Original instructions

Orion2 Base

Safety light grids

Type 4 Active Opto-electronic Protective Device (AOPD)

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Table of Contents

1 Introduction

1.1 Scope

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

1.2 Audience

This document is intended for authorized installation personnel.

1.3 Prerequisites

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

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

1.4 Abbreviations

ACM: Advanced Configuration Mode

AOPD: Active Opto-electronic Protective Device

BCM: Basic Configuration Mode

EDM: External Device Monitoring

MPCE: Machine Primary Control Element

OSSD: Output Signal Switching Device (switching output)

RX: Receiver

TX: Transmitter

1.5 Special notes

Pay attention to the following special notes in the document:

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

2 Overview

2.1 General description

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

The Orion2 Base 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/A12013	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 positioned within the AOPD detection zone.

The transmitter and the receiver are equipped with the command and control functions.

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

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

”).

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

During installation, 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 = I + d

where:

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

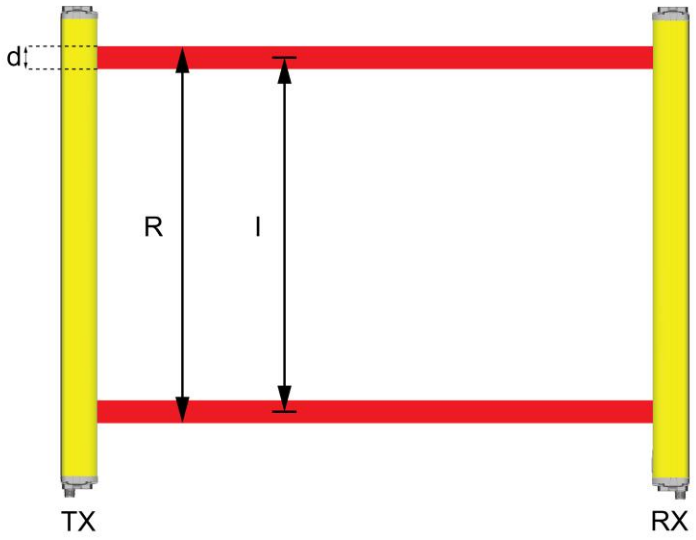


Figure 1 – Resolution

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

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

2.3 Protected height

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.

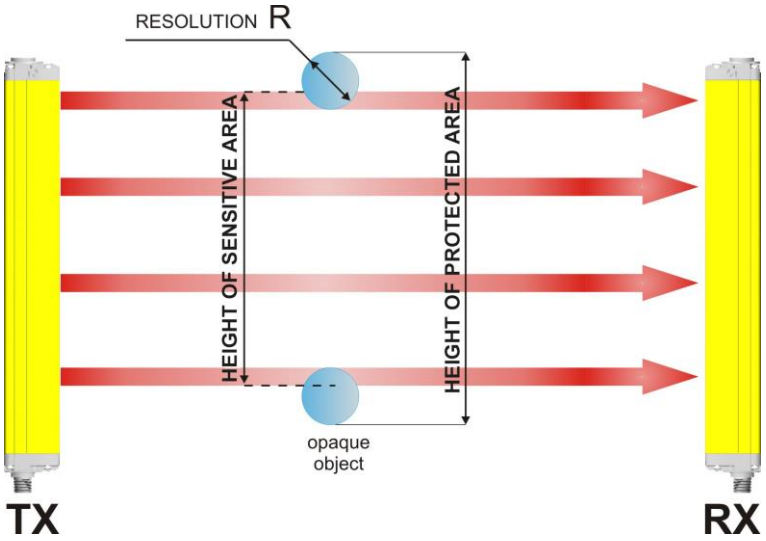


Figure 2 – Protected height

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 × 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.

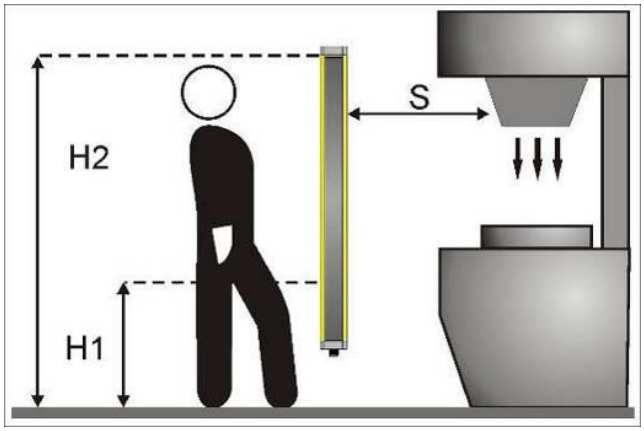


Figure 3 – Minimum distance for a vertically assembled AOPD

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

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

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

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

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

S = K × (T1 + T2) + C

	Orion2-4-K2-050-B	Orion2-4-K4-120-B
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 Base light grids, the following points must be observed:

- The stopping system of the machine must be electrically controlled.
- This control system must be able to stop the hazardous movement of the machine within the total machine stopping time T as per paragraph 2.4 – “Minimum installation distance”, and during all working cycle phases.
- Mounting and connection of the AOPD must be carried out by qualified personnel only, according to the indications included in the special sections (see paragraphs 3; 4; 5; 6) and in the applicable standards.
- The AOPD must be securely placed in a particular position so that access to the hazard zone is not possible without the interruption of the beams (see paragraph 3 – “Installation”).
- The personnel operating in the hazard zone must be well trained and must have adequate knowledge of all the operating procedures of the AOPD.
- The TEST/RESET button must be located outside the hazard zone because the operator must check the hazard zone during all test and 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 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 the presence of smog, fog or airborne dust.
- A sudden change in environment temperature, with very low minimum peaks, can generate a small condensation layer on the lenses and jeopardize the function.

3.2 General information on positioning the AOPD

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

⚠ **Warning!** Figure 4 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 5).

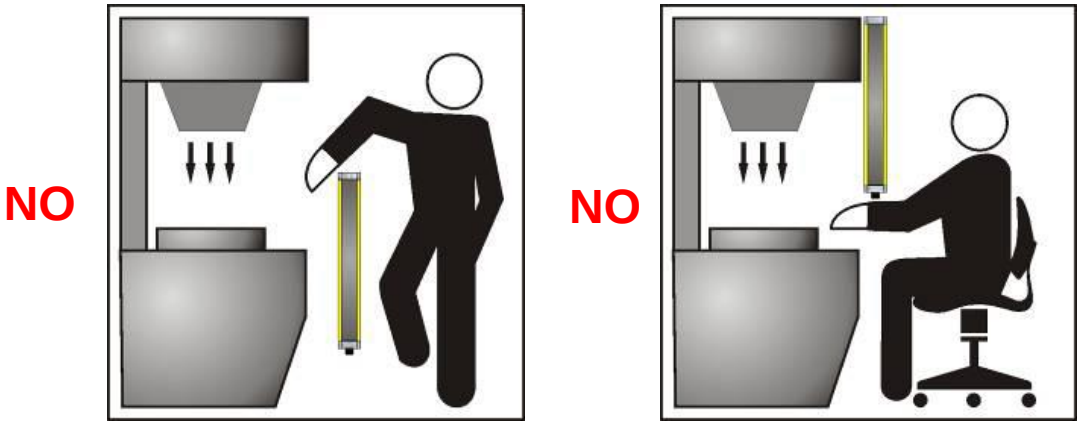


Figure 4 – Incorrect device positioning

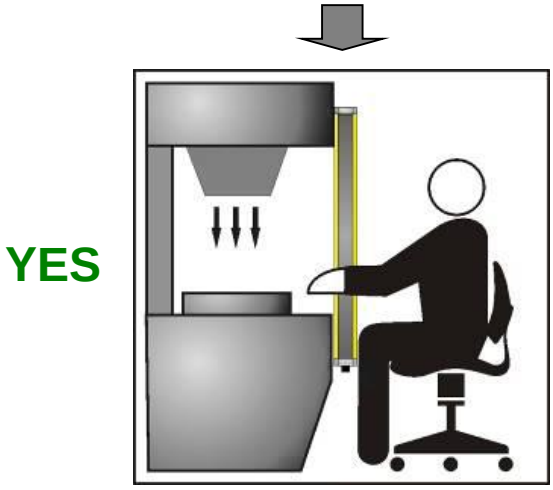


Figure 5 – Correct device positioning

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

When the installation of the AOPD close to the hazard zone is not possible, a second AOPD must be mounted in a horizontal position in order to prevent any lateral access, see Figure 7.

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

NO

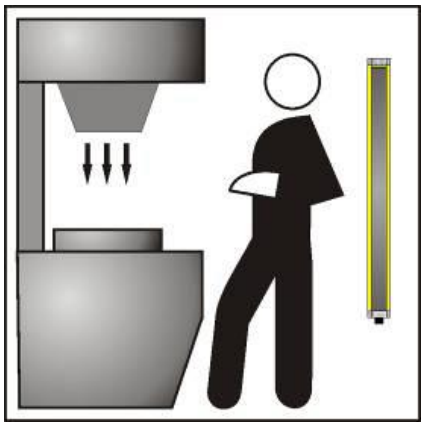


Figure 6 – Incorrect installation

YES

Figure 7 – Correct installation

3.2.1 Minimum installation distance

See paragraph 2.4 – “Minimum installation distance”.

3.2.2 Minimum distance to reflecting surfaces

Reflecting surfaces placed near the light beams of the AOPD (over, under or laterally) can cause passive reflections. These reflections can compromise the recognition of an object inside the detection zone (see Figure 8).

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.

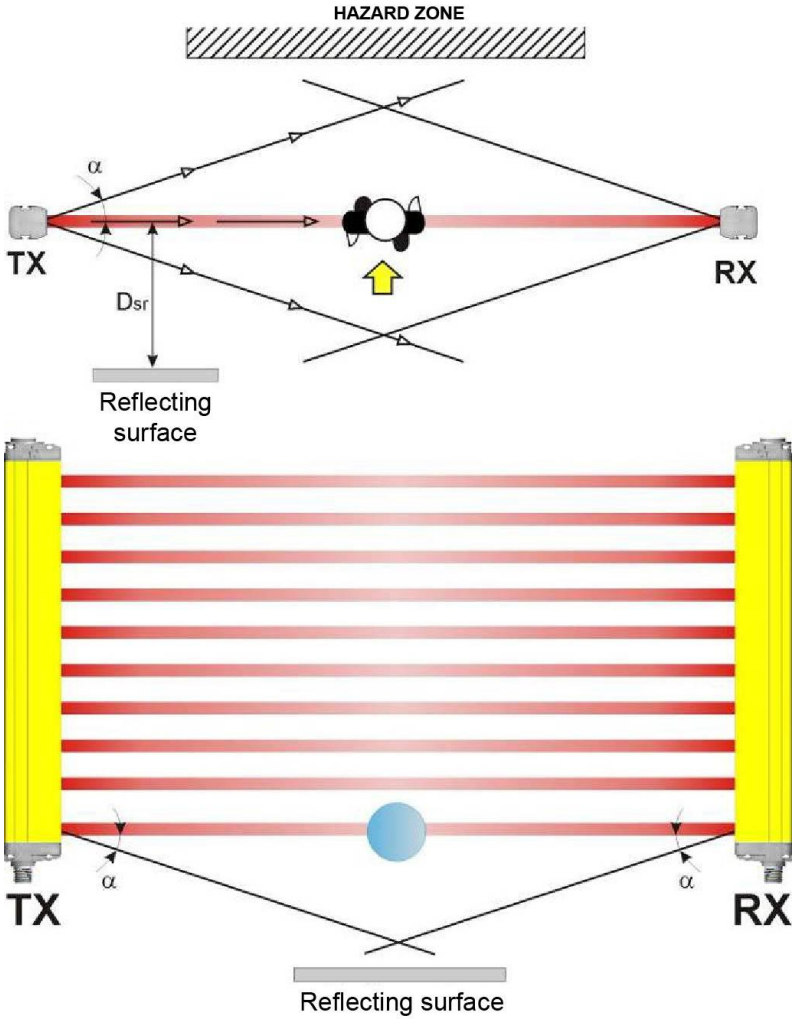


Figure 8 – Distance to reflecting surfaces

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:

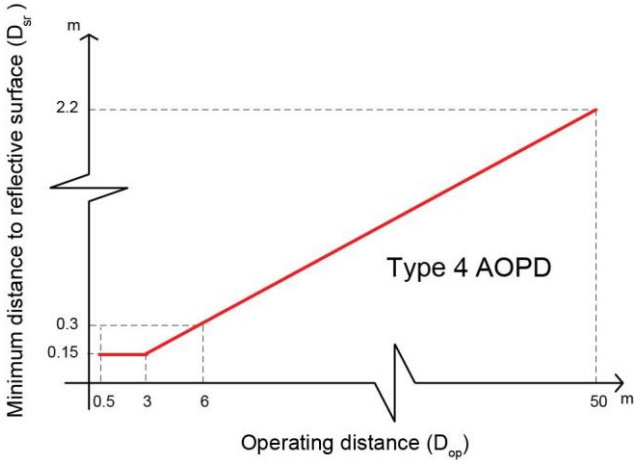


Figure 9 – Minimum distance to a reflective surface as a function of the operating distance

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

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

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

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

3.2.3 Minimum distance between adjacent devices

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

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

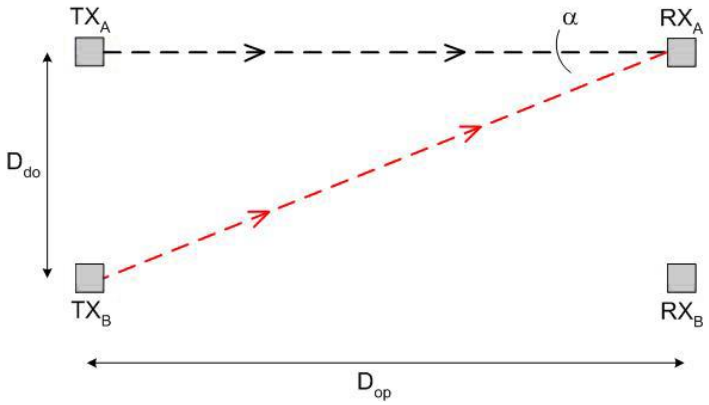


Figure 10 – Distance between adjacent devices

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 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.

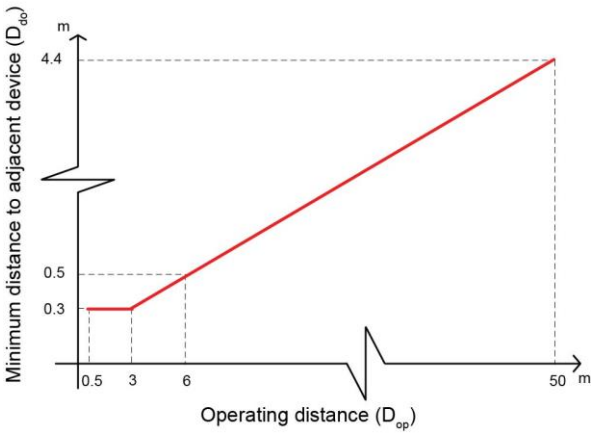


Figure 11 – Minimum distance to an adjacent device as a function of the operating distance

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

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

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

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

3.2.4 Installation of several adjacent AOPDs

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

Figure 12 provides some examples of correct and incorrect installations when it comes to interferences.

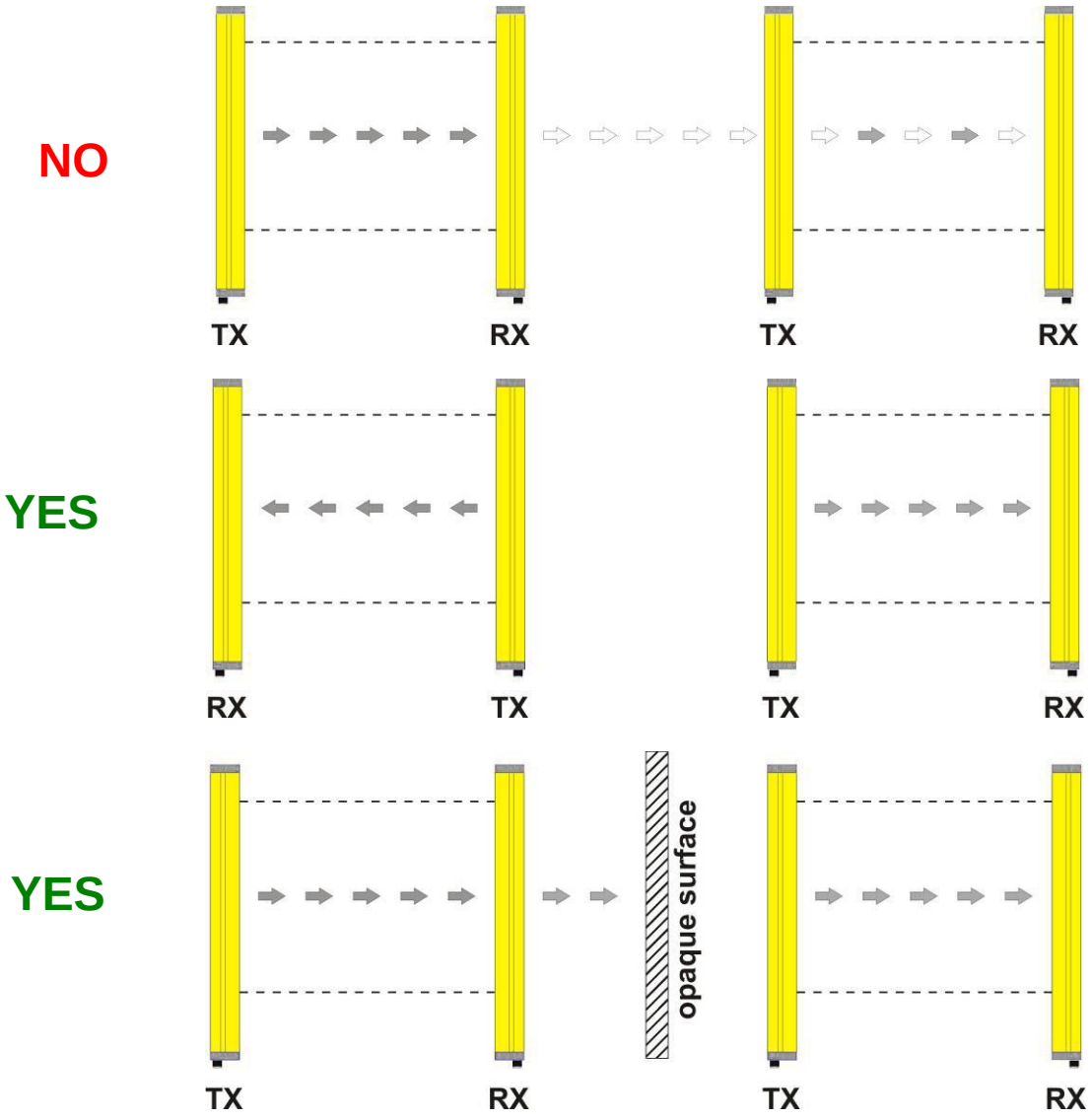


Figure 12 – Installation of several devices close to each other

3.2.5 Transmitter and receiver orientation

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

The configurations shown in Figure 13 must be avoided.

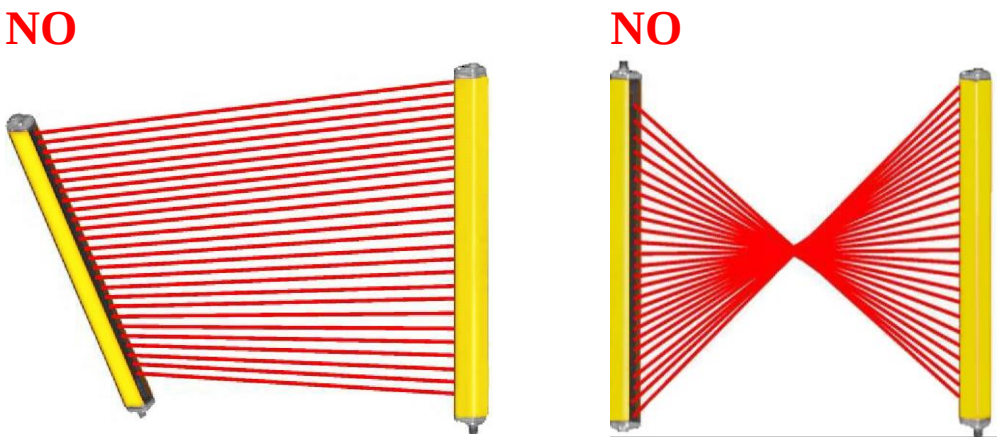


Figure 13 – Incorrect orientation

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

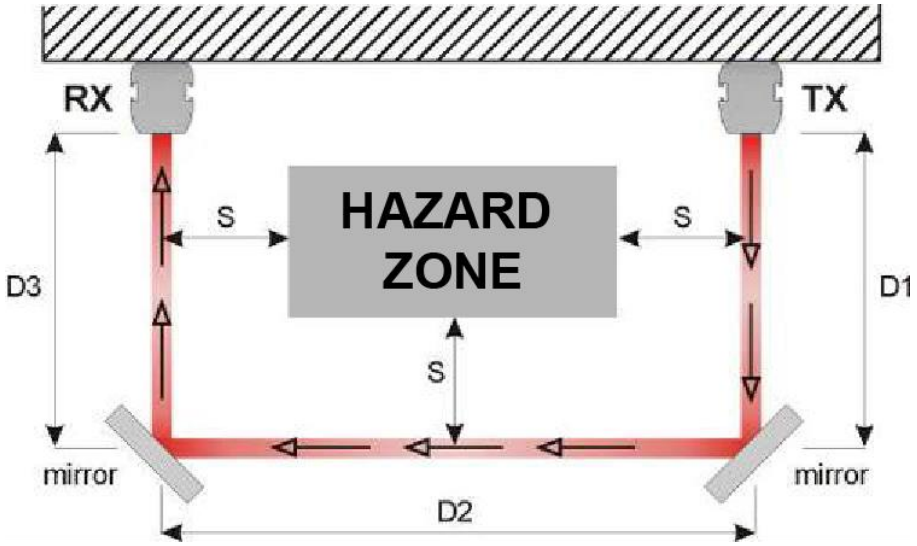


Figure 14 – Use of deviating mirrors

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 (▶I) during beam interruption along the entire detection zone, using the suitable “Test Piece” and following the Figure 15 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.

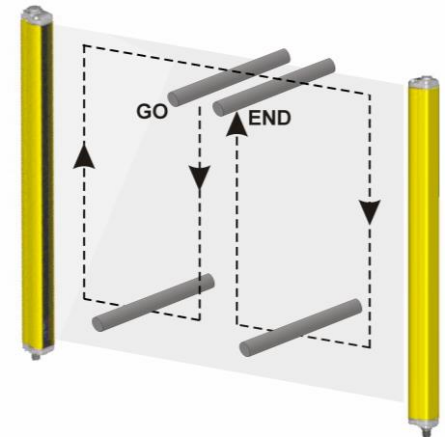


Figure 15 – Scheme for checking the function

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

4 Mechanical mounting

The 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 Base models. To mount the AOPD, insert the supplied threaded pins into the grooves on the two units (see Figure 16).

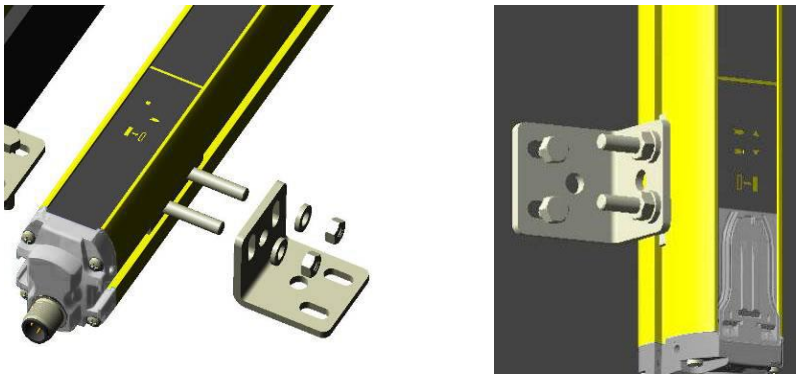


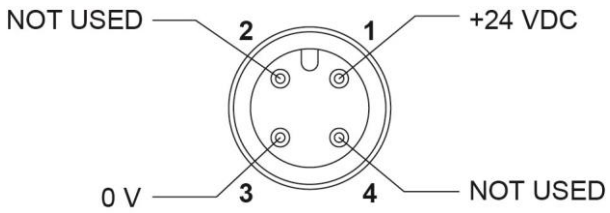
Figure 16 – Mounting with angled fixing brackets

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, a M12-4 pole connector for the transmitter and a M12-8 pole connector for the receiver.

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.

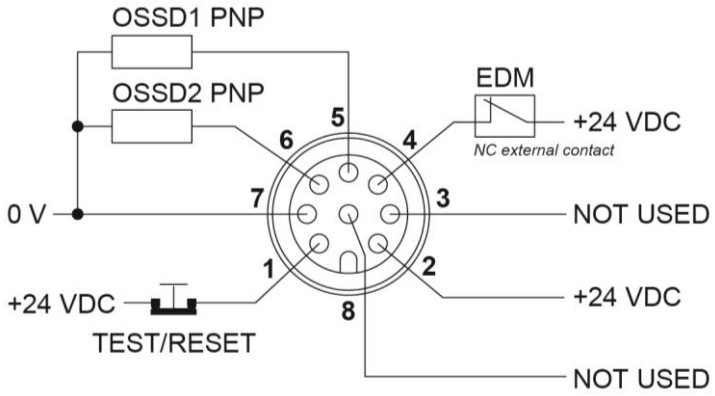
5.1 Transmitter (TX)



Pin	Wire[1]	Function	Connection to	Refer to
1	Brown	Supply	+24 VDC	
2	White	*Not used*		
3	Blue	Supply	0 V	
4	Black	*Not used*		

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

5.2 Receiver (RX)



Pin	Wire[1]	Function		Connection to	Refer to
1	White	TEST/RESET[2]	Auto. Reset with no function	+24 VDC	7.3, 7.4
			Auto. Reset with Acknowledge function or Alignment mode	NC contact to +24 VDC	
			Manual Reset	NC contact to +24 VDC	
2	Brown	Supply		+24 VDC	
3	Green	*Not used*			
4	Yellow	EDM[2]	Function used/activated	NC contact of force-guided relay	7.6
			Function not used/deactivated	Not connected	
5	Grey	OSSD1		Safety control module for ex.	
6	Pink	OSSD2		Safety control module for ex.	
7	Blue	Supply		0 V	
8	Red	*Not used*			

[1] Colors according to ABB Jokab Safety standard cables.
[2] Automatic/manual reset and EDM functions are configured with dip-switches.

5.3 Important notes on connections

For the correct functioning of the Orion2 Base 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 cables undergoing high current variations (e.g. motor power supplies, inverters, etc.).
- Do not connect the OSSD wires of different AOPDs in the same multi-pole cable.
- The TEST/RESET wire must be connected to the supply voltage of the AOPD through a NC push-button.

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

- The EDM wire must be connected to +24 VDC through a normally closed contact before powering. If the EDM function is selected and the wire is not correctly connected at powering, the device enters Error mode.
- 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

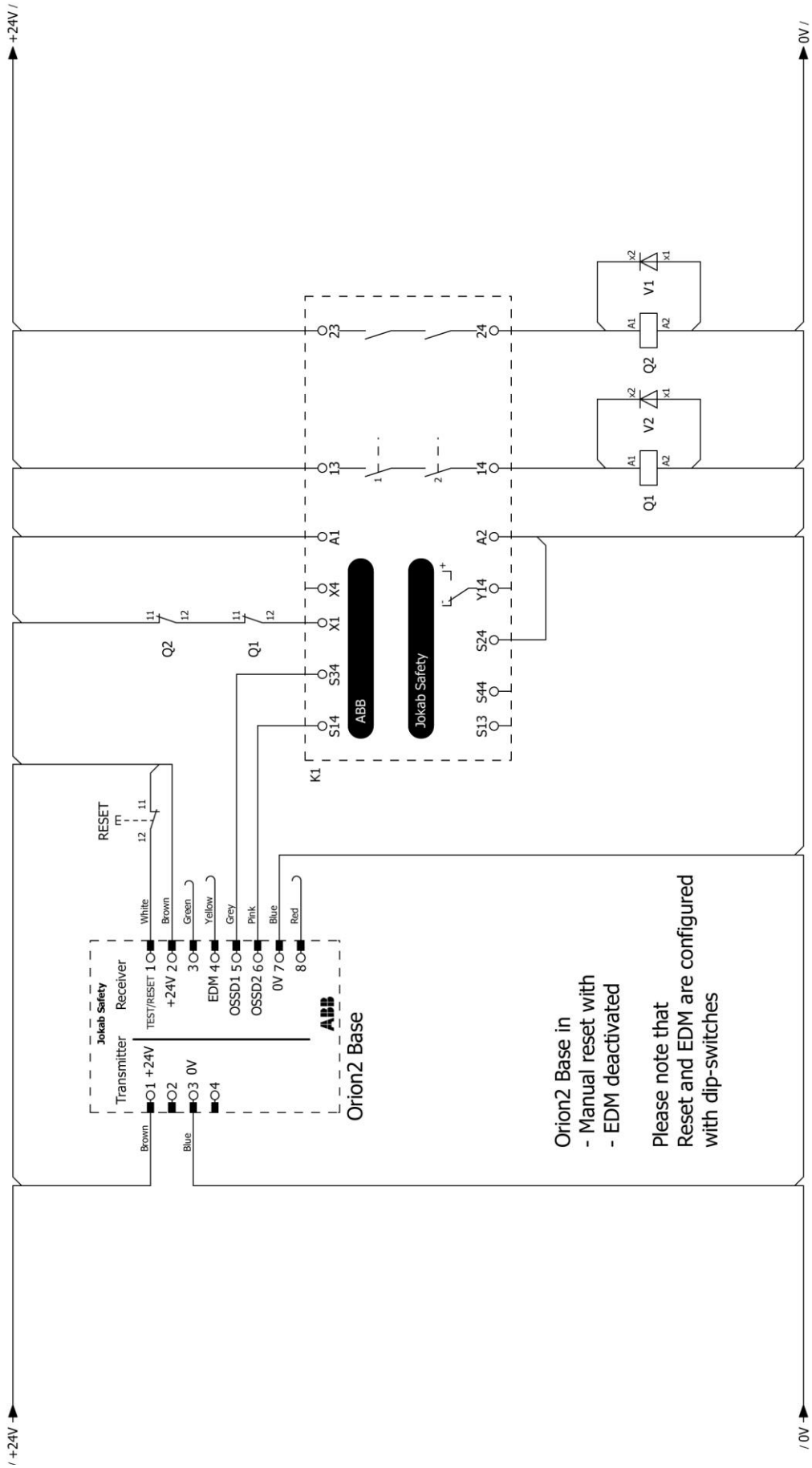


Figure 17 – Connection to a RT9 safety relay

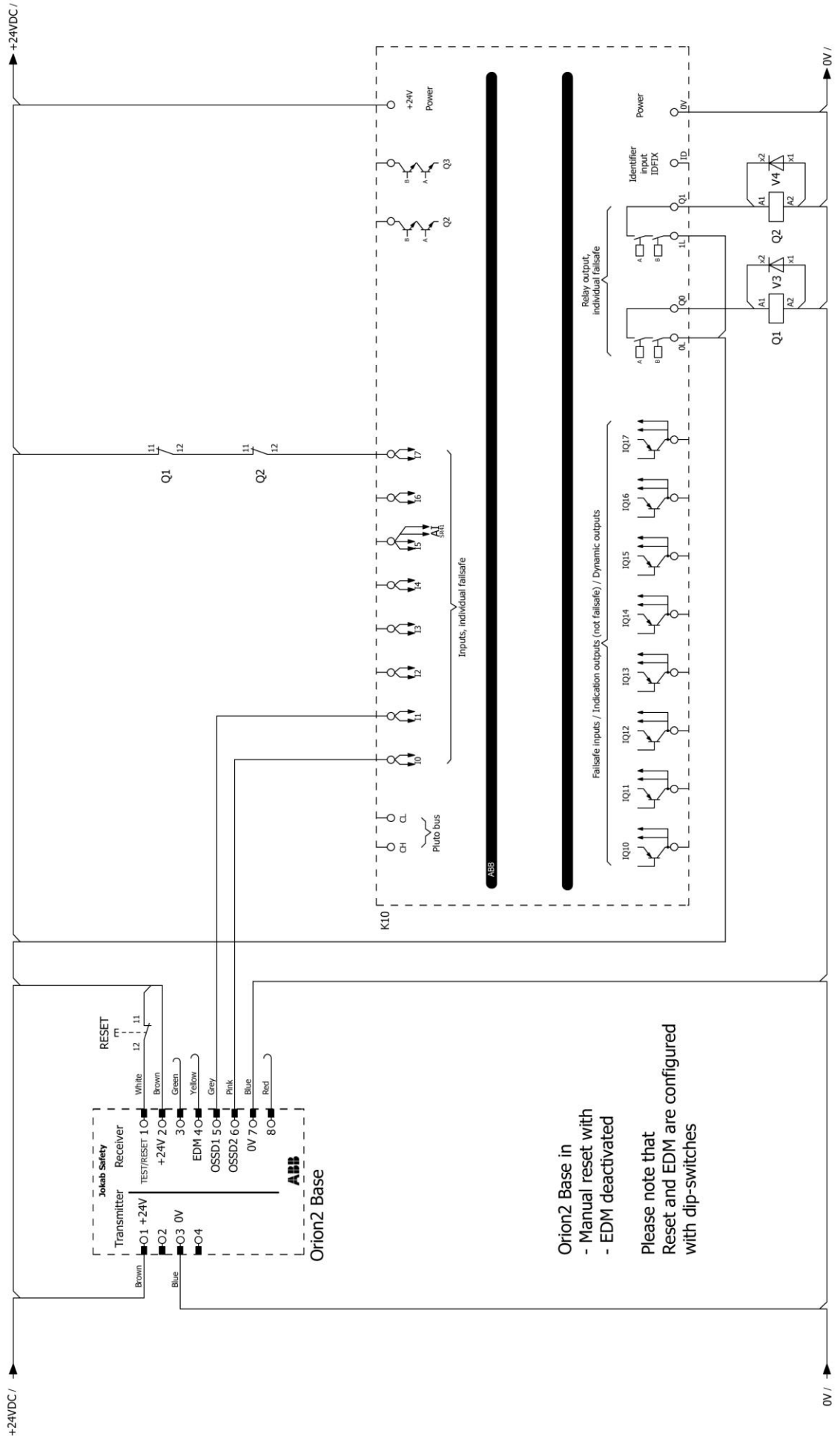


Figure 18 – Connection to a Pluto B20 Safety PLC

The figures show the connection between Orion2 Base and the RT9 safety relay/ Pluto B20 Safety PLC when the AOPD is in Manual Reset mode with a reset button connected to the AOPD.

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

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

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

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

YES

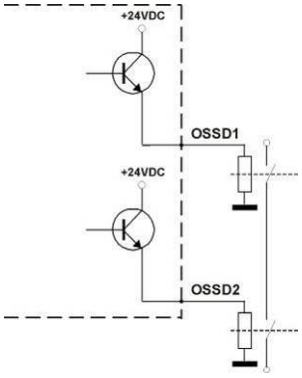
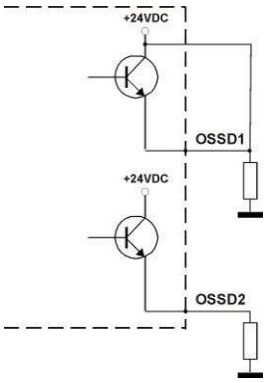
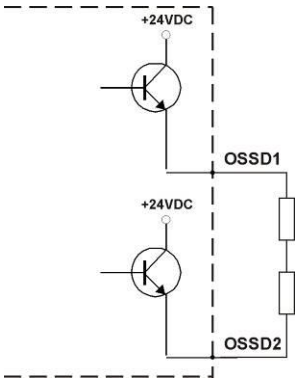


Figure 19 – Correct connection of OSSD outputs

NO



NO



NO

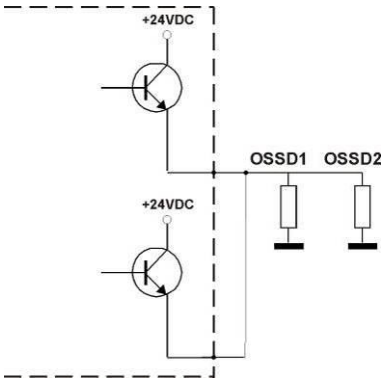


Figure 20 – Incorrect connection of OSSD outputs

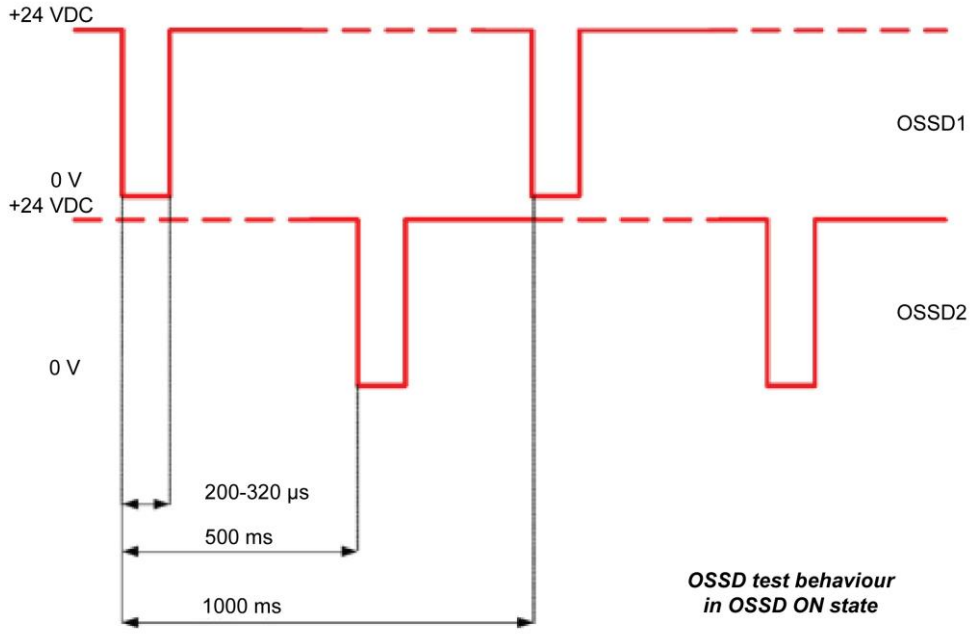


Figure 21 – Time chart of the OSSD outputs

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 22 – 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 TEST/RESET button and keep it pressed (open the contact).
- Re-connect the power supply.
- Release the TEST/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 centre 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 (Figure 23) and easily opened with a screwdriver, facilitates the access to the internal dip-switches.

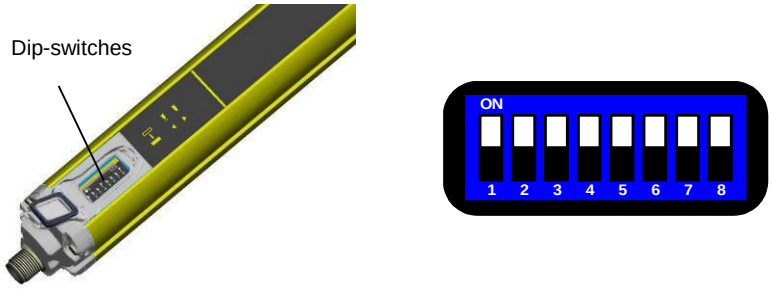


Figure 23 – Location of the dip-switches

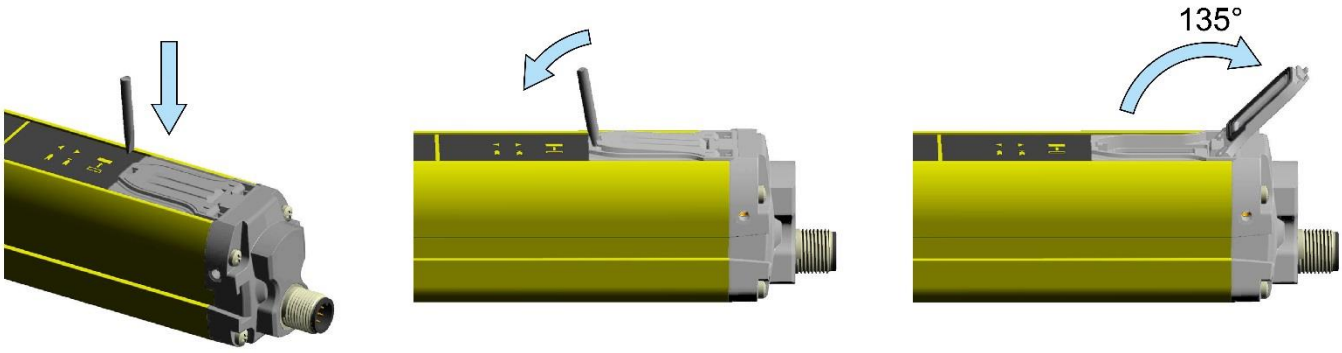


Figure 24 – Lock over the dip-switches

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 allows to set the functions as described in the following table:

dip-switches	Function	ON	OFF
1 and 5	-	-	-
2 and 6	-	-	-
3 and 7	EDM	Deactivated	Activated
4 and 8	Reset	Automatic	Manual

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.

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.

7.2 Configuration at delivery

The device is supplied with the following configuration:

EDM deactivated
Automatic Reset

NB: The EDM function can be activated only if the specific input is correctly connected to the appropriate device. For further information on these functions, see paragraphs 7.3 and 7.4.

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. In this case, the Yellow LED “LAST” is continuously on, see paragraph 8.3.2 – “Normal operation mode”.

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

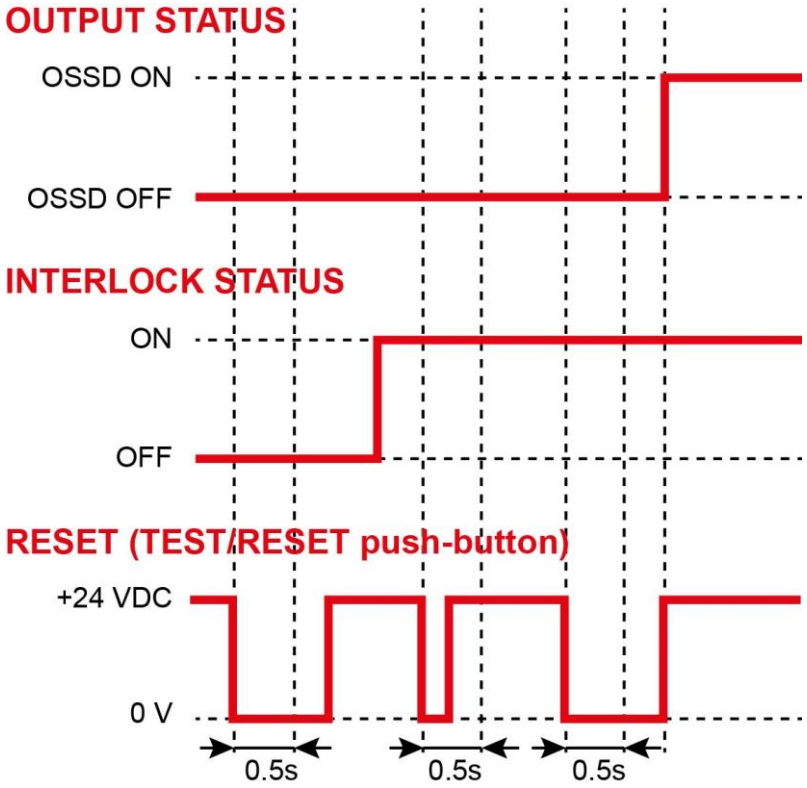


Figure 25 – Time chart of the Manual Reset function

Figure 26 below illustrates how Automatic reset and Manual Reset work:

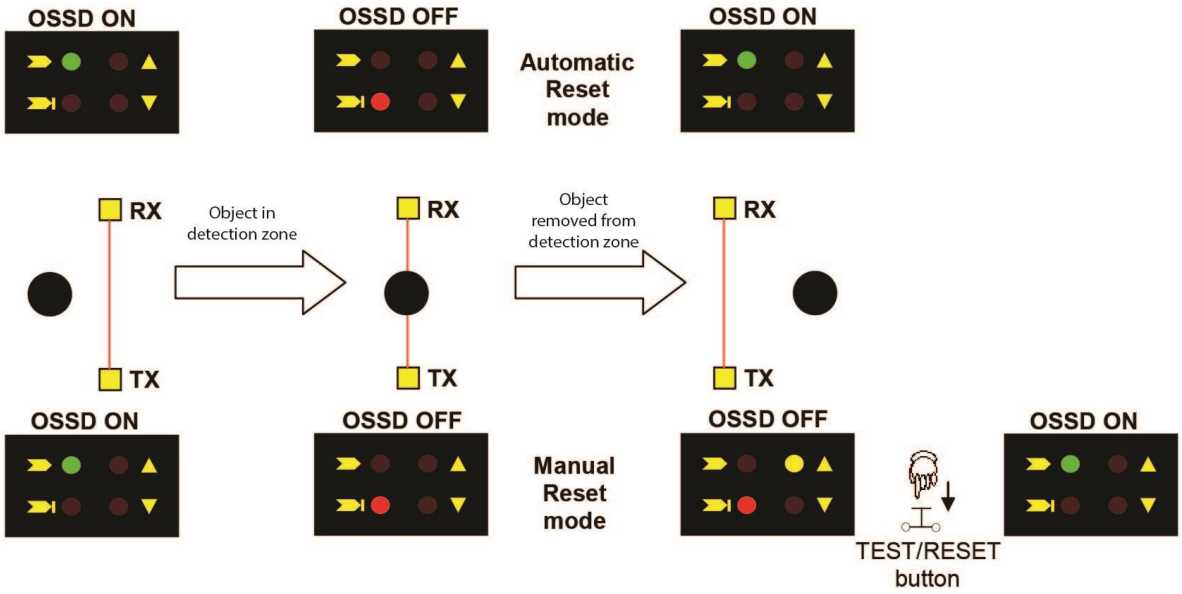


Figure 26 – Automatic/Manual Reset

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 27).

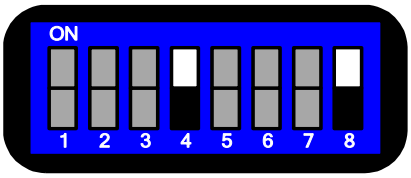


Figure 27 – Dip-switch settings for Automatic Reset function

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 Test function

The Test function is activated by pressing the TEST push-button for at least 0.5 s.

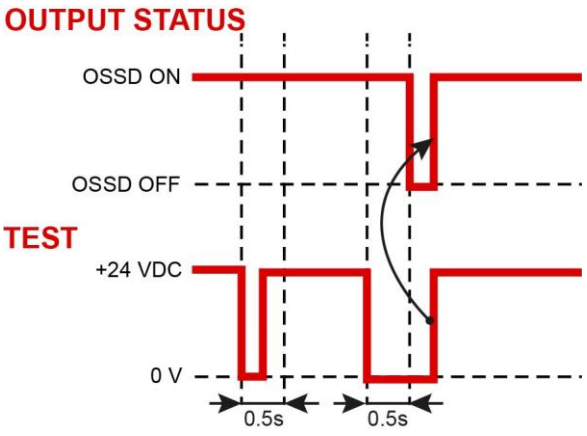


Figure 28 – Time chart of the Test function in Automatic Reset

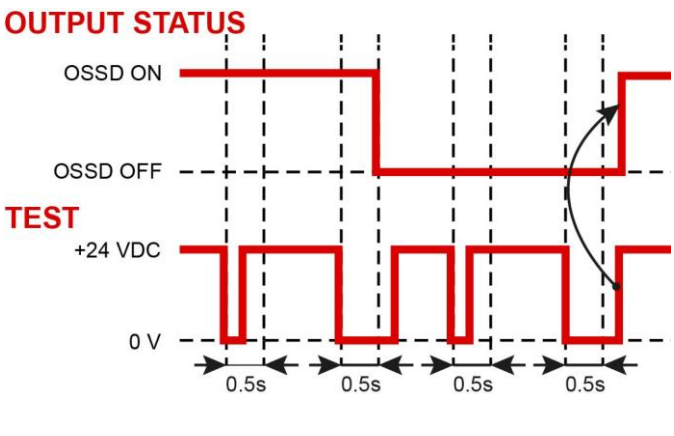


Figure 29 – Time chart of the Test function in Manual Reset

7.5 Acknowledge function

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

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

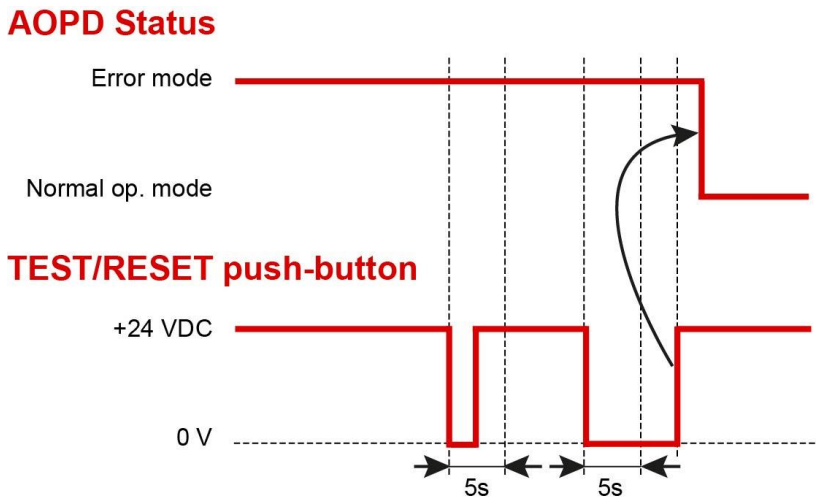


Figure 30 –Time chart of the Acknowledge function

7.6 EDM function

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

To correctly use this function:

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

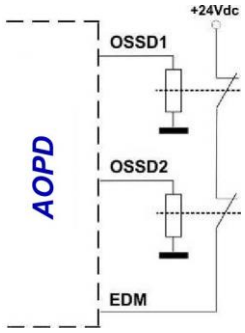


Figure 31 – Connection of EDM

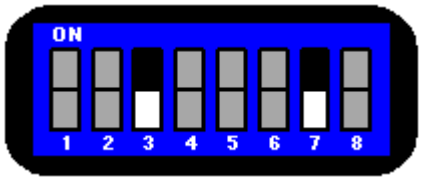


Figure 32 – Dip-switches 3 and 7 OFF to activate the EDM function

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

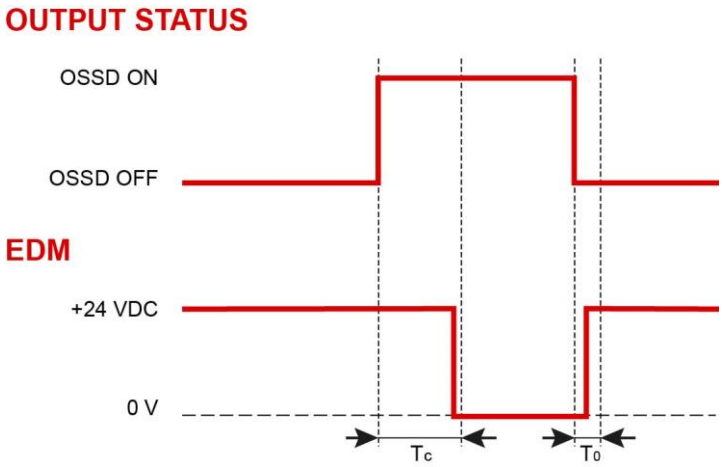


Figure 33 – Time chart of the EDM function

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.

$T_C \leq 350$ 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.

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

8 Diagnostic functions

8.1 Visualisation 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 34).

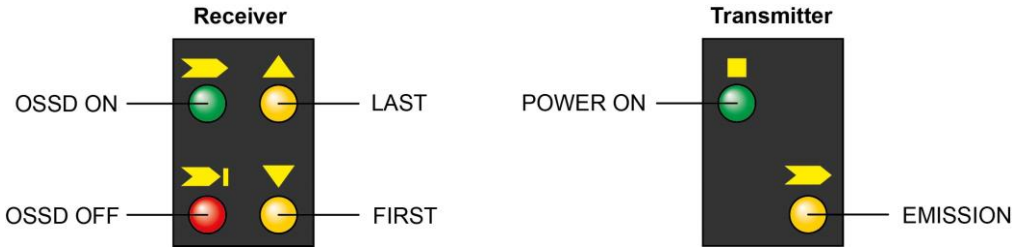


Figure 34 – LEDs on the transmitter and the receiver

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

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

8.3.1 Alignment mode

In this mode, the OSSD outputs are off (▶I).

- Green LED (▶): on when transmitter and receiver aligned and no object is in the detection zone.
- Red LED (▶I): on when the transmitter and the emitter 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).

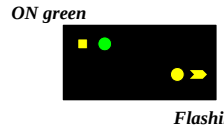
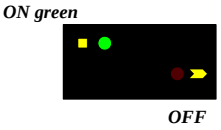
8.3.2 Normal operation mode

- 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 TEST/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.

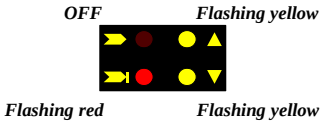
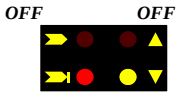
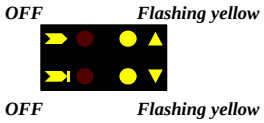
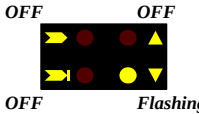
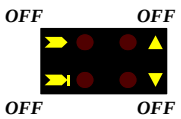
8.4 Diagnostic messages

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
	Generic error on transmitter side	- Check the power supply; if the error persists, contact your ABB Jokab Safety representative and replace both units.
	Power supply error	- Check the power supply; if the error persists, contact your ABB Jokab Safety representative.
	The power supply voltage is outside the allowed range Main microprocessor error	- Check the power supply; if the error persists, contact your ABB Jokab Safety representative.

8.4.2 Receiver:

Display	Description	Action
	OSSD error	- 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”. - Check that the load characteristics are in accordance with the Technical data (see paragraph 11 – “Technical data”).
	EDM error	- Check the wiring and connections of the EDM, as well as the time sequence (see the Time chart, Figure 33). - Switch the devices off and on; if the error persists, replace the external switching device.
	Microprocessor error	- Check the position of the configuration dip-switches. Dip-switches 5-8 should be in the same position as dip-switches 1-4. - Switch the devices off and on; if the error persists, contact your ABB Jokab Safety representative.
	Optical error	- Check the alignment. - Switch the devices off and on; if the error persists, contact your ABB Jokab Safety representative.
	Power supply error Main microprocessor error	- Check the wiring and connections of the power supply. Check that its value is within the allowed range. - Switch the devices off and on; if the error persists, contact your ABB Jokab Safety representative.

9 Periodical checks

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

Check that:

- The AOPD remains in OSSD OFF state (▰▶▮) during beam interruption along the entire detection zone, using the suitable “Test Piece” and following the Figure 15 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 OSSD outputs switch off (the red LED ▰▶▮ turns on and the controlled machine stops) when the Test function is activated.
- The stopping time of the machine, including the response times of the AOPD and of the machine, is within the limits defined for the calculation of the minimum installation distance (see paragraph 2.4 – “Minimum installation distance”).
- The minimum installation distance between the hazard zone and the AOPD is in accordance with the instructions included in paragraph 2.4 – “Minimum installation distance”.
- Access of a person between the AOPD and the hazard zone of the machine is not possible, nor is it possible for him/her to stay there without being detected.
- Access to the hazard zone of the machine from any unprotected area is not possible.
- The AOPD and the external electrical connections are not damaged.

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

10 Device maintenance

Orion2 Base light grids do not require special maintenance operations.

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

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

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

11 Technical data

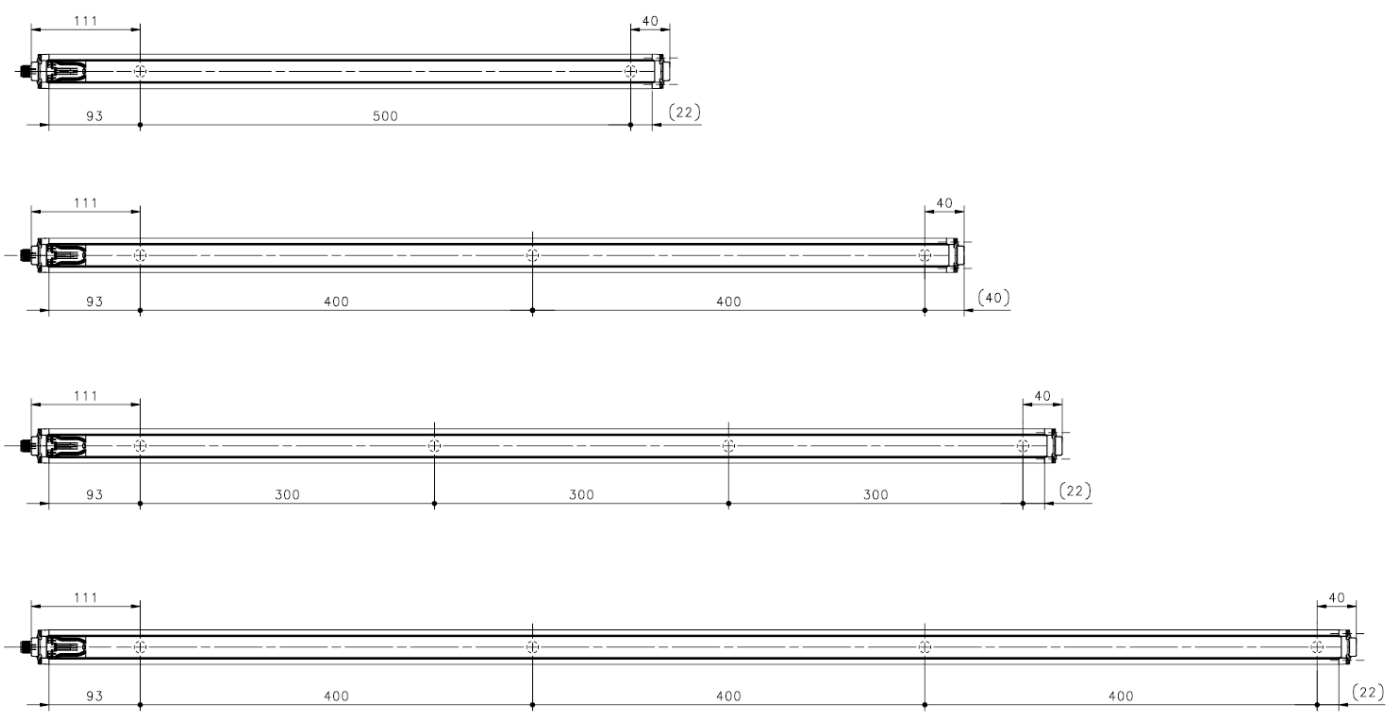
Manufacturer	
Address	ABB JOKAB SAFETY Varlabergsvägen 11 SE-434 39 Kungsbacka Sweden
Electrical data	
Power supply (Vdd):	+24 VDC ± 20 % (SELV/PELV)
Internal capacitance:	23 nF (TX) /120 nF (RX)
Consumption (TX):	30 mA max / 0.9 W
Consumption (RX):	75 mA max (without load) / 2.2 W
Outputs	2 PNP
Short-circuit protection: Output current: Leakage current: Capacitive load (pure): Resistive load (pure):	Max. 1.4 A at 55°C, min. 1.1 A at -10°C 0.5 A max. / output < 1 mA 65 nF max at 25°C 56 Ω min. at +24 VDC
Response time:	From 14 to 16 ms – See table below
Electrical protection:	Class III – use SELV/PELV
Connections:	TX: M12 4-poles male connector, RX: M12 8-poles male connector
Cable length:	50 m max. (see note *) with 50 nF capactive load and +24 VDC
Optical data	
Emission type:	Infrared (880 nm)
Resolution:	See paragraph 12 – “Model overview”
Protected height:	See paragraph 12 – “Model overview”
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)
Mechanical protection:	IP65 (EN 60529:2000)
Vibrations:	Width 0.35 mm, Frequency 10 … 55 Hz, 20 sweeps for each axis, 1 octave/min (EN 60068-2-6:2008)
Shock resistance:	16 ms (10 G) 10^3 shocks per axis (EN 60068-2-29:2008)
Housing material:	Painted alluminium (yellow RAL 1003)
Cap material:	PC Lexan 943A
Lens material:	PMMA
Weight:	1.2 kg max./ m for each single unit

* If a longer cable has to be used, please verify that the same specifications are respected

Functional safety data		
EN ISO 13849-1:2008	PL e, Cat 4	
EN IEC 61508-1:2010 EN IEC 61508-2:2010 EN IEC 61508-3:2010 EN IEC 61508-4:2010	SIL 3	
EC 62061:2005/A1:2013	SIL CL 3	
Prob. of danger failure/hour (1/h)	PFH_d	$2{,}62 \times 10^{-9}$
Life span (years)	T1	20
Mean Time to Dangerous Failure (years)	$MTTF_d$	384

12 Model overview

Type	Article number	Height of the sensitive area (mm)	Inter-axis (mm)	Number of Beams	Resolution (mm)	Response time (ms)	Operating distance (m)
Orion2-4-K2-050-B	2TLA022304R0000	515	500	2	515	14	0.5..50
Orion2-4-K3-080-B	2TLA022304R0100	815	400	3	415	14	0.5..50
Orion2-4-K4-090-B	2TLA022304R0200	915	300	4	315	16	0.5..50
Orion2-4-K4-120-B	2TLA022304R0300	1215	400	4	415	16	0.5..50



13 Dimensions

13.1 Profiles

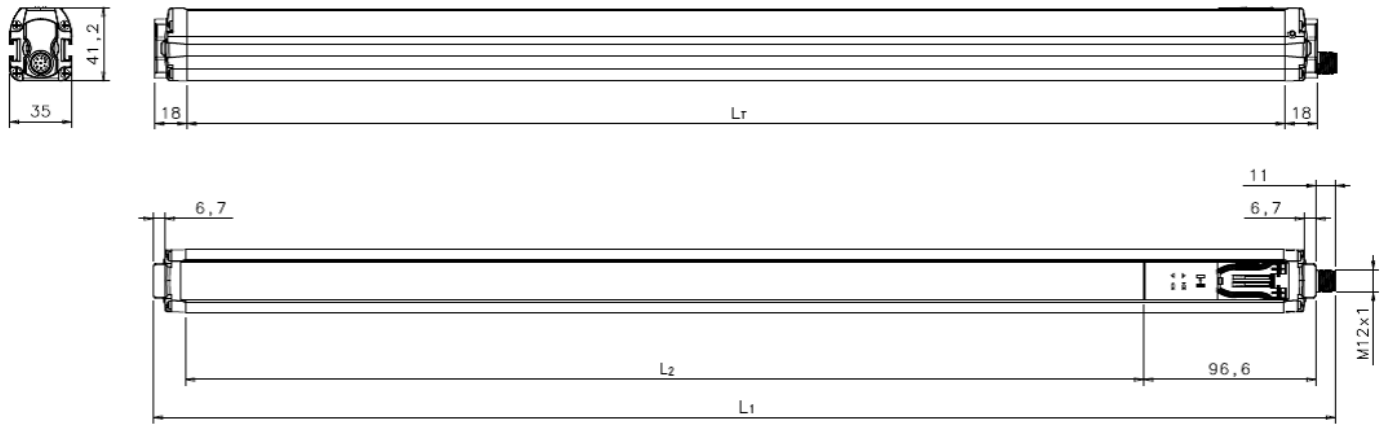


Figure 35 – Dimensions of the profiles

NB: All dimensions in millimetres.

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

13.2 Angled fixing bracket

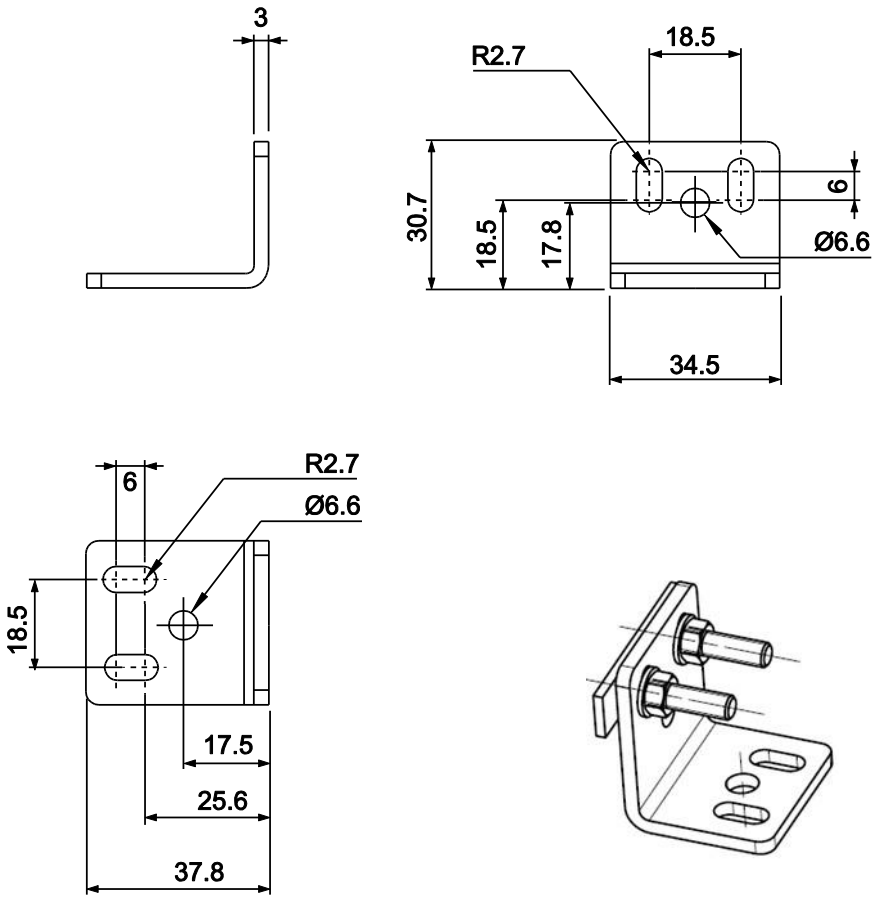


Figure 36 – Dimensions of the angled fixing bracket

NB: All dimensions in millimetres.

13.3 Fixing bracket with profile

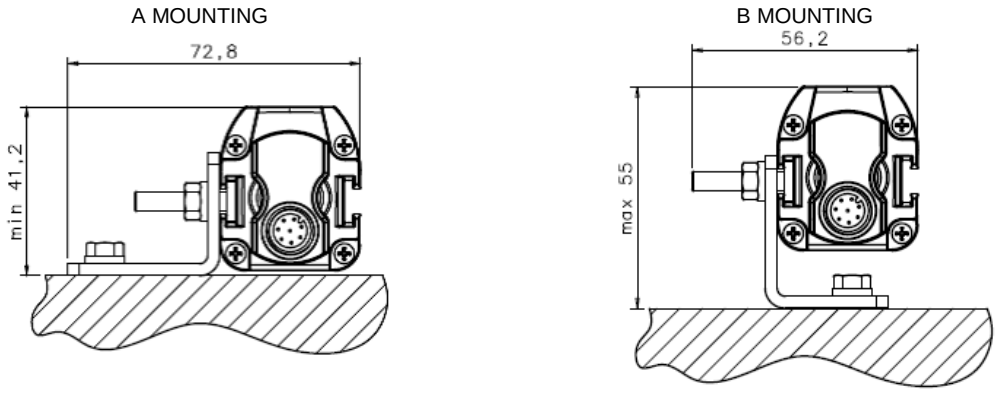


Figure 37 – Dimensions of the angled fixing bracket with a profile

NB: All dimensions in millimetres.

14 EC Declaration of conformity

EC Declaration of conformity

(according to 2006/42/EC, Annex2A)

We	ABB AB JOKAB Safety Varlabergsvägen 11 SE-434 39 Kungsbacka Sweden	declare that the safety components of ABB make with type designations and safety functions as listed below, is in conformity with the Directives 2006/42/EC 2004/108/EC

Authorised to compile the technical file	ABB AB JOKAB Safety Varlabergsvägen 11 SE-434 39 Kungsbacka Sweden

Product	Certificate
Light curtain/light beam Orion, all models	Z10 15 02 49833 011

Certification Body	TÜV Süd Product Service GmbH Ridlerstrasse 65 80339 München Germany
Used harmonized standards	EN 61496-1:2013, EN ISO 13849-1:2008, EN 62061:2005/A1:2013
Other used standards	EN 61496-2, EN 61508-1:2010, EN 61508-2:2010, EN 61508-3:2010, EN 61508-4:2010

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Kungsbacka 2015-03-19

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