Advanced Configuration Mode

AOPD: Active Opto-electronic Protective Device

BCM: Basic Configuration Mode

EDM: External Device Monitoring

MPCE: Machine Primary Control Element


OSSD: Output Signal Switching Device (switching output)

RX: Receiver

TX: Transmitter

## 1.5 Special notes

Pay attention to the following special notes in the document:

 **Warning!** Danger of severe personal injury!  
An instruction or procedure which, if not carried out correctly, may result in injury to the operator or other personnel.

**Caution!** Danger of damage to the equipment!  
An instruction or procedure which, if not carried out correctly, may damage the equipment.

**NB:** Notes are used to provide important or explanatory information.

## 2 Overview

### 2.1 General description

The Orion2 Extended light grids are Active Opto-electronic Protective Devices (AOPDs) that are used to protect working areas that, in presence of machines, robots, and automatic systems in general, can become hazardous for operators that get in touch, even accidentally, with moving parts.

The Orion2 Extended light grids are Type 4 intrinsic safety systems used as accident-prevention protection devices and are manufactured in accordance with the international Standards in force for safety, in particular:

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

The device, consisting of one transmitter and one receiver housed inside strong aluminum profiles, generates infrared beams and detects any opaque object interrupting a beam.

The transmitter and the receiver are equipped with the command and control functions. The synchronization 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, via LEDs (see paragraph 8 – “Diagnostic functions”). During installation, two yellow LEDs facilitate the alignment of both units (see paragraph 6 – “Alignment procedure”).

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

## 2.2 Resolution

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

The resolution  $R$  is calculated using the following formula:

$$R = l + d$$

where:

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

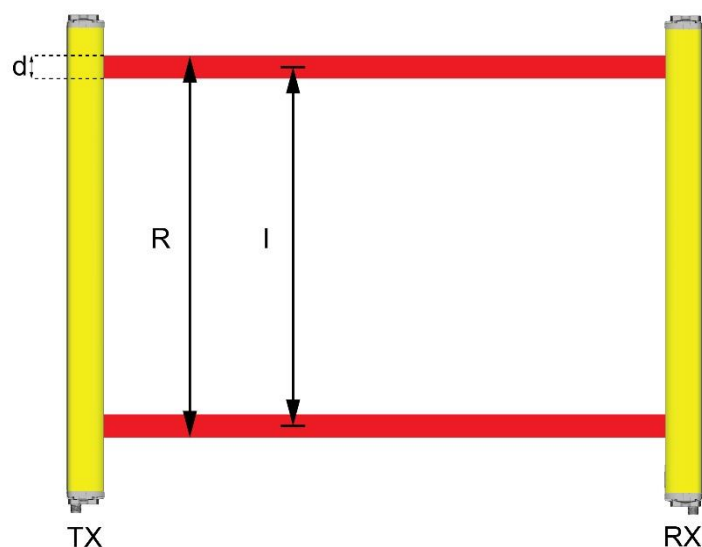


Figure 1 – Resolution

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

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

## 2.3 Protected height

It is important to distinguish between the “Height of the sensitive area” and the “Height of the protected area” (see Figure 2).

The height of the sensitive area is the distance between the lower and the upper limits respectively of the first and the last lens. The protected area is the area where an opaque object with dimensions larger or equal to the resolution of the AOPD will certainly cause the interruption of a beam.

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

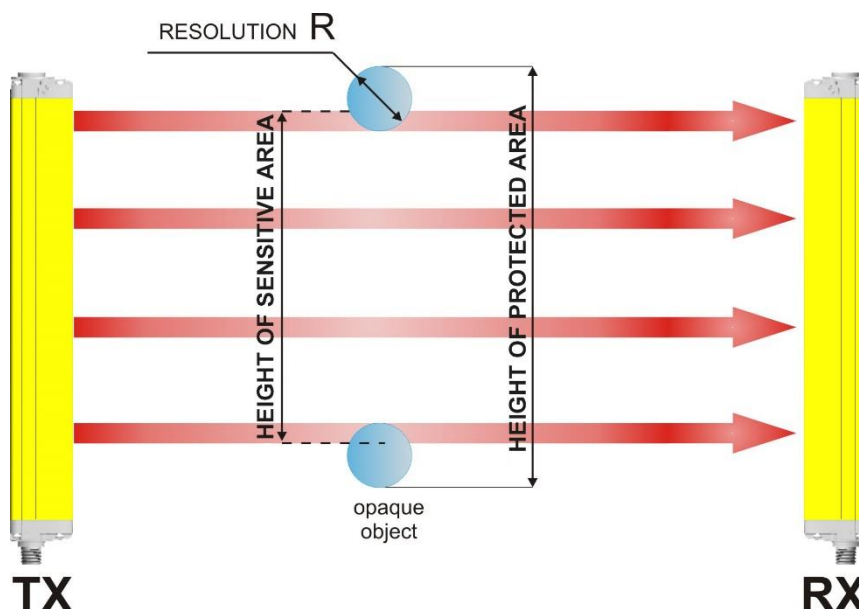


Figure 2 – Protected height

## 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:

$$S = (K \times T) + C$$

- 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:

- Calculation of the minimum distance for reaching through the detection zone,  $S_{RT}$ .
- Calculation of the minimum distance for reaching over the detection zone,  $S_{RO}$ .
- 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.

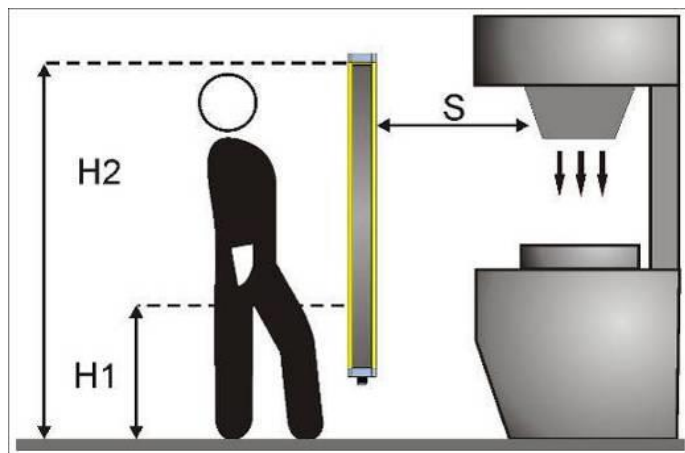


Figure 3 – Minimum distance for a vertically assembled AOPD

S = minimum distance in mm

H1 = height of the lowest beam

H2 = height of the uppermost beam

$H1 \leq 300 \text{ mm}^*$

$H2 \geq 900 \text{ mm}$

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

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

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

$K = 1600 \text{ mm/s}$  for devices with resolution  $d > 40 \text{ mm}$

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

Orion2 cannot be used horizontally.

### 2.4.3 Angled assembled AOPD

See the latest version of EN ISO 13855.

### 2.4.4 Practical examples

Let's suppose we have an Orion2 Extended light grid in a vertical position and with no risk of reaching over it.

$$S = K \times (T1 + T2) + C$$

	Orion2-4-K2-050-E	Orion2-4-K4-120-E
T1, response time of AOPD (see paragraph 12 – “Model overview”)	0.014 s	0.016 s
T2, stopping time machine + safety control system (value as ex.)	0.380 s	0.380 s
C, for AOPD with resolution > 40 mm	850 mm	850 mm
K, for AOPD with resolution > 40 mm	1600 mm/s	1600 mm/s
S, minimum installation distance	1479 mm	1482 mm

## 2.5 Safety information

### **Warning!**

For a correct and safe use of Orion2 Extended light grids, the following points must be observed:

- The stopping system of the machine must be electrically controlled.
- This control system must be able to stop the hazardous movement of the machine within the total machine stopping time T as per paragraph 2.4 – “Minimum installation distance”, and during all working cycle phases.
- Mounting and connection of the AOPD must be carried out by qualified personnel only, according to the indications included in the special sections (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 paragraph 3 – “Installation”).
- The personnel operating in the hazard zone must be well trained and must have adequate knowledge of all the operating procedures of the AOPD.
- The RESET button must be located outside the hazard zone because the operator must check the hazard zone during all the reset and override operations. It must be impossible to reach the button from the hazard zone.
- The external lamp signaling that muting is active must be visible from all operating sides.
- Please carefully respect the mounting instructions for the muting sensors, see paragraph 7.6 – “Muting”.
- If the external device monitoring (EDM) function is to be used, it must be activated with the dip-switches.

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

## 3 Installation

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

- The outputs (OSSD) of the AOPD must be used as machine stopping devices and not as command devices. The machine must have its own Start command.
- The dimension of the smallest object to be detected must be larger than the resolution of the AOPD.
- The AOPD must be installed in a room complying with the technical characteristics indicated in paragraph 11 – “Technical data”.
- Do not place the AOPD near strong and/or flashing light sources or similar devices.
- Strong electromagnetic interferences can jeopardize the function of the AOPD. Please contact your ABB Jokab Safety representative for advice.
- The operating distance of the device can be reduced in presence of smog, fog or airborne dust
- A sudden change in environment temperature, with very low minimum peaks, can generate a small condensation layer on the lenses and so jeopardize the function.
- The Muting/Override function is signaled by a muting/override lamp. Make sure that the lamp has sufficient lighting and is visibly positioned near the hazard zone.
- Make sure to correctly use the muting sensors as described in the instructions supplied hereinafter.
- Avoid incongruent connections that cannot be controlled and thus, exclude undesired potentially dangerous activations.

### 3.2 General Information on positioning the AOPD

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

#### 3.2.1 Minimum installation distance

See paragraph 2.4 – “Minimum installation distance”.

#### 3.2.2 Minimum distance to reflecting surfaces

Reflecting surfaces placed near the light beams of the AOPD (over, under or laterally) can cause passive reflections. These reflections can compromise the recognition of an object inside the detection zone (see Figure 4).

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.

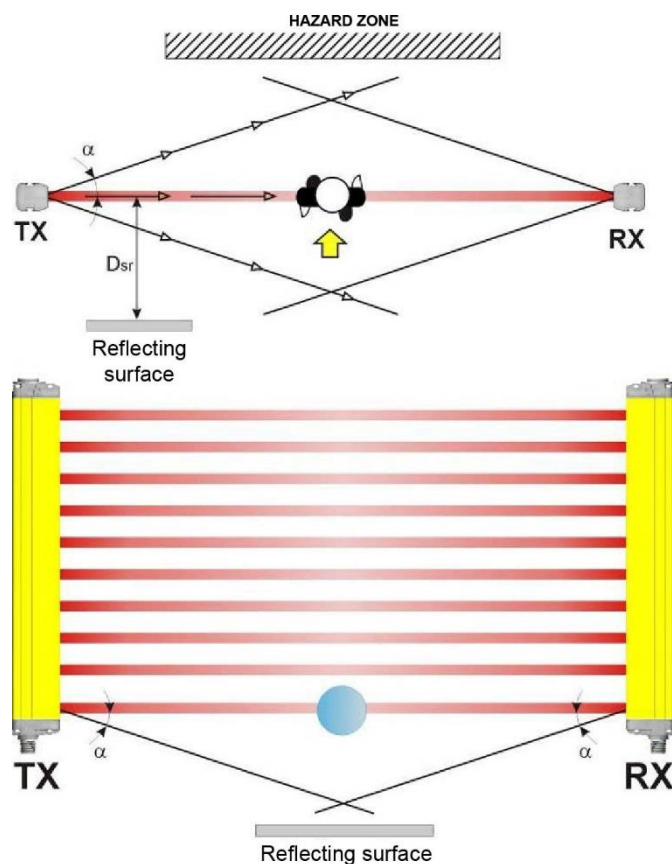


Figure 4 – Distance to reflecting surfaces

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,  $EAA_{MAX} = 5^\circ$  ( $\alpha = \pm 2.5^\circ$ ).

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

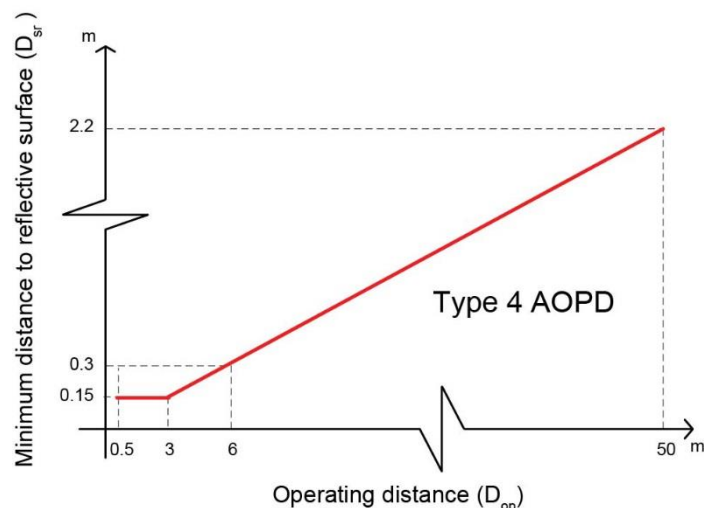


Figure 5 – Minimum distance to a reflective surface as a function of the operating distance

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

$$D_{sr} \text{ (m)} = 0.15 \quad \text{for operating distances} < 3 \text{ m}$$

$$D_{sr} \text{ (m)} = 0.5 \times \text{operating distance (m)} \times \tan(2\alpha) \quad \text{for operating distances} \geq 3 \text{ m}$$

**Warning!** If the reflecting surface is the floor, whatever the calculated  $D_{sr}$ , the minimum installation distance to the floor must still be respected, see paragraph 2.4.

### 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 dangerously 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.

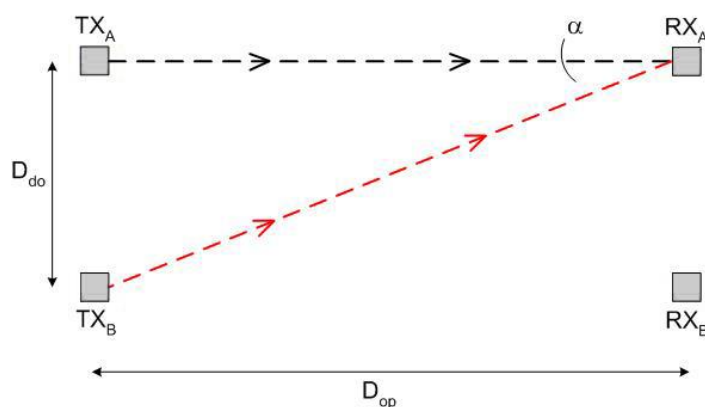


Figure 6 – Distance between adjacent devices

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,  $EAA_{MAX} = 5^\circ$  ( $\alpha = \pm 2.5^\circ$ ).

The diagram below shows the minimum 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.

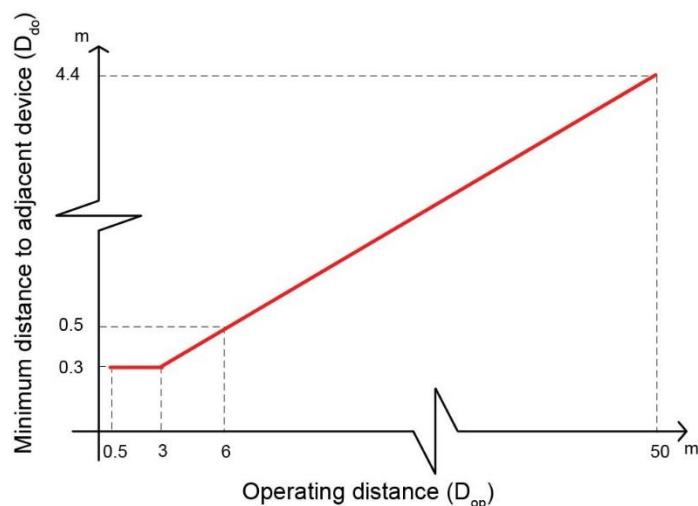


Figure 7 – Minimum distance to an adjacent device as a function of the operating distance

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

$$D_{do} (m) = 0.3 \quad \text{for operating distance} < 3 \text{ m}$$

$$D_{do} (m) = \text{operating distance (m)} \times \tan(2\alpha) \quad \text{for operating distance} \geq 3 \text{ m}$$

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

### 3.2.4 Installation of several adjacent AOPDs

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

Figure 8 provides some examples of correct and incorrect installations when it comes to interferences.

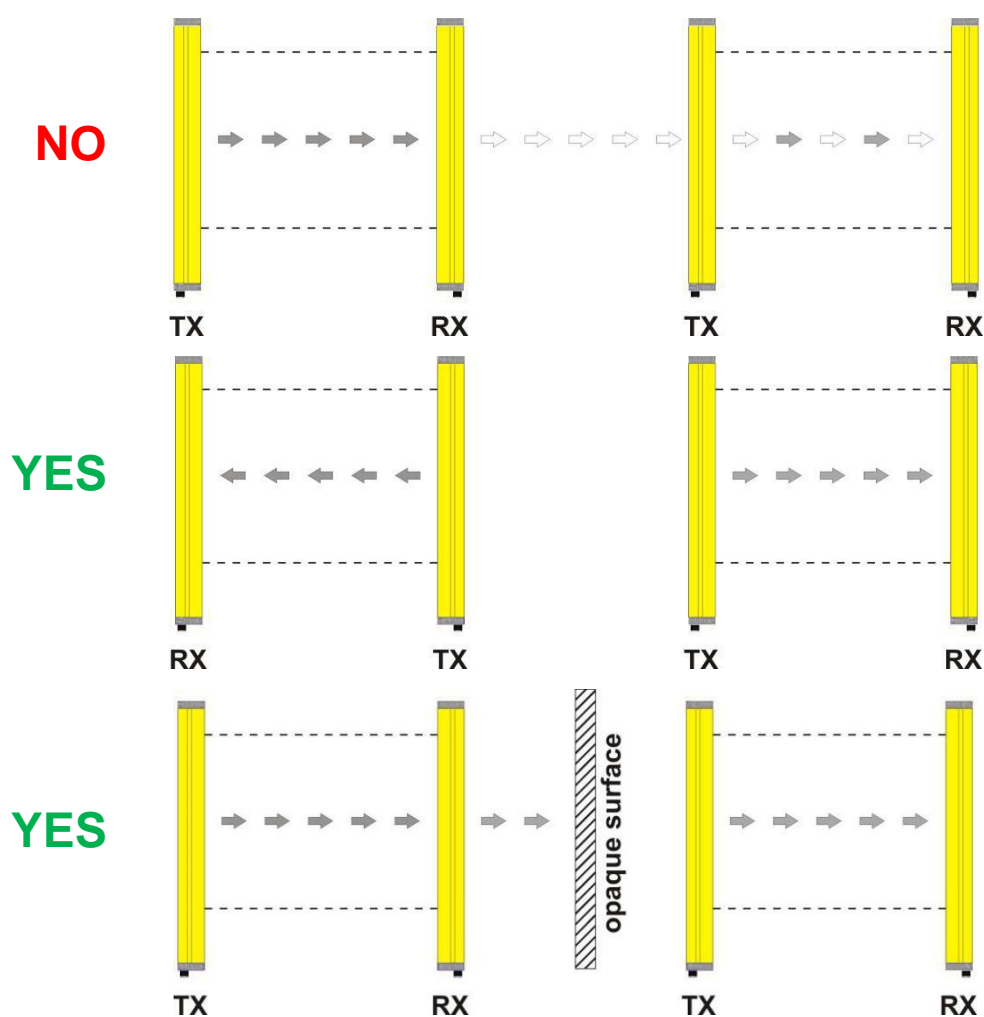


Figure 8 – Installation of several devices close to each other



### 3.2.5 Transmitter and receiver orientation

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

The configurations shown in Figure 9 must be avoided.

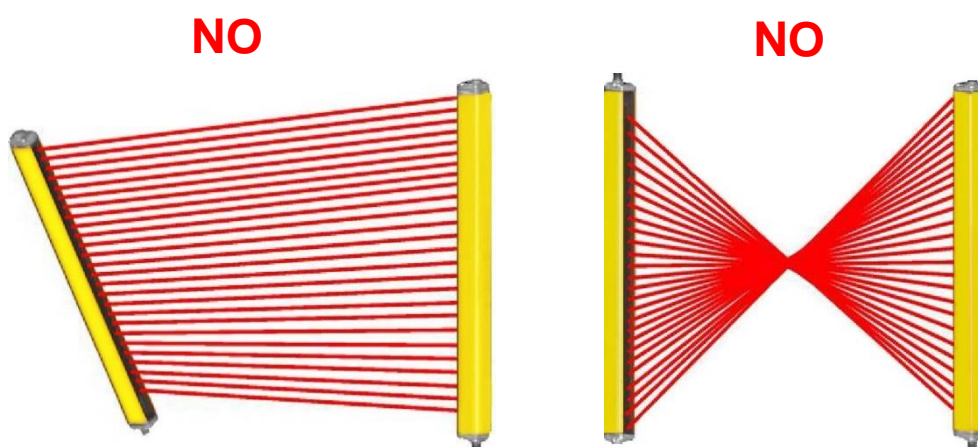


Figure 9 – Incorrect orientation

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

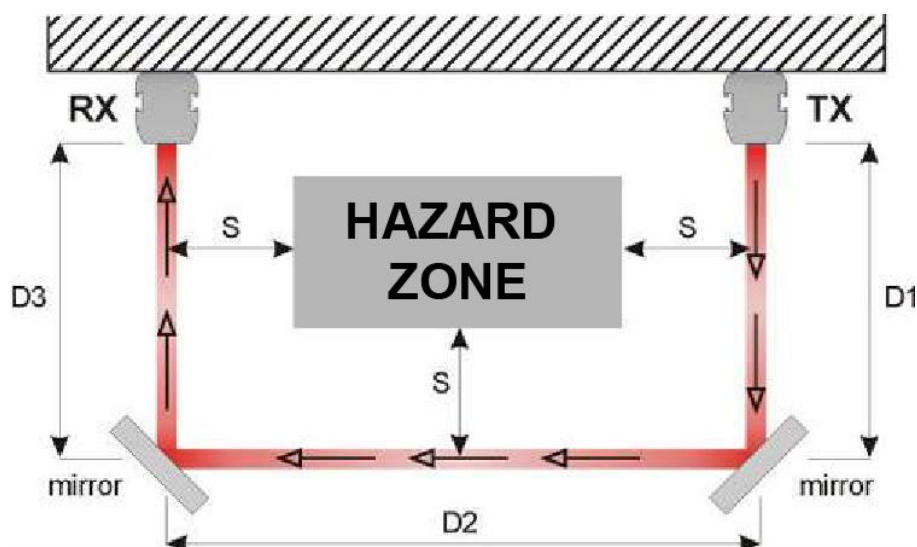


Figure 10 – Use of deviating mirrors


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

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

### 3.3 Checks after first installation

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

Check that:

- The AOPD remains in OSSD OFF state () during beam interruption along the entire detection zone, using the suitable "Test piece" according to the Figure 11 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.

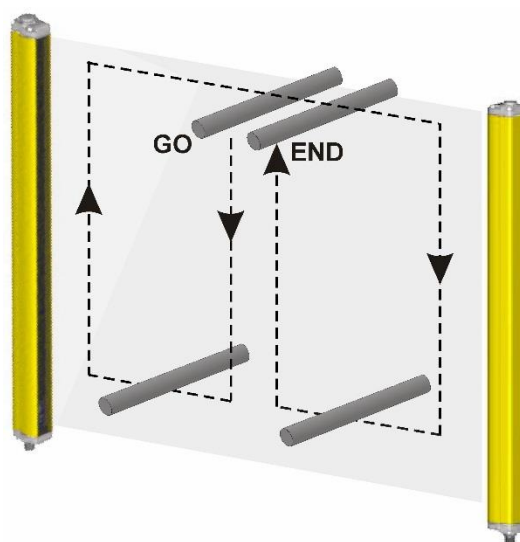



Figure 11 – Scheme for checking the function

- The AOPD is correctly aligned: press slightly the product side in both directions and check that the red LED  does not turn on.
- The stopping time of the machine, including the response times of the AOPD and of the machine, is within the limits defined 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 shall remain in OSSD ON state for at least 10-15 minutes and, after placing the specific test piece in the detection zone, remain in the OSSD OFF state for the same period of time.
- All additional functions behave as expected by activating them in different operating conditions.

## 4 Mechanical mounting

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

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

### 4.1 Mounting with angled fixing brackets

Angled fixing brackets are supplied with all Orion2 Extended models. To mount the AOPD, insert the supplied threaded pins into the grooves on the two units (see Figure 12).

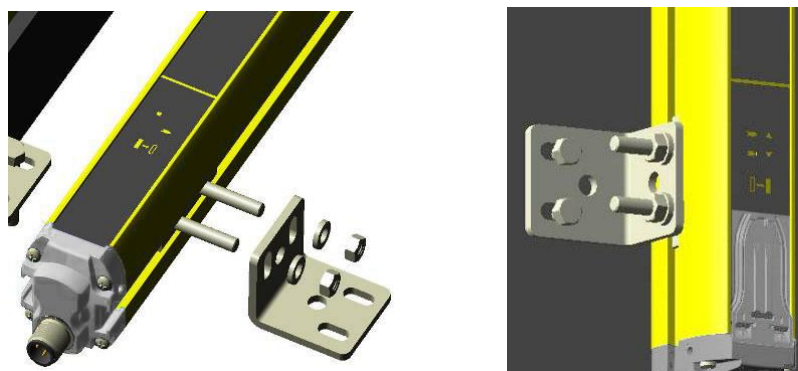


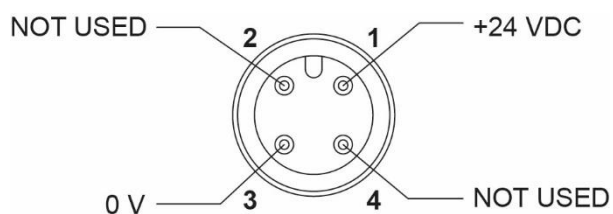
Figure 12 – Mounting with the angled fixing brackets

## 5 Electrical connections

All electrical connections to the transmitter and the receiver are made through male M12 connectors located on the lower part of the two units.

Use only shielded cables for the connection of the two units. It is recommended to connect the shield to Ground on the electrical cabinet side.

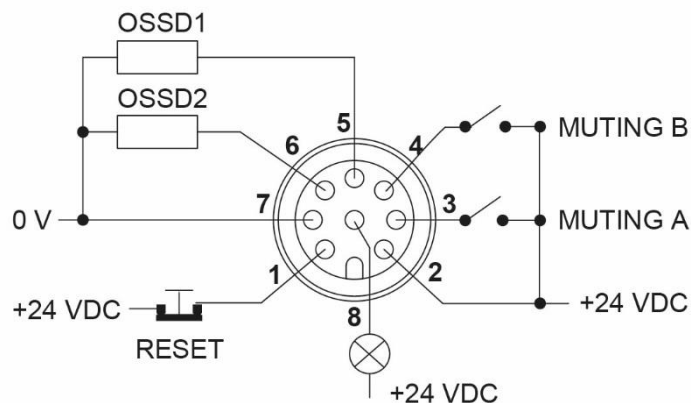
### 5.1 Transmitter (TX)



Pin	Wire <sup>1</sup>	Function	Connection to	Refer to
1	Brown	Supply	+24 VDC	
2	White	Not used		
3	Blue	Supply	0 V	
4	Black	Not used		

<sup>1</sup>Colors according to ABB Jokab Safety standard cables

## 5.2 Receiver (RX)




Pin	Wire <sup>1</sup>	Function	Connection to	Refer to
1	White	RESET ACKN. EDM	Auto. Reset with no function	7.3, 7.4, 7.5
			Auto. Reset with EDM	
			Manual Reset with no function	
			Manual Reset with EDM	
2	Brown	Supply	+24 VDC	
3	Green	MUTING A	Muting sensor A	7.6
4	Yellow	MUTING B	Muting sensor B	
5	Grey	OSSD1	Safety control module for ex.	
6	Pink	OSSD2	Safety control module for ex.	
7	Blue	Supply	0 V	
8	Red	Muting lamp	Muting lamp and +24 VDC	7.6

<sup>1</sup>Colors according to ABB Jokab Safety standard cables

### 5.3 Important notes on connections

For the correct functioning of the Orion2 Extended light grids, the following precautions regarding the electrical connections have to be respected:

- Use a suitably insulated low-voltage supply system type SELV or PELV.
- Use only shielded cables for the connection of the two units. It is recommended to connect the shield to Ground on the electrical cabinet side.
- 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.
- If used, the RESET button should be a NC push-button connected to the supply voltage of the AOPD.

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

- If the EDM function is to be used, the normally closed contacts of the monitored external devices should be connected to pin 1 and +24 VDC before powering. If the EDM function is activated and the wire is not correctly connected at powering, the device enters Error mode. See paragraph 7.5 – “EDM function”.
- The Muting function is activated when the muting sensors connected to the AOPD are activated according to the expected sequence, see paragraph 7.6 – “Muting”. The Muting lamp integrated to the receiver is activated accordingly.
- Read about the Muting function and the positioning of the muting sensors in paragraph 7.6 – “Muting”.

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

## 5.4 Connection examples

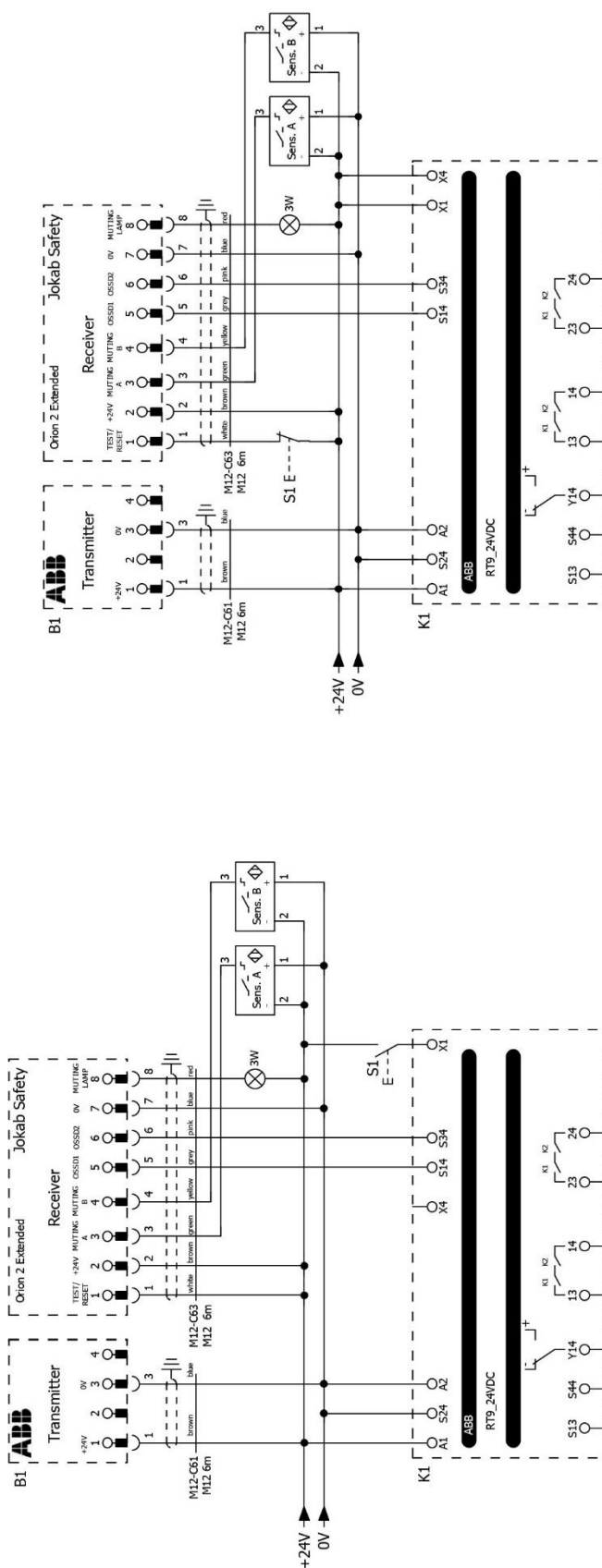


Figure 13 – Connection to a RT9 safety relay

ORION2 Extended with muting sensors

Reset button connected to the light guard

Configuration of the light guard:

- Manual reset
- EDM deactivated

ORION2 Extended with muting sensors

Reset button connected to the safety relay

Configuration of the light guard:

- Automatic reset
- EDM deactivated



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

NB: The OSSD1 and OSSD2 safety contacts cannot be connected in series or in parallel, but can be used separately (Figure 14) conforming to the safety requirements of the plant.

If one of the configurations of Figure 15 is erroneously used, the device enters Error mode (OSSD error, see paragraph 8 – “Diagnostic functions”).

**Warning!** Connect both OSSD outputs to the activating device. Failure to connect an OSSD to the activating device jeopardizes the SIL and/or PL of the system that the AOPD controls.

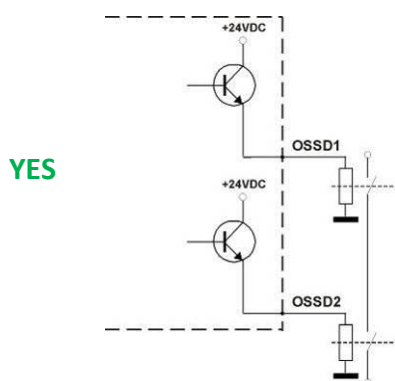


Figure 14 – Correct connection of OSSD outputs

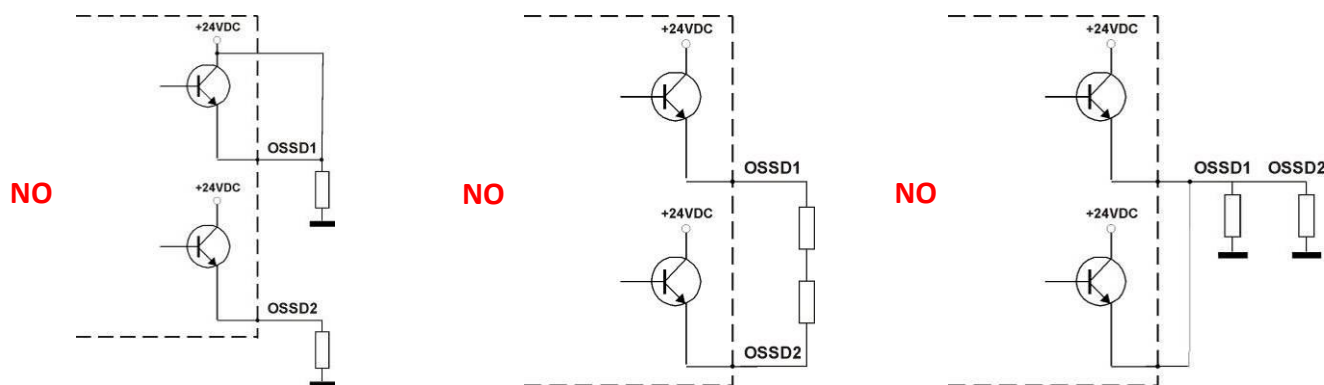


Figure 15 – Incorrect connection of OSSD outputs

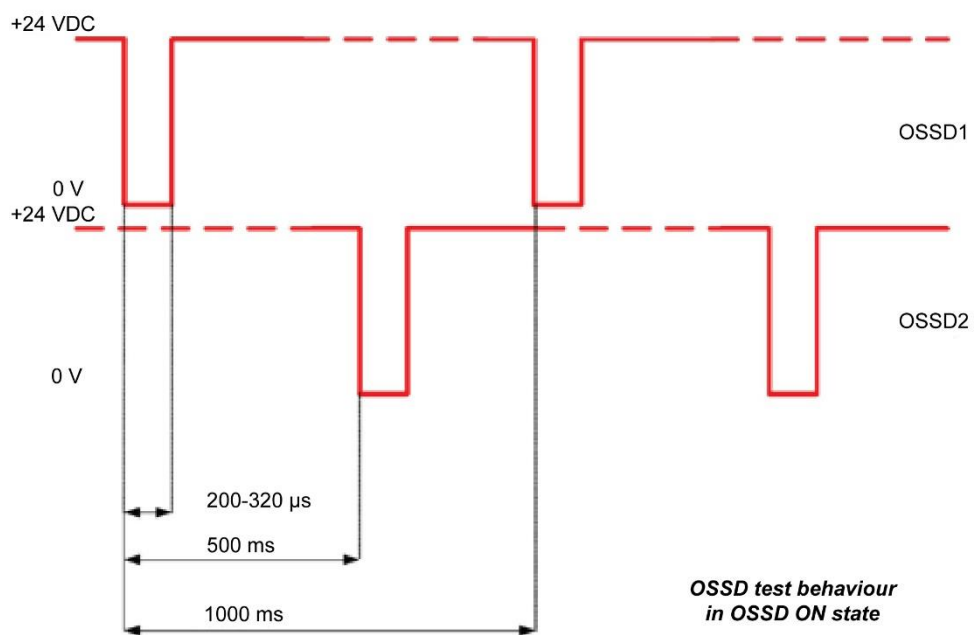


Figure 16 – Time chart of the OSSD outputs

## 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. Two yellow LED indicators (▲LAST, ▼FIRST) facilitate the alignment procedure. The operator can verify the operating condition of the AOPD through four LEDs on the receiver and two LEDs on the transmitter (Figure 17).















Figure 17 – Displays on transmitter and receiver

## 6.1 Correct alignment procedure

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

- Disconnect the power supply.
- Press the RESET button and keep it pressed (open the contact).
- Re-connect the power supply.
- Release the RESET button.
- Check the LEDs at the bottom of the transmitter: if the green one (POWER ON) and the yellow one (EMISSION) are ON, the unit is running correctly.

NB: The OSSD outputs are off in alignment mode.

- Check which one of the following conditions is present on the receiver:
    1. Red LED () on: AOPD not aligned.
    2. Green LED () on: AOPD already aligned. In this case, the two yellow LEDs (FIRST, LAST) are on too.
  - Proceed with the following steps to change from condition 1 to condition 2:
    - A Keep the receiver in a steady position and adjust the transmitter until the lower yellow LED (FIRST) turns on. This condition shows the alignment of the first lower beam.
    - B Rotate the transmitter, pivoting around the lower optics axis, until the upper yellow LED (LAST) turns on. The red LED () must be off and the green LED () on.
- NB: Make sure that the green LED () is on and steady.
- C Slightly turn both units both ways to find the limits of the area in which the green LED () is steady. Place both units in the center of this area.
- Fix the two units firmly using pins and brackets.
  - Disconnect the power supply.
  - Re-connect the power supply.
  - Check that the green LED on the receiver is on when the beams are not interrupted. Then check that the green LED () turns off and the red LED () turns on when one single beam is interrupted.

## 7 Functions

### 7.1 Dip-switch selectable functions

A slot situated on the front side of the receiver (see Figure 18) and easily opened with a screwdriver, facilitates the access to the internal dip-switches

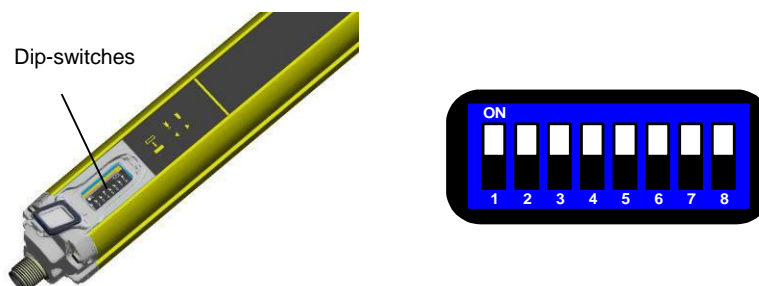


Figure 18 – Location of the dip-switches

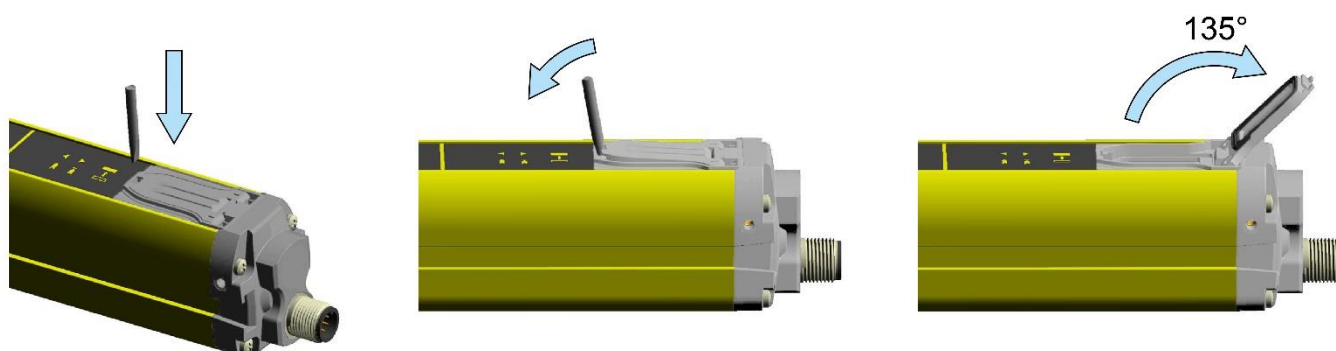


Figure 19 – Lock over the dip-switches

To open the lid, insert the tip of a flat screwdriver into the groove of the hinged lid and lever it up slightly until the snap happens. Open the lid totally (135°). A light brake maintains the lid in open position. To close the lid, press on the zone around the groove until the closing snap.

The dip-switches allow setting the functions as described in the following table:

Dip-switches	Function	ON	OFF
1 and 5	Muting timeout	10 min.	$\infty$
2 and 6	Muting	T/X-muting	L-muting
3 and 7	EDM	Deactivated	Activated
4 and 8	Reset	Automatic	Manual

NB: As shown in the figure and in the previous table, each function is associated with two different dip-switches. The two different dip-switches associated with a particular function must be configured in the same way

**Warning!** An infinite muting (timeout =  $\infty$ ) is not compliant with EN 61496-1:2013. Therefore, all possible risks must be considered and related precautions undertaken before selecting the option “ $\infty$ ”.

**Warning!** The device does not accept configuration changes during normal operation. A change is taken into account after the next powering of the device. Therefore, the management and the use of the configuration dip-switches should be performed with great care.

## 7.2 Configuration at delivery

The device is supplied with the following configuration:

Muting timeout = 10 min
T / X-muting
EDM deactivated
Automatic Reset

N.B: The Muting function can only be activated if the muting sensors are properly connected to the Muting A and Muting B inputs and if one of the lamps operates correctly. If the EDM function is activated and pin 1 is not correctly connected at powering, the device enters Error mode. For further information on these functions, see paragraph 7.6 – “Muting” and paragraph 7.5 – “EDM function”.

## 7.3 Reset function

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

The AOPD can be reset to the OSSD ON state in two different ways:

- **Automatic Reset:**

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

- **Manual Reset:**

When activated, the AOPD returns to OSSD ON once the RESET button has been pushed, provided that the object has been removed from the detection zone. The condition when the object has been removed and the system is waiting for reset is called interlock.

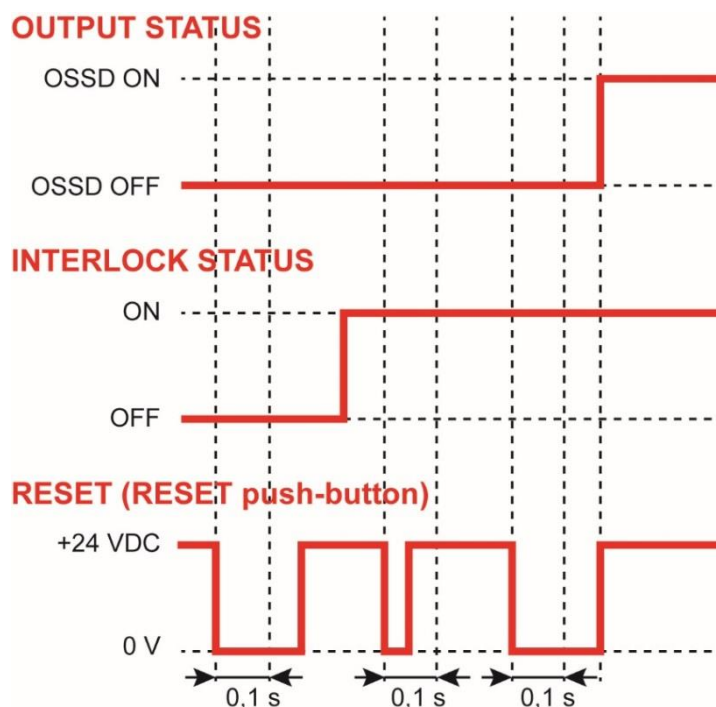


Figure 20 – Time chart of the Manual Reset function

Figure 21 below illustrates how Automatic Reset and Manual Reset work:

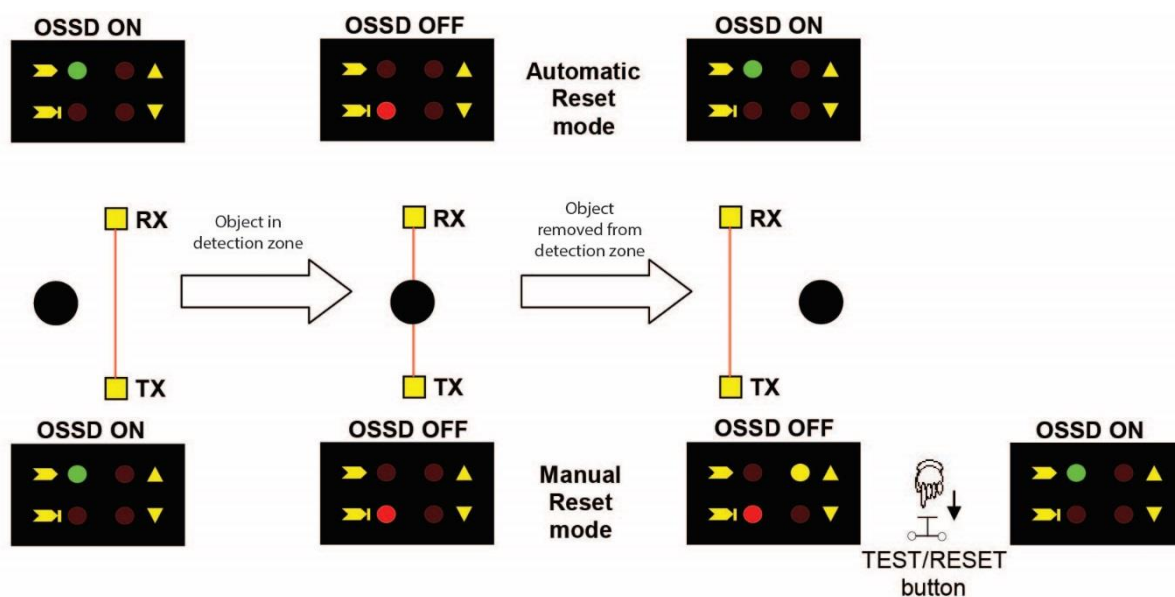


Figure 21 – Automatic/Manual Reset

The selection of the Manual/Automatic Reset function is made with the dip-switches placed under the lid on the receiver: dip-switches 4 and 8 must be ON for the Automatic Reset function and OFF for the Manual Reset function.

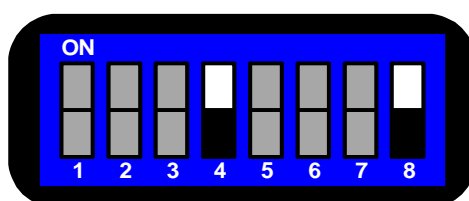


Figure 22 – Dip-switch settings for Automatic Reset function

NB: The dip-switches in grey are not used for this function. The used dip-switches are in white and have to be in the ON position for an Automatic Reset function.



## 7.4 Acknowledge function

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

The Acknowledge function is activated by pressing the RESET push-button for at least 5 s. The AOPD then returns to normal operation mode.

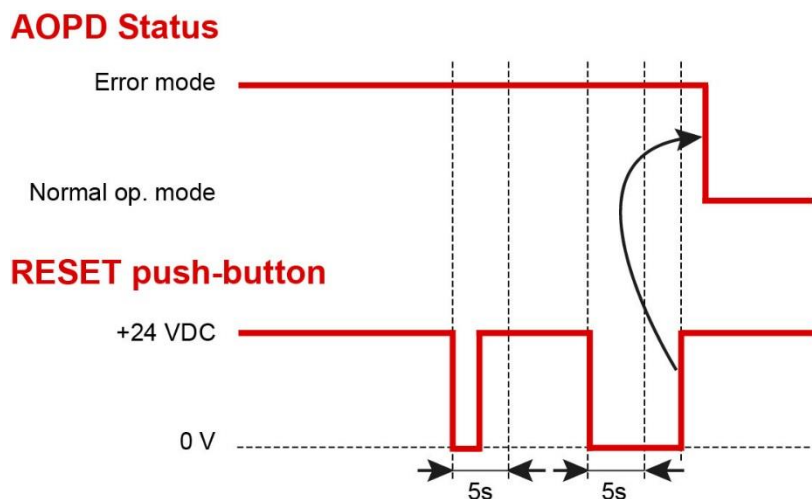


Figure 23 – Time chart of the Acknowledge function

## 7.5 EDM function

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

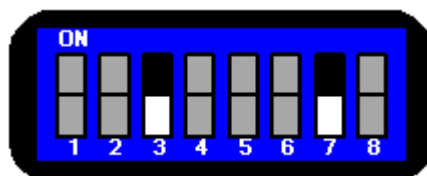


Figure 24 – Dip-switches 3 and 7 OFF to activate the EDM function

To correctly use this function:

- activate it using the corresponding dip-switches,
- connect pin1 to +24 VDC through the normally closed contacts of the device to be monitored.

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

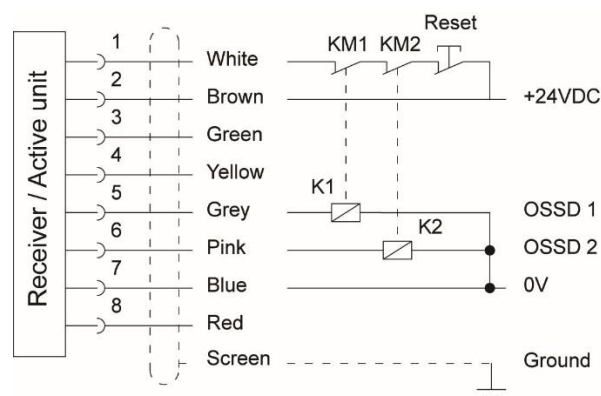


Figure 25 – Connection of EDM, e.g. external contactors K1 and K2

## OUTPUT STATUS

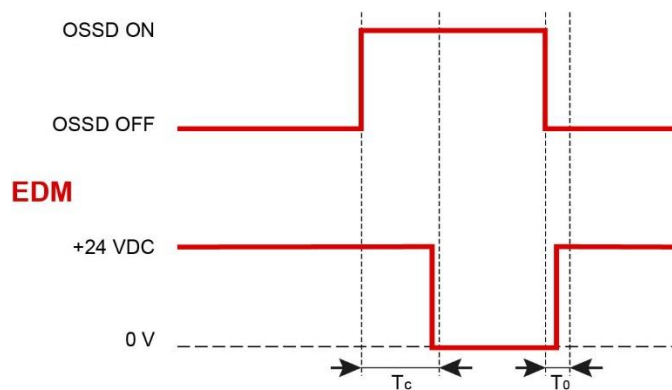


Figure 26 – Time chart of the EDM function

$T_C$  and  $T_0$  are the times between the change of state of the OSSD outputs and the change of state of the NC contacts of the external devices.

$T_C \leq 200$  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.

The use of non-conform devices may cause errors. Periodical testing of the function is recommended.

## 7.6 Muting

The Muting function allows automatic bypassing of the safety function on the whole 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.

This function is particularly suitable when an object, but not a person, has to pass through the hazard zone, under certain conditions.

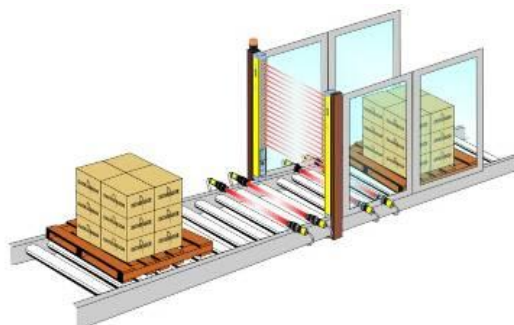


Figure 27 – Example of muting application

**Warning!** 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.

### 7.6.1 Typical muting application and connection of the AOPD

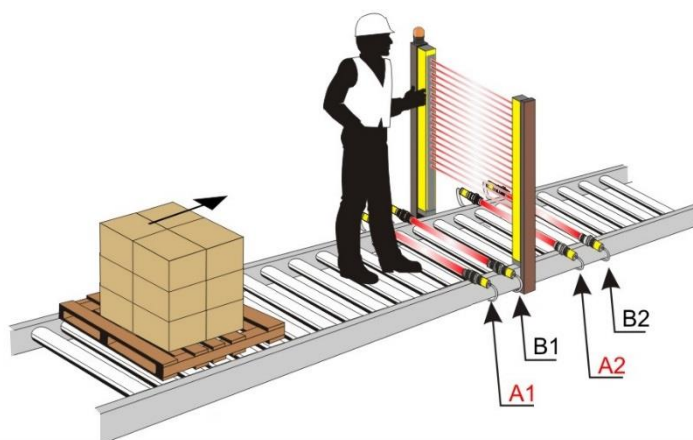


Figure 28 – Typical muting application

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

**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.

- The AOPD has two inputs (MUTING A and MUTING B) for the activation of this function, according to the current standards.
- The output of the muting sensors (A1, B1, A2 and B2) are connected to the Muting A and Muting B inputs.
- The outputs of the muting sensors should be high when the object is detected.
- The muting sensors can be optical sensors, mechanical sensors, proximity sensors, etc.
- Following a correct activation sequence of these sensors, the AOPD is temporarily bypassed.
- If MUTING A and MUTING B 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.
- MUTING A and MUTING B cannot be activated simultaneously.
- Muting cannot be requested when the OSSD outputs are off.
- The muting signals are allowed to drop 100 ms max.
- The value of the muting timeout is chosen between 10 min and infinite with dip-switches 1 and 5.

**⚠ Warning!** An infinite muting (timeout =  $\infty$ ) is not compliant with EN 61496-1:2013. Therefore, all possible risks must be considered and related precautions undertaken before selecting the option “ $\infty$ ”.



Figure 29 – Integrated lamp

- When the Muting function is on, the integrated lamp on the top of the receiver is on and the lamp output (pin 8) is driven.
- If both the integrated lamp and the external lamp are 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.

**⚠ Warning!** The lamps should be as visible as possible.

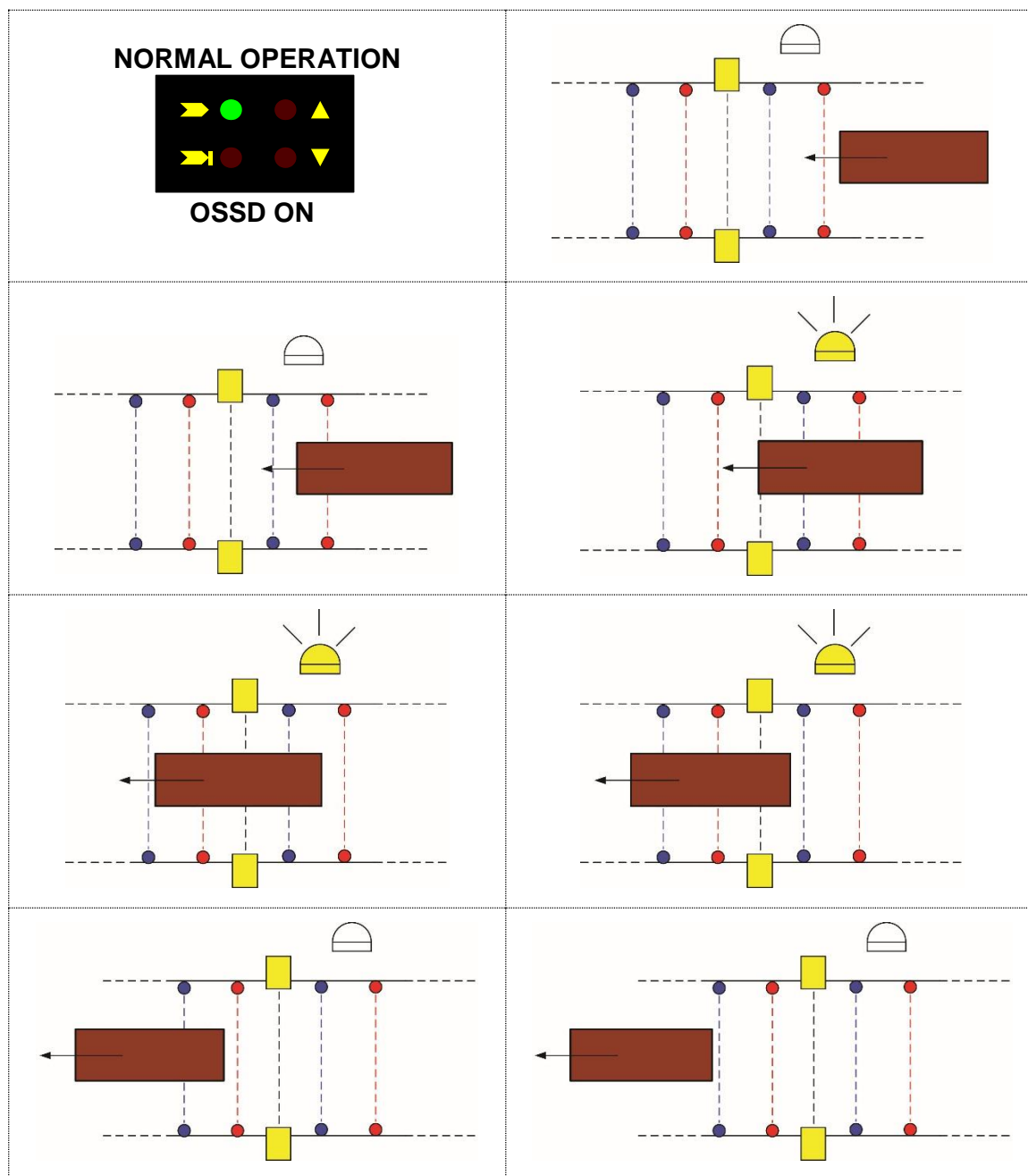


Figure 30 – The muting lamp is on when the muting function is activated

## 7.6.2 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 is chosen with the dip-switches 2 and 6 and T / X-muting is the configuration at delivery (2 and 6 ON).

**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.

### 7.6.3 T / X-muting

Suitable when the objects/"boxes" can move in both directions. This is the default setting.

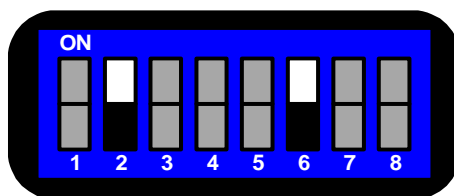


Figure 31 – Dip-switches 2 and 6 ON for T / X-muting

- T-muting demands four muting sensors, A1, B1, A2 and B2.
- X-muting demands two muting sensors, A1 and B2.

The sensors named A1/A2 are connected to MUTING A and the sensors named B1/B2 are connected to MUTING B. The sensors that end with "1" are on the same side of the AOPD and the sensors that end with "2" are on the opposite side of the AOPD.

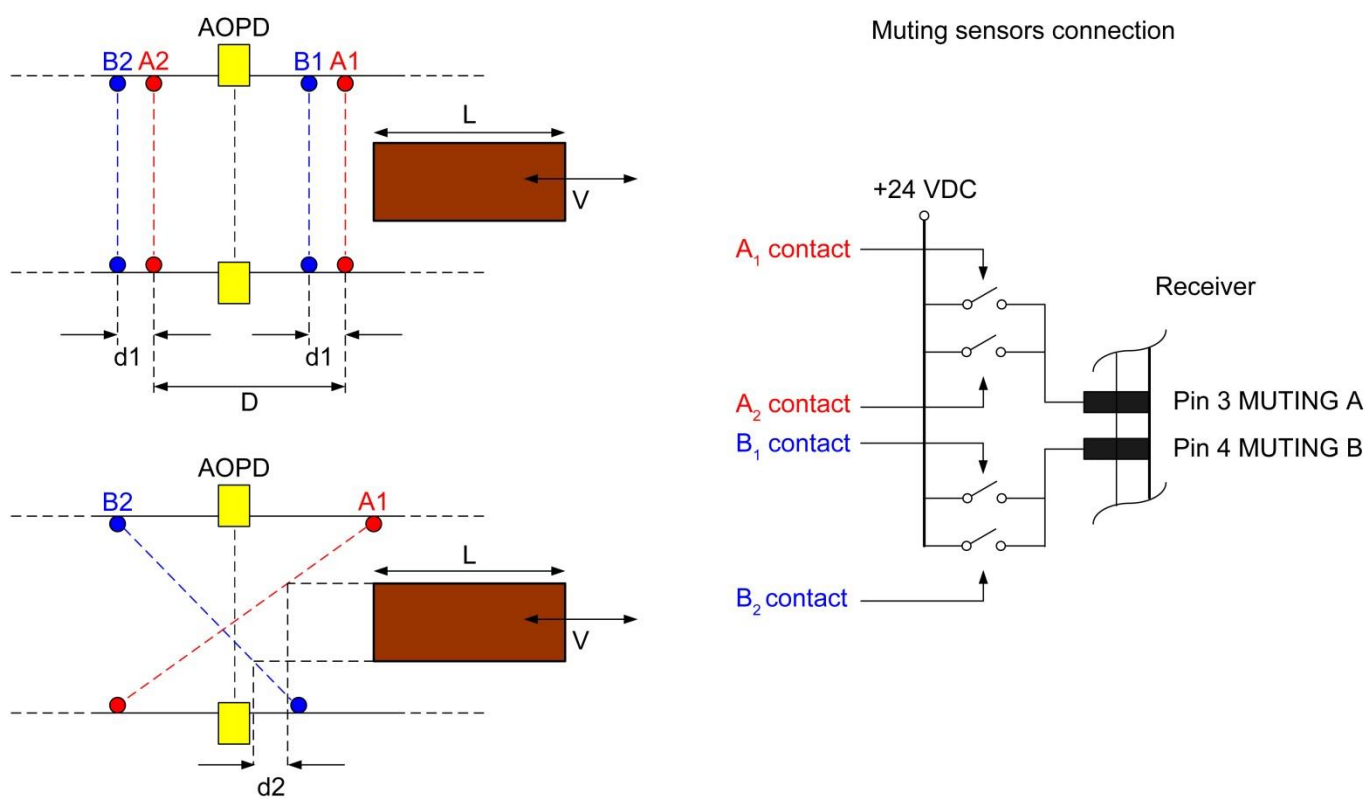


Figure 32 – Connection of T / X-muting

**⚠ Warning!** In X-muting, the crossing point of the two muting sensors must be within the hazard zone.

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 distance between the muting sensors. (d1 depends on V, see below.)
- $d2 =$  The distance for the muting request to be accepted. (d2 depends on V, see below.)
- $T_{AB\ max} =$  The maximum activation delay allowed between MUTING A and MUTING B.

Then

D must be less than L,  $D < L$

$$d1_{\max} [\text{cm}] = V [\text{m/s}] \times T_{AB\ \max} [\text{s}] \times 100$$

$$d2_{\max} [\text{cm}] = V [\text{m/s}] \times T_{AB\ \max} [\text{s}] \times 100$$

NB: guidance in the positioning of the muting sensors can be found in IEC/TS 62046.

In T/X-muting, the Muting function is activated when the signal on MUTING B goes high within a fixed  $t_{AB}$  max time after the rise of the signal on MUTING A or vice versa.

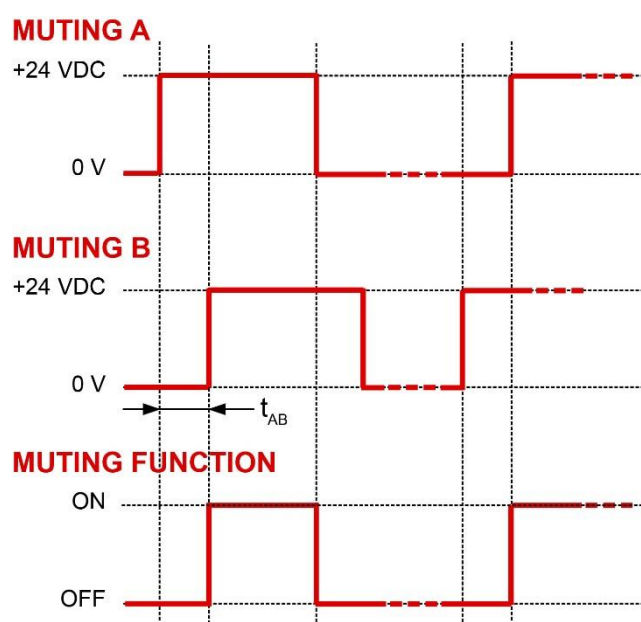


Figure 33 – Time chart of the T / X-muting function

T and X-muting	
$t_{AB}$ min	0,01 s
$t_{AB}$ max	4 s
End of muting	As soon as A or B goes low
Muting timeout (maximum muting time if the conditions of muting persist, e.g. if the “box” stops during the transit)	10 minutes if dip-switches 1 and 5 ON Infinite if dip-switches 1 and 5 OFF (“10 min” is the default value, see paragraphs 7.1 and 7.2)

**Warning!** An infinite muting (timeout =  $\infty$ ) is not compliant with EN 61496-1:2013. Therefore, all possible risks must be considered and related precautions undertaken before selecting the option “ $\infty$ ”.



## 7.6.4 L-muting

Suitable when the objects/“boxes” move in one direction only.

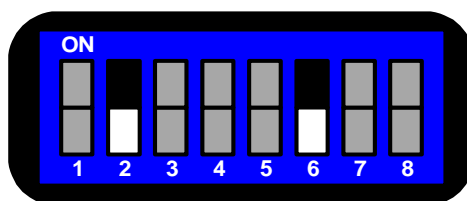


Figure 34 – Dip-switches 2 and 6 OFF for L-muting

- L-muting demands two muting sensors, A and B.

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.

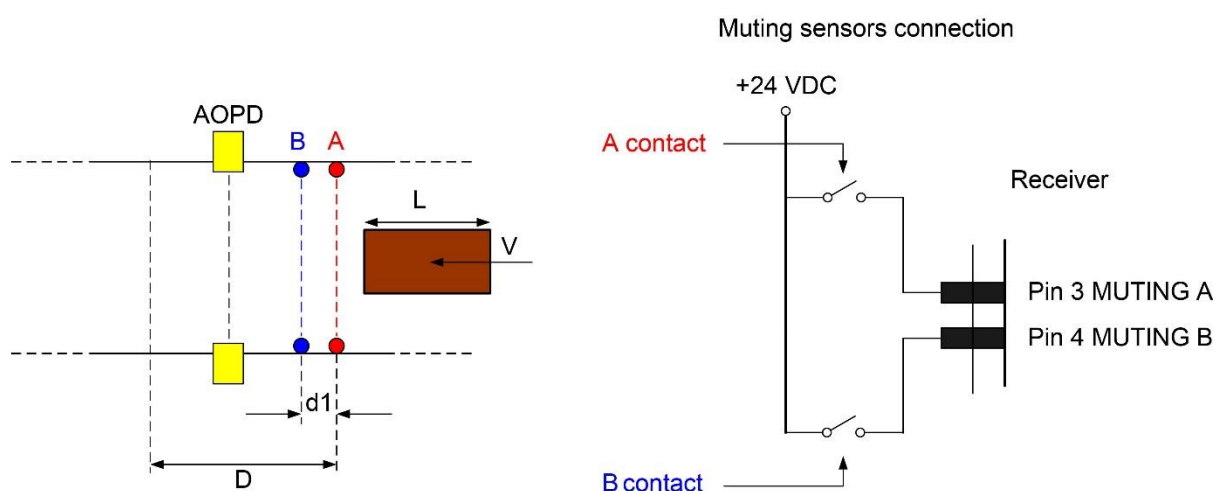


Figure 35 – Connection of L muting

**⚠ Warning!** In L-muting, the two muting sensors must be within the hazard zone and the “box” shall be allowed to go out of the hazard zone only.

If

- $L$  = The length of the “box”.
- $V$  = The speed of the “box”.
- $d1$  = The distance between the muting sensors. ( $d1$  depends on  $V$ , see below.)
- $T_{AB \text{ max}}$  = The maximum activation delay allowed between MUTING A and MUTING B.

Then

$$d1_{\text{max}} [\text{cm}] = V [\text{m/s}] \times T_{AB \text{ max}} [\text{s}] \times 100$$

NB: guidance in the positioning of the muting sensors can be found in IEC/TS 62046.

In L-muting mode, the Muting function is activated when the signal on MUTING B goes high within a fixed  $t_{AB}$  max time after the rise of the signal on MUTING A.

NB: MUTING A has to go high first. If MUTING B goes high before MUTING A, the Muting function is not activated.

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

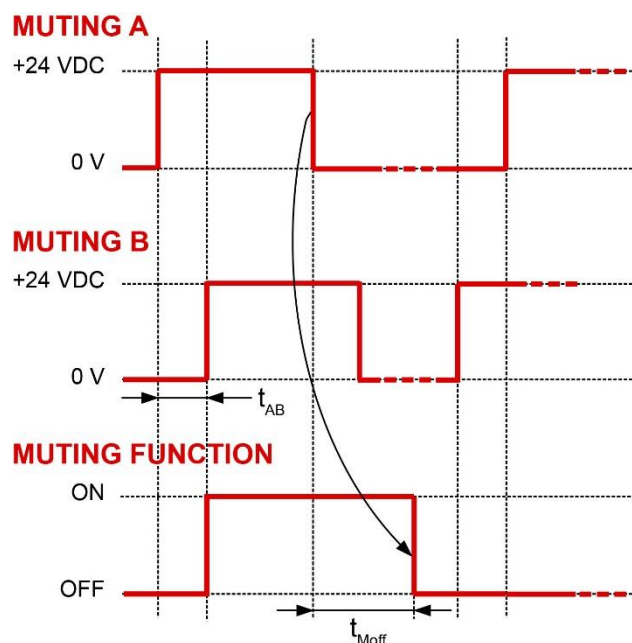


Figure 36 – Time chart of the L-muting function

L-muting	
$t_{AB}$ min	0,01 s
$t_{AB}$ max	4 s
End of muting ( $t_{Moff}$ )	$2 \times t_{AB}$ from when MUTING A goes low
Muting timeout (maximum muting time if the conditions of muting persist, e.g. if the “box” stops during the transit)	10 minutes if dip-switches 1 and 5 ON Infinite if dip-switches 1 and 5 OFF (“10 min” is the default value, see paragraphs 7.1 and 7.2)

**Warning!** An infinite muting (timeout =  $\infty$ ) is not compliant with EN 61496-1:2013. Therefore, all possible risks must be considered and related precautions undertaken before selecting the option “ $\infty$ ”.

## 7.7 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.

**⚠ Warning!** Make sure that the operator can check the entire hazard zone during the whole override operation.

- To start override, the OSSD outputs must be switched off and at least one beam must be interrupted.
- If the entire detection zone is free for more than 2 s, the override function is immediately deactivated.
- The maximum timeout for the override function is 600 s. After this timeout, the OSSD outputs will switch on if the AOPD is in Automatic Reset, or wait for reset of the AOPD is in Manual Reset.
- The standard requires the use of a device like a hold-to-run device so that it is impossible to enter the hazardous zone while maintaining the action on the device.
- When the Override function is on, the integrated lamp on the top of the receiver is on and the lamp output (pin 8) is driven.
- If both the integrated lamp and the external lamp are broken and/or not connected, the override request causes the AOPD to enter Error mode and the OSSD outputs to switch off. The corresponding error is indicated.

When the requirements are met, the display informs the user that an override is possible and required.



Figure 37 – Indication that the override function can be activated

### 7.7.1 Override at start-up

- Switch off the power supply.
- Restore the power supply and press the RESET button after approx. 5 s but within 9 s and keep it pressed for at least 5 s. The OSSD outputs switch on and remain activated for a maximum time of 600 s.
- The override function is now activated and the integrated lamp flashes. So does the external lamp if connected.
- If the AOPD is in Automatic Reset, the OSSD outputs remain on after the end of the override.
- If the AOPD is in Manual Reset, the RESET button must be pushed and released after the end of the override in order to switch the OSSD outputs on.

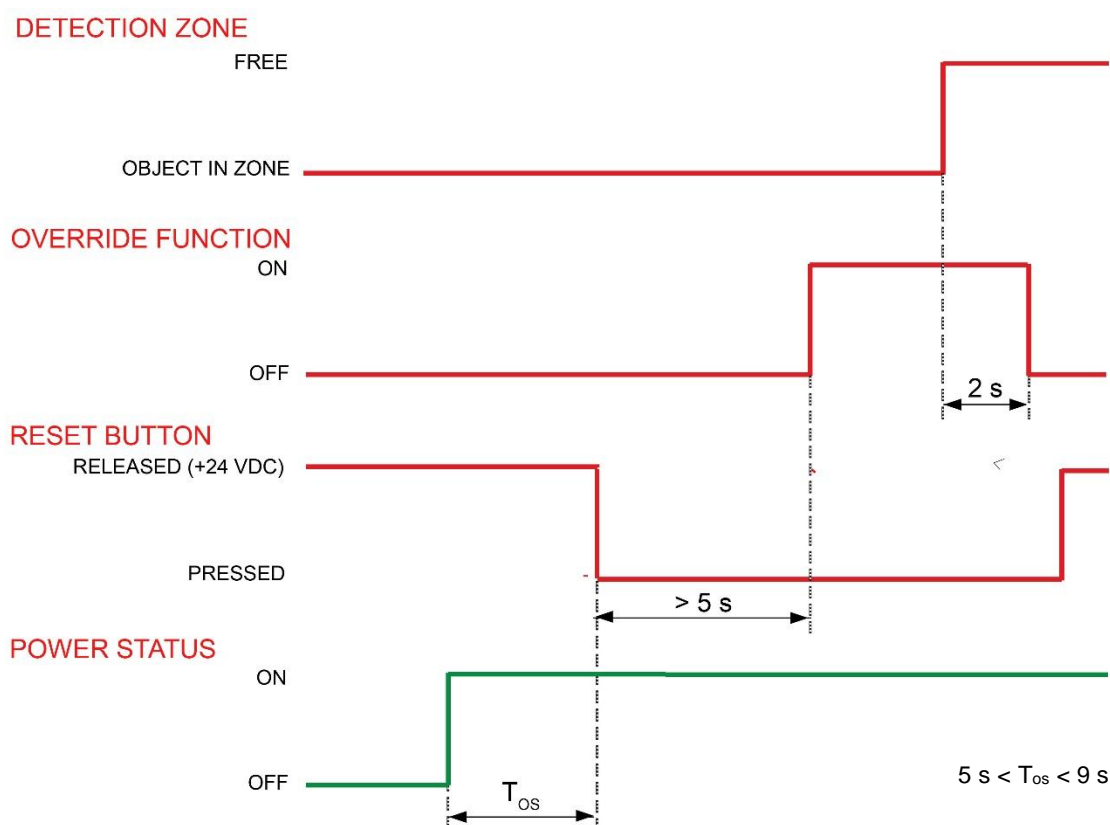


Figure 38 – Time chart for the Override function at start-up

## 7.7.2 Override at run time

- One or both muting inputs must be active.
- Press and release the RESET button 3 times < 1 s. The OSSD outputs will be activated for more than 2 s and 600 s max.
- The override function is now activated and the integrated lamp flashes. So does the external lamp if connected.
- If the AOPD is in Automatic Reset, the OSSD outputs remain on after the end of the override.
- If the AOPD is in Manual Reset, the RESET button must be pushed and released after the end of the override in order to switch the OSSD outputs on.

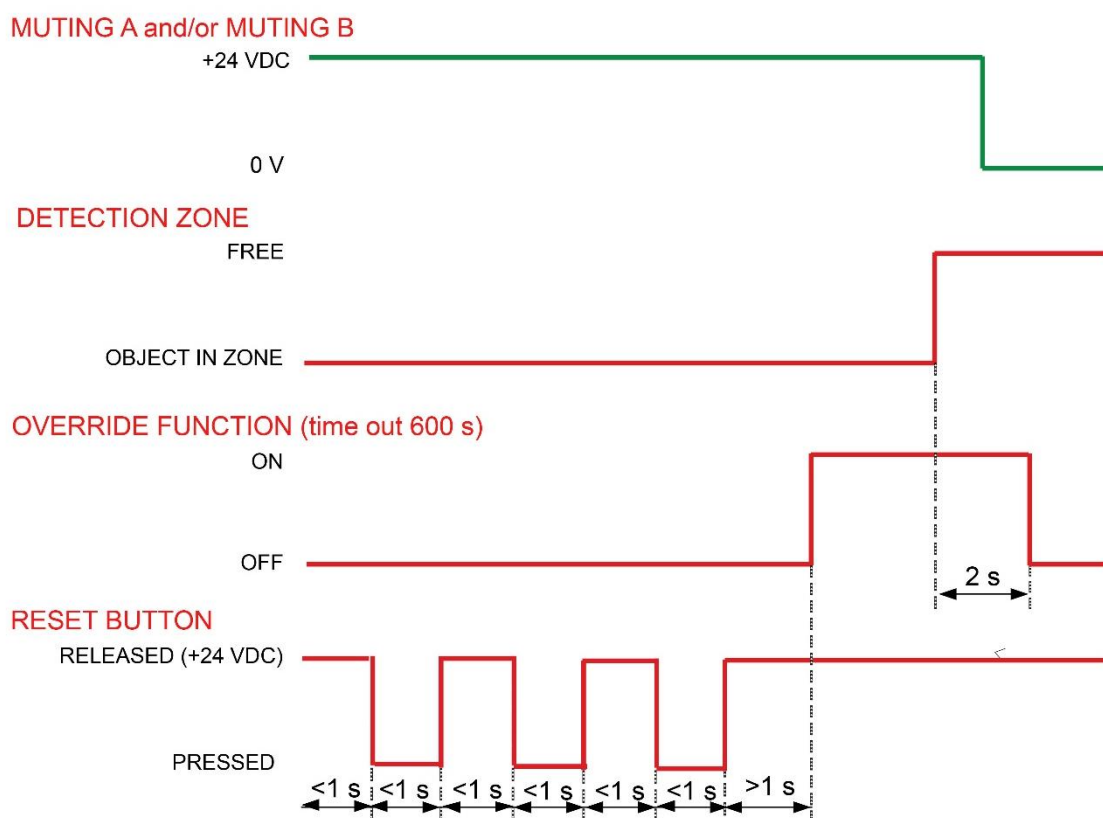


Figure 39 – Time chart for the Override function at run time

## 8 Diagnostic functions

### 8.1 Visualization of the status of the AOPD

The operator can check the status of the AOPD using four LEDs on the receiver and two LEDs on the transmitter (Figure 40).



Figure 40 – LED display on the receiver and the transmitter

### 8.2 LEDs on the transmitter

- Yellow LED (EMISSION): when on, the unit is transmitting correctly.
- Green LED (POWER ON): when on, the unit is correctly powered.

### 8.3 LEDs on the receiver

The meaning of the LEDs on the receiver depends on the operating mode of the AOPD.

#### 8.3.1 Alignment mode

In this mode, the OSSD outputs are off (➡|).

- Green LED (➡): on when transmitter and receiver are aligned and no object is in the detection zone.
- Red LED (➡|): on when the transmitter and the transmitter are not aligned or an object is in the detection zone.
- Yellow LED (▲ LAST): on when the last optical beam of the transmitter is correctly aligned with the corresponding optical beam of the receiver (top of the device).
- Yellow LED (▼ FIRST): on when the first optical beam of the transmitter is correctly aligned with the corresponding optical beam of the receiver (bottom of the device).




### 8.3.2 Normal operation mode

- Green LED (➡): on when no object is in the detection zone.
- Red LED (➡I): on when an object is in the detection zone and the OSSD outputs are off.
- Yellow LED (▲LAST): continuously on when the AOPD is in INTERLOCK mode. In order to reset the AOPD, the RESET button must be pushed after the object has been removed from the detection zone. This occurs only when the Manual Reset function is activated.








## 8.4 Diagnostic messages

The operator can evaluate the main causes of system stops and errors, using the same LEDs as above.

### 8.4.1 Transmitter:

Display	Description	Action
<p><i>ON green</i></p>  <p><i>Flashing yellow</i></p>	Generic error on transmitter side	- Check the power supply; if the error persists, contact your ABB Jokab Safety representative and replace both units.
<p><i>OFF</i></p>  <p><i>OFF</i></p>	Power supply error	- Check the power supply; if the error persists, contact your ABB Jokab Safety representative.
<p><i>ON green</i></p>  <p><i>OFF</i></p>	<p>The power supply voltage is outside the allowed range</p> <p>Main microprocessor error</p>	- Check the power supply; if the error persists, contact your ABB Jokab Safety representative.

## 8.4.2 Receiver:



Display	Description	Action
<p> <i>OFF</i>      <i>Flashing yellow</i>    <i>Flashing red</i>      <i>Flashing yellow</i> </p>	OSSD error	<ul style="list-style-type: none"> <li>- Check the wiring and connections of the OSSD outputs. Make sure that there is no short-circuit between them or with the supply voltage. See also 5.4 – “Connection examples”.</li> <li>- Check that the load characteristics are in accordance with the Technical data (see paragraph 11 – “Technical data”).</li> </ul>
<p> <i>OFF</i>      <i>OFF</i>    <i>Flashing red</i>      <i>Flashing yellow</i> </p>	EDM error	<ul style="list-style-type: none"> <li>- Check the wiring and connections of the EDM, as well as the time sequence (see the Time chart).</li> <li>- Switch the devices off and on; if the error persists, replace the external switching device.</li> </ul>
<p> <i>OFF</i>      <i>Flashing yellow</i>    <i>OFF</i>      <i>Flashing yellow</i> </p>	Microprocessor error	<ul style="list-style-type: none"> <li>- Check the position of the configuration dip-switches. Dip-switches 5-8 shall be in the same position as dip-switches 1-4.</li> <li>- Switch the devices off and on; if the error persists, contact your ABB Jokab Safety representative.</li> </ul>
<p> <i>OFF</i>      <i>Flashing yellow</i>    <i>Red ON</i>      <i>OFF</i> </p>	Override possible	<ul style="list-style-type: none"> <li>- This is NOT an error.</li> <li>- Activate the Override function to remove the material from the detection zone.</li> </ul>
<p> <i>OFF</i>      <i>OFF</i>    <i>OFF</i>      <i>Flashing yellow</i> </p>	Optical error	<ul style="list-style-type: none"> <li>- Check the alignment.</li> <li>- Switch the devices off and on; if the error persists, contact your ABB Jokab Safety representative.</li> </ul>
<p> <i>Flashing green</i>      <i>Flashing yellow</i>    <i>OFF</i>      <i>Flashing yellow</i> </p>	Integrated lamp error	<ul style="list-style-type: none"> <li>- Switch the devices off and on; if the error persists, contact your ABB Jokab Safety representative.</li> </ul>
<p> <i>OFF</i>      <i>OFF</i>    <i>OFF</i>      <i>OFF</i> </p>	Power supply error Main microprocessor error	<ul style="list-style-type: none"> <li>- Check the wiring and connections of the power supply. Check that its value is within the allowed range.</li> <li>- Switch the devices off and on; if the error persists, contact your ABB Jokab Safety representative.</li> </ul>



## 9 Periodical checks

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

Check that:

- The AOPD remains in OSSD OFF state () during beam interruption along the entire detection zone, using the suitable “Test piece” according to the Figure 11 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  does not turn on.
- The stopping time of the machine, including the response times of the AOPD and of the machine, is within the limits defined 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 frequency of the checks depends on the particular application and on the operating conditions of the AOPD.

## 10 Device maintenance

Orion2 Extended light grids do not require special maintenance operations.

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

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

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

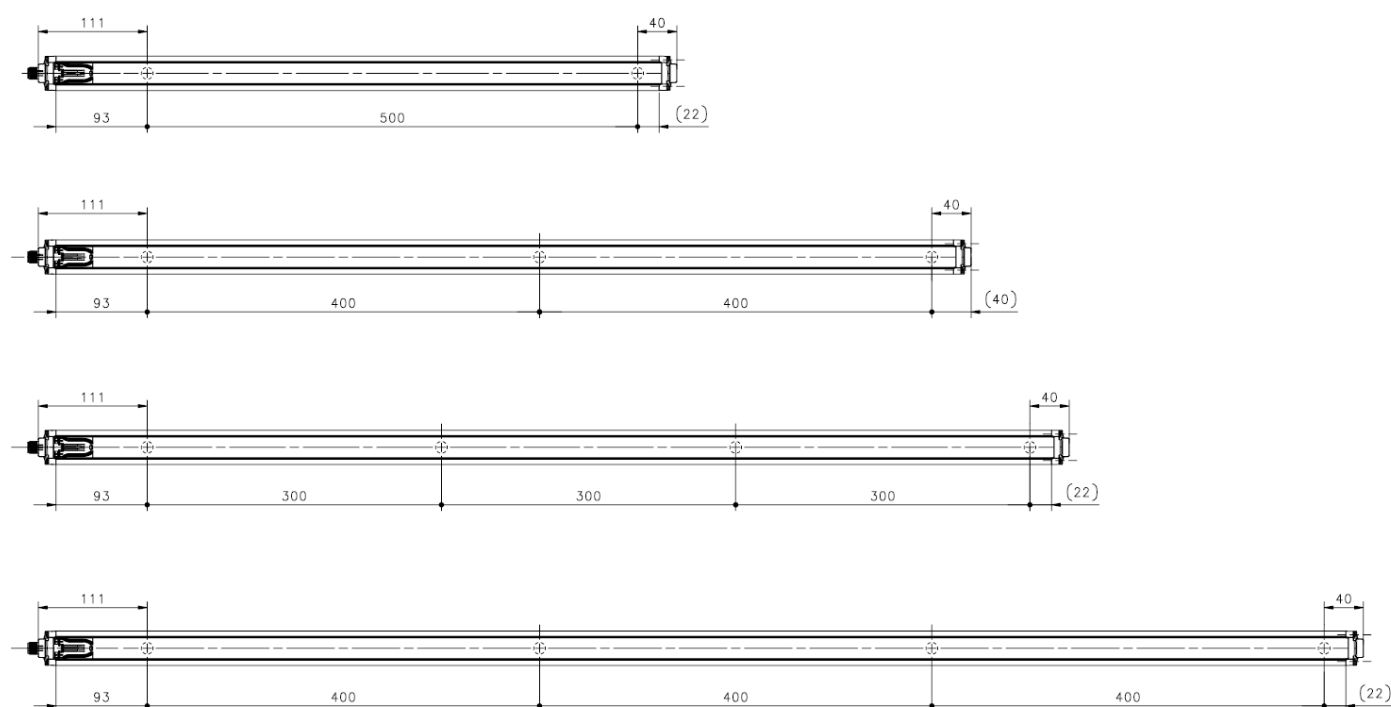
## 11 Technical data

Manufacturer	
Address	ABB JOKAB SAFETY Varlabergsvägen 11 SE-434 39 Kungsbacka Sweden
Electrical data	
Power supply (Vdd):	+24 VDC $\pm$ 20 % (SELV/PELV)
Internal capacitance:	23 nF (TX) /120 nF (RX)
Consumption (TX):	0.5 W during normal operation
Consumption (RX):	2 W during normal operation
Outputs:	2 PNP outputs
Short-circuit protection:	max: 1.4 A at 55 °C, min: 1.1 A at -10 °C
Output current:	0.5 A max / each output
Output voltage – status ON:	Vdd –1 V min
Output voltage – status OFF:	0.2 V max
Leakage current:	< 1 mA
Capacitive load	65 nF max at 25 °C
Resistive load (pure):	56 $\Omega$ min. at +24 VDC
Current for external lamp:	20 mA min, 250 mA max
Response time:	From 14 to 16 ms – See table below
Electrical protection:	Class III – use SELV/PELV
Connections:	Transmitter: M12-4 poles male connector Receiver: M12-8 poles male connector
Optical data	
Emission type:	Infrared (880 nm)
Resolution:	315 mm (4 beams) 415 mm (3 and 4 beams) 515 mm (2 beams)
Operating distance:	0.5...50 m
Ambient light rejection:	According to IEC-61496-2:2013

Mechanical and environmental data		
Operating temperature:	- 10...+ 55 °C	
Storage temperature:	- 25...+ 70 °C	
Temperature class:	T6 (TX / RX)	
Humidity:	15...95 % (no condensation)	
Protection class:	IP65 (EN 60529: 2000)	
Vibrations:	Width 0.35 mm, Frequency 10 ... 55 Hz 20 sweep for each axis, 1 octave /min (EN60068-2-6:2008)	
Shock resistance:	16 ms (10 G) 10 <sup>3</sup> shocks per axis (EN 60068-2-29:2008)	
Housing material:	Painted aluminum (yellow RAL 1003)	
Caps material:	PC Lexan 943A	
Lens material:	PMMA	
Weight:	1.2 kg max./ m for each single unit	
Functional safety data		
EN ISO 13849-1:2008	PL e, Cat 4	
EN IEC 61508-1:2010	SIL 3	
EN IEC 61508-2:2010		
EN IEC 61508-3:2010		
EN IEC 61508-4:2010		
EN IEC 62061:2005/A1:2013	SIL CL 3	
Prob. of Dangerous Error/Hour (1/h)	PFH <sub>d</sub>	2.62x10 <sup>-9</sup>
Life span (years)	T1	20
Mean Time to Dangerous Error (years)	MTTF <sub>d</sub>	384

## 12 Model overview

Model	Article number	Protected height (mm)	Operating distance (m)	Number of beams	Interaxis (mm)	Response time (ms)	Resolution (mm)
Orion2-4-K2-050-E	2TLA022305R0000	515	0.5..50	2	500	14	515
Orion2-4-K3-080-E	2TLA022305R0100	815	0.5..50	3	400	14	415
Orion2-4-K4-090-E	2TLA022305R0200	915	0.5..50	4	300	16	315
Orion2-4-K4-120-E	2TLA022305R0300	1215	0.5..50	4	400	16	415



## 13 Dimensions

### 13.1 Profiles

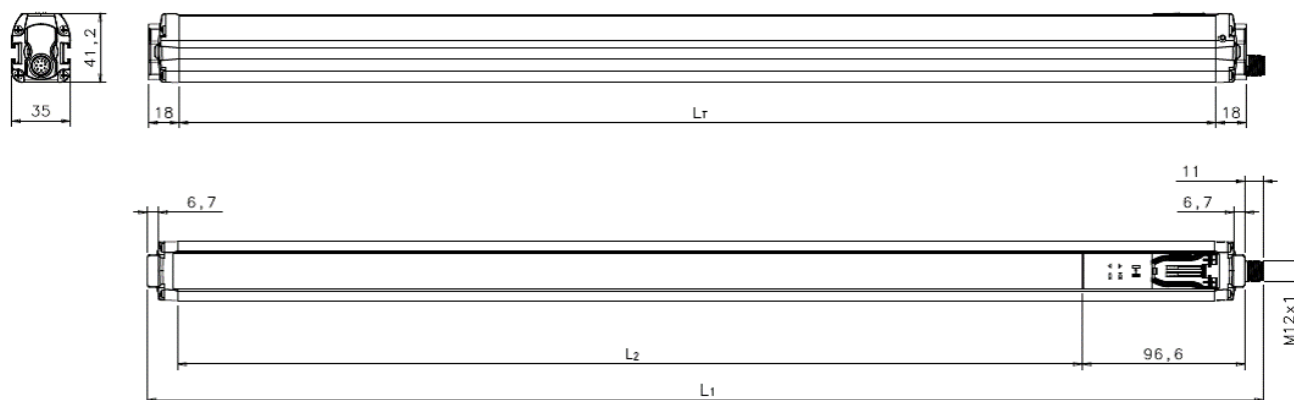


Figure 41 – Dimensions of the profiles

NB: All dimensions in millimeters.

Model	$L_r$ (mm)	$L_1$ (mm)	$L_2$ (mm)
Orion2-4-K2-050-E	617	664	538.4
Orion2-4-K3-080-E	917	964	838.4
Orion2-4-K4-090-E	1017	1064	938.4
Orion2-4-K4-120-E	1317	1364	1238.4

## 13.2 Angled fixing bracket

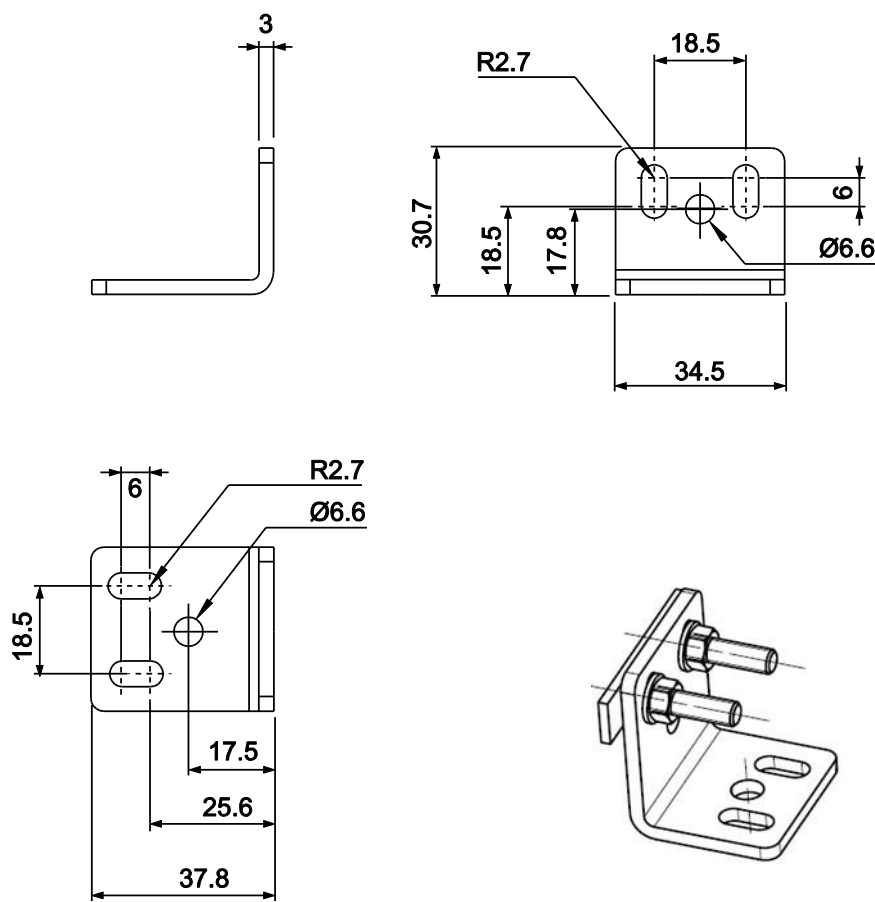


Figure 42 – Dimensions of the angled fixing bracket

NB: All dimensions in millimeters.

## 13.3 Fixing bracket with profile

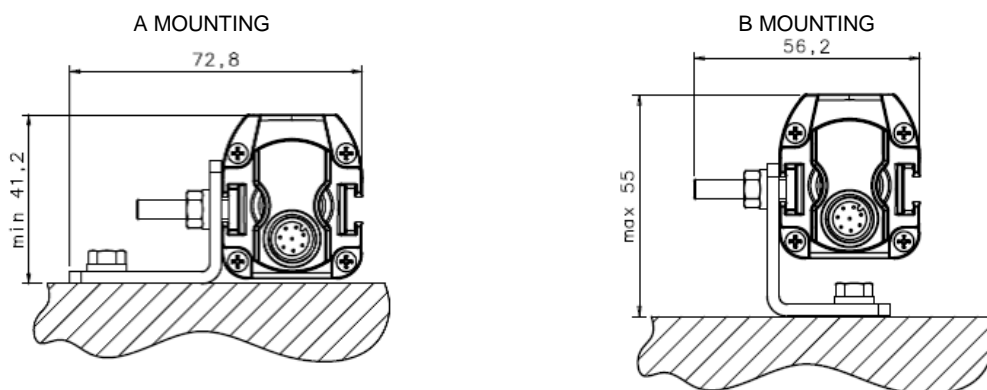


Figure 43 – Dimensions of the angled fixing bracket with a profile

NB: All dimensions in millimeters.

## 14 EC Declaration of conformity



### EC Declaration of conformity

(according to 2006/42/EC, Annex2A)

We **ABB AB**  
JOKAB Safety  
Varlabergsvägen 11  
SE-434 39 Kungsbacka  
Sweden

declare that the safety components of ABB make with type designations and safety functions as listed below, is in conformity with the Directives

2006/42/EC  
2004/108/EC

Authorised to compile the technical file

**ABB AB**  
JOKAB Safety  
Varlabergsvägen 11  
SE-434 39 Kungsbacka  
Sweden

**Product**  
Light curtain/light beam  
Orion, all models

**Certificate**  
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](http://www.abb.com)  
[www.jokabsafety.com](http://www.jokabsafety.com)

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