

## > SG4 FIELDBUS Safety Light Curtains



ORIGINAL INSTRUCTIONS (ref. 2006/42/EC)

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Italy

“SG4 FIELDBUS” Instruction Manual

Ed.: 05/2018

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Product Service

# CERTIFICATE

No. Z10 17 10 70800 061

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Via San Vitalino 13  
40012 Lippo di Calderara di Reno  
ITALY

**Factory(ies):** 96012, 70800

**Certification Mark:**



**Product:** Electro-Sensitive Protective Equipment  
Safety Light Curtain (Type 4)

**Model(s):** SG4-Fieldbus  
For nomenclature see attachment

**Parameters:**

Supply Voltage:	24 ±20% Vdc
Resolution:	14mm, 30mm or 2, 3, 4 beams
Protection class:	IP65

**Tested according to:**

- 2006/42/EC
- EN 61496-1:2013
- EN 61496-2:2013
- EN ISO 13849-1:2015 (Cat.4, PL e)
- EN 61508-1:2010 (SIL3)
- EN 61508-2:2010 (SIL3)
- EN 61508-3:2010 (SIL3)
- EN 61508-4:2010 (SIL3)
- EN 62061:2005/A2:2015 (SIL CL3)

The product was tested on a voluntary basis and complies with the essential requirements. The certification mark shown above can be affixed on the product. It is not permitted to alter the certification mark in any way. In addition the certification holder must not transfer the certificate to third parties. See also notes overleaf.

**Test report no.:** DB91137T

**Valid until:** 2022-10-09

**Date,** 2017-10-10

(Jürgen Blum)

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## **CE COMPLIANCE**

CE marking states the compliance of the product with essential requirements listed in the applicable European directive. Since the directives and applicable standards are subject to continuous updates, and since Datalogic promptly adopts these updates, therefore the EU declaration of conformity is a living document. The EU declaration of conformity is available for competent authorities and customers through Datalogic commercial reference contacts. Since April 20<sup>th</sup>, 2016 the main European directives applicable to Datalogic products require inclusion of an adequate analysis and assessment of the risk(s). This evaluation was carried out in relation to the applicable points of the standards listed in the Declaration of Conformity. Datalogic products are mainly designed for integration purposes into more complex systems. For this reason it is under the responsibility of the system integrator to do a new risk assessment regarding the final installation.

### **Warning**

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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## 1 GENERAL INFORMATION

### 1.1 GENERAL DESCRIPTION

The safety light curtains are optoelectronic multibeam devices that are used to protect working areas that, in presence of machines, robots, and automatic systems in general, can become dangerous for operators that can get in touch, even accidentally, with moving parts.

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

NORM	DESCRIPTION
EN 61496-1: 2013	Safety of machinery: electrosensitive protective equipment. Part 1: General prescriptions and tests.
EN 61496-2: 2013	Safety of machinery: electrosensitive protective equipment - Particular requirements for equipment using active optoelectronic protective devices.
EN ISO 13849-1: 2015	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/A2: 2015	Safety of machinery. Functional safety of electrical/ electronic/programmable electronic safety-related control systems.

The device, consisting of one emitter and one receiver contained inside aluminium profiles, generates infrared beams that detect any opaque object positioned within the light curtain detection field.

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

The connections are made through one or more connectors as specified in cfr.**ELECTRICAL CONNECTIONS on page 29**.

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

The microprocessor guarantees the check and the management of the beams that are sent and received through the units: the microprocessor – through some LEDs – informs the operator about the general conditions of the safety light curtain (cfr.**USER INTERFACE AND DIAGNOSTICS on page 46**).

The receiver is the main controller for all functions. It monitors all safety actions in case of failure and performs general functions as well.

During installation, an user interface facilitates the alignment of both units (cfr.**ALIGNMENT PROCEDURE on page 32**).

SG4 Fieldbus light curtains have no safety outputs (OSSDs). Instead they perform an optical scan and send the result to a PLC via the Ethernet POWERLINK by means of the openSAFETY protocol. As soon as an object, or a limb or the operator's body accidentally interrupts one or some of the infrared beams sent by the emitter, the receiver immediately triggers the Safety State over the connected safety Fieldbus. The PLC program will then elaborate these results and consequently switch its safety outputs or control any safety device over the network.

Some parts or sections of this manual containing important information for the user or installing operator are preceded by a note:



**Notes and detailed descriptions about particular characteristics of the safety devices in order to better explain their functioning. Special instructions regarding the installation process.**

This manual contains all the information necessary for the selection and operation of the safety devices.

However, specialised knowledge not included in this technical description is required for the planning and implementation of a safety light curtain on a power-driven machine.

As the required knowledge may not be completely included in this manual, we suggest the customer to contact Datalogic Technical Service for any necessary information relative to the functioning of the light curtains and the safety rules that regulate the correct installation (cfr. **USER INTERFACE AND DIAGNOSTICS on page 46**).

## 1.2 PACKAGE CONTENTS

Package contains the following objects:

- Receiver (RX)
- Emitter (TX)
- Quick Guide of safety light curtain
- Periodical checklist and maintenance schedule
- 4 angled fixing brackets and specific fasteners
- 2 additional angled fixing brackets for models with heights included between 1200 and 1800 mm



## 1.3 HOW TO CHOOSE THE DEVICE

There are at least three different main characteristics that should be considered when choosing a safety light curtain, after having evaluated the risk assessment.

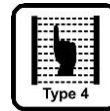
### 1.3.1 Detection capability

The detection capability (or resolution) of the device is the minimum diameter that an opaque object must have in order to obscure at least one of the beams that constitute the detection zone and to actuate the sensing device.

The resolution is related to the part of the body to be protected.

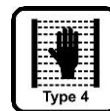
**R=14 mm**

**Finger protection**

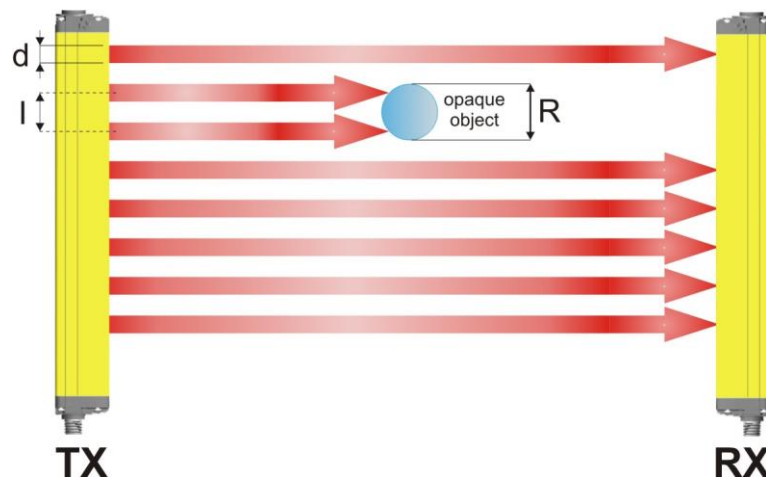


**R=30 mm**

**Hand protection**



As shown in **Fig 1 - on page 9**, the resolution only depends on the geometrical characteristics of the lenses, diameter and distance between centres, and is independent of any environmental and operating conditions of the safety light curtain.



**Fig 1 - Detection capability**

The resolution value is obtained applying the following formula:

$$R = l + d$$

where:

$l$ =Interaxes between two adjacent optics

$d$ =Lens diameter

### 1.3.2 Height of the detection zone

The controlled height is the height protected by the safety light curtain.

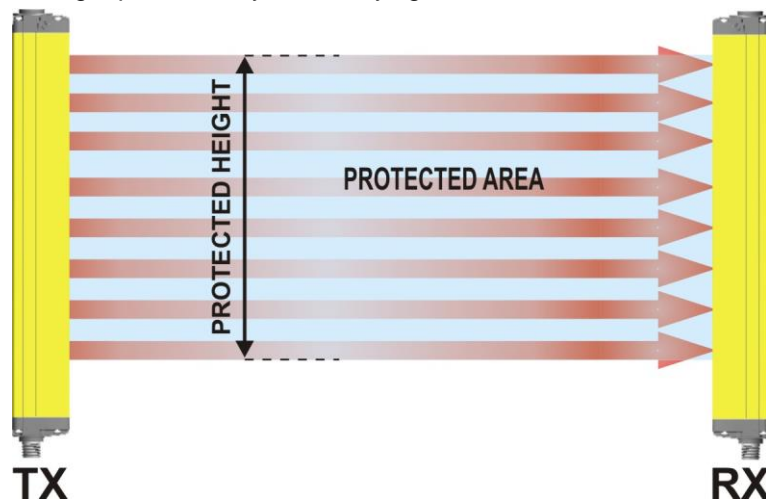
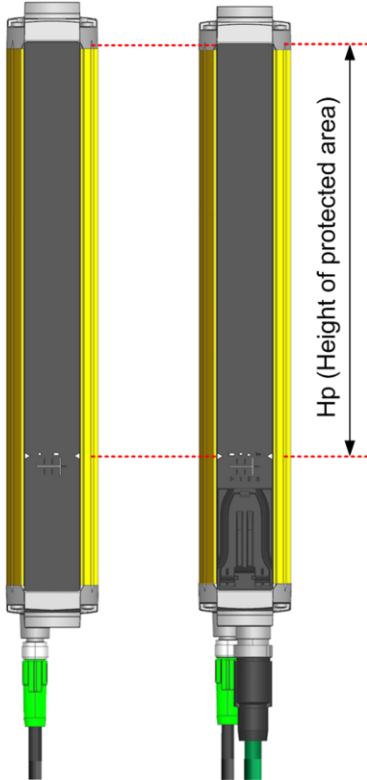


Fig 2 - Detection Zone

	Models	Controlled height Hp (mm)
	SG4-xx-015-OP-x	150
	SG4-xx-030-OP-x	300
	SG4-xx-045-OP-x	450
	SG4-xx-060-OP-x	600
	SG4-xx-075-OP-x	750
	SG4-xx-090-OP-x	900
	SG4-xx-105-OP-x	1050
	SG4-xx-120-OP-x	1200
	SG4-xx-135-OP-x	1350
	SG4-xx-150-OP-x	1500
	SG4-xx-165-OP-x	1650
	SG4-xx-180-OP-x	1800
	SG4-S2-060-OP-x	600
	SG4-S3-080-OP-x	800
	SG4-S4-090-OP-x	900
	SG4-S4-120-OP-x	1200

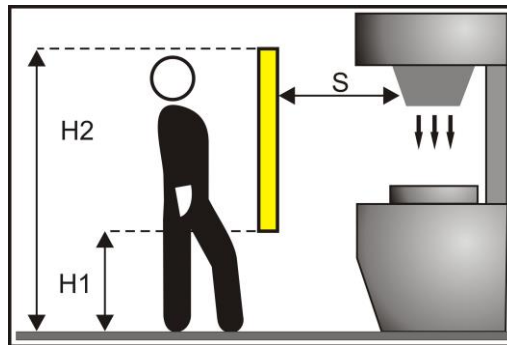
### 1.3.3 Minimum installation distance

The safety device must be positioned at a specific safety distance (**Fig 3 - on page 11**).

This distance must ensure that the dangerous area cannot be reached before the dangerous motion of the machine has been stopped by the Safety Control System.

The safety distance depends on 4 factors, according to the EN ISO 13855 Standard:

- Response time of the ESPE (the time between the effective beam interruption and the opening of the OSSD contacts)
- Machine stopping time including Safety Control System computing and actuating time if present.
- ESPE resolution
- Approaching speed of the object to be detected



**Fig 3 - Installation distance (vertical positioning)**

The following formula is used for the calculation of the safety distance:

$$S = K (t_1 + t_2) + C$$

where:

- S = Minimum safety distance in mm  
 K = Speed of the object, limb or body approaching the dangerous area in mm/sec  
 t<sub>1</sub> = Response time of the ESPE in seconds (see cfr. **TECHNICAL DATA on page 50**)  
 t<sub>2</sub> = Machine stopping time in seconds (including the Safety Control System)  
 C = Additional distance based on the possibility to insert the body or one of body parts inside the dangerous area before the protective device trips.  
     C=8 (R -14) for devices with resolution ≤ 40 mm  
     C=850 mm for devices with resolution > 40 mm  
 R = Resolution of the system



**K value is:**

**2000 mm/s if the calculated value of S is ≤ 500 mm**

**1600 mm/s if the calculated value of S is > 500 mm**

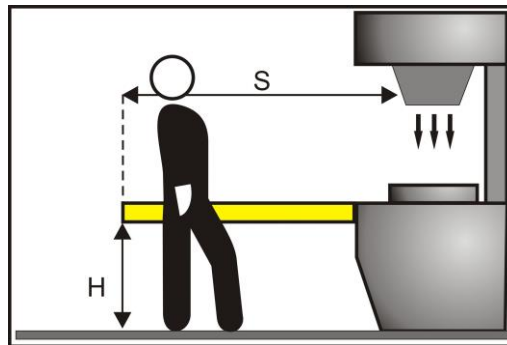
When devices with > 40 mm resolution are used, the height of the top beam has to be  $\geq 900$  mm (H2) from machine supporting base while the height of the bottom beam has to be  $\leq 300$  mm (H1).

If the safety light curtain must be mounted in a horizontal position (**Fig 4 - on page 12**) the distance between the dangerous area and the most distant optical beam must be equal to the value calculated using the following formula:

$$S = 1600 \text{ mm/s} (t_1 + t_2) + 1200 - 0,4 H$$

where:

- S = Minimum safety distance in mm.
- t1 = Response time of the ESPE in seconds (cfr. **TECHNICAL DATA on page 50**)
- t2 = Machine stopping time in seconds (including the Safety Control System)
- H = Beam height from ground; this height must always be less than 1,000 mm.



**Fig 4 - Installation distance (horizontal positioning)**

### Practical examples

Let's suppose to have a light curtain with height = 600 mm

To calculate the distance of the device from the ESPE, in a vertical position, the following formula is used:

$$S = K \cdot T + C$$

where:

- S = Minimum safety distance in mm.
- t1 = ESPE response time
- t2 = Machine total stopping time (Including safety control system).
- T = (t1 + t2) Overall system stopping performance
- C =  $8 \cdot (R - 14)$  for devices with resolution  $\leq 40$  mm
- R = Resolution of the system



The reference standard is EN ISO 13855 "Safety of machinery - Positioning of safeguards with respect to the approach speeds of parts of the human body". The following information is to be considered as indicative and concise. For correct safety distance please refer to complete standard EN ISO 13855.

In particular, if access to the hazard zone by reaching over the detection zone of vertically mounted electro-sensitive protective equipment cannot be excluded, an additional distance must be applied, depending on the height of the hazard zone and the height of upper edge of the ESPE detection zone. For reference, apply EN ISO 13855 par. 6.5.

## 1.4 TYPICAL APPLICATIONS

SG4 FIELDBUS is the first safety light curtain with integrated openSAFETY protocol over POWERLINK network.

Adding the POWERLINK interface to the field-proven SG light curtain platform allows for a new solution for safety that's easy to integrate in existing networks and communicates seamlessly with safety programmable controllers through openSAFETY protocol.

These features result in less wiring and hardware, fewer errors in commissioning and maintenance and increase the overall machine availability. New advanced functions, such as blanking and muting are available in order to improve flexibility and safety of the machine.

With finger, hand and body protection, the SG4 FIELDBUS models can be implemented in any application where standard safety light curtains are currently used, in a wide range of applications where control and protection of the access to dangerous zones is necessary.

In particular they can be used in the following applications:

- Primary packaging machinery (packing, filling, labelling, etc...)
- Secondary packaging machinery (palletisers/depalletisers)
- Material handling machines,
- Storing machines;
- Bending and metal-working machinery
- Process lines
- Automatic and semi-automatic assembly lines
- Automatic and semi-automatic quality inspection machinery
- Automatic warehouses;
- Robotics.
- Cutting machinery

and in the following industries:

- Food & Beverage
- Wood
- Automotive
- Electronics
- Metal working
- Textile
- Intralogistics

**Example 1: Hazardous point protection on a automatic machine**

The operator positions the part and takes it back after machining.

The operator must be protected against possible abrasions while working.

The operator positions the products and takes them back after working and must be protected against possible harm by movable parts of the machine.

The light curtain is installed in a position where any attempt to reach the dangerous point from the operator causes the immediate stop of any dangerous movement of the machine.



**Fig 5 - Hazardous point protection on automatic machine**

### Example 2: Fixed and floating blanking

The blanking function is used when an object detected in a defined part of the detection zone must not cause an OFF state of the light curtains outputs.

Fixed blanking is when the object must remain in a fixed position, with a given tolerance.

Floating blanking is when the object can move along the detection zone.

Depending on the configuration of the light curtain, in floating blanking the object can also leave the detection zone or not.

Monitoring individual beams makes it possible to define areas that can be blanked and areas that are always active.

Inside the blanked areas, the position of the blanked beams can change (floating blanking) or be predefined (fixed blanking). It is also possible to synchronize the blanking time window with the process phases (for example activating the blanking in correspondence with a robot movement).

In the picture is showed the behaviour when a floating blanking is set up in a delimited area of the light curtain, and with a limit of 3 beams: if an object is interrupting less than 3 beams, the light curtain will remain in ON state, if the object is interrupting more than 3 beams, the light curtain will go in OFF state.

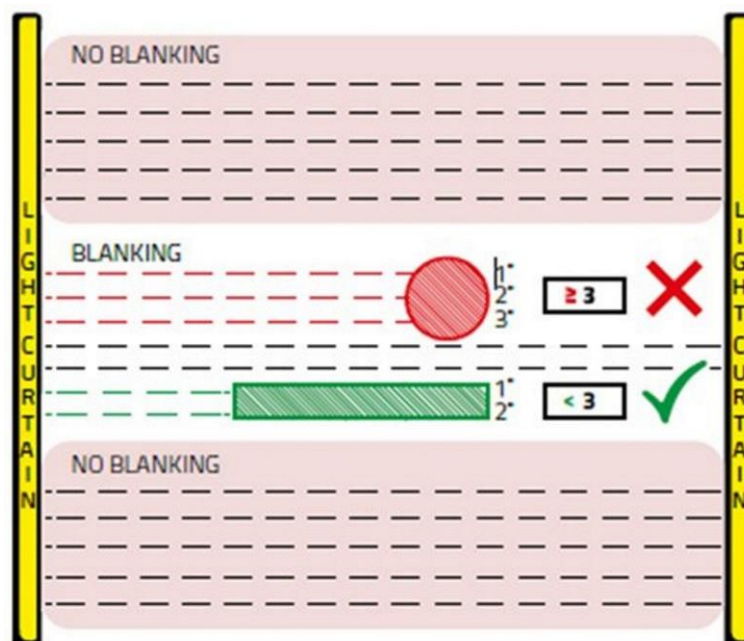


Fig 6 - Fixed and floating blanking



This application is possible only with advanced models (see SG4-xx-xxx-OP-A) and using dedicated functional blocks in the safety controller, able to manage the information related to any single beam.

## 1.5 SAFETY INFORMATION



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

- The stopping system of the machine must be electrically controlled.
- This control system must be able to stop the dangerous movement of the machine within the total machine stopping time T as per paragraph **Minimum installation distance on page 10** and during all working cycle phases.
- Mounting and connection of the safety light curtain must be carried out by qualified personnel only, according to the indications included in the special sections (refer to sections **INSTALLATION on page 17**, **MECHANICAL MOUNTING on page 26**, **ELECTRICAL CONNECTIONS on page 29**, **ALIGNMENT PROCEDURE on page 32**) and in the applicable standards.
- The safety light curtain must be securely placed in a particular position so that access to the dangerous zone is not possible without the interruption of the beams (refer section **INSTALLATION on page 17**).
- The personnel operating in the dangerous area must be well trained and must have adequate knowledge of all the operating procedures of the safety light curtain.
- The Restart button must be located outside the dangerous zone because the operator must check the dangerous zone during all Restart operations.



Please carefully read the instructions for the correct functioning before powering the light curtain on.



## 2 INSTALLATION

### 2.1 PRECAUTIONS TO BE OBSERVED FOR THE CHOICE AND INSTALLATION



Make sure that the protection level assured by the light curtain device is compatible with the real danger level of the machine to be controlled, according to EN ISO 13849-1: 2015 or EN 62061:2005/A2: 2015.

- Use only matched emitter and receiver pairs with same serial no.
- 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 device.
- The ESPE must be installed in an environment complying with the characteristics indicated in **TECHNICAL DATA on page 50**.
- The ESPE must not be installed close to strong and/or flashing light sources, in particular close to the front window of receiving unit.
- The presence of intense electromagnetic disturbances could affect correct operation of the device. This condition shall be carefully assessed with the advice of DATALOGIC Technical Service.
- 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 thus jeopardize correct operation.

## 2.2 GENERAL INFORMATION ON DEVICE POSITIONING

The safety light curtain should be carefully positioned in order to provide the necessary protection. Access to the dangerous area must only be possible by passing through the protecting safety light beams.



Fig 7 - on page 18 shows some examples of possible access to the machine from the top and the bottom sides. These situations may be very dangerous and so the installation of the safety light curtain at sufficient height in order to completely cover the access to the dangerous area (Fig 8 - on page 18) becomes necessary. Please refer to EN ISO 13855 for correct device positioning.

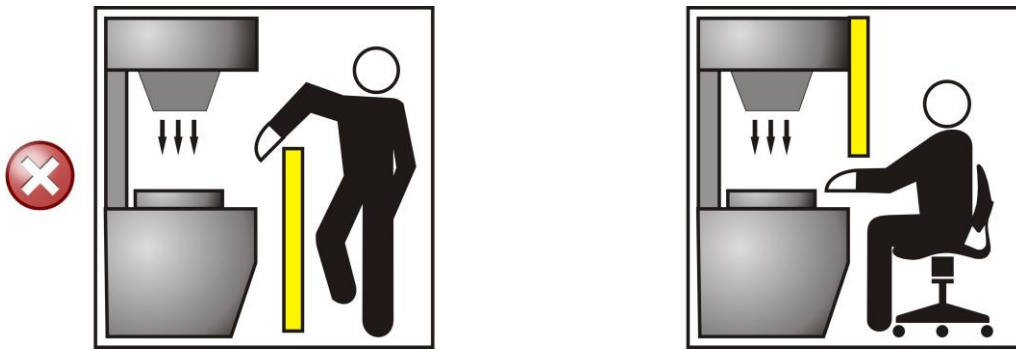


Fig 7 - Wrong light curtain positioning

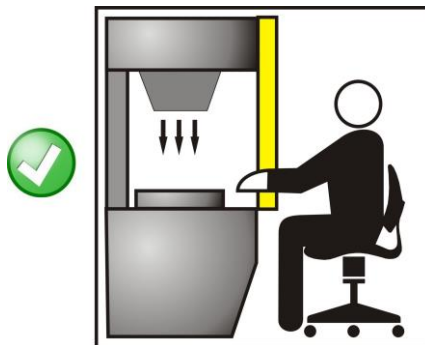


Fig 8 - Correct light curtain positioning



If the operator is able to enter in the dangerous area, an additional mechanical protection must be mounted to prevent the access.

Under standard operating conditions, machine starting must not be possible while operators are inside the dangerous area.

Where it is not possible to install safety light curtain very near to the dangerous zone, a second light curtain must be mounted in a horizontal position in order to prevent unintentional restart of the machine, as shown in Fig 10 - on page 18.



Fig 9 - Wrong light curtain positioning

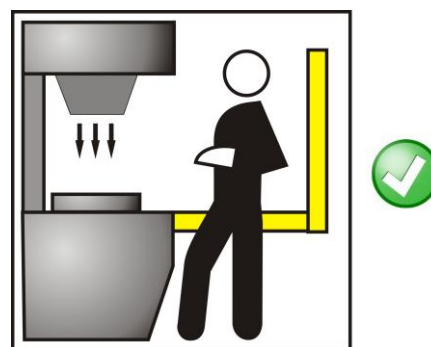


Fig 10 - Correct light curtain positioning

### 2.2.1 Minimum distance from reflecting surfaces

Reflecting surfaces placed near the light beams of the safety device (over, under or laterally) can cause passive reflections. These reflections can affect the recognition of an object inside the controlled area. Moreover, if the RX receiver detects a secondary beam (reflected by the side-reflecting surface) the object might not be detected, even if the object interrupts the main beam.

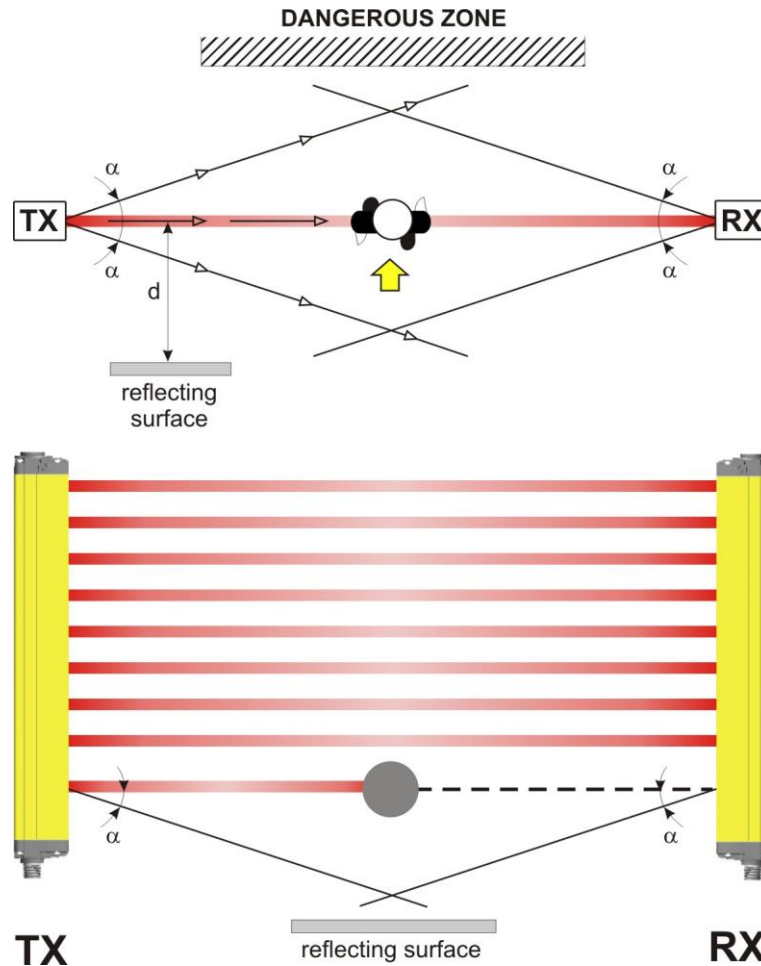


Fig 11 - Distance from reflecting surfaces

It is important to position the safety light curtain according to the minimum distance from reflecting surfaces. The minimum distance depends on:

- operating distance between emitter (TX) and receiver (RX);
- real aperture angle of ESPE (EAA); especially:

for ESPE Type 4 EAA = 5° ( $\alpha = \pm 2.5^\circ$ )

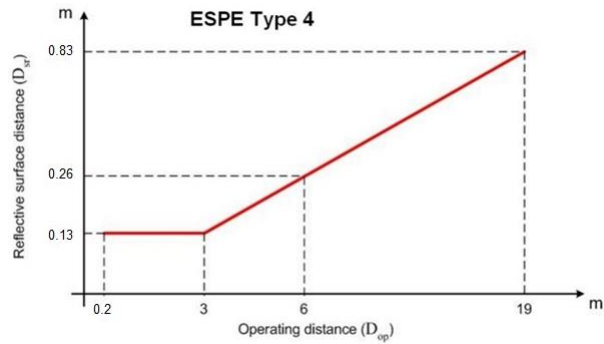


Fig 12 - Minimum distance from reflective surface

The formula to get Dsr is the following:

**For ESPE Type 4:**

$$D_{sr} (m) = 0.13$$

for operating distance < 3 m

$$D_{sr} (m) = [0.5 \times \text{operating distance (m)} \times \tan 5^\circ]$$

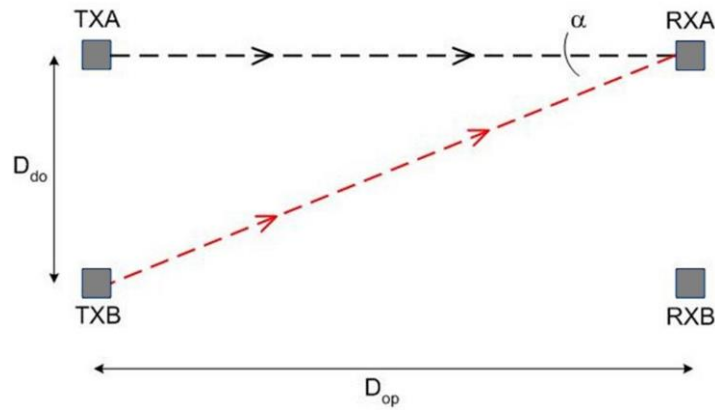
for operating distance  $\geq$  3 m

### 2.2.2 Distance between homologous devices

The following graphic shows the distance from the interfering devices ( $D_{do}$ ) according to the operating distance ( $D_{op}$ ) of the couple (TXA – RXA).

If different safety devices have to be installed in adjacent areas, the emitter of one device must not interfere dangerously with the receiver of the other device.

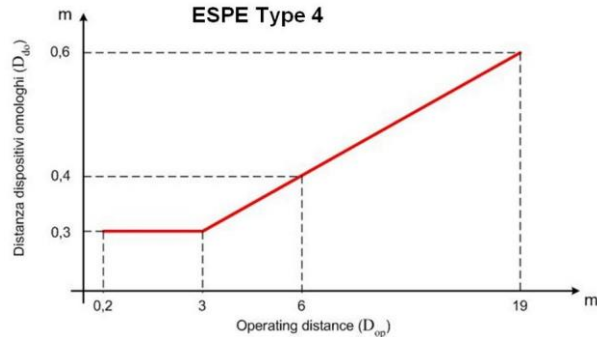
The TXB interfering device must be positioned outside a minimum  $D_{do}$  distance from the TXA – RXA emitter-receiver couple axis.



**Fig 13 - Distance between homologous devices**

This minimum  $D_{do}$  distance depends on:

- the operating distance between emitter (TXA) and receiver (RXA)
- the effective aperture angle of the ESPE (EAA)



**Fig 14 - ESPE Type4**

The following table shows, for convenience, the values of the minimum installation distances relative to some operating distances:

Operating distance (m)	Minimum installation distance (m)
3	0.3
6	0.4
10	0.5
19	0.6



The interfering device (TXB) must be positioned at the same Ddo distance, calculated as shown above, even if closer to TXA respect to RXA.  
Installation precautions have to be taken to avoid interference between homologous devices. A typical situation is represented by the installation areas of several adjacent safety devices aligned one next to the other, for example in plants with different machines.

The figure provides two examples:

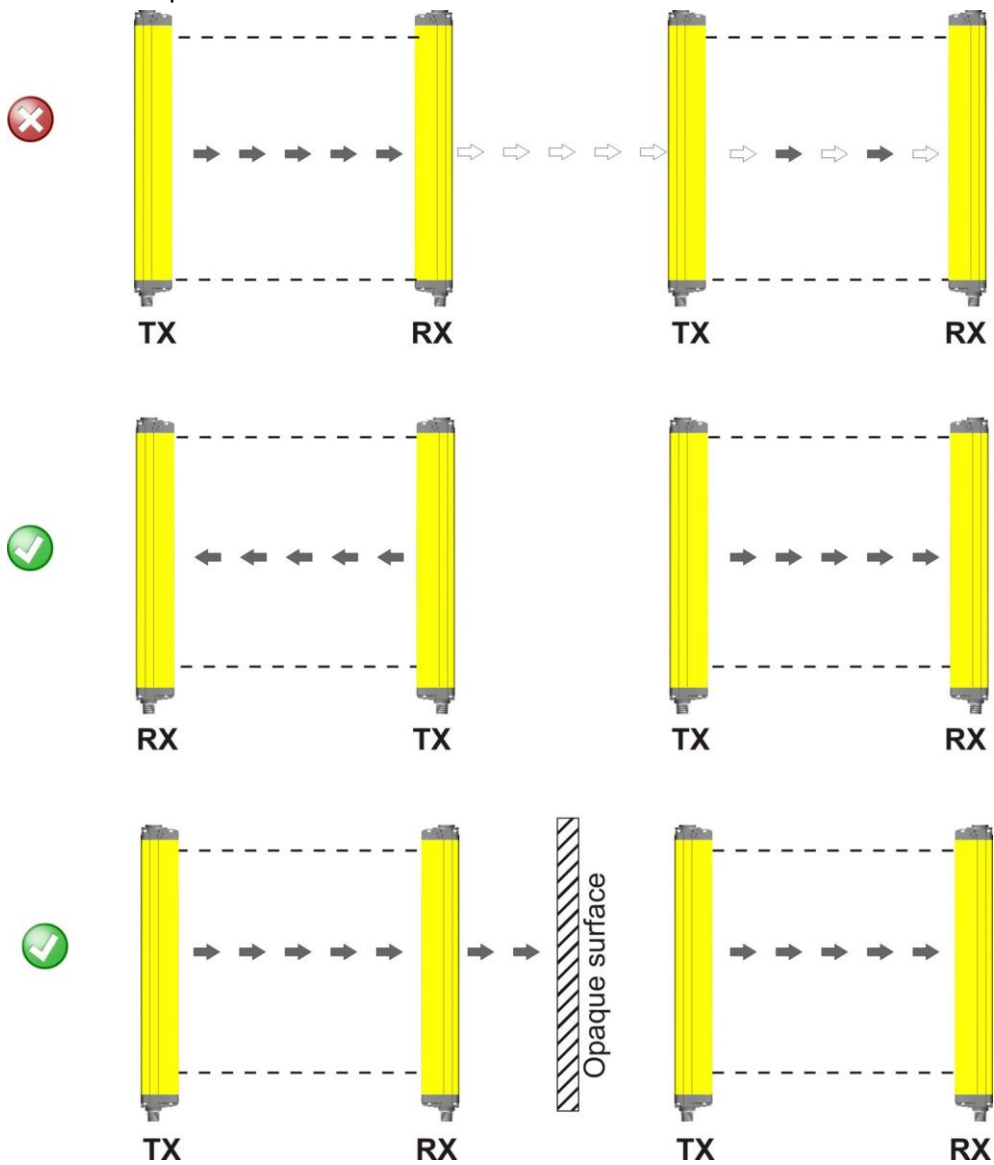


Fig 15 - Recommended positioning for homologous devices



If two light curtains have to be mounted near each other as reported in the first example of Fig 15 - on page 22.

### 2.2.3 Emitter and Receiver Orientation

The two units shall be assembled parallel each other, with the beams arranged at right angles with the emission and receiving surface, and with the connectors pointing to the same direction.

The configurations shown in the figure must be avoided:

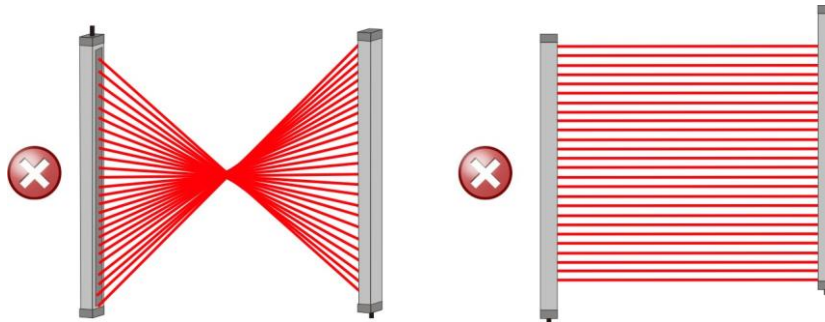


Fig 16 - Wrong light curtain TX-RX orientations

### 2.2.4 Use of deviating mirrors

The control of any dangerous area, with several but adjacent access sides, is possible using only one safety device and well-positioned deviating mirrors.

The figure shows a possible solution to control two different access sides, using one mirror placed at 45° with respect to the beams.

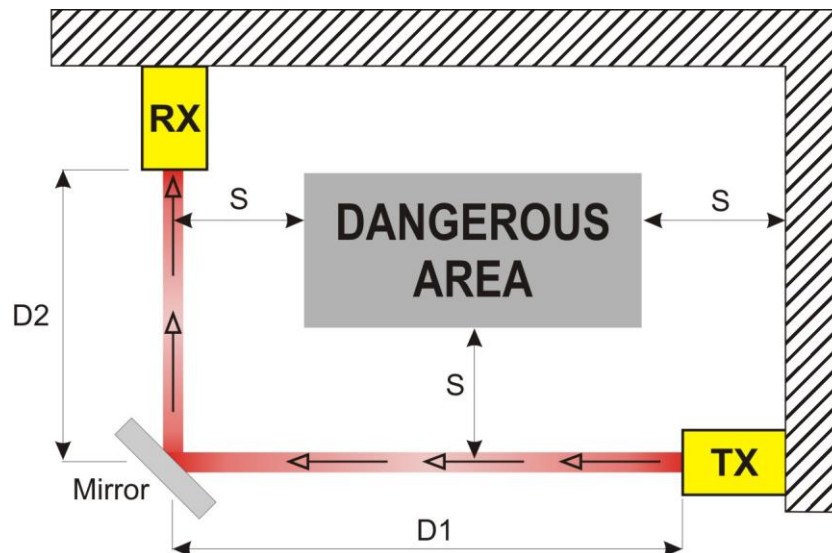


Fig 17 - Use of deviating mirrors

The operator must respect the following precautions when using the deviating mirrors:

- The alignment of the emitter and the receiver can be a very critical operation when deviating mirrors are used. Even very small displacements of the mirror is enough to lose alignment. The use of the DATALOGIC laser pointer accessory is recommended under these conditions.
- The minimum safety distance (S) must be respected for each single section of the beams.
- The effective operating range decreases by about 20% by using only one deviating mirror.

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

Number of mirrors	Operating Distance (14mm)	Operating Distance (30mm)
0	6.0 m	19 m
1	4.8 m	15.2 m

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

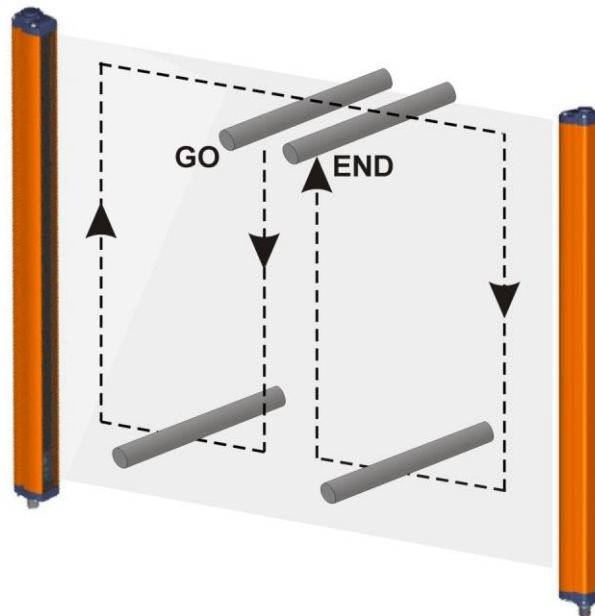


### 2.2.5 Controls after first installation

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.

Verify that:

- ESPE remains blocked (➤ lit RED) intercepting the beams along the protected area using the specific test piece, following the scheme in **Fig 18 - on page 25**.



**Fig 18 - Path of the test piece**

TP14 for light curtains with 14 mm resolution: SG4-14-xxx-OP-x

TP30 for light curtains with 30 mm resolution: SG4-30-xxx-OP-x

TP40 for body resolution light curtain: SG4-Sx-xxx-OP-x

- ESPE has been correctly aligned: press slightly on the product side, in both directions the ➤ LED must remain green.
- The response time at machine STOP, including ESPE, safety control system and machine response time, must be within the limits defined in the calculation of the safety distance (cfr. **Minimum installation distance on page 10**).
- The safety distance between the dangerous parts and ESPE must comply with the requirements indicated in **Minimum installation distance on page 10**.
- A person must not access or remain between ESPE and the dangerous parts of the machine.
- Access to the dangerous areas of the machine must not be possible from any unprotected area.
- ESPE must not be disturbed by external light sources, ensuring that it remains in Normal Operation (➤ lit GREEN) for at least 10-15 minutes, then place the specific test piece in the protected area and verify the permanence of SAFE condition (➤ lit RED) for the same period.

### 3 MECHANICAL MOUNTING

Emitting (TX) and receiving (RX) units must be installed with the relevant sensitive surfaces facing each other. The connectors must be positioned on the same side and the distance between the two units must be within the operating range of the used model (cfr. **TECHNICAL DATA** on page 50).

The two units must be positioned the most aligned and parallel possible.

For a fine alignment please refer to cfr. **ALIGNMENT PROCEDURE** on page 32.

Two types of brackets can be used to fix the two units: "L" type standard brackets and Rotating Brackets accessory kit.



For lengths up to 1200 mm, 2 "C-type" brackets are sufficient, for greater lengths it is recommended to use 3 brackets, the third one as an additional support in the middle.

#### 3.1 FIXING WITH "L" BRACKETS

"L" metal brackets are included with all SG4 FIELDBUS models.

They allow product installation where no alignment adjustment is needed.

Additional optional supports can be used in combination with "L" brackets to allow for some angular adjustment or vibration dampening (cfr. **ACCESSORIES** on page 57).

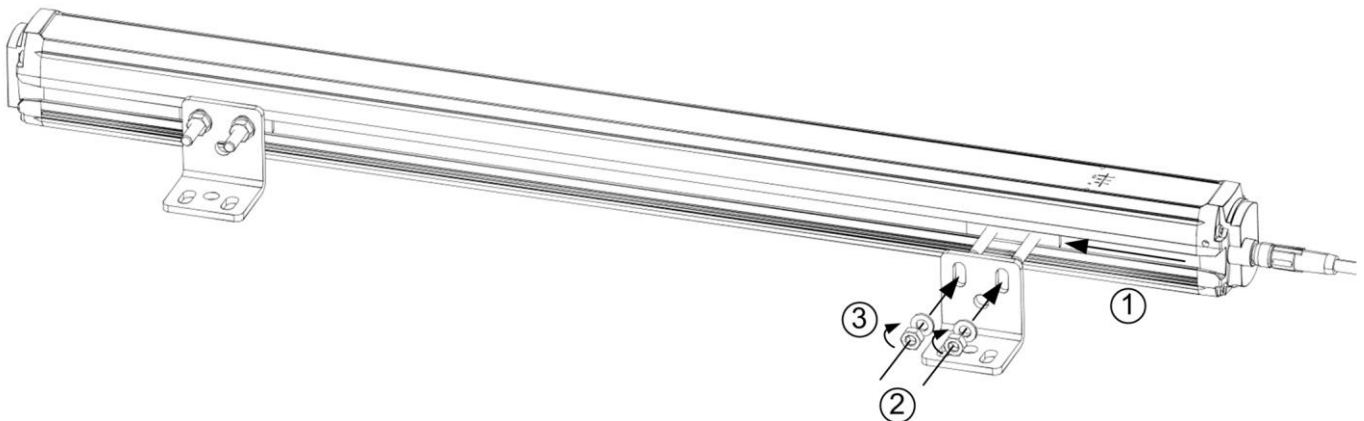


Fig 19 - Standard "L" brackets assembly

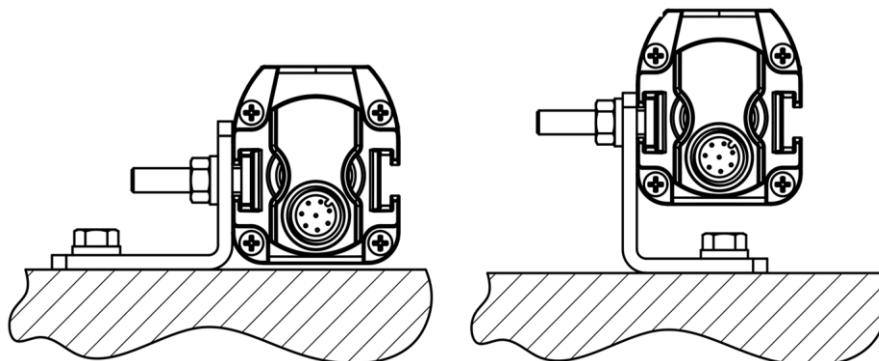


Fig 20 - "L" bracket mounting options

### 3.2 FIXING WITH OPTIONAL ROTATING BRACKET KIT

Rotating brackets available on request (4x KIT - Order Code 95ASE2840), can be used as an alternative or together with “L” brackets.

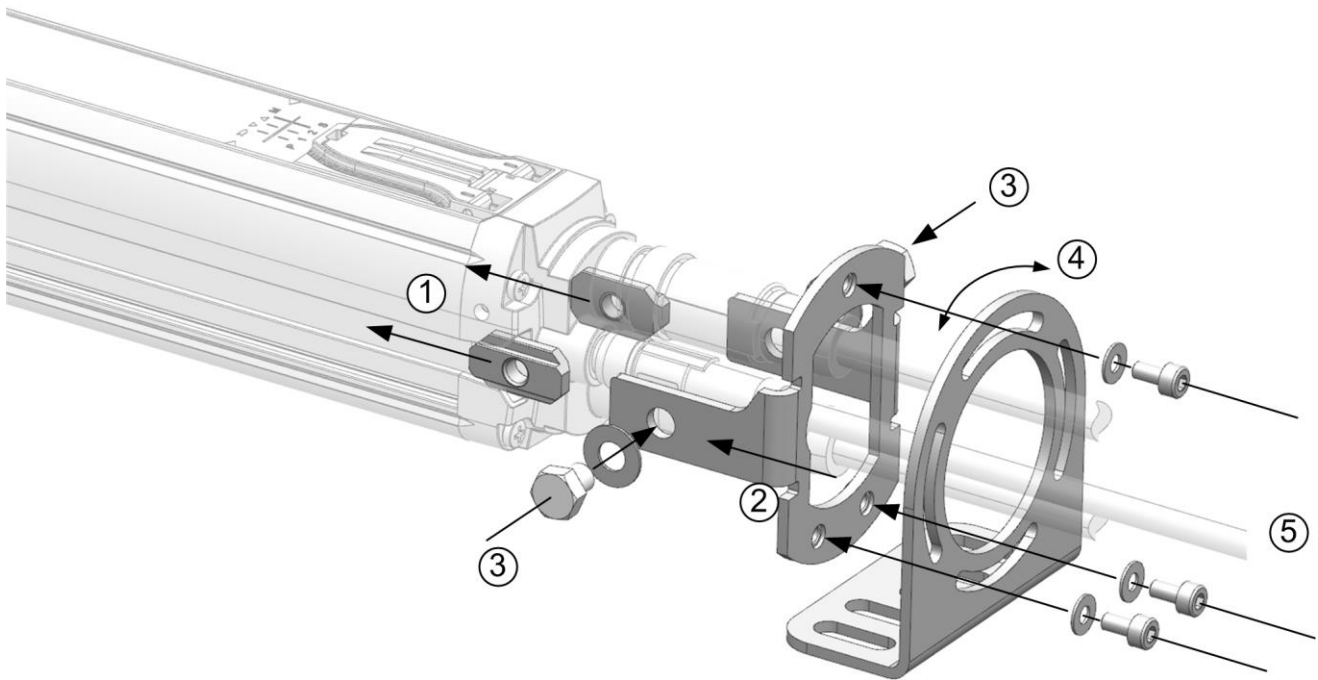


Fig 21 - Rotating bracket assembly

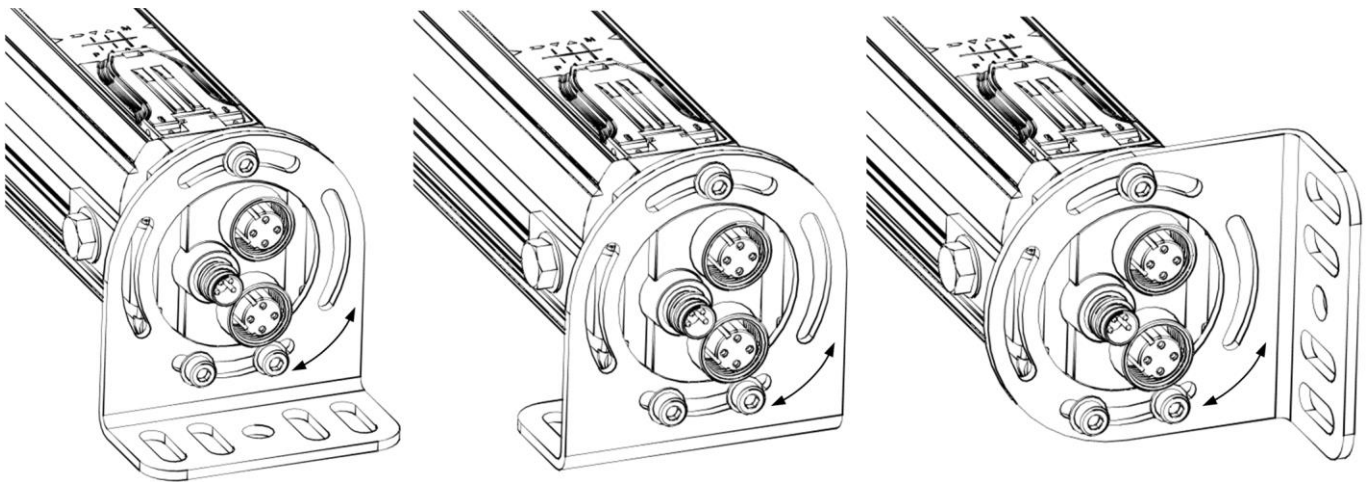


Fig 22 - Rotating bracket mounting options

### 3.3 ANTI-VIBRATION SUPPORTS

In case of applications with particularly strong vibrations, vibration dampers together with standard or rotating mounting brackets are recommended to reduce the impact of the vibrations (cfr. **ACCESSORIES** on page 57).

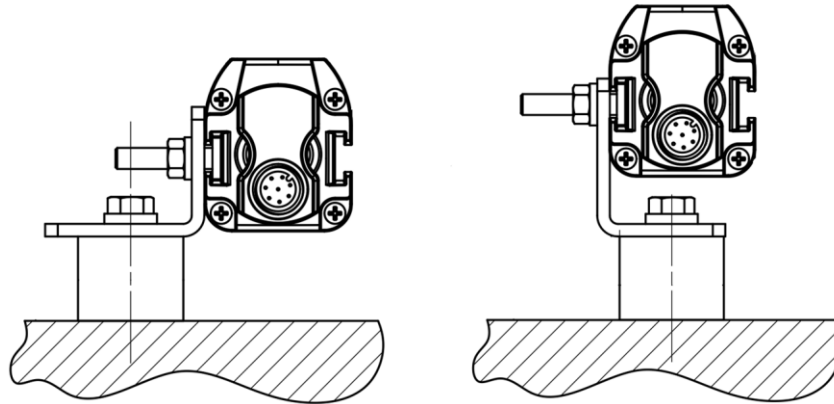


Fig 23 - Anti-vibration supports with standard brackets

4 ELECTRICAL CONNECTIONS

4.1 PIN-OUT AND CONFIGURATION PIN CONNECTION

4.1.1 Receiver (RX)

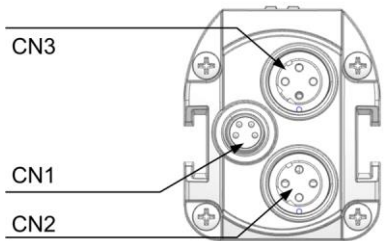
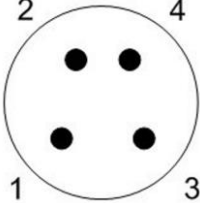
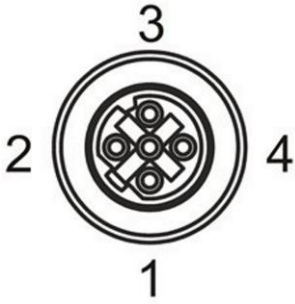
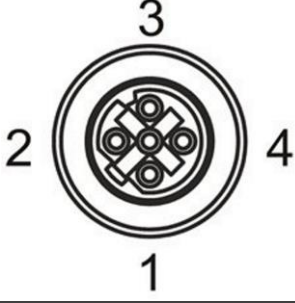


Fig 24 - Receiver unit connectors placement

For the receiver an M8 4-pin male connector is used for power supply, while two M12 D-coded female Ethernet connectors provides dual port Ethernet POWERLINK CN Node connection.

<b>CN1</b>	<b>SIGNAL</b>	<b>POWER CONNECTOR</b>
1	24VDC (BROWN)	
2	NOT USED (WHITE)	
3	0 V (BLUE)	
4	NOT USED (BLACK)	

<b>CN2</b>	<b>SIGNAL</b>	<b>ETHERNET POWERLINK PORT1</b>
1	TxD+, transmit data +	
2	RxD+, receive data +	
3	TxD-, transmit data -	
4	RxD-, receive data -	

<b>CN3</b>	<b>SIGNAL</b>	<b>ETHERNET POWERLINK PORT2</b>
1	TxD+, transmit data +	
2	RxD+, receive data +	
3	TxD-, transmit data -	
4	RxD-, receive data -	

**POWERLINK (transmission technology, cable specification)**

Safety instrumented openSAFETY communication is embedded in the POWERLINK standard protocol and transmitted via the same network.

S/UTP Cat5e must be used for transmission according to the 100Base-TX Fast Ethernet standard (overall shield with 2 x 2 twisted pair unshielded copper wires).

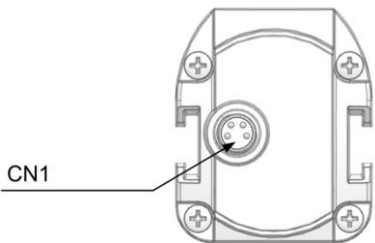
The cables are designed for bit rates of up to 100 Mbit/s.

The transmission velocity is automatically detected by the measuring system and does not have to be set by means of switches.



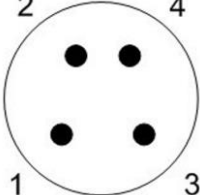
**We recommend that you use class 2 hubs for setting up the EPL network.  
The cable length between two devices may not exceed 100 m.**

**4.1.2 Emitter (TX)**



**Fig 25 - Emitter unit connectors placement**

For the emitter an M8 4-pin male connector is used for power supply.

CN1	SIGNAL	POWER CONNECTOR
1	24VDC (BROWN)	
2	NOT USED (WHITE)	
3	0 V (BLUE)	
4	NOT USED (BLACK)	

## 4.2 NOTES ON CONNECTIONS

For the correct operation of the safety light curtains, the following precautions regarding the electrical connections have to be respected:

- 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.).
- The power supply must provide safe mains isolation (SELV/PELV), no PE (Protective Earth) is therefore required.
- The device is already equipped with internal overvoltage and overcurrent suppression devices.
- **The use of other external components is not recommended.**

## 5 ALIGNMENT PROCEDURE

The alignment between the emitting and the receiving units is necessary to obtain the correct operation of the light curtain.

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 emitting unit's beams coincide with the optical axes of the corresponding elements of the receiving unit.

The beam used to synchronize the two units is the closest to the connector.

Thereon we refer to such beam as SYNC and to the last one as LAST.

When SYNC beam is not engaged all other beams scan it's not possible, thus it's mandatory to have SYNC beam aligned and not intercepted.

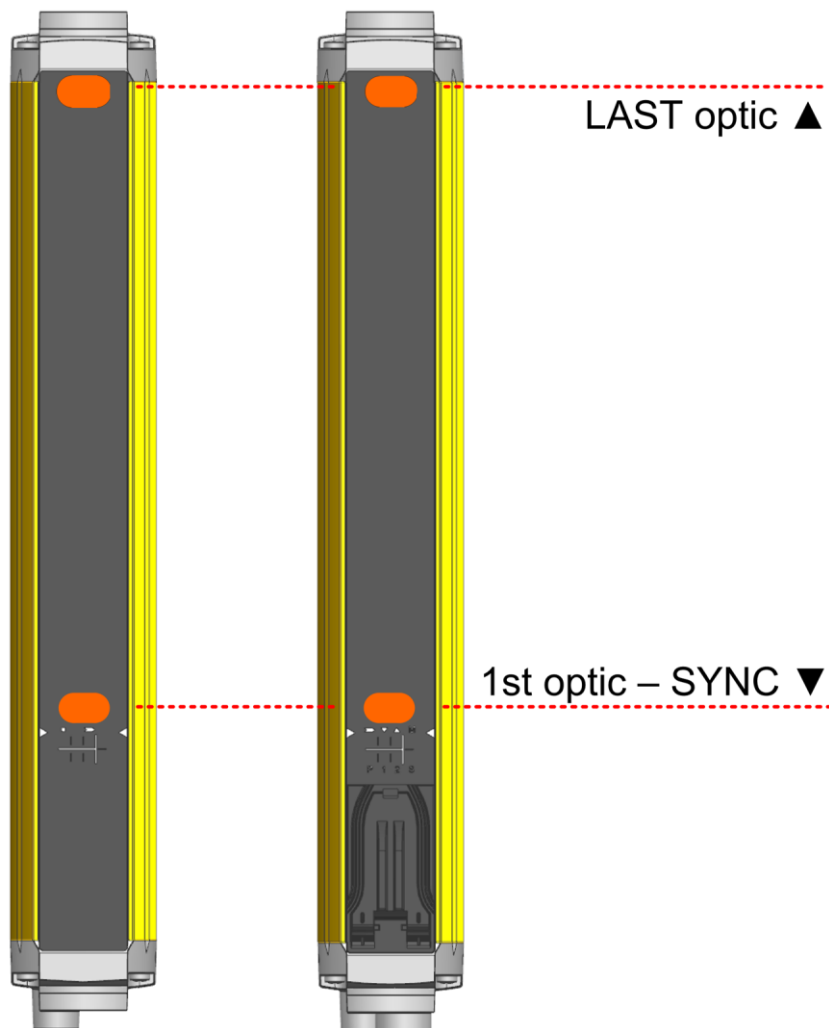
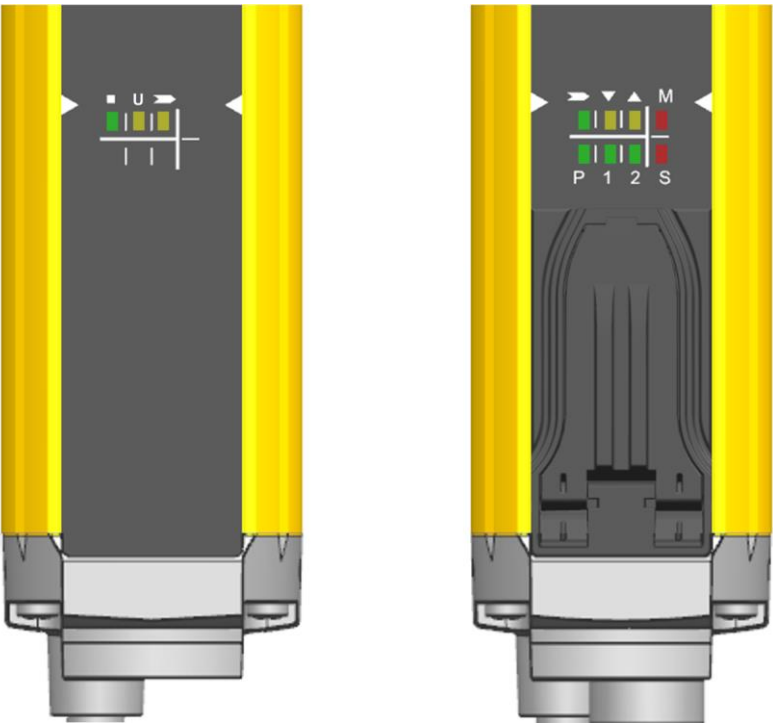


Fig 26 - SYNC and LAST beam position



A LED user Interface provides indications about optic alignment together with Fieldbus connection status.  
 LEDs are clearly identified through symbols or labels allowing their immediate reading, independently of bars directions; Find below a short description of Leds indications about optical alignment.  
 For Fieldbus connection LEDs please refer to cfr. **USER INTERFACE AND DIAGNOSTICS** on page 46.



**Fig 27 - LED user interface label**

The standard installation described hereinafter is the one shown in **Fig 26 - on page 32**, with the bar assembled with the connectors pointing down.

Two yellow LEDs (▲ LAST, ▼ SYNC) on receiver unit facilitates the alignment procedure.  
 During standard operation, the LEDs indicate the safety light curtain optical alignment status, as shown in the table.

**ALIGNMENT STATUS**

LED colour	Symbol	FREE	INTERCEPTED		
Yellow	▲	OFF	ON	ON	OFF
Yellow	▼	OFF	ON	OFF	OFF
Red/Green	➡	GREEN	RED	RED	RED
		SYNC ad LAST beam engaged No intercepted Beams	UNITS not aligned	SYNC engaged LAST not aligned	Units correctly aligned but at least one intermediate beam intercepted

## 5.1 CORRECT ALIGNMENT PROCEDURE

The light curtain alignment can be effected only after having completed the mechanical installation and the electrical connections as described above.

Compare alignment results with those given in the following table:

- Check the green LED (■) and the yellow LED (➤) on the TX unit. If both ON, the emitter is running correctly;
- Verify that the sensitive area from the safety light curtain is free;
- Verify that one of the following conditions is present on the RX unit:

### 1. FREE

Alignment LED (➤) lit GREEN.

Both yellow LEDs (▲, ▼) OFF.

Units are aligned.

### 2. INTERCEPTED

Alignment LED (➤) lit RED.

The status of both yellow LEDs (▲, ▼) does not matter.

Units are not aligned.

Continue with the following steps to switch from condition 2 to condition 1:

1. Keep the receiver in a steady position and regulate the emitter until the yellow LED (▼ SYNC) is OFF. This condition shows the effective alignment of the first synchronisation beam.
2. Rotate the emitter, pivoting on the lower optics axis, until the yellow LED (▲ LAST) is OFF. Under these conditions, if no other beam is intercepted Alignment LED (➤) should turn GREEN.
3. Delimit the area in which the LED ➤ is steady GREEN through some micro adjustments - for the first and then for the second unit - then place both units in the centre of this area.



**Ensure that the green LED ➤ is steady ON.**

- Fix the two units firmly using brackets.
- Verify that the ➤ LED on the RX unit is ON green and beams are not interrupted, then verify that the LED turns ON red if even one single beam is interrupted (condition where an object has been detected).
- This verification shall be made with the special cylindrical "Test Piece" having a size suitable to the resolution of the device used.



**Passing the Test Piece along the whole sensitive area and at any distance from the two units, the ➤ LED shall be always ON red and never change status.**

## 6 COMMISSIONING AND CONFIGURATION

### 6.1 BASIC RULES

- All openSAFETY devices used on the bus must have a POWERLINK certificate and an openSAFETY certificate.
- All safety instrumented devices must also have a certificate from a “Notified Body” (e.g., TÜV, BIA, HSE, INRS, UL, etc.).
- The shielding effect of cables must also be ensured after installation (bending radii/tensile strength!) and after connector changes. In cases of doubt, use more flexible cables with a higher current carrying capacity.

Upon completion of installation, a visual inspection with report should be carried out.

Whenever possible, the quality of the network should be verified using a suitable bus analysis tool: no duplicate IP addresses, no reflections, no telegram repetitions, etc.

M12 D-coded male Ethernet connectors must be used for transmission.

### 6.2 POWERLINK / OPENSAFETY

For a description of the functional principle of POWERLINK and of the complete communication processing, please refer to the EPSG specification DS 301 Communication Profile Specification.

For the safety protocol of openSAFETY, please refer to the EPSG specification WDP 304 Safety Profile Specification.

On request, this and more information about POWERLINK and openSAFETY are available from the Ethernet POWERLINK Standardization Group (EPSG) at the following address:

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POWERLINK-OFFICE EPSG  
 Bonsaiweg 6  
 15370 Fredersdorf  
 Germany  
 Phone: + 49 (0) 33439 - 539270  
 Fax: + 49 (0) 33439 - 539272  
 Email: [info@ethernet-powerlink.org](mailto:info@ethernet-powerlink.org)  
 Internet: <http://www.ethernet-powerlink.org>  
<http://www.open-safety.org>

### 6.3 B&R CONFIGURATION TOOLS

The SG4 Filedbus uses the B&R Automation Studio environment for integration with the PLC through Description Files. The SafeDESIGNER configuration tool provides the configuration and programming interface for the safety application. Depending on the SG4 Fieldbus model the following hardware and software requirements apply:

Model	HW	SW
Base (SG4-xx-xxx-OP-B)	SafeLOGIC SL81xx, SLXxxx	Automation Studio 4.2.8.x SL Upgrades 1.10.x.x SafetyRelease 1.10 SafeDESIGNER 4.2.x
Advanced (SG4-xx-xxx-OP-A)	SafeLOGIC SL81xx only	Automation Studio 4.3.3.x SL Upgrades 1.10.2.x SafetyRelease 1.10 SafeDESIGNER 4.3.3

## 6.4 DEVICE DESCRIPTION FILE

### 6.4.1 Importing device in B&R Automation Studio

In order to make the light curtain available in Automation Studio it's necessary to import the description files in Automation Studio.

1. Select Tools -> Import Fieldbus Device

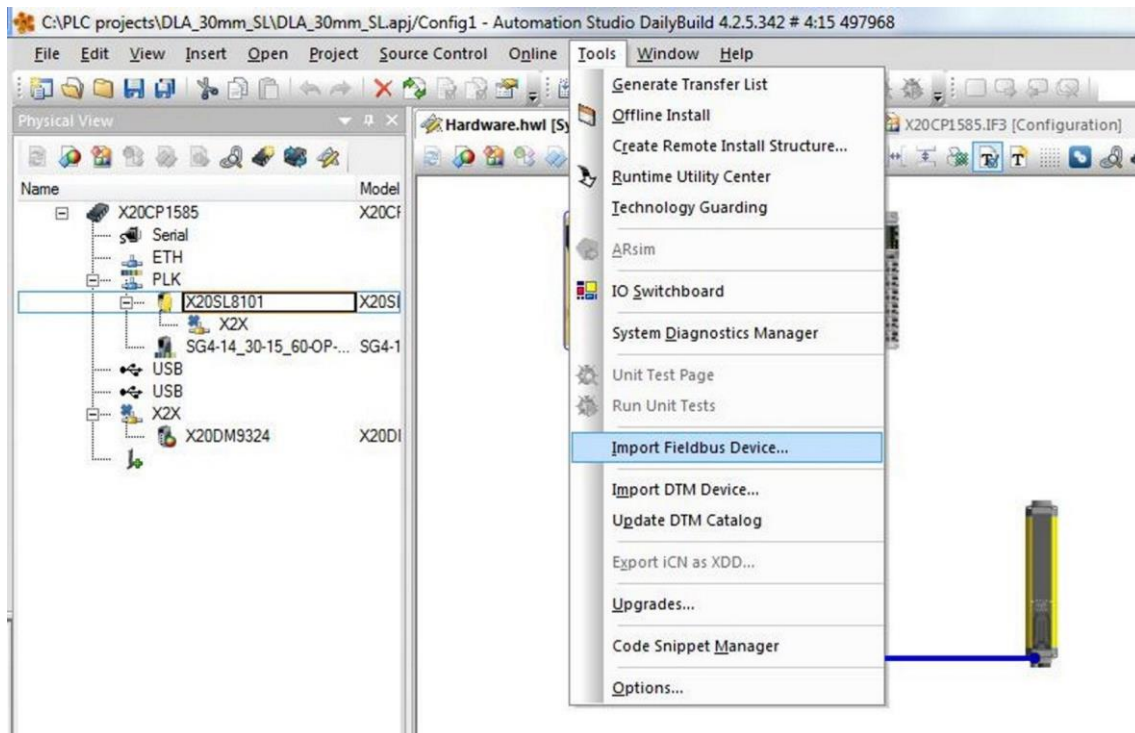
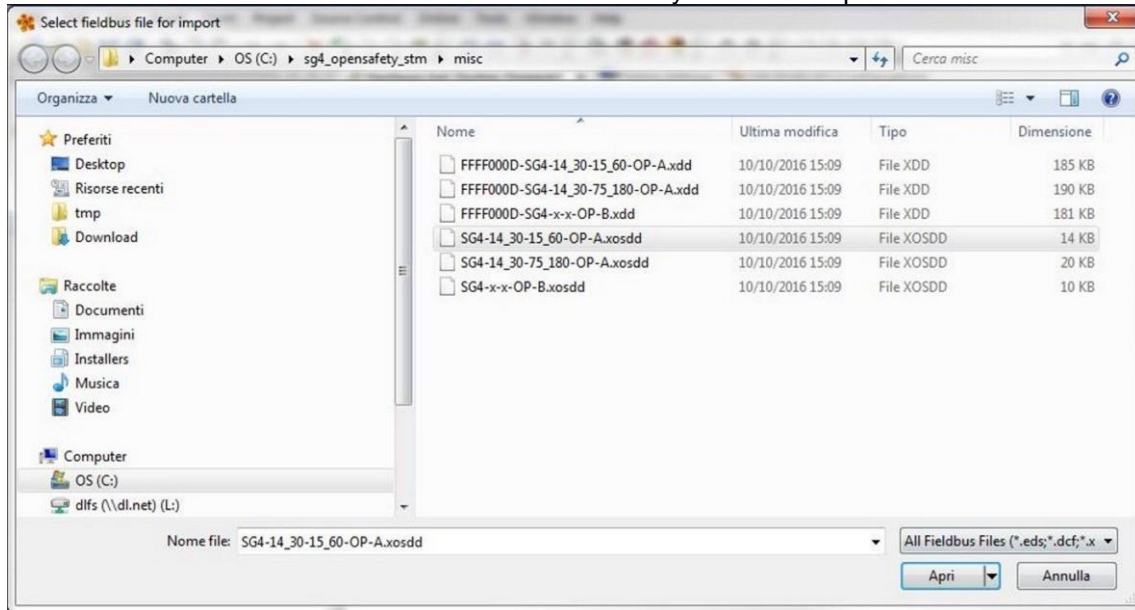


Fig 28 - Step 1 - Importing the device

For SG4 FIELDBUS Series light curtains different description files are available depending on the specific light curtain model, please refer to the table below:

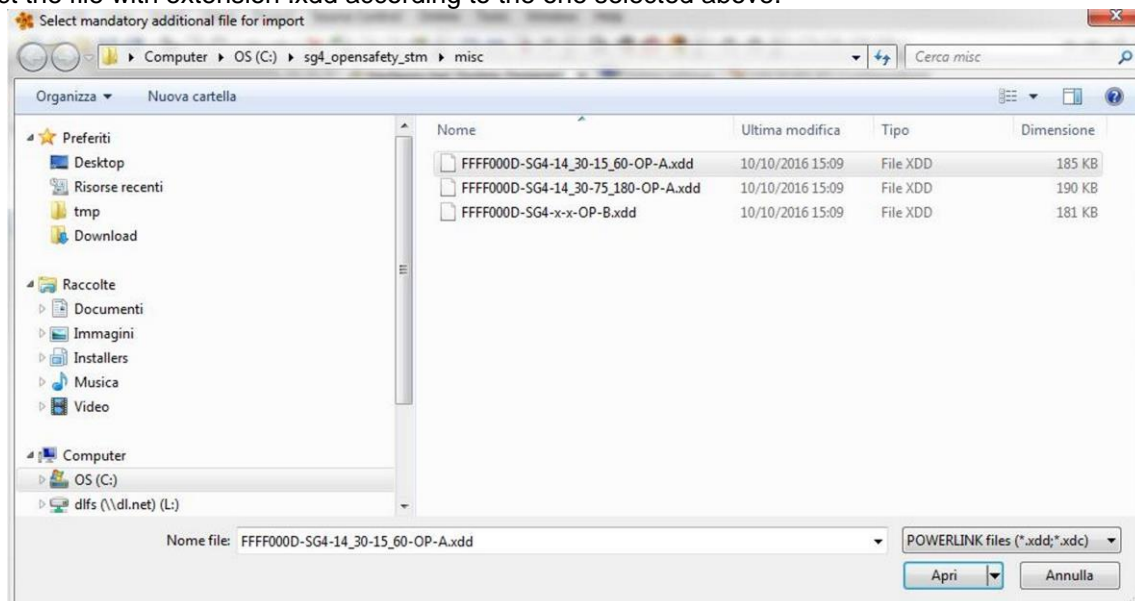
Model	Length (mm)	Description Files
Base (SG4-xx-xxx-OP-B)	150-1800	FFFF000D-SG4-x-x-OP-B.xdd SG4-x-x-OP-B.xosdd
Advanced up to 600mm (SG4-xx-xxx-OP-A)	150-600	FFFF000D-SG4-14_30-15_60-OP-A.xdd SG4-14_30-15_60-OP-A.xosdd
Advanced from 750mm to 1800mm (SG4-xx-xxx-OP-A)	750-1800	FFFF000D-SG4-14_30-75_180-OP-A.xdd SG4-14_30-75_180-OP-A.xosdd

2. Select first the file with extension .xosdd related to the device you want to import.



**Fig 29 - Step 2 - Importing the device**

3. Select the file with extension .xdd according to the one selected above.



**Fig 30 - Step 3 - Importing the device**

Once imported, the device will be present in Automation Studio Hardware Catalog, ready to be used in the project. Just search for the right device and drag&drop.

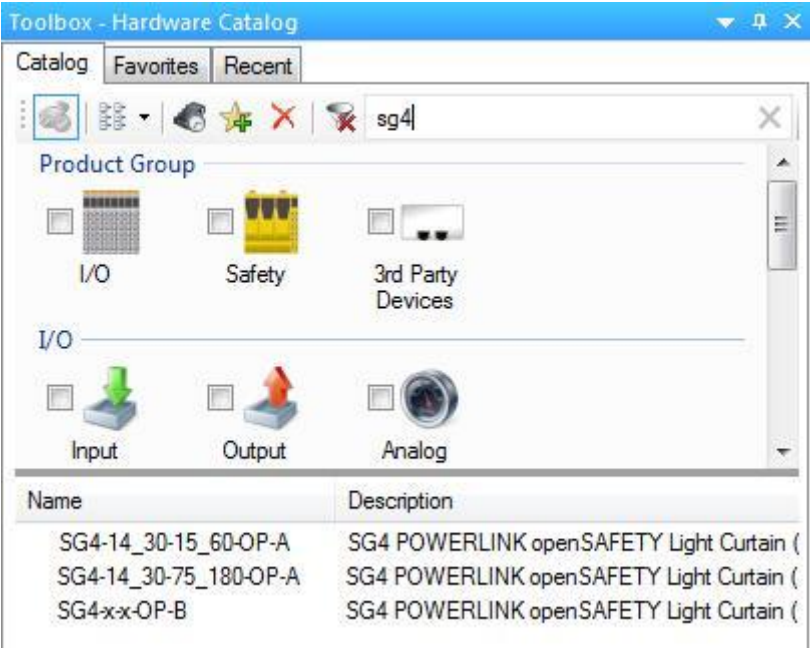


Fig 31 - SG4 FIELDBUS devices in Automation Studio Hardware Catalog

## 6.5 SAFETY FIRMWARE UPDATE

When importing Device Description Files (.XDD/.XOSDD) make sure in same folder there also is one .fw file.

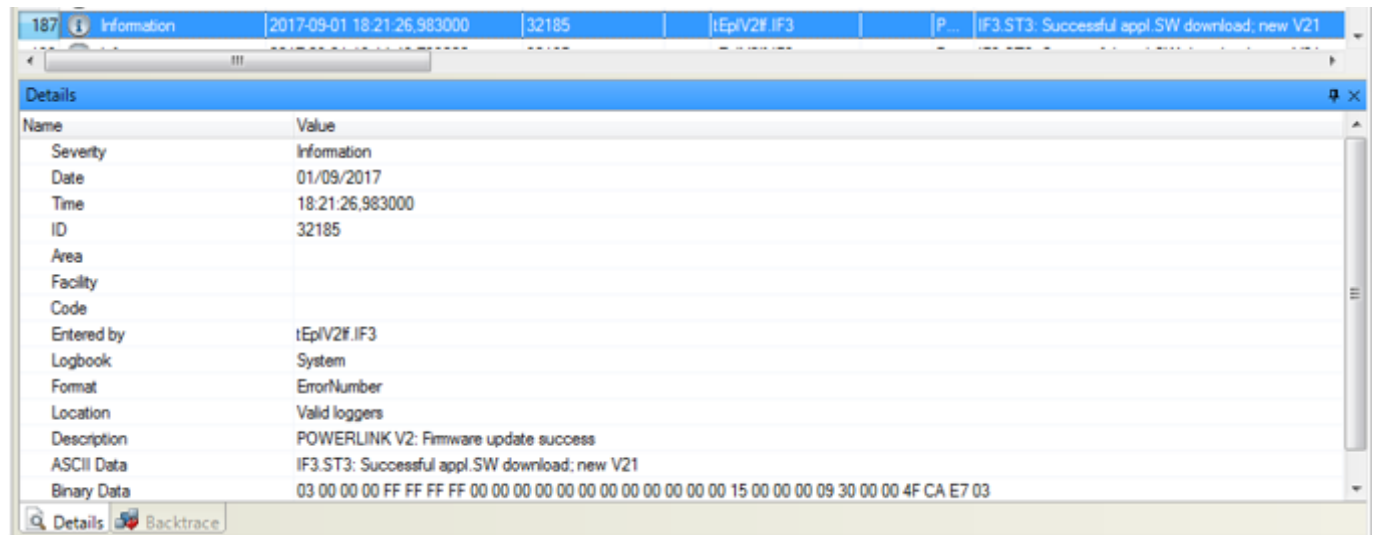
 0xFFFF000D_SG4.fw	01/09/2017 18:12	File FW	109 KB
 FFFF000D-SG4-x-x-OP-B.xdd	29/06/2017 14:42	File XDD	180 KB
 SG4-OP.png	01/06/2016 10:52	Immagine PNG	115 KB
 SG4-x-x-OP-B.xosdd	29/06/2017 14:40	File XOSDD	12 KB

### Fig 32 - Description Files packet including firmware

This is the Light Curtain Safety Firmware that will be embedded in PLC project and automatically loaded on the device when first connected on Ethernet POWERLINK bus.

The Firmware is loaded on PLC after a successful re-build and transfer of Automation Studio project following Device Description Files import.

When Updating firmware, POWERLINK Status Led (Cfr. **USER INTERFACE AND DIAGNOSTICS** on page 46) emits a double blink until update completion, then a log line can be found in PLC Logger which shows node number and firmware version downloaded to device.



**Fig 33 - SafeDESIGNER response time parameters for main SafeLOGIC**



## 6.6 SETTING DEVICE ADDRESS

In Automation Studio right-click on SG4 FIELDBUS device and select “Change node number”, set the address from 1 to 240.

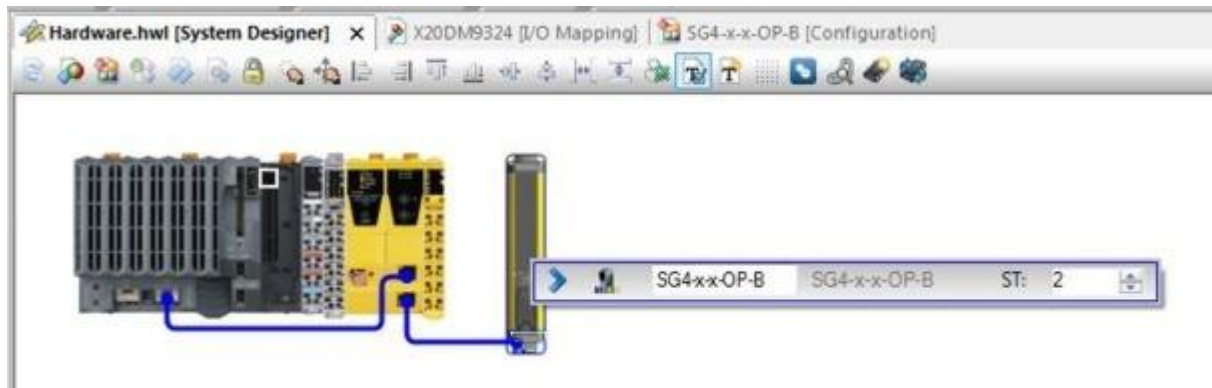


Fig 34 - Select EPL device address in Automation Studio

On device choose same address by setting the two rotary switches under the blue plastic flap. Use a proper tool as a little flat-head screwdriver to open the flap and set the switches.



**EPL address in Automation studio is visualized in decimal format, while the rotary switches are Hex type.**

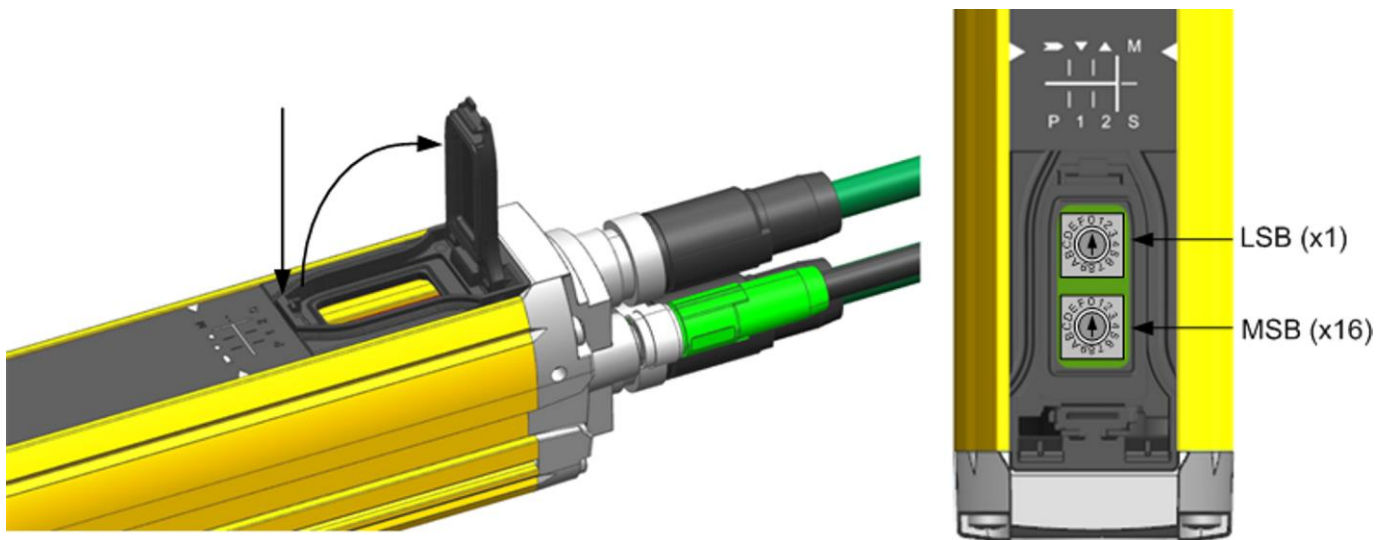


Fig 35 - Select EPL device address on the device



## 6.7 CONFIGURING A LIGHT CURTAIN IN SAFEDESIGNER

To configure the device accordingly with its resolution, height and typology, open SafeDESIGNER (right-click on the SafeLOGIC and select SafeDESIGNER)

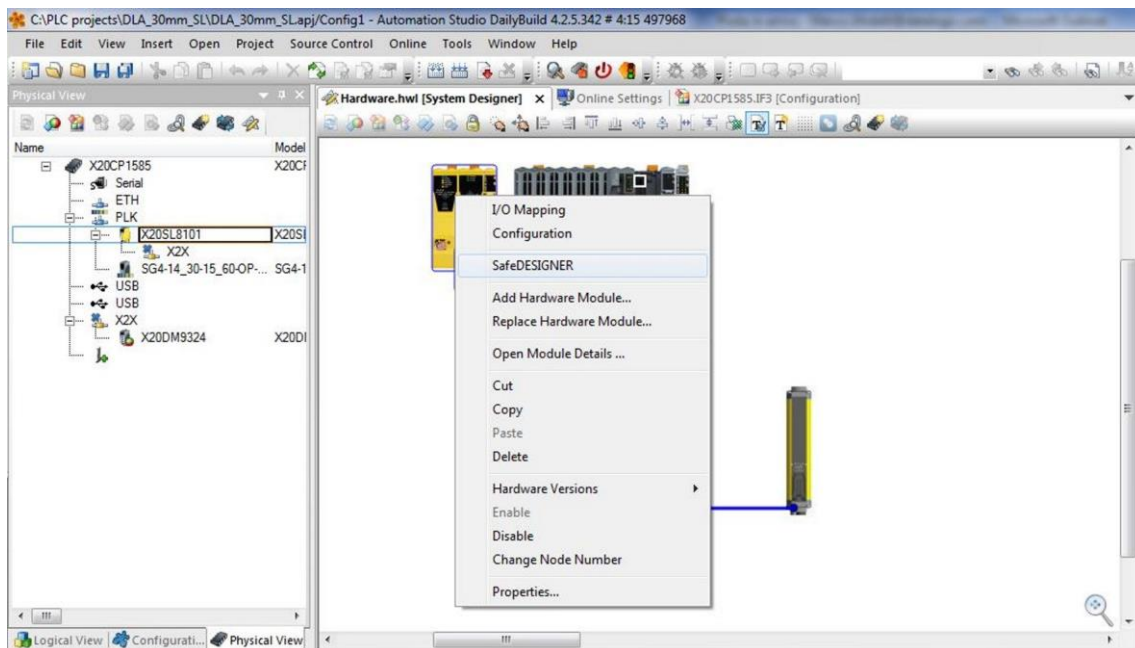


Fig 36 - open SafeDESIGNER

Change the LC parameters according with the specific light curtain model. For example, for 14mm models with 150 mm of protecting length select the following parameters:

The screenshot shows the 'SafeDESIGNER' configuration window. On the left, a tree view shows the configuration hierarchy: SL1, SL1.SM1, SL1.SM2 (selected), General, InputSafeChannels, and OutputSafeChannels. On the right, the configuration details for 'SG4-x-x-OP-B SG4 POWERLINK openSAFETY Light Curtain' are displayed. The 'BasicConfiguration' tab is active, showing a table of parameters. The 'Resolution' and 'Length' parameters are highlighted with a red box.

Parameter	Value	Unit
<b>Basic</b>		
Min required FW Rev	Basic Release	
Optional	No	
External UDID	No	
<b>Safety Response Time</b>		
Manual Configuration	No	
Safe Data Duration	20000	us
Additional Tolerated Packet Loss	0	packets
Packets per Node Guarding	5	packets
<b>BasicConfiguration</b>		
Resolution	14 mm	
Length	15 cm	

Fig 37 - Configuring device parameters

For all other parameters please refer to B&R Automation Studio user documentation.

## 6.8 PROCESS DATA STRUCTURE

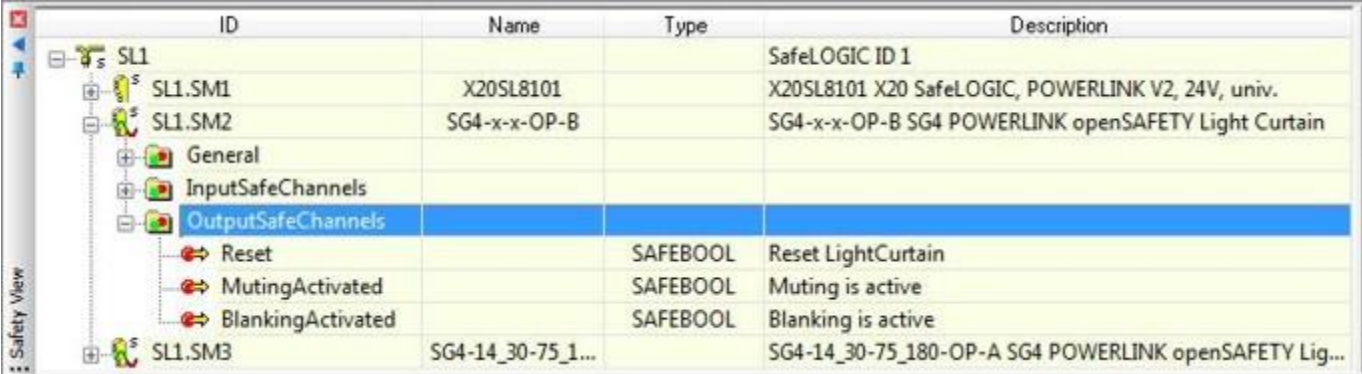
### 6.8.1 Control Byte

Control byte represents a set of information transmitted from the PLC to the light curtain.

The table below shows in details the meaning of the single bits.

Bit	Name	Function
0	Reset	Acknowledge The control bit "Reset" is used to acknowledge an error state or (depending on the configuration) to acknowledge startup. Acknowledgement is done by a transition from logical FALSE (zero) to logical TRUE (one).
1	MutingActivated	Signals if muting is active on the ESPE device 0: Muting is not active on ESPE device (default value if muting is not supported by device) 1: Muting is active on ESPE device
2	BlankingActivated	Signals if blanking is active on the ESPE device 0: Blanking is not active on ESPE device (default value if feature is not supported by device) 1: Blanking active on ESPE device
3 -7	Reserved	

Control Byte data points are accessible in SafeDESIGNER as Output Safe Channels.



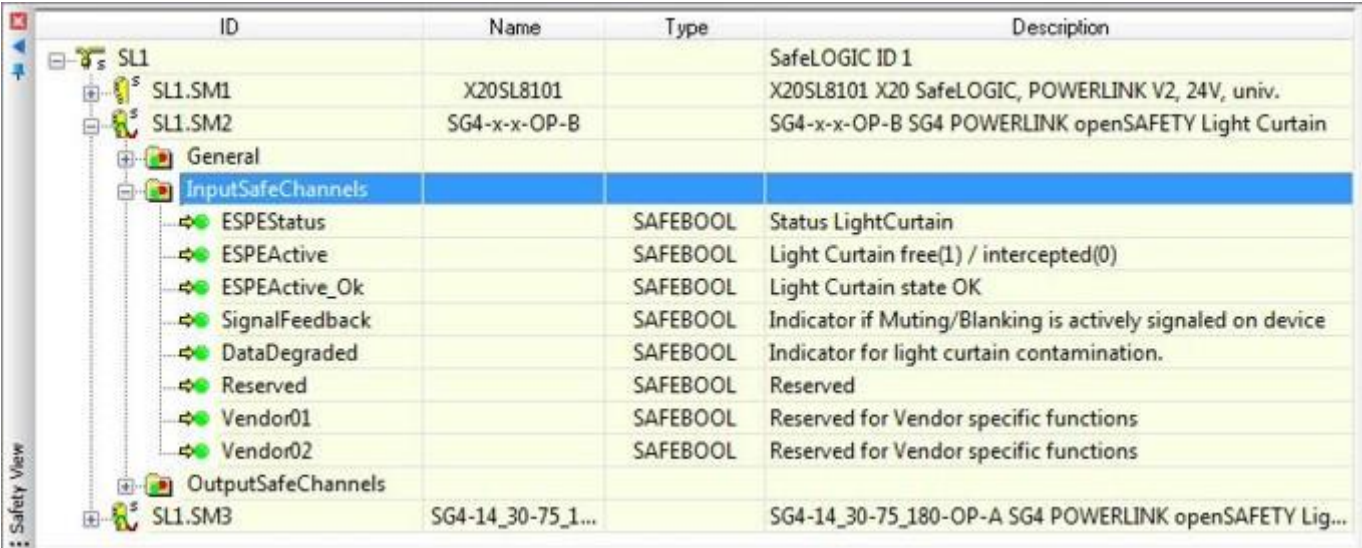
ID	Name	Type	Description
SL1			SafeLOGIC ID 1
SL1.SM1	X20SL8101		X20SL8101 X20 SafeLOGIC, POWERLINK V2, 24V, univ.
SL1.SM2	SG4-x-x-OP-B		SG4-x-x-OP-B SG4 POWERLINK openSAFETY Light Curtain
General			
InputSafeChannels			
OutputSafeChannels			
Reset		SAFEBOOL	Reset LightCurtain
MutingActivated		SAFEBOOL	Muting is active
BlankingActivated		SAFEBOOL	Blanking is active
SL1.SM3	SG4-14_30-75_1...		SG4-14_30-75_180-OP-A SG4 POWERLINK openSAFETY Lig...

Fig 38 - Output Safety Channels

## 6.8.2 Status byte

Control byte represents a set of information transmitted from the light curtain to the PLC. The table below shows in details the meaning of the single bits.

Bit	Name	Function
0	ESPEStatus	Functioning Status of light curtain and connection: when 0 all other bits are non-significant. 0: openSAFETY connection not present or non-resettable error occurred on device 1: openSAFETY connection and device working
1	ESPEActive	Light curtain optics status 0: INTERCEPTED (at least one beam intercepted) 1: FREE (all beams free)
2	ESPEActive_Ok	Light curtain operation status 0: error occurred, reset is necessary 1: device is ok, all bits transmitted are valid
3	SignalFeedback	For devices with integrated signaling device for muting or blanking. 0: signaling device off or defective 1: signaling device defective on
4	DataDegraded	Optical signal quality: 0: at least one beam with low signal quality 1: all beams with good signal quality.
5-7	Reserved	



ID	Name	Type	Description
SL1			SafeLOGIC ID 1
SL1.SM1	X20SL8101		X20SL8101 X20 SafeLOGIC, POWERLINK V2, 24V, univ.
SL1.SM2	SG4-x-x-OP-B		SG4-x-x-OP-B SG4 POWERLINK openSAFETY Light Curtain
General			
InputSafeChannels			
ESPEStatus		SAFEBOOL	Status LightCurtain
ESPEActive		SAFEBOOL	Light Curtain free(1) / intercepted(0)
ESPEActive_Ok		SAFEBOOL	Light Curtain state OK
SignalFeedback		SAFEBOOL	Indicator if Muting/Blanking is actively signaled on device
DataDegraded		SAFEBOOL	Indicator for light curtain contamination.
Reserved		SAFEBOOL	Reserved
Vendor01		SAFEBOOL	Reserved for Vendor specific functions
Vendor02		SAFEBOOL	Reserved for Vendor specific functions
OutputSafeChannels			
SL1.SM3	SG4-14_30-75_1...		SG4-14_30-75_180-OP-A SG4 POWERLINK openSAFETY Lig...

Fig 39 - Input Safety Channels

### 6.8.3 Single beam transport set (Advanced Light Curtain only)

SG4 FIELDBUS Advanced Light Curtains implements openSAFETY Vision profile, which one of the key functionalities is the ability to transport single beams information for further analysis and advanced functions in combination with dedicated safety code of functional blocks library.

#### BeamStatus-Bytes

Along with single beams information openSAFETY Visions profile transports some “status-bytes” to specify when relative Ray-bytes are used or signal if a problem occurred on some ray.

On SG4 FIELDBUS a maximum of 4 BeamStatus-bytes are implemented. Each BeamStatus-byte represents the status of 8 Rays-bytes, with each bit representing the status of one Rays-byte.

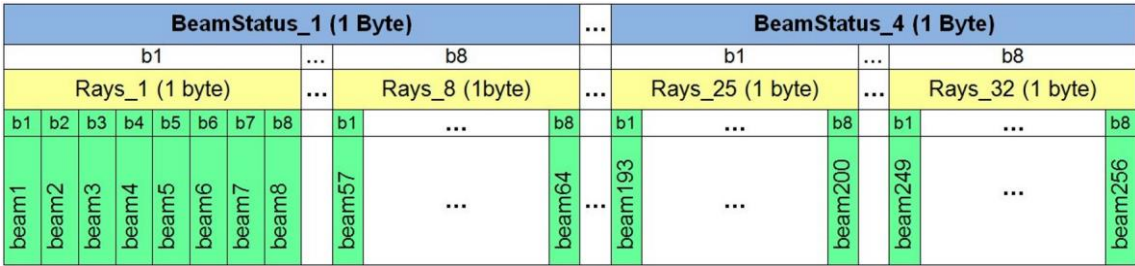


Fig 40 - BeamStatus-byte

#### Rays-Bytes

Each Rays byte represents the status of 8 contiguous beams, with each bit

BeamStatus_[N].bit[n]	1: beam (N-1)x8+n FREE 0: beam(N-1)x8+n INTERCEPTED
-----------------------	--

The figure below shows an example of a SG4-30-030-OP-A with 16 beams whose status is transmitted on 2 bytes (8+8 bits).

Rays\_1.beam1 is the status of the first optic (Sync optic) whereas Rays\_2.beam16 the one from last optic.



**When Sync Beam (beam1) is intercepted the light curtain can't detect the status the other beams, thus they're considered intercepted (all beams bit set to 0).**  
**As a consequence, when using single beams information for any advanced function, it's recommendable to install the light curtain so that sync optic it's not intercepted by the material for which the advanced functions are intended for.**

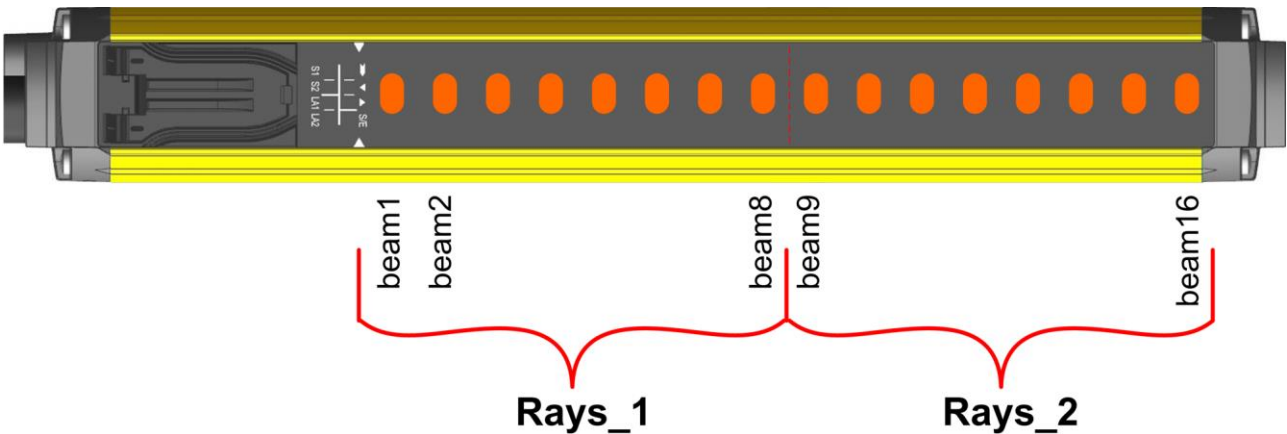


Fig 41 - SG4-30-030-OP-A with 16 beams

## 6.9 SAFEDESIGNER CONFIGURATION FOR ADVANCED MODELS

From SafeDesigner 4.3.3, LightCurtain\_SF library provides a set of functional blocks (FUBs) which allow safety light curtain advanced functions, taking advantage of single beam information transport.

To add the library to the current project choose Add Library from the Project menu in SafeDESIGNER.

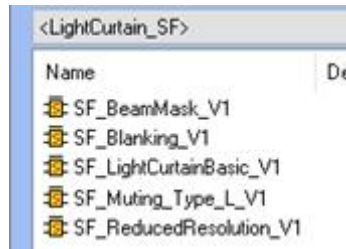


Fig 42 - LightCurtain\_SF library function blocks



**SF\_LighCurtainBasic\_V1 block must always be added to the project when using any other FUB from LightCurtain\_SF library, even if not using any of it's output. The only exception is SF\_Muting\_Type\_L\_V1 block.**

SF\_LighCurtainBasic\_V1 FUB provides the interface for all the data points from Control Byte and Status Byte

S\_Status\_ESPEActive output form SF\_LighCurtainBasic\_V1 FUB provides the same unprocessed safety output as Basic model.

For more comprehensive information about Light Curtain\_SF library and detailed user guide of each FUB please refer to the dedicated documentation included in SafeDESIGNER.

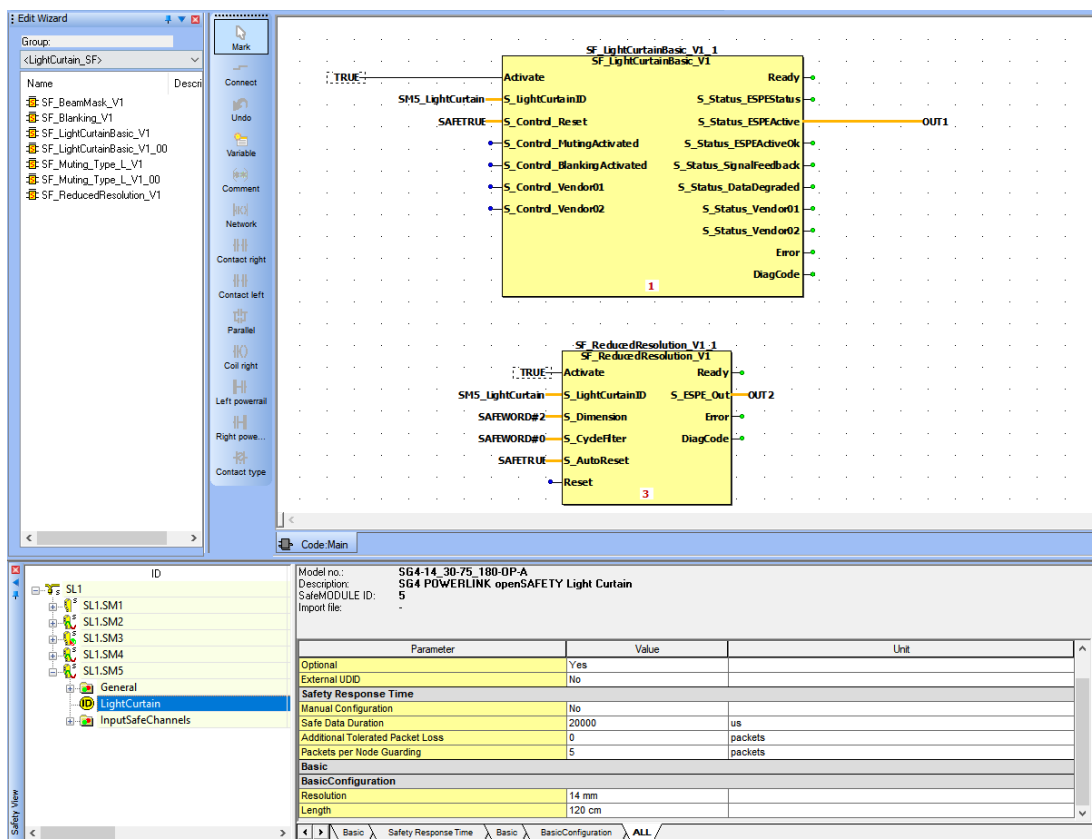


Fig 43 - Example Project with SF\_ReducedResolution\_V1 FUB



## 7 USER INTERFACE AND DIAGNOSTICS

### 7.1 USER INTERFACE

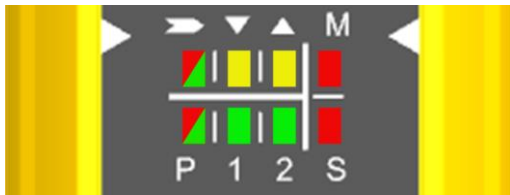


Fig 44 - Receiver

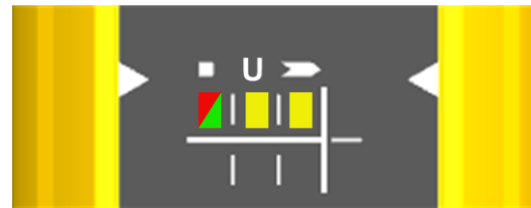


Fig 45 - Emitter

On the bottom side of the light curtain a user interface with 8 LEDs helps the customer to check the status of the light curtain and the POWERLINK / openSAFETY variation.

#### Receiver (RX):

LED	COLOR	FUNCTION NORMAL OPERATION	FUNCTION ERROR
	Red/Green	BEAM STATUS Red On ► At least one beam intercepted Green On ► All beams free	Red On
	Yellow	SYNC BEAM On ► First beam intercepted or not aligned	Blinking ▼ uP ERROR ▲ OPTIC ERROR ▼▲ openSAFETY ERROR
	Yellow	LAST BEAM On ► Last beam intercepted or not aligned	
<b>M</b>	Red	MASTER uP STATUS Off ► Normal operation Blinking ► Boot 	On ► Error on uP MASTER
<b>S</b>	Red	SLAVE uP STATUS see LED M	On ► Error on uP SLAVE
<b>P</b>	Red/Green	ETHERNET POWERLINK STATUS Green On ► normal operation Green blinking: pre-op Green double-blinking: Firmware Update in progress	Red On ► Ethernet Powerlink Error
<b>1</b>	Green	EPL PORT 1 LINK On ► there is a link Blinking ► there is activity on this link	no error indicator
<b>2</b>	Green	EPL PORT 2 LINK On ► there is a link Blinking ► there is activity on this link	no error indicator

#### Emitter (TX):



LED	COLOR	FUNCTION NORMAL OPERATION	FUNCTION ERROR
	Green	POWER Green On ► Power On, Normal Operation	Red On
<b>U</b>	Yellow	-	Blinking
	Yellow	EMISSION On ► Emission active	OPTIC ERROR U uP ERROR U  openSAFETY ERROR

## 8 PERIODICAL CHECKS

---

The following is a list of recommended check and maintenance operations that should be periodically carried-out by qualified personnel (cfr. **Controls after first installation on page 24**)

Check that:

- The ESPE stays locked ( red) during beam interruption along the entire protected area, using the suitable "Test Piece" (according to the **Fig 18 - on page 25** scheme).
- The ESPE is correctly aligned. Press slightly product side, in both directions and the LED  must not turn red.
- The response time upon machine STOP (including response time of the ESPE and of the machine) is within the limits defined for the calculation of the safety distance (see cfr. **INSTALLATION on page 17**).
- The safety distance between the dangerous areas and the ESPE are in accordance with the instructions included in **INSTALLATION on page 17**.
- Access of a person between ESPE and machine dangerous parts is not possible nor is it possible for him/her to stay there.
- Access to the dangerous area of the machine from any unprotected area is not possible.
- The ESPE and the external electrical connections are not damaged.

The frequency of checks depends on the particular application and on the operating conditions of the safety light curtain.

## 8.1 GENERAL INFORMATION AND USEFUL DATA



**Safety MUST be a part of our conscience.**

The safety devices fulfill their safety function only if they are correctly installed, in accordance with the Standards in force.

If you are not certain to have the expertise necessary to install the device in the correct way, DATALOGIC is at your disposal to assist you during the installation.

The device uses fuses that are not self-resetting. Consequently, in presence of short-circuits causing the cut-off of these fuses, both safety light curtains (RX and TX) shall be sent to DATALOGIC Repair Service Department.

A power failure caused by interference may temporarily trigger the Safety State over the connected safety Fieldbus, but the safe functioning of the light curtain will not be compromised.

## 8.2 WARRANTY

The warranty period for this product is 36 months.

See the General Terms and Conditions of Sales at [www.datalogic.com](http://www.datalogic.com) for further details.

DATALOGIC will not be liable for any damages to persons and things caused by the non-observance of the correct installation modes and device use.

In case of a non-functioning device, always return the pair of emitting and receiving units (having the same serial numbers) for repair or replacement.



## 9 DEVICE MAINTENANCE

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DATALOGIC safety light curtains do not require special maintenance operations.

To avoid the reduction of the operating distance, optic protective front surfaces must be cleaned at regular intervals.

Use soft cotton cloths dampened in water.

Do not apply too much pressure on the surface in order to avoid making it opaque.

Please do not use on plastic surfaces or on light curtain painted surfaces:

- **alcohol or solvents**
- **wool or synthetic cloths**
- **paper or other abrasive materials**

### 9.1 PRODUCT DISPOSAL

DATALOGIC recommends to dispose of the product in compliance with local laws or contact authorised waste collection centres.

## 10 TECHNICAL DATA

SAFETY CATEGORY	
	Type 4 (rif. EN 61496-1: 2013)
	SIL 3 (rif. EN 61508)
	SIL CL 3 (ref. EN 62061:2005/A2: 2015)
	PL e, Cat. 4 (rif. EN ISO 13849-1: 2015)
	PFHd [1/h] = 1,02E-08
	MTTFd [years] = 118

ELECTRICAL DATA	
Power supply (Vdd):	24 VDC $\pm$ 20%
Consumption (TX):	3 W max
Consumption (RX):	5 W max
Electrical protection:	Class III
Connections:	RX:1xM8 4-pole Power + 2xM12 D-coded Ethernet TX:1xM8 4-pole Power
Cables:	Power: 50m max, unshielded 4 pole power cable Ethernet: 100m Max S/FTP or F/FTP cat5
Controlled height:	SG4-14/SG4-30: 150..1800 mm SG4-Sx: 600...1200 mm
Resolution	SG4-30: 30mm SG4-14: 14mm

OPTICAL DATA	
Emitting light ( $\lambda$ ):	Infrared, LED (940 nm)
Lens Diameter:	SG4-14: 4,65mm SG4-30: 11,25mm SG4-Sx: 30mm (virtual diameter from 2 beams)
Beam Spacing:	SG4-14: 9,35mm SG4-30: 18,75mm
Operating distance:	SG4-14: 0.2...6 m SG4-30: 0.2...19 m SG4-Sx: 0.2...19 m
Ambient light rejection:	EN 61496-2: 2013

MECHANICAL AND ENVIRONMENTAL DATA	
Operating temperature:	0...+ 50 °C
Storage temperature:	- 25...+ 70 °C
Temperature class:	T6
Humidity:	15...95 % (no condensation)
Mechanical protection:	IP 65 EN 60529
Vibrations:	Width 0.35 mm, Frequency 10 ... 55 Hz 20 sweep per axis, 1octave/min EN 60068-2-6
Shock resistance:	16 ms (10 G) 1,000 shocks per axis EN 60068-2-29
Housing material:	Painted aluminium (yellow RAL 1003)
Front side material:	PMMA
Caps material:	PBT Valox 508 (PANTONE 072C)
Rotary Switch Flap Material:	LEXAN 943A black
Weight:	1.35 kg per linear meter for single unit

\* Recovery Time may be longer if both first and last optics are intercepted.

## 10.1 SAFETY RESPONSE TIME

Since SG4 FIELDBUS has no safety outputs it's not possible to define a worst case Response Time from detection to output deactivation only depending on light curtain.

Total Safety Response Time will depend on Light Curtain detection time, Data Runtime on the bus, output activation and actuator stopping time.

Only part (1) and (2) from figure below depends on light curtain and its parametrization in SafeDESIGNER.

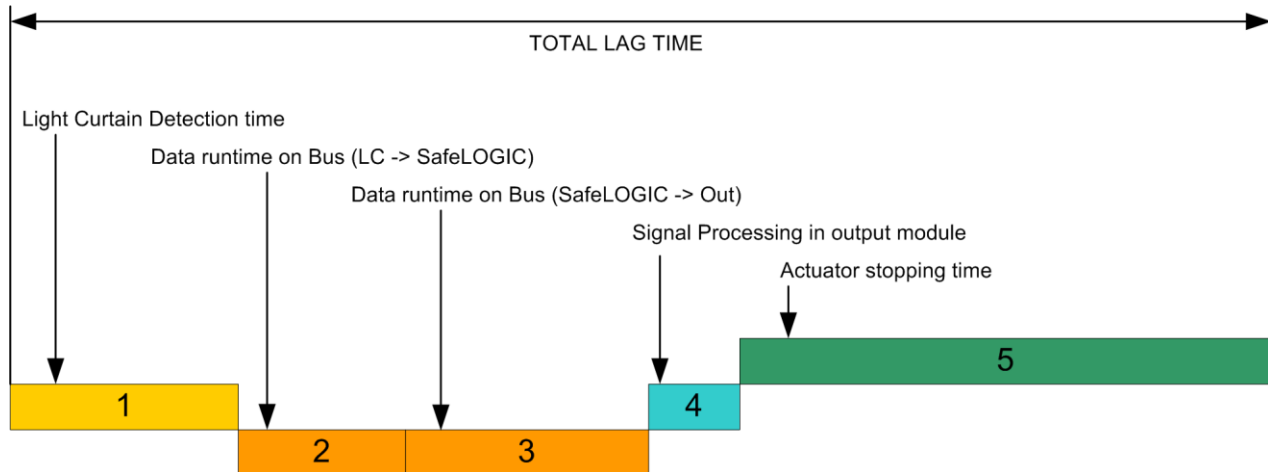


Fig 46 - Total Safety Response time

### 10.1.1 Light curtain Detection time for Basic Models

Times below are referred to the worst case time from object detection to openSAFETY information ready to be transmitted on Bus, where a standard filter of two optic scans is applied for optimal environmental compatibility.

Model (14mm)	Time (ms)	Model (30mm)	Time (ms)	Model (Body)	Time (ms)
SG4-14-015-OP-B	19	SG4-30-015-OP-B	19	SG4-S2-060-OP-B	24
SG4-14-030-OP-B	22	SG4-30-030-OP-B	21	SG4-S3-080-OP-B	27
SG4-14-045-OP-B	25	SG4-30-045-OP-B	22	SG4-S4-090-OP-B	27
SG4-14-060-OP-B	29	SG4-30-060-OP-B	24	SG4-S4-120-OP-B	31
SG4-14-075-OP-B	31	SG4-30-075-OP-B	25		
SG4-14-090-OP-B	35	SG4-30-090-OP-B	27		
SG4-14-105-OP-B	38	SG4-30-105-OP-B	29		
SG4-14-120-OP-B	41	SG4-30-120-OP-B	31		
SG4-14-135-OP-B	44	SG4-30-135-OP-B	32		
SG4-14-150-OP-B	47	SG4-30-150-OP-B	34		
SG4-14-165-OP-B	51	SG4-30-165-OP-B	36		
SG4-14-180-OP-B	54	SG4-30-180-OP-B	38		

### 10.1.2 Light curtain Detection time for Advanced Models

Model	Time (ms)	Tcycle
SG4-14-015-OP-A	14	5
SG4-14-030-OP-A	16	6
SG4-14-045-OP-A	18	7
SG4-14-060-OP-A	21	9
SG4-14-075-OP-A	23	10
SG4-14-090-OP-A	25	11
SG4-14-105-OP-A	27	12
SG4-14-120-OP-A	29	13
SG4-14-135-OP-A	31	14
SG4-14-150-OP-A	33	15
SG4-14-165-OP-A	35	16
SG4-14-180-OP-A	38	17
SG4-30-015-OP-A	14	5
SG4-30-030-OP-A	15	6
SG4-30-045-OP-A	16	7
SG4-30-060-OP-A	17	7
SG4-30-075-OP-A	18	8
SG4-30-090-OP-A	19	9
SG4-30-105-OP-A	20	9
SG4-30-120-OP-A	21	10
SG4-30-135-OP-A	23	11
SG4-30-150-OP-A	24	11
SG4-30-165-OP-A	25	12
SG4-30-180-OP-A	27	12



Please note that Detection Times from table above are only valid when using S\_ESPE\_Out of any any function block from LightCurtain\_SF Library with S\_CycleFilter input set to 0.

When using S\_Status\_ESPEActive output from SF\_LightCurtainBasic\_V1 block use Base model detection times from

For S\_CycleFilter > 0 use the following formula:

$$\text{Light Curtain Detection Time} = \text{Detection time} + \text{S\_CycleFilter} \times \text{Tcycle}$$

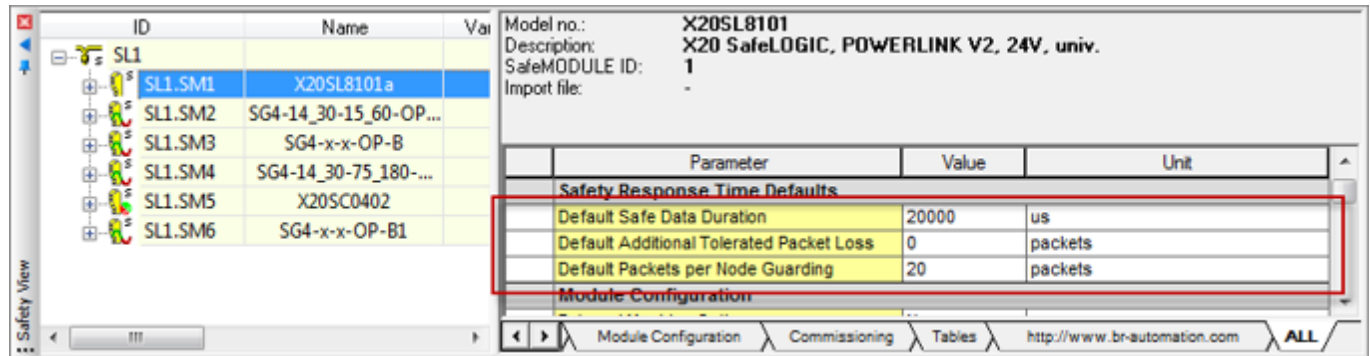
It is strongly recommended to use at least S\_CycleFilter = 1 to avoid false safety requests from ambient interference.

### 10.1.3 Data runtime on Bus (Light Curtain -> SafeLOGIC)

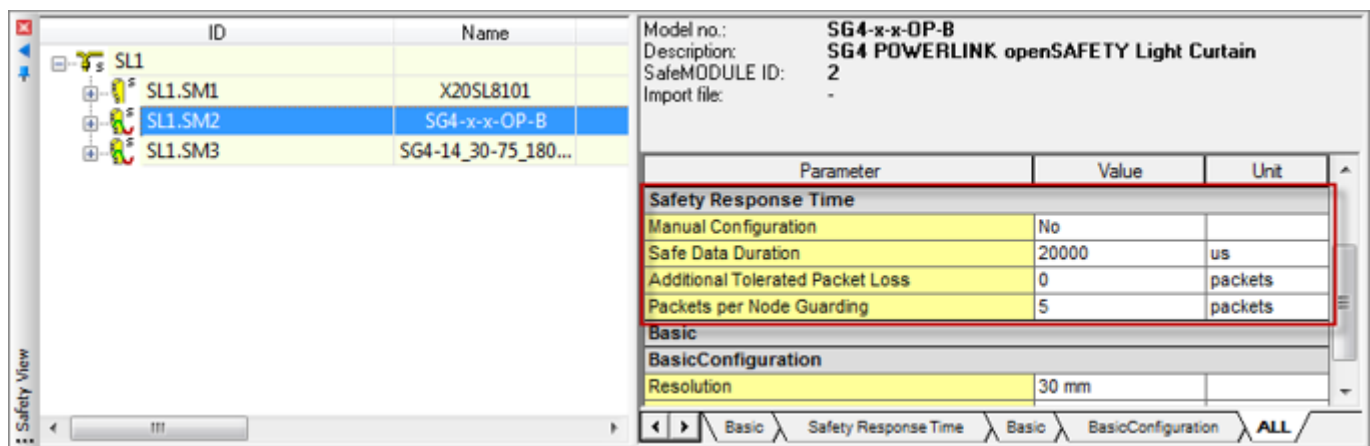
To calculate Total Safety Response Time, all times in **Fig 46 - on page 51** must be added.

Among those the time (2) in the figure, depends on Safety Response Time settings in SafeDESIGNER "Safety View" window for SG4 FIELDBUS node.

Those settings can be found for each Safety Node, including SafeLOGIC (**Fig 47 - on page 53**) and SG4 FIELDBUS (**Fig 48 - on page 53**).



**Fig 47 - SafeDESIGNER response time parameters for main SafeLOGIC**



**Fig 48 - SafeDESIGNER response time parameters for generic SG4 FIELDBUS node**

#### Case 1) "Manual Configuration" for SG4 FIELDBUS node is set to NO:

Default Safe Data Duration and Default Additional Tolerated Packet Loss from SafeLOGIC node has to be used in formula below.

$$\text{Data runtime on Bus (Light Curtain -> SafeLOGIC)} = \text{Default Safe Data Duration} \times (\text{Default Additional Tolerated Packet Loss} + 1)$$

#### Case 2) "Manual Configuration" for SG4 FIELDBUS node is set to YES:

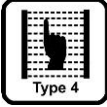

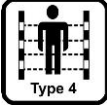
Safe Data Duration and Additional Tolerated Packet Loss from particular SG4 FIELDBUS node has to be used in formula below.

$$\text{Data runtime on Bus (Light Curtain -> SafeLOGIC)} = \text{Safe Data Duration} \times (\text{Additional Tolerated Packet Loss} + 1)$$

Safe Data Duration and Additional Tolerated Packet Loss allowed settings depend mainly on Ethernet POWERLINK network configuration.

Please refer to B&R Help Explorer to choose a proper setting.

## 11 AVAILABLE MODELS

Base Model	P/N	Advanced Model	P/N	Resolution (mm)	Protected Height	Number of Beams
SG4-14-015-OP-B	957901770	SG4-14-015-OP-A	957902050	14 mm FINGER PROTECTION 	150	16
SG4-14-030-OP-B	957901780	SG4-14-030-OP-A	957902060		300	32
SG4-14-045-OP-B	957901790	SG4-14-045-OP-A	957902070		450	48
SG4-14-060-OP-B	957901800	SG4-14-060-OP-A	957902080		600	64
SG4-14-075-OP-B	957901810	SG4-14-075-OP-A	957902090		750	80
SG4-14-090-OP-B	957901820	SG4-14-090-OP-A	957902100		900	96
SG4-14-105-OP-B	957901830	SG4-14-105-OP-A	957902110		1050	112
SG4-14-120-OP-B	957901840	SG4-14-120-OP-A	957902120		1200	128
SG4-14-135-OP-B	957901850	SG4-14-135-OP-A	957902130		1350	144
SG4-14-150-OP-B	957901860	SG4-14-150-OP-A	957902140		1500	160
SG4-14-165-OP-B	957901870	SG4-14-165-OP-A	957902150		1650	176
SG4-14-180-OP-B	957901880	SG4-14-180-OP-A	957902160		1800	192
SG4-30-015-OP-B	957901890	SG4-30-015-OP-A	957902170	30 mm HAND PROTECTION 	150	8
SG4-30-030-OP-B	957901900	SG4-30-030-OP-A	957902180		300	16
SG4-30-045-OP-B	957901910	SG4-30-045-OP-A	957902190		450	24
SG4-30-060-OP-B	957901920	SG4-30-060-OP-A	957902200		600	32
SG4-30-075-OP-B	957901930	SG4-30-075-OP-A	957902210		750	40
SG4-30-090-OP-B	957901940	SG4-30-090-OP-A	957902220		900	48
SG4-30-105-OP-B	957901950	SG4-30-105-OP-A	957902230		1050	56
SG4-30-120-OP-B	957901960	SG4-30-120-OP-A	957902240		1200	64
SG4-30-135-OP-B	957901970	SG4-30-135-OP-A	957902250		1350	72
SG4-30-150-OP-B	957901980	SG4-30-150-OP-A	957902260		1500	80
SG4-30-165-OP-B	957901990	SG4-30-165-OP-A	957902270		1650	88
SG4-30-180-OP-B	957902000	SG4-30-180-OP-A	957902280		1800	96
SG4-S2-060-OP-B	957902010			BODY PROTECTION 	50	2
SG4-S3-080-OP-B	957902020				80	3
SG4-S4-090-OP-B	957902030				90	4
SG4-S4-120-OP-B	957902040				120	4

## 12 OVERALL DIMENSIONS

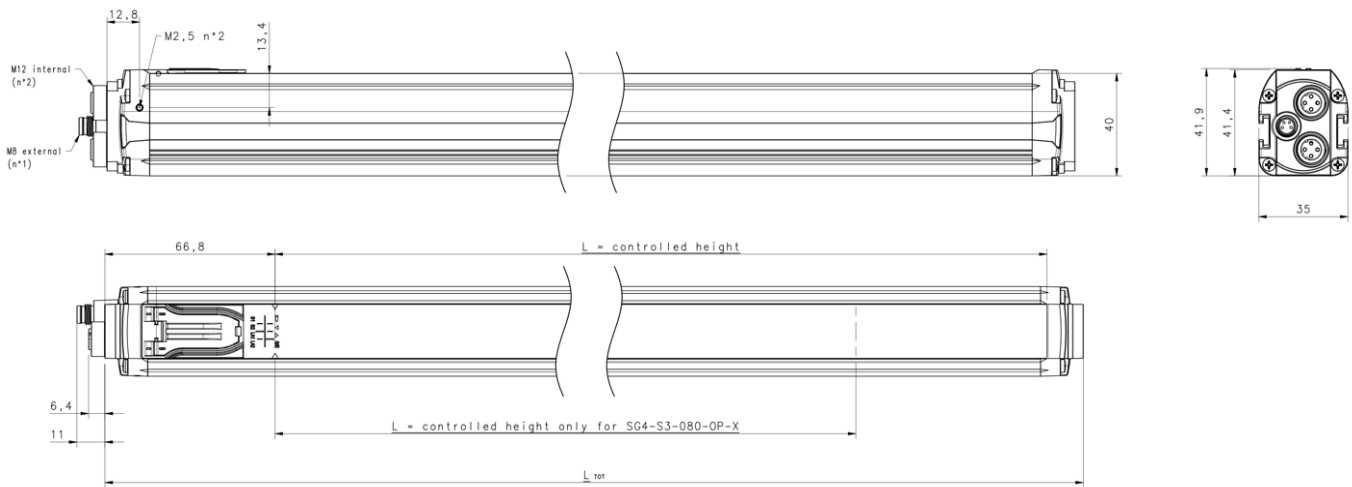


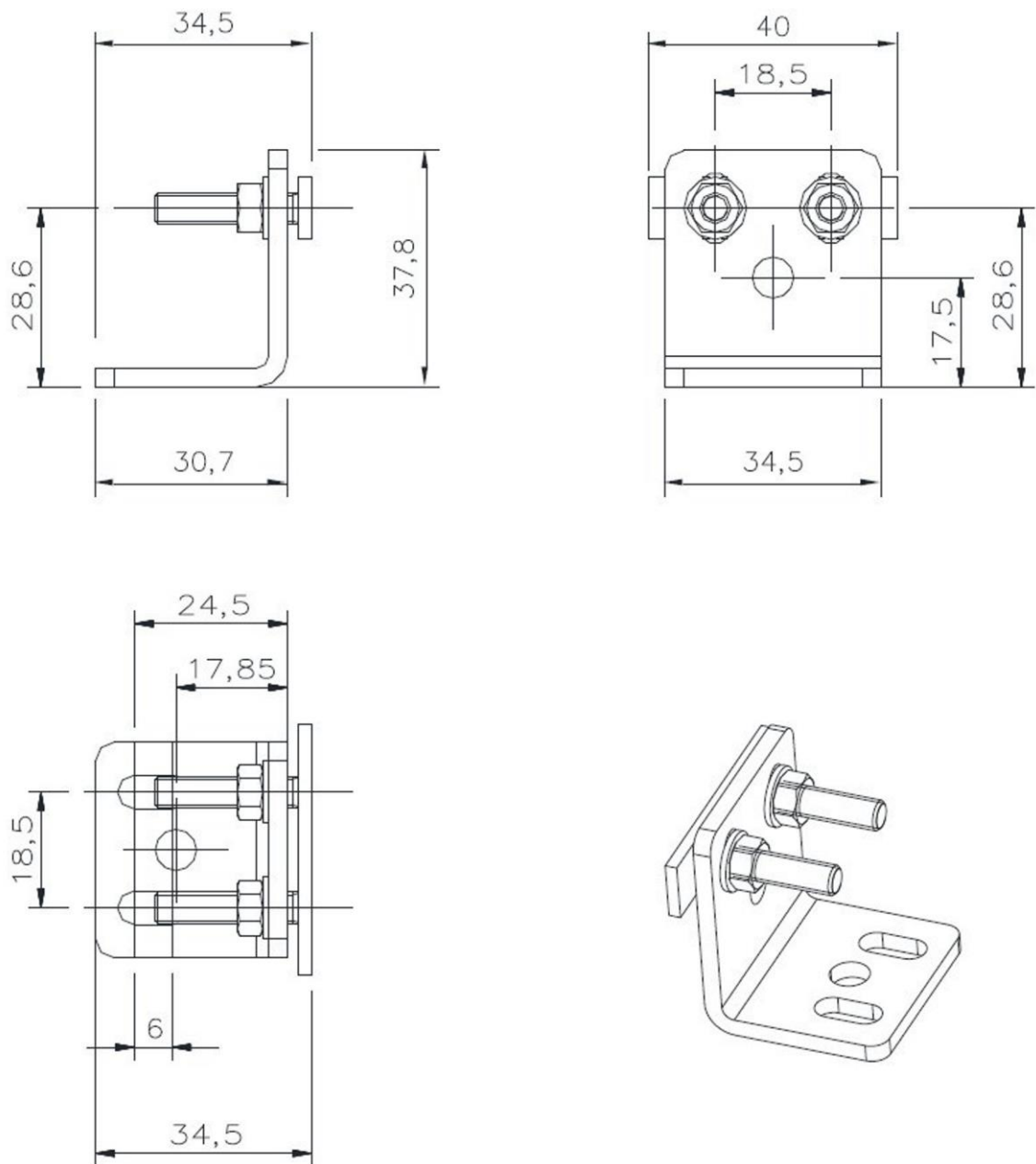
Fig 49 - Overall dimensions (mm)

MODELS	Ltot (mm)	L controlled height (mm)
SG4-xx-015-OP-x	233,6	150
SG4-xx-030-OP-x	383,3	300
SG4-xx-045-OP-x	533	450
SG4-xx-060-OP-x	682,7	600
SG4-xx-075-OP-x	832,4	750
SG4-xx-090-OP-x	982,1	900
SG4-xx-105-OP-x	1131,8	1050
SG4-xx-120-OP-x	1281,5	1200
SG4-xx-135-OP-x	1431,2	1350
SG4-xx-150-OP-x	1580,9	1500
SG4-xx-165-OP-x	1730,6	1650
SG4-xx-180-OP-x	1880,3	1800
SG4-S2-060-OP-B	682,7	600
SG4-S3-080-OP-B	982,1	825
SG4-S4-090-OP-B	982,1	900
SG4-S4-120-OP-B	1281,5	1200

**13 INCLUDED ACCESSORIES**

**Metal angled fixing bracket (ST-KSTD)**

MODEL	DESCRIPTION
ST-KSTD	Angled fixing bracket (4 pcs kit)



**Fig 50 - Dimensions (mm)**



## 14 ACCESSORIES

(dimensions in mm)

### 14.1 (ST-KSTD) METAL ANGLED FIXING BRACKET

MODEL	DESCRIPTION	CODE
ST-KSTD	Angled fixing bracket (4 pcs kit)	95ACC1670

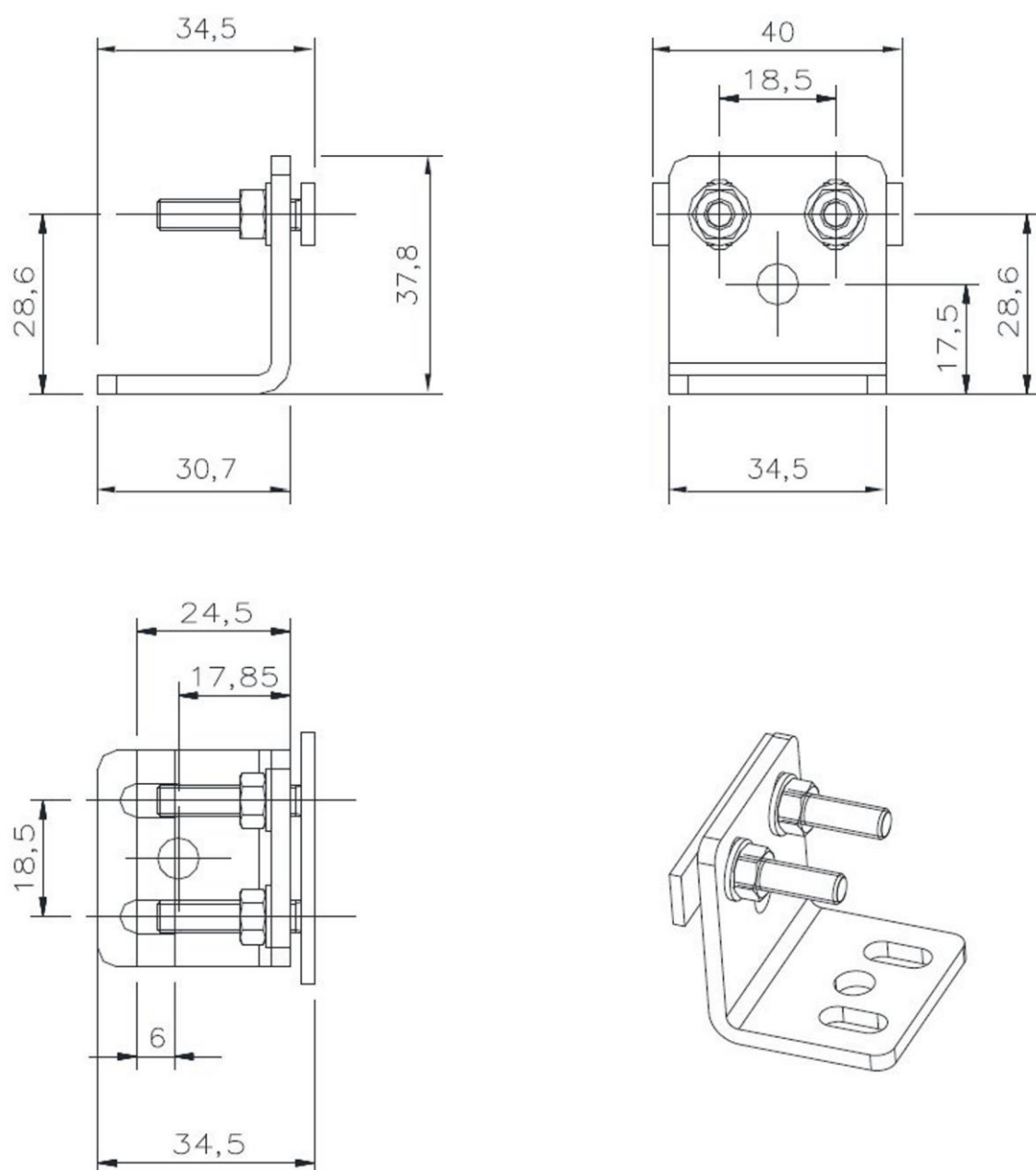
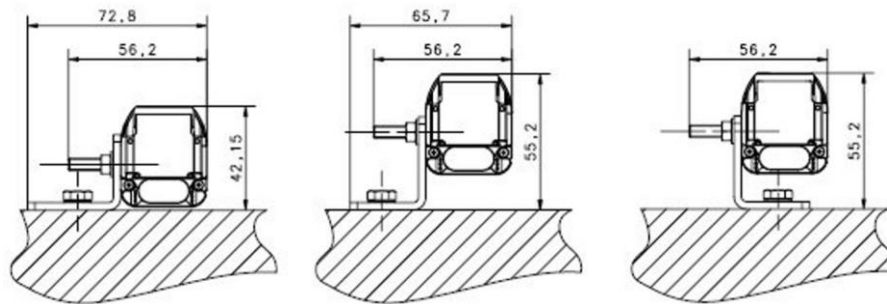
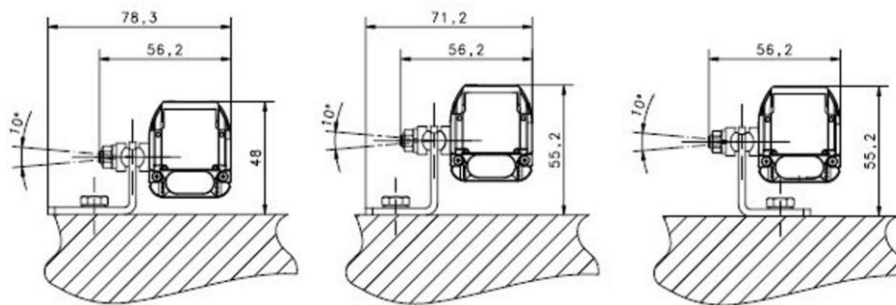
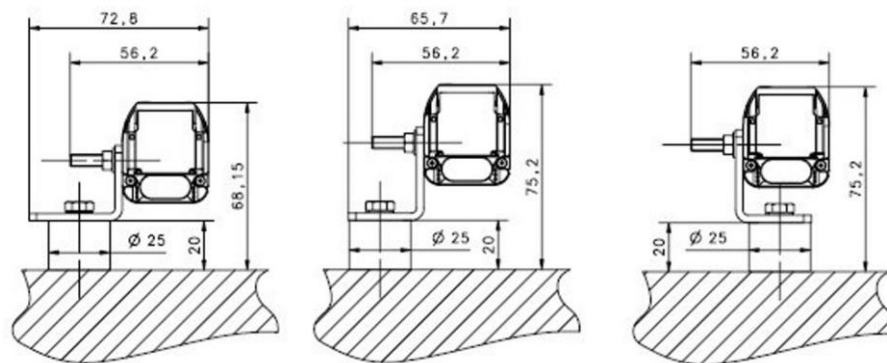
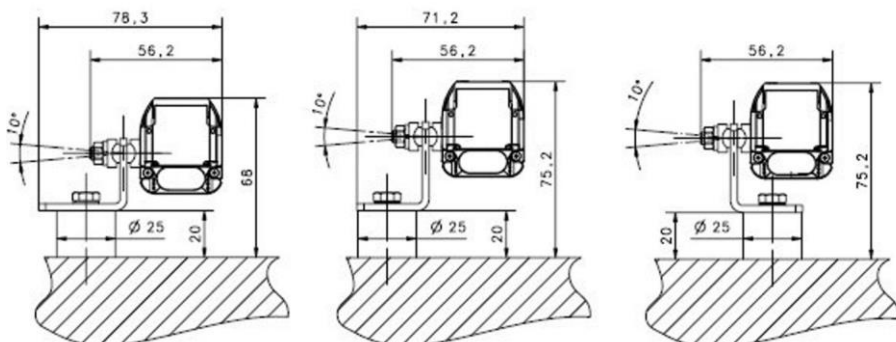


Fig 51 - ST-KSTD

**Angled fixing bracket mounting with orientable and antivibration supports**

MODEL	DESCRIPTION	CODE
ST-K4OR	Orientable supports (4 pcs kit)	95ACC1680
ST-K6OR	Orientable supports (6 pcs kit)	95ACC1690
ST-K4AV	Antivibration supports (4 pcs kit)	95ACC1700
ST-K6AV	Antivibration supports (6 pcs kit)	95ACC1710


**Fig 52 - Angled fixing bracket**

**Fig 53 - Angled fixing bracket + Orientable support**

**Fig 54 - Angled fixing bracket + Antivibration support**

**Fig 55 - Angled fixing bracket + Orientable support + Antivibration support**

## 14.2 (ST-KPXMP) PLASTIC ANGLED FIXING BRACKET

MODEL	DESCRIPTION	CODE
ST-KP4MP	Angled fixing bracket (4 pcs kit)	95ASE1100
ST-KP6MP	Angled fixing bracket (6 pcs kit)	95ASE1110

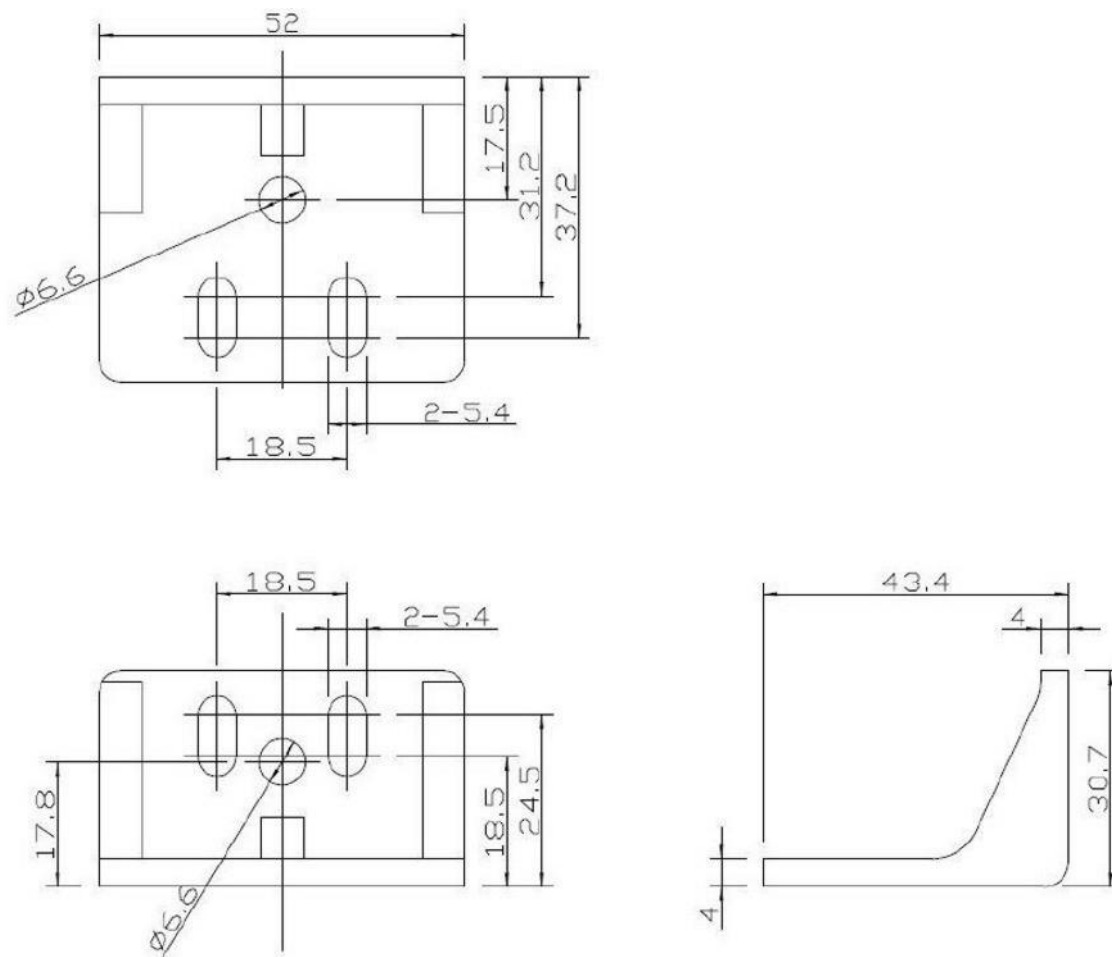
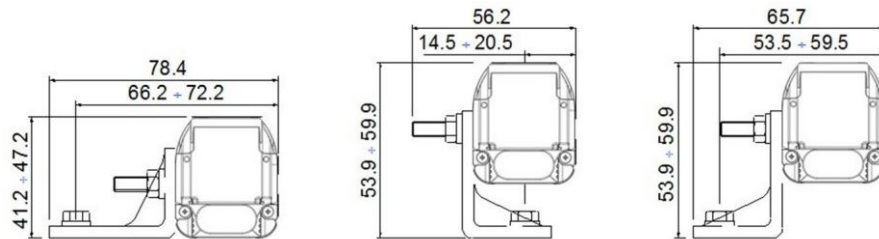
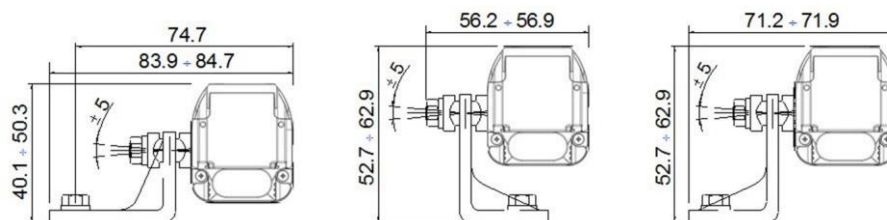
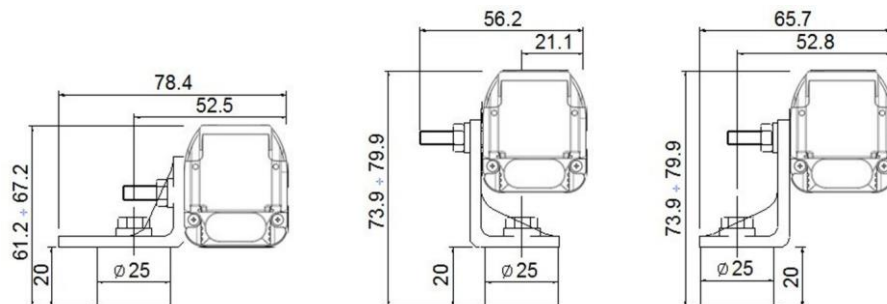
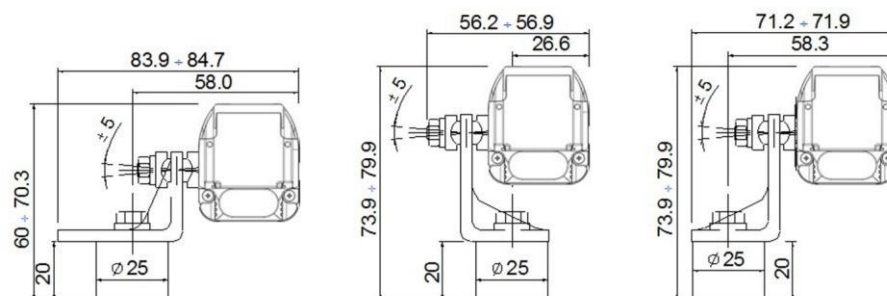


Fig 56 - ST-KPxMP

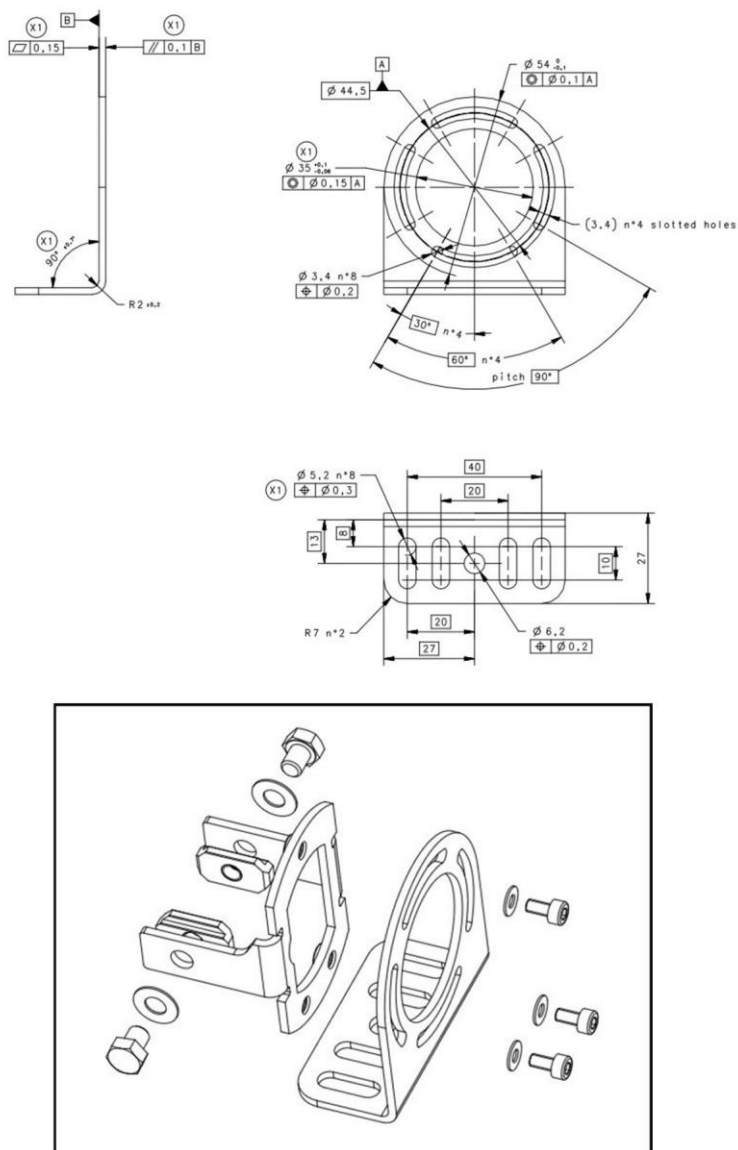
**Angled fixing bracket mounting with orientable and antivibration supports**

MODEL	DESCRIPTION	CODE
ST-K4OR	Orientable supports (4 pcs kit)	95ACC1680
ST-K6OR	Orientable supports (6 pcs kit)	95ACC1690
ST-K4AV	Antivibration supports (4 pcs kit)	95ACC1700
ST-K6AV	Antivibration supports (6 pcs kit)	95ACC1710


**Fig 57 - Angled fixing bracket**

**Fig 58 - Angled fixing bracket + Orientable support**

**Fig 59 - Angled fixing bracket + Antivibration support**

**Fig 60 - Angled fixing bracket + Orientable support + Antivibration support**

### 14.3 (ST-K4ROT-OP) METAL ROTATING FIXING BRACKET

MODEL	DESCRIPTION	CODE
ST-K4ROT-OP	Rotating fixing bracket (4 pcs kit)	95ASE2840



**Fig 61 - Dimensions (mm)**

## 14.4 (SG-PSM) PROTECTIVE STANDS WITH ADJUSTABLE MIRRORS

MODEL	DESCRIPTION	CODE
SG-PSM-2-500	Protective stand with 2 mirrors H=500 mm	95ASE2300
SG-PSM-3-800	Protective stand with 3 mirrors H=800 mm	95ASE2310
SG-PSM-4-900	Protective stand with 4 mirrors H=900 mm	95ASE2320
SG-PSM-4-1200	Protective stand with 4 mirrors H=1200 mm	95ASE2330

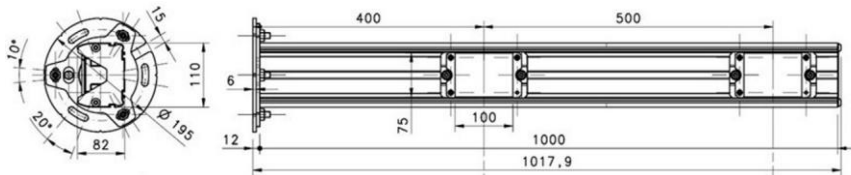


Fig 62 - Protective stands with adjustable mirrors SG-PSM

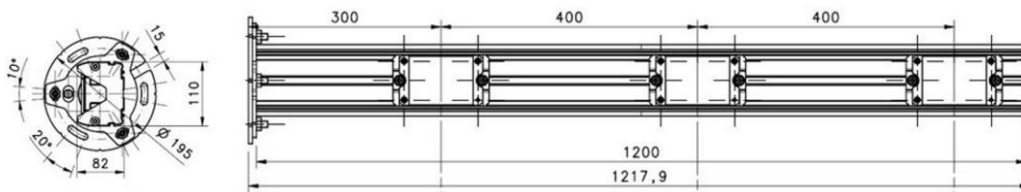


Fig 63 - Protective stands with adjustable mirrors SG-PSM

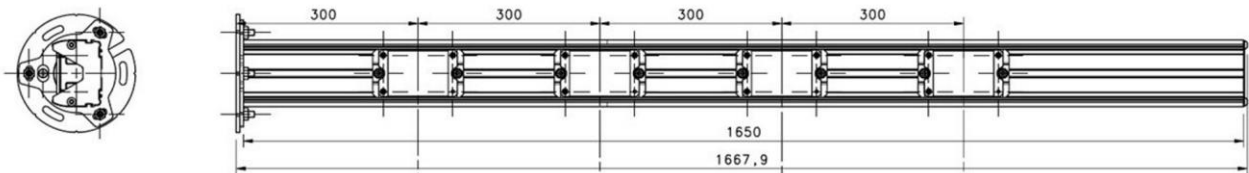


Fig 64 - Protective stands with adjustable mirrors SG-PSM

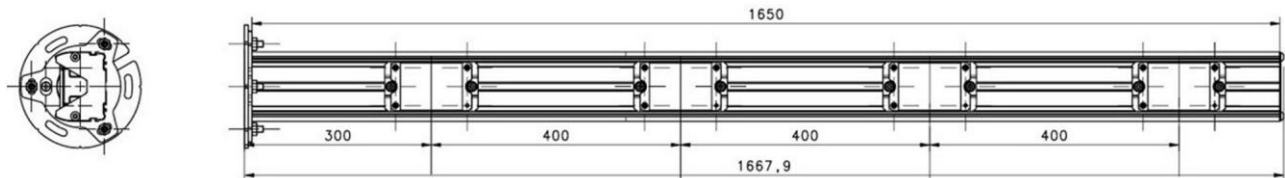


Fig 65 - Protective stands with adjustable mirrors SG-PSM

### 14.5 (SG-PSB) PROTECTIVE STANDS

MODEL	DESCRIPTION	L (mm)	CODE
SG-PSB 600	Protective stand H=600 mm	600	95ASE2240
SG-PSB 1000	Protective stand H=1000 mm	1000	95ASE2250
SG-PSB 1200	Protective stand H=1200 mm	1200	95ASE2260
SG-PSB 1650	Protective stand H=1650 mm	1650	95ASE2270
SG-PSB 1900	Protective stand H=1900 mm	1900	95ASE2280

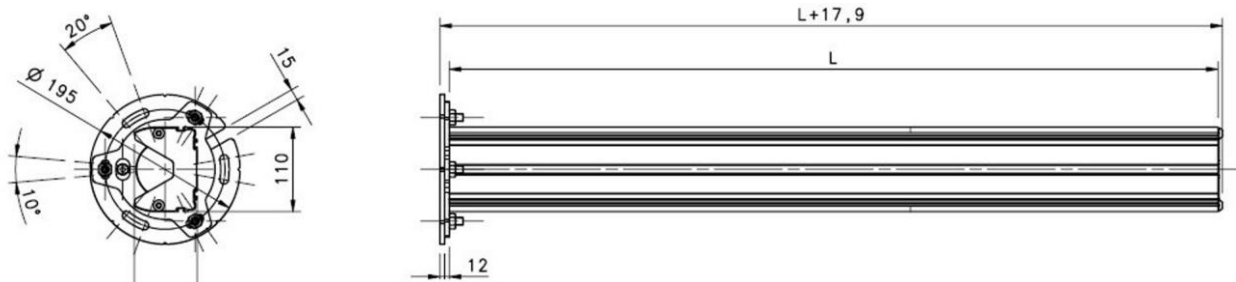


Fig 66 - Dimensions (mm)

#### Mounting kit

MODEL	DESCRIPTION	CODE
ST-PS4-SG-SE	Mounting kit (4 pcs kit)	95ASE1750
ST-PS6-SG-SE	Mounting kit (6 pcs kit)	95ASE1760

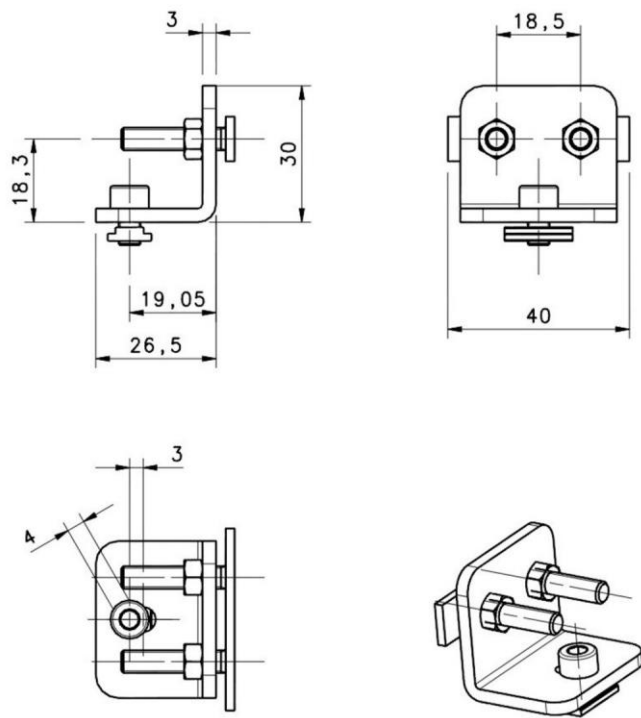


Fig 67 - Fixing kit



14.6 (SG-P) PLATE KIT FOR PROTECTIVE STANDS

MODEL	DESCRIPTION	CODE
SG-P	Plate kit with springs	95ASE2290

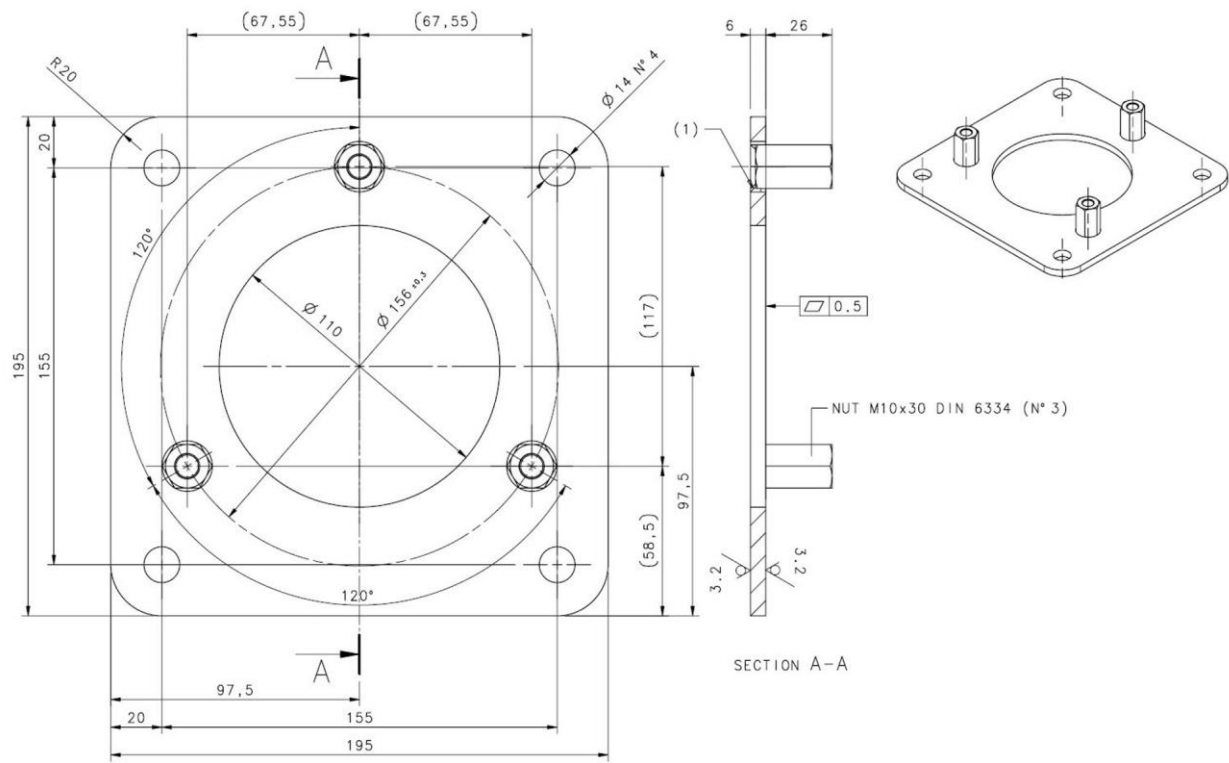


Fig 68 - Dimensions (mm)

Mounting with SG-PSB

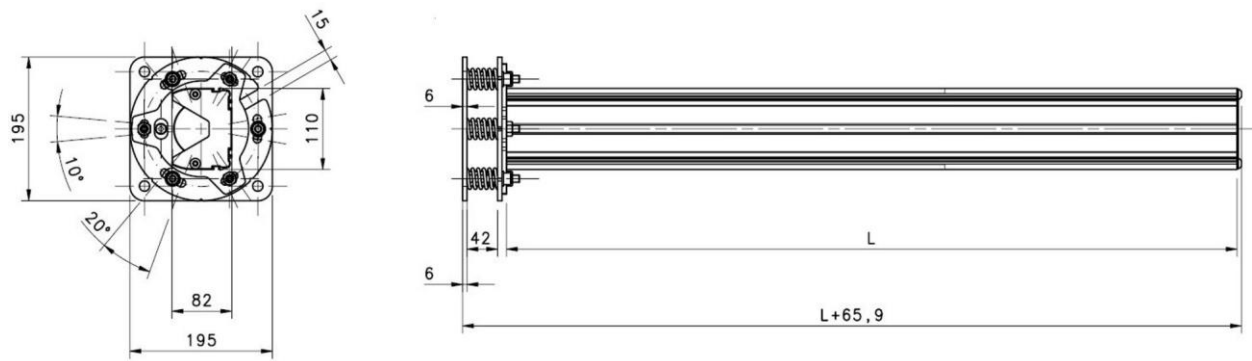


Fig 69 - Mounting



## 14.7 (SE-S) COLUMNS AND FLOOR STANDS

MODEL	DESCRIPTION	L(mm)	X (mm)	CODE
SE-S 800	Column and floor stand H= 800 mm	800	30x30	95ACC1730
SE-S 1000	Column and floor stand H= 1000 mm	1000	30x30	95ACC1740
SE-S 1200	Column and floor stand H= 1200 mm	1200	30x30	95ACC1750
SE-S 1500	Column and floor stand H= 1500 mm	1500	45x45	95ACC1760
SE-S 1800	Column and floor stand H= 1800 mm	1800	45x45	95ACC1770

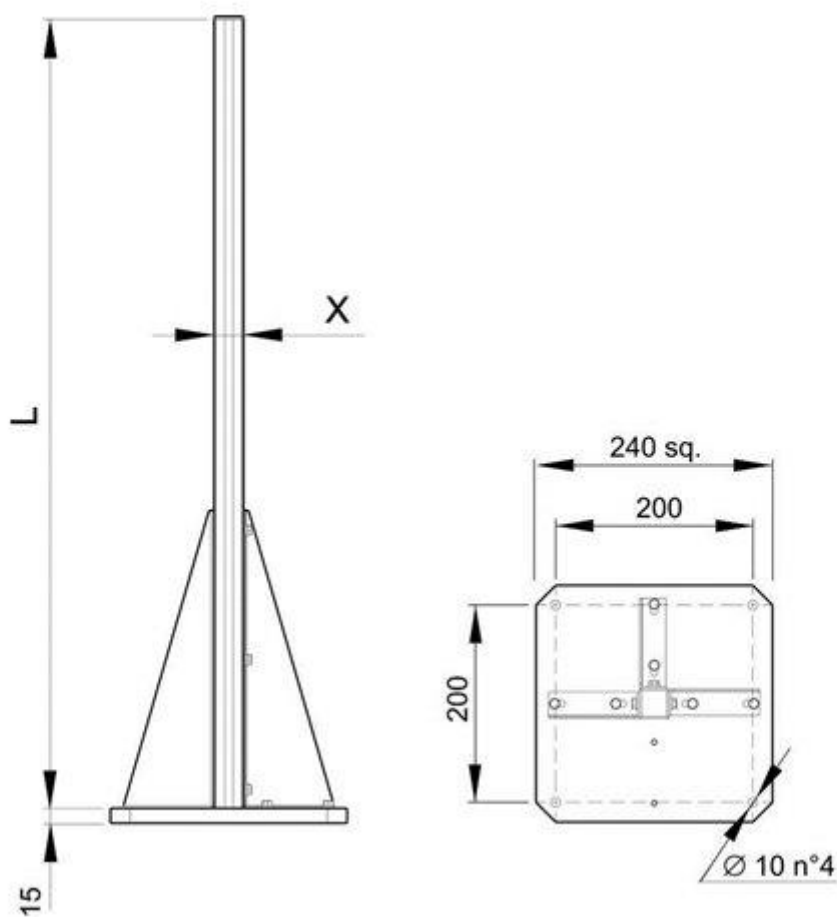


Fig 70 - Dimensions (mm)

## 14.8 (SG-DM) DEVIATING MIRRORS

MODEL	DESCRIPTION	L1 (mm)	L2 (mm)	L3 (mm)	CODE
SG-DM 600	Deviating mirror version 600 mm	545	376	580	95ASE1680
SG-DM 900	Deviating mirror version 900 mm	845	676	880	95ASE1690
SG-DM 1200	Deviating mirror version 1200 mm	1145	976	1180	95ASE1700
SG-DM 1650	Deviating mirror version 1650 mm	1595	1426	1630	95ASE1710
SG-DM 1900	Deviating mirror version 1900 mm	1845	1676	1880	95ASE1720

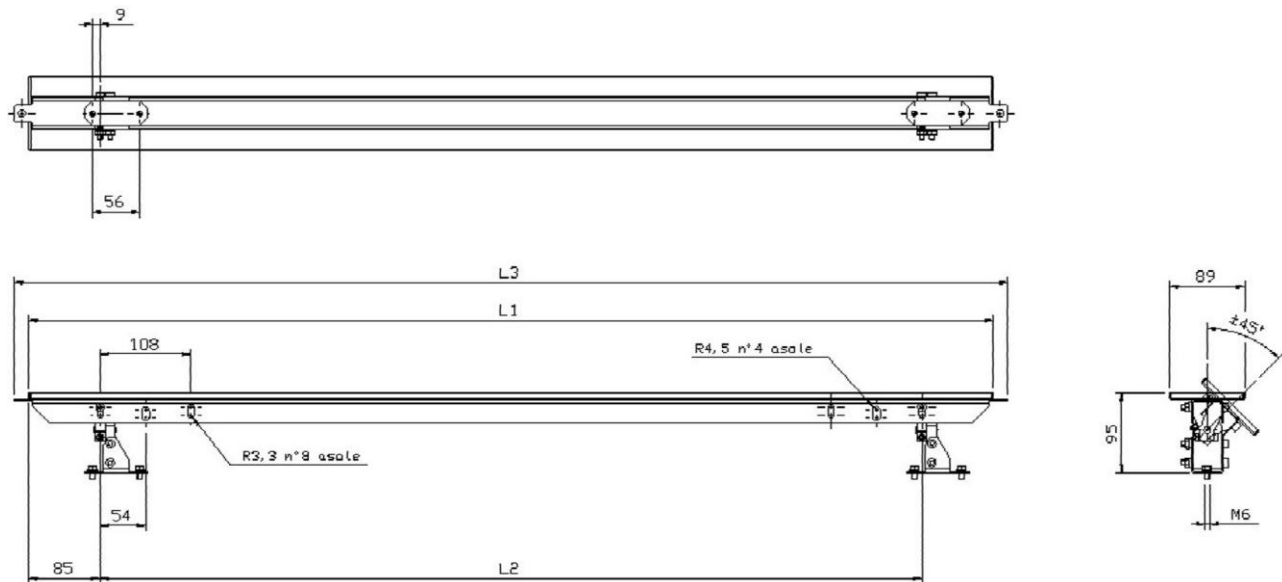


Fig 71 - Dimensions ( mm)

The image includes the mirror SG-DM and a mounting kit ST-DM.

MODEL	DESCRIPTION	CODE
SG-DM 150	Deviating mirror version 150 mm	95ASE1670

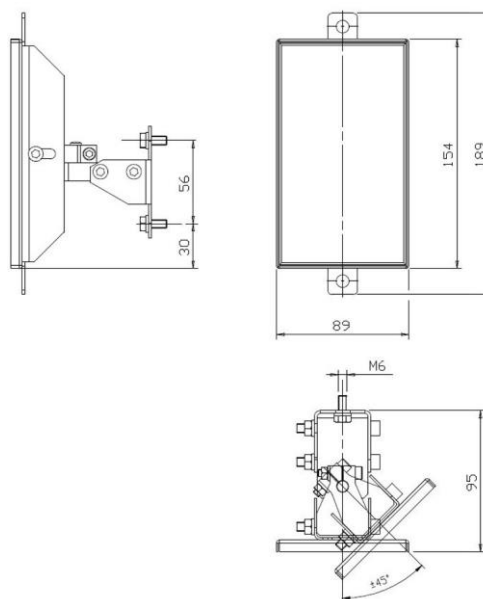
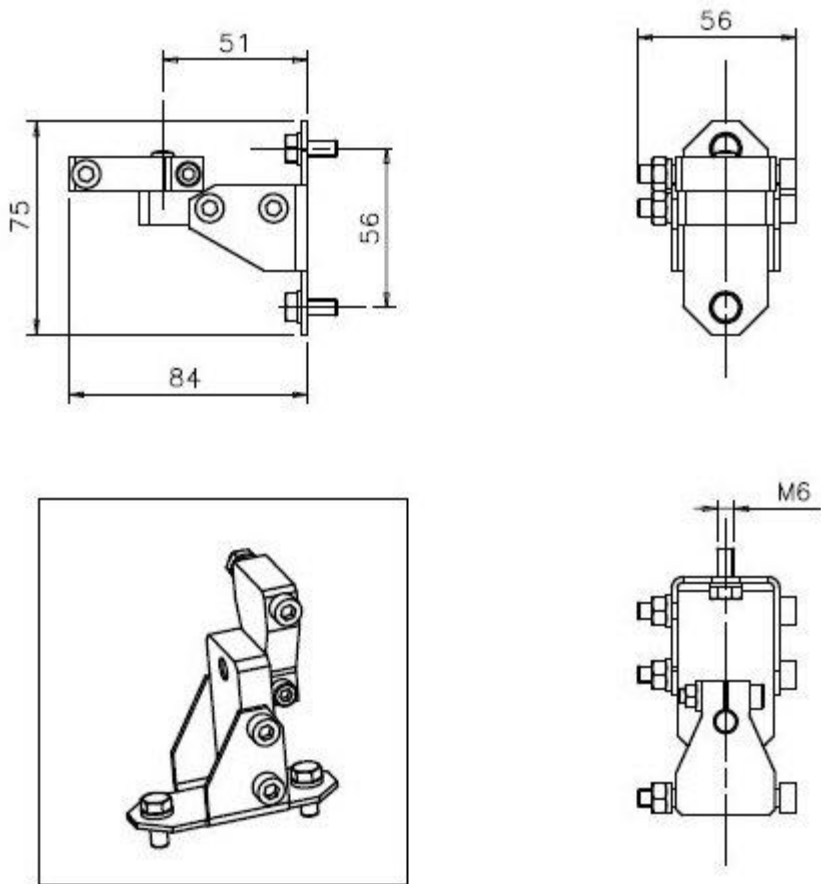


Fig 72 - SG-DM 150 Dimensions (mm)

The image includes the mirror SG-DM and a mounting kit ST-DM.

**Mounting kit for SG-DM with SE-S column and floor stands**

MODEL	DESCRIPTION	CODE
ST-DM	SG-DM mounting kit (2 pcs kit)	95ASE1940

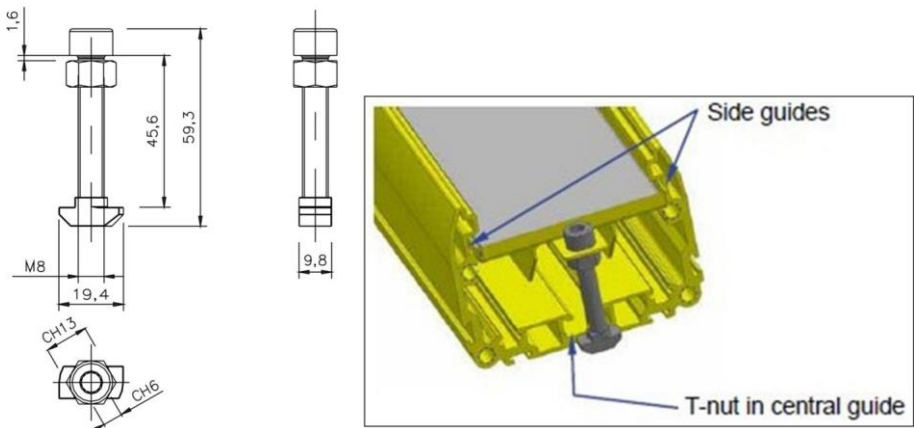


**Fig 73 - Mounting kit**

For each SG-DM mirror order 1 mounting kit ST-DM.

**Mounting kit SG-DM on SG-PSB (ST-PS-DM)**

MODEL	DESCRIPTION	CODE
ST-PS-DM	Deviating mirror SG-DM mounting kit (2 T-nuts)	95ASE1770



**Fig 74 - Mounting kit**

For each SG-DM mirror order 1 mounting kit ST-PS-DM.

## 14.9 (SG-LS) PMMA LENS SHIELD

MODEL	DESCRIPTION	CODE
SG-LS 150	Lens shield H=150 mm (5 pcs)	95ASE1450
SG-LS 300	Lens shield H=300 mm (5 pcs)	95ASE1460
SG-LS 450	Lens shield H=450 mm (5 pcs)	95ASE1460
SG-LS 600	Lens shield H=600 mm (5 pcs)	95ASE1470
SG-LS 750	Lens shield H=750 mm (5 pcs)	95ASE1480
SG-LS 900	Lens shield H=900 mm (5 pcs)	95ASE1490
SG-LS 1050	Lens shield H=1050 mm (5 pcs)	95ASE1500
SG-LS 1200	Lens shield H=1200 mm (5 pcs)	95ASE1510
SG-LS 1350	Lens shield H=1350 mm (5 pcs)	95ASE1520
SG-LS 1500	Lens shield H=1500 mm (5 pcs)	95ASE1530
SG-LS 1650	Lens shield H=1650 mm (5 pcs)	95ASE1540
SG-LS 1800	Lens shield H=1800mm (5 pcs)	95ASE1560



Each package contains what is necessary to protect a single unit (TX or RX ).  
To protect both TX and RX , two pieces of the same code are needed.

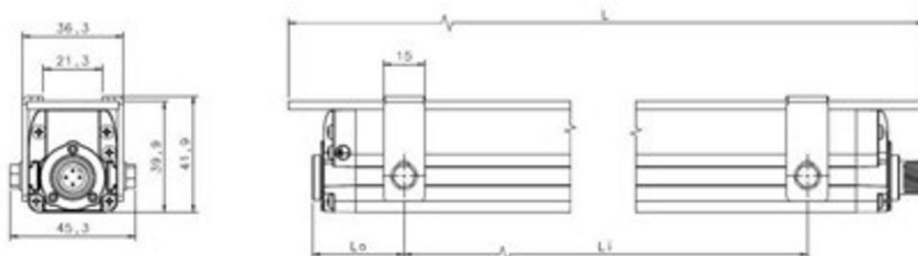


Fig 75 - Dimensions (mm)

	MODEL	L	Li	Lo
n° 2+2 brackets	015	245	160	30
	030	392	345	45
	045	540	400	60
	060	686	520	75
	075	832	590	115
	090	980	640	175
	105	1126	740	200
n° 3+3 brackets	120	1274	445	200
	135	1422	520	200
	150	1568	595	200
	165	1715	670	200
	180	1860	745	200

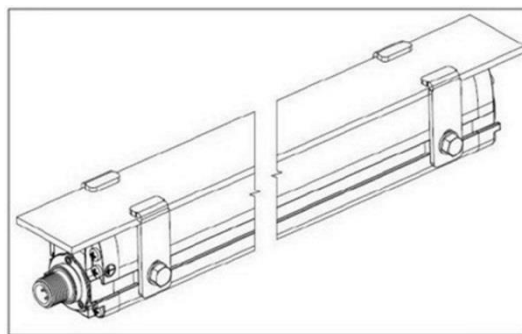


Fig 76 - Mounting kit

## 14.10 (TP) TEST PIECE

MODEL	DESCRIPTION	CODE
TP-14	Test piece Ø 14mm L=300mm	95ACC1630
TP-30	Test piece Ø 30mm L=300mm	95ACC1650
TP-40	Test piece Ø 40mm L=300mm	95ACC1820

## 14.11 CONNECTION CABLES

### 4-pole M8 cables

MODEL	DESCRIPTION	CODE
CS-B1-02-G-03	4-pole M8 cable (axial) 3 m	95A251420
CS-B1-02-G-05	4-pole M8 cable (axial) 5 m	95A251430
CS-B1-02-G-07	4-pole M8 cable (axial) 7 m	95A251440
CS-B1-02-G-10	4-pole M8 cable (axial) 10 m	95A251480
CS-B2-02-G-03	4-pole M8 cable (radial) 3 m	95A251450
CS-B2-02-G-05	4-pole M8 cable (radial) 5 m	95A251460
CS-B2-02-G-07	4-pole M8 cable (radial) 7 m	95A251470
CS-B2-02-G-10	4-pole M8 cable (radial) 10 m	95A251530

## 14.12 ETHERNET CABLES

MODEL	DESCRIPTION	CODE
CAB-ETH-M01	M12 axial - RJ45 - POWERLINK 1	93A051346
CAB-ETH-M03	M12 axial - RJ45 - POWERLINK 3	93A051347
CAB-ETH-M05	M12 axial - RJ45 - POWERLINK 5	93A051348
CAB-ETH-M10	M12 axial - RJ45 - POWERLINK 10	93A051391
ETH CABLE M12-M12 1M	M12 axial - M12 - POWERLINK 1	93A050065
ETH CABLE M12-M12 3M	M12 axial - M12 - POWERLINK 3	93A050066
ETH CABLE M12-M12 5M	M12 axial - M12 - POWERLINK 5	93A050067

### 14.13 (SG-LP) LASER POINTER

MODEL	DESCRIPTION	CODE
SG-LP	Laser pointer	95ASE5590

The laser pointer of the SG-LP series represents a valid alignment and installation support for the safety light curtain series.

The pointer can be moved along the light curtain profile to verify the complete device alignment (top and bottom).

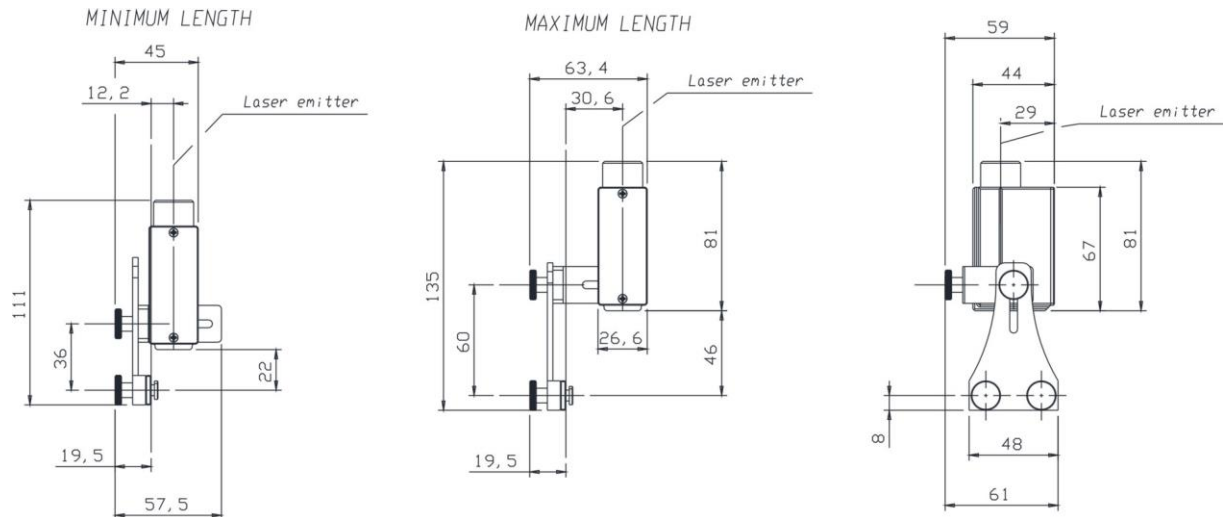


Fig 77 - Dimensions (mm)



Fig 78 - Laser pointer

## 15 GLOSSARY

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**AOPD (Active optoelectronic protective device):** its detection function is achieved thanks to the use of optoelectronic receivers and emitters detecting the optical beams interruptions inside the device caused by an opaque object present inside the specified detecting area.

An active optoelectronic protective device (AOPD) can operate both in emitter-receiver mode and in retro-reflective light curtains.

**Block condition (=BREAK):** status of the light curtain taking place when a suitably-sized opaque object (see cfr. **Detection capability (or Resolution) on page 71**) interrupts one or several light curtain beams.

**Crossing hazard:** situation under which an operator crosses the area controlled by the safety device, which stops and keeps the machine stopped until the hazard is eliminated, and then enters the dangerous area. Now the safety device could not be able to prevent or avoid an unexpected restart of the machine with the operator still present inside the dangerous area.

**Dangerous area:** area representing an immediate or imminent physical hazard for the operator working inside it or who could get in contact with it.

**Detection capability (or Resolution):** the minimum dimension which an opaque object must have in order to interrupt at least one beams of the ESPE whatever is position across the protected height.

**Detection zone:** zone within which a specified test piece will be detected by the ESPE

**EDM (External device monitoring):** device used by the ESPE to monitor the status of the external command devices.

**Emitter (TX):** unit emitting infrared beams, consisting of a set of optically-synchronized LEDs. The emitting unit, combined with the receiving unit (installed in the opposite position), generates an optical "curtain", i.e. the detecting area.

**EPL (Ethernet POWERLINK):** A real-time industrial Ethernet technology solution.

**ESPE (Electro-sensitive protective equipment):** assembly of devices and/or components working together to activate the protective disabling function or to detect the presence of something and including at least: a sensor, command/control devices and output signal switching devices.

**Force-guided contacts:** Relay contacts are force guided when they are mechanically connected so that they must switch simultaneously on input change.

If one contact of the series remains "welded", no other relay contact is able to move.

That relay characteristic allows the use of EDM function.

**Interlock:** operating state of ESPE in Manual Restart Mode when all beams are free but the Restart command hasn't been received yet.

**Machine operator:** qualified person allowed to use the machine.

**Min. installation distance:** min. distance necessary to allow machine dangerous moving parts to completely stop before the operator can reach the nearest dangerous point. This distance shall be measured from the middle point of the detecting area to the nearest dangerous point. Factors affecting min. installation distance value are machine stop time, total safety system response time and light curtain resolution.

**MPCE (Machine primary control element):** electrically-powered element having the direct control of machine regular operation so as to be the last element, in order of time, to operate when the machine has to be enabled or blocked.

**N.C.:** normally closed

**N.O.:** normally opened

**Normal Operation:** operating state of ESPE when all beams are free.

**OSSD (Output signal switching device):** part of the ESPE connected to machine control system. When the sensor is enabled during standard operating conditions, it switches to disabled status.

**Protective device:** device having the function to protect the operator against possible risks of injury due to the contact with machine potentially-dangerous parts.


**Qualified operator:** a person who holds a professional training certificate or having a wide knowledge and experience and who is acknowledged as qualified to install and/or use the product and to carry out periodical test procedures.

**Receiver (RX):** unit receiving infrared beams, consisting of a set of optically-synchronized phototransistors. The receiving unit, combined with the emitting unit (installed in the opposite position), generates an optical "curtain", i.e. the detecting area.

**Response time:** maximum time between the occurrence of the event leading to the actuation of the sensing device and the output signal switching devices achieving the OFF-state

**Restart interlocking device (=RESTART):** device preventing machine automatic restart after sensor activation during a dangerous phase of machine operating cycle, after a change of machine operating mode, and after a variation in machine start control devices.

**Risk:** probability of occurrence of an injury and severity of the injury itself.

**Safe State:** operating state of ESPE when at least one beam is intercepted.  
The  LED on the receiver light curtain is lit RED.

**Safety light curtain:** it is an active optoelectronic protective device (AOPD) including an integrated system consisting of one or several emitting elements and one or several receiving elements forming a detection area with a detecting capacity specified by the supplier.

**Start interlocking device (= START):** device preventing machine automatic start if the ESPE is live or the voltage is disabled and enabled once again.

**Test piece:** opaque object having a suitable size and used to test safety light curtain correct operation.

**Type (of ESPE):** the Electro-sensitive Protective Equipment (ESPE) have different reactions in case of faults or under different environmental conditions.

The classification and definition of the "type" (ex. type 2, type 4, according to EN 61496-1: 2013) defines the minimum requirements needed for ESPE design, manufacturing and testing.

**Working point:** machine position where the material or semifinished product is worked.



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