

SH4 ADVANCED

PRODUCT REFERENCE GUIDE



Safety Light Curtains

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Patents

See www.patents.datasensing.com for patent list.

This product is covered by one or more of the following patents:

Utility patents: IT1363719, IT1427575, US10188007

ORIGINAL INSTRUCTIONS (ref. 2006/42/EC)

This manual refers to software version 1.0.2 and later.

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PREFACE

ABOUT THIS MANUAL

This Product Reference Guide (PRG) is provided for users seeking advanced technical information, including connection, programming, maintenance and specifications. The Quick Reference Guide (QRG) and other publications associated with this product can be downloaded free of charge from the website listed on the back cover of this manual.

Manual Conventions

The symbols listed below are used in this manual to notify the reader of key issues or procedures that must be observed when using the product:



NOTE: Notes contain information necessary for properly diagnosing, repairing and operating the safety light curtain.



CAUTION: This symbol advises you of actions that could damage equipment or property.



WARNING: This symbol advises you of actions that could result in harm or injury to the person performing the task.

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CHAPTER 1

GENERAL INFORMATION

GENERAL DESCRIPTION

The safety light curtains are optoelectronic multi-beam 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: 2020	Safety of machinery: electro-sensitive protective equipment. Part 1: General prescriptions and tests.
EN 61496-2: 2020	Safety of machinery: electro-sensitive 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 62061:2021	Safety of machinery. Functional safety of electrical/ electronic/programmable electronic safety-related control systems.

The device, consisting in one emitting and one receiving unit housed inside strong aluminum profiles, generates infrared beams that detect any opaque object positioned within the light curtain detection field.

The emitting and the receiving units are equipped with command and control functions (no external control unit is required).

Electrical connections are made through removable pig-tails which attaches to the light curtain through a custom connector (the same for all models) and provides one or two M12 standard connectors from 5 to 12pin.

The synchronization between the trasmitter and the receiver takes place optically by means of both the first and the last optic: no electrical connection between the two units is required and one (of two) sync beam can be part of a blanked area.

The microprocessors guarantee the check and the management of the beams that are sent and received through the units: the microprocessors - through some LEDs - inform the operator about the general conditions of the light curtain and about eventual faults.

As soon as an object, a limb or the operator's body accidentally interrupts the beams sent by the trasmitter, the receiver immediately switches off the OSSD output and blocks the machine (if correctly connected to the OSSD).

The SH4 safety light curtains are used in all automation fields where it is necessary to control and protect the access to dangerous zones. In particular they are used in Manufacturing industry, especially the three main vertical markets: Automotive, Electronics, Food & Beverage. Most common vertical applications: Robotics, Metalworking, Intra-logistic and Material Handling (incl. Packaging and Assembling), General Manufacturing.

The unit consists of modular optical units, that are made of one or more transmitter and receiver pairs.

Each optical unit can be composed by bars containing a lot of optical units, according to kind of model.

Receiver part is the main controller of all function, it checks and decides about safety action in case of failure has other generic issue.

Trasmitter is a one task device: it runs continuously, lighting in sequence it's IR-photo emitters.



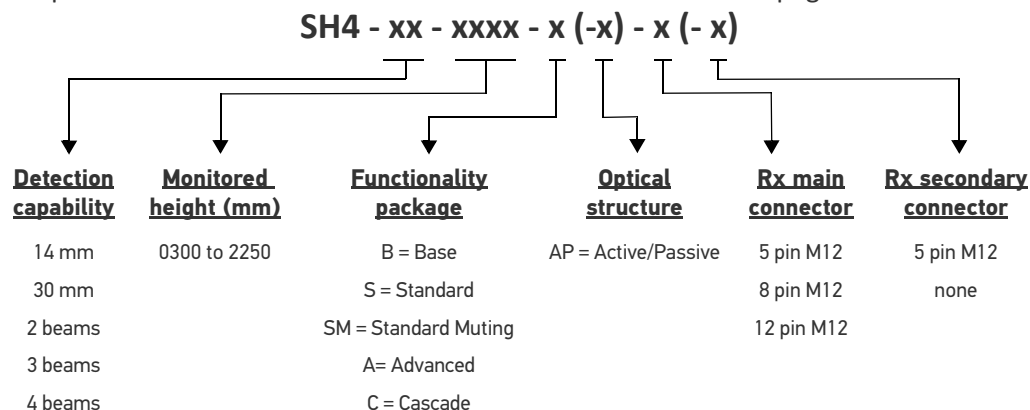
NOTE: This manual contains all the information necessary for the selection and operation of the safety devices.

However, specialized 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 Datasensing Technical Service for any necessary information relative to the functioning of the light curtains and the safety rules that regulate the correct installation.

MODEL DESCRIPTION

SH4 safety light curtains are described by their model description which indicates the characteristics listed in the diagram below. Not all combinations are available. For a complete list of combinations see the Models tab on the Product page of the website.



NOTE: For 14/30 mm resolutions protected height starts from 300 mm up to 2250 mm with 150 mm modularity.

BASE	STANDARD	STANDARD MUTING	ADVANCED
FUNCTION			
Automatic Restart	Manual / Automatic Restart		
	Reset		
	External Device Monitoring (EDM)		
	Alignment Function		
		2-signals T Muting / L Muting	
		Single Override	
		2-signals muting dependent Override	
		Partial muting (half protection height) ¹	
		Muting input filtering and timeout setting	
		Anti-interference coding (AIC) ²	
			4-signals Muting
			Dynamic partial muting ²
			Partial Muting ¹ (at beams level)
			Fixed Blanking ²⁻³
			External signal fixed ²⁻⁴ blanking teach-in
			Floating Blanking ²
			Reduced resolution ²
			Integrated aimer ²
CONFIGURATION			
-	By wiring	By Dip-Switch	By APP via Wi-Fi

1. NOT available for SH4-2-0500-x-AP-x(-x) models.
2. NOT available for SH4-2/3/4-xxxx-x-AP-x(-x) models.
3. 1 up to 5 simultaneous fixed or floating blanking zones can be used.
4. The response time depends on model height and the activation of anti interference code: for details refer to Response times table.



NOTE: This Product Reference Guide describes the Advanced models. For Standard Muting and Base/Standard models refer to relative Product Reference Guide.

COMPLIANCE

European Declaration of Conformity

Hereby, Datasensing S.r.l. declares that the full text of the European Declaration of Conformity is available at: www.datasensing.com. Select the link from the downloads section of the product page.

UKCA Declaration of Conformity

Hereby, Datasensing S.r.l. declares that the full text of the UKCA Declaration of Conformity is available at: www.datasensing.com. Select the link from the downloads section of the product page.

Laser Safety

The following information applies to Laser Aimer system, used on SH4-14/30-xxxx-A-x(-x) models. The laser radiation is visible to the human eye and is emitted from the window indicated in the figure below.

LASER RADIATION - DO NOT STARE INTO BEAM

CLASS 2 LASER PRODUCT

MAX OUTPUT RADIATION 1 mW

TRANSMITTER WAVE LENGTH 630-660nm

IEC 60825-1 (2014).

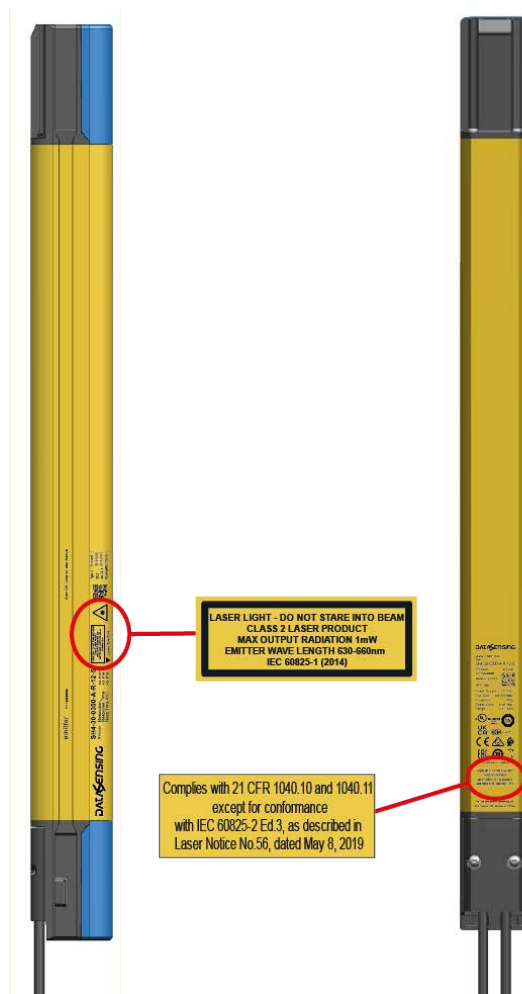


Figure 1: Laser label on TX unit

CHAPTER 2

INSTALLATION

PACKAGE CONTENTS

Package contains the following objects:

- Receiver (RX) or Active Unit for SH4-2/3/4-xxxx-x-AP-x(-x) models
- Transmitter (TX) or Passive Unit for SH4-2/3/4-xxxx-x-AP-x(-x) models
- Quick Guide of safety light curtain
- 4 angled fixing brackets and specific fasteners
- 2 additional angled fixing brackets for models with heights equal or greater than 1200 mm.

PRECAUTIONS TO BE OBSERVED FOR THE CHOICE AND INSTALLATION



CAUTION: 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 62061:2021.

- The outputs (OSSD) of the ESPE 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 level of the device.
- The ESPE must be installed in an environment complying with the characteristics indicated in [Appendix A](#), .
- 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 device's correct operation. This condition shall be carefully assessed with the advice of Data-sensing 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.

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.

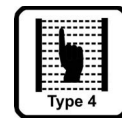
Detection capability

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.

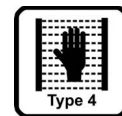
$R = 14 \text{ mm}$

Finger protection



$R = 30 \text{ mm}$

Hand protection



As shown in the following figure the resolution only depends on the geometrical characteristics of the lenses, diameter and distance between centers, and is independent of any environmental and operating conditions of the safety light curtain.

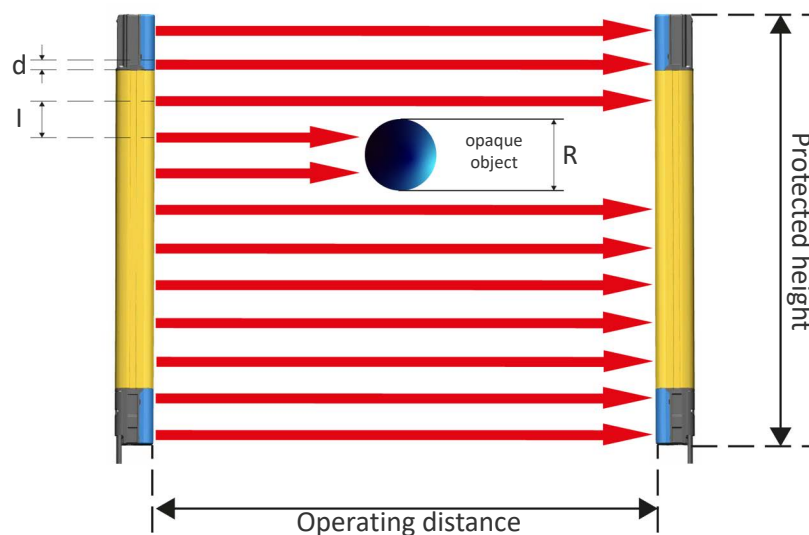


Figure 2: Detection capability

The resolution value is obtained applying the following formula:

$$R = I + d$$

where:

I = Interaxes between two adjacent optics

d = Lens diameter

MODEL	I	d	R
SH4-14-xxxx-x-x(-x)	10	4	14
SH4-30-xxxx-x-x(-x)	25	5	30
SH4-2-0500-x(-AP)-x(-x)	500	21	521
SH4-3-0800-x(-AP)-x(-x)	400	21	421
SH4-4-0900-x(-AP)-x(-x)	300	21	321
SH4-4-1200-x(-AP)-x(-x)	400	21	421

Height of the detection zone

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

In SH4-14/30 Protected Height is equal to ESPE total length: no dead zone is present.

In SH4-2/3/4, first beam center is positioned at 130 mm from light curtain bottom, protected height is defined as the distance between uppermost and lowermost beam centreline.

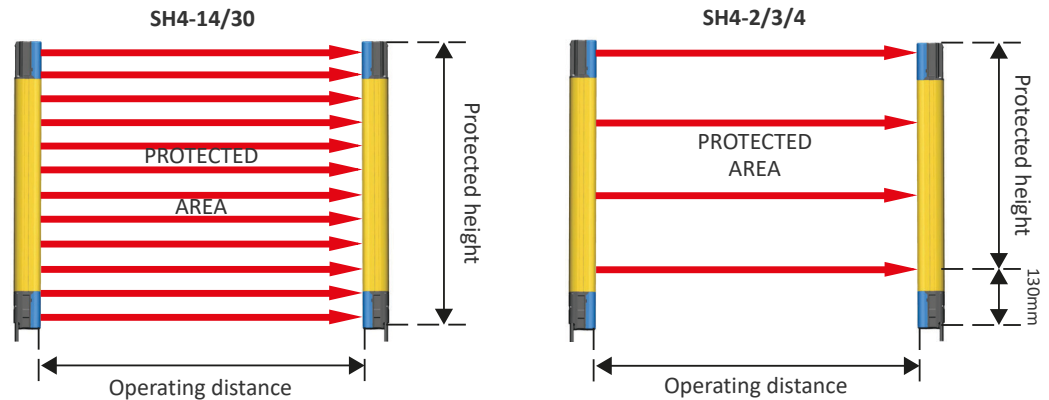


Figure 3: Detection zone

Referring to the figure above the protected height is reported in the table here below.

MODEL	PROTECTED HEIGHT (mm)
SH4-14/30-0300-x-x(-x)	300
SH4-14/30-0450-x-x(-x)	450
SH4-14/30-0600-x-x(-x)	600
SH4-14/30-0750-x-x(-x)	750
SH4-14/30-0900-x-x(-x)	900
SH4-14/30-1050-x-x(-x)	1050
SH4-14/30-1200-x-x(-x)	1200
SH4-14/30-1350-x-x(-x)	1350
SH4-14/30-1500-x-x(-x)	1500
SH4-14/30-1650-x-x(-x)	1650
SH4-14/30-1800-x-x(-x)	1800
SH4-14/30-1950-x-x(-x)	1950
SH4-14/30-2100-x-x(-x)	2100
SH4-14/30-2250-x-x(-x)	2250
SH4-2-0500-x(-AP)-x(-x)	500
SH4-3-0800-x(-AP)-x(-x)	800
SH4-4-0900-x(-AP)-x(-x)	900
SH4-4-1200-x(-AP)-x(-x)	1200

Minimum installation distance

The safety device must be positioned at a specific safety distance (Operating distance). 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

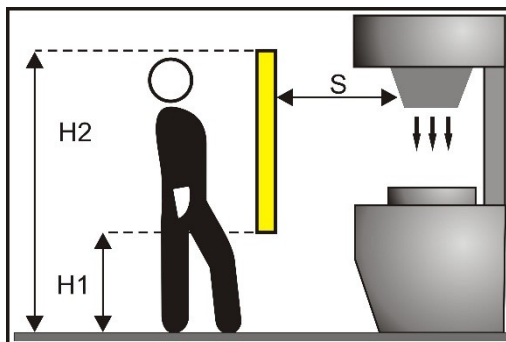


Figure 4: Installation distance (vertical positioning)

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/s
- t₁ = Response time of the ESPE in seconds (see appendix “Technical Data”).
- t₂ = Machine stopping time in seconds (including the Safety Control System)
- C = Additional distance based on the possibility to insert the body or one of the 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



NOTE: 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 ≥ 900 mm (H2) from machine supporting base while the height of the bottom beam has to be ≤ 300 mm (H1).

If the safety light curtain must be mounted in a horizontal position (see figure below) 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 (see appendix “Technical Data”.)
- 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

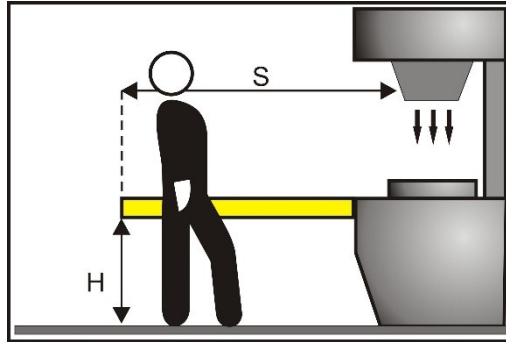


Figure 5: Installation distance (horizontal positioning)

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 stopping time (including the Safety Control System)
- T = (t1 + t2) Overall system stopping performance
- C = 8 * (R - 14) for devices with resolution ≤ 40 mm
- R = Resolution of the system

In all cases, if K = 2000 mm/s, then S > 500 mm.

Distance will have to be recalculated using K = 1600 mm/s.



NOTE: 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

TYPICAL APPLICATIONS

Example 1: Operating point protection on drilling machines

The operator positions the part and takes it back after machining. The operator must be protected against possible abrasions while working.

Solution: SH4 14mm safety light curtain is especially suitable for this kind of application, which requires the installation of the device directly on the machine.

Advantages: Highly reduced profile size guarantees installation flexibility for machine dimensions.



Example 2: Bending presses

The safety device must protect the operator from being squashed between the top and bottom tool or the machined part during the fast approach phase.

Solution: If only one beam of the safety light curtain is darkened while the press is moving down, the mobile tool bar will stop.

Advantages: The safety light curtain can be used in most bending operations thanks to its easy installation and compact dimensions.

As well as offering excellent reliability, SH4 ensures increased plant productivity as it reduces the dead times necessary for machine accessing, adjustment and maintenance.



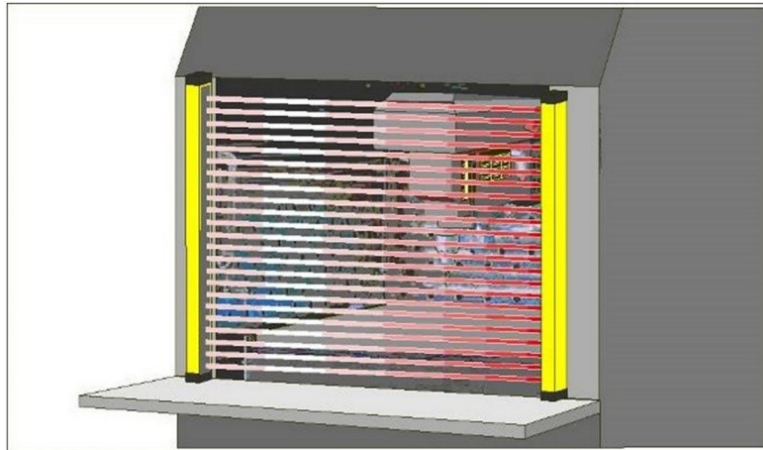
Example 3: Paper cutting machines

These machines typically cut paper to a specific size for newspapers or special applications.

The operator must be protected against abrasion or cuts by cutter blades.

Solution: SH4 30mm safety light curtain is especially suitable for this kind of application, which require the installation of the device directly on the machine.

Advantages: Highly reduced profile and the two side slots ensure installation flexibility for machine dimensions.

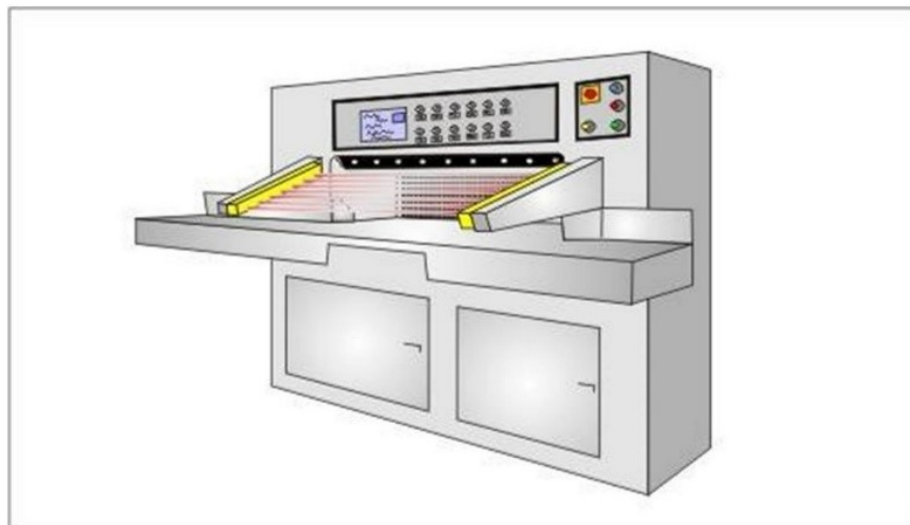


Example 4: Milling machines

A milling machine is a machine tool used for the shaping of metals and other solid materials. Operator hands and body must be protected from being dragged, entangled or cut by the tool / spindle.

Solution: SH4 30mm safety light curtain is the best solution considering the required safety levels and application type. When even just one of the light curtain beams is interrupted, the machine is immediately stopped.

Advantages: Highly reduced profile size guarantees installation flexibility for machine dimensions.



SAFETY INFORMATION



CAUTION: 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 "[Installation](#)" on page 5, "[Mechanical Mounting](#)" on page 21, "[Connections](#)" on page 26, "[Alignment Procedure](#)" on page 52) 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 to "[Installation](#)" on page 5).
- 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 TEST button must be located outside the dangerous zone because the operator must check the dangerous zone during all Test operations.
- The RESET/RESTART button must be located outside the dangerous zone because the operator must check the dangerous zone during Reset/Restart operations.



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

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.



CAUTION: The figure below 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 curtain at sufficient height in order to completely cover the access to the dangerous area (correct positioning) becomes necessary.

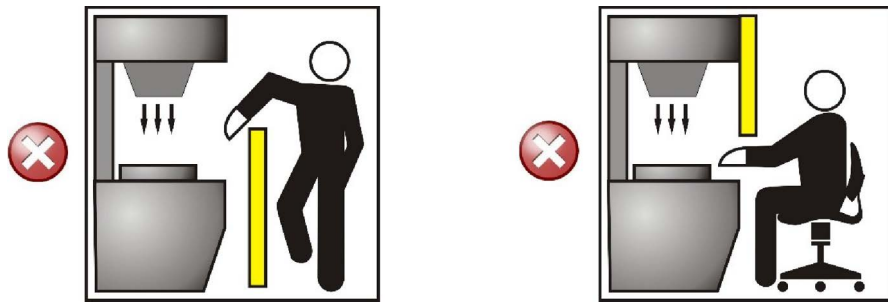


Figure 6: Wrong light curtain positioning



Figure 7: Correct light curtain positioning



CAUTION: 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 any lateral access, as shown in the following figures.



Figure 8: Wrong light curtain positioning

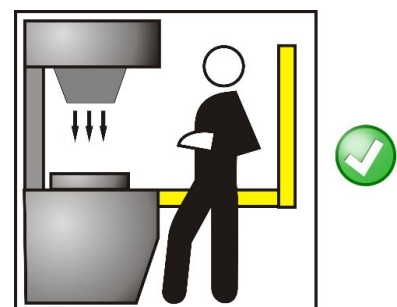


Figure 9: Correct light curtain positioning

Minimum distance from reflecting surface (D_{SR})

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.

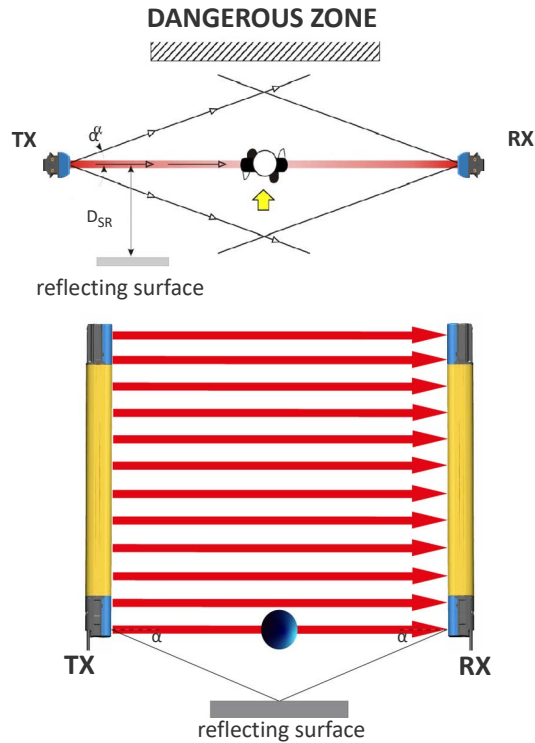


Figure 10: Distances from reflective surfaces

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 transmitter (TX) and receiver (RX);
- real aperture angle of ESPE (EAA); especially:

for ESPE Type 4 EAA = $\pm 2.5^\circ$

In the diagrams shows the minimum distance from the reflecting surface (D_{SR}), based on the operating distance:

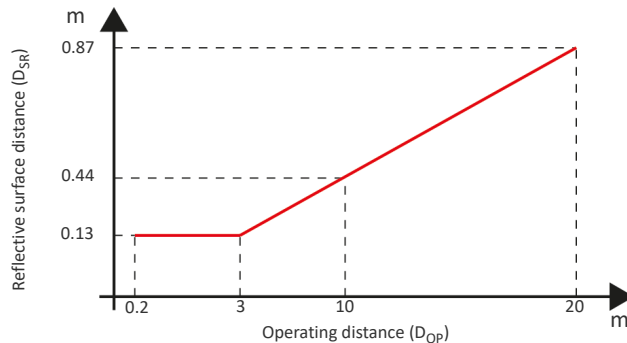


Figure 11: Minimum distance from reflective surface

The formula to get D_{SR} is the following:

$$D_{SR} \text{ (m)} = 0.13$$

for operating distance < 3 m

$$D_{SR} \text{ (m)} = \text{operating distance (m)} \times \tan(2.5^\circ)$$

for operating distance ≥ 3 m

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 transmitter 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 transmitter-receiver couple axis.

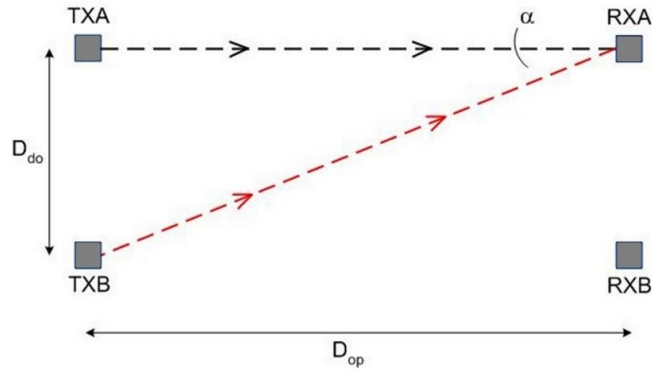


Figure 12: Distance between homologous devices

This minimum D_{do} distance depends on:

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

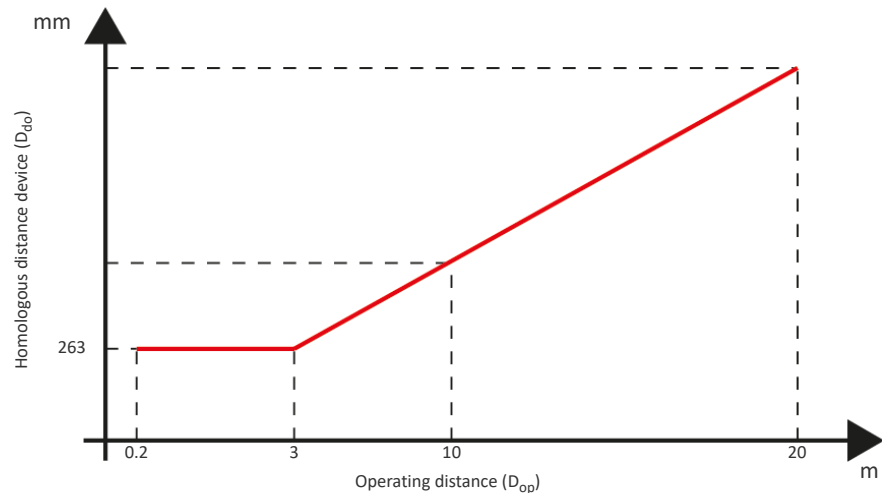


Figure 13 - ESPE Type 4

The formula to get D_{do} is the following:

$$D_{do} \text{ (mm)} = 263$$

for operating distance < 3 m

$$D_{do} \text{ (m)} = \text{operating distance (m)} \times \text{tg } 5^\circ$$

for operating distance ≥ 3 m



CAUTION: The interfering device (TBX) must be positioned at the same D_{do} 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:

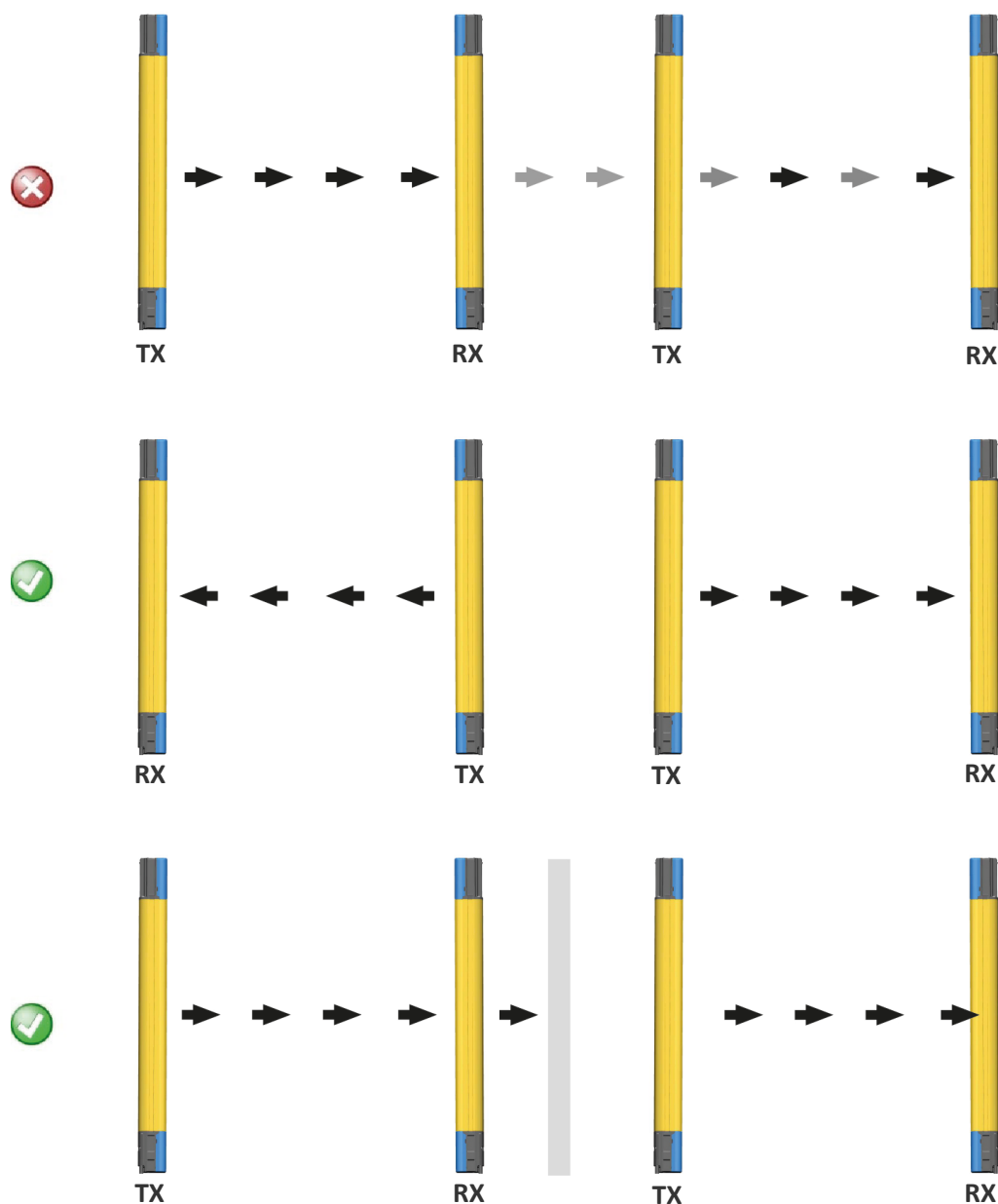


Figure 14: Recommended positioning for homologous devices



CAUTION: If two light curtains have to be mounted near each other as reported in the first example of the figure above.

Transmitter 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:

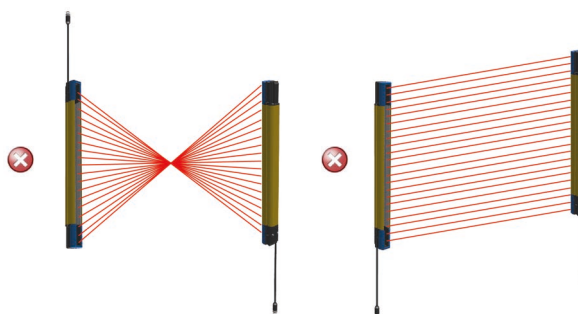


Figure 15: Wrong light curtain TX-RX orientations

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.

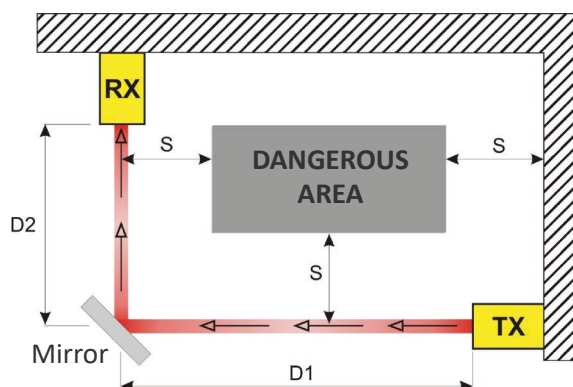


Figure 16: Use of deviating mirrors

The operator must respect the following precautions 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 very small displacements of the mirror is enough to lose alignment.
- The use of Datasensing 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.

NO. OF MIRRORS	OPERATING DISTANCE (14mm)	OPERATING DISTANCE (30mm)
0	10 m	20
1	8 m	16

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

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.

Check that:

- The ESPE remains in Safe State intercepting the beams along the detection zone using the specific test piece (TP-14, TP-30), following the scheme shown in Figure 17.

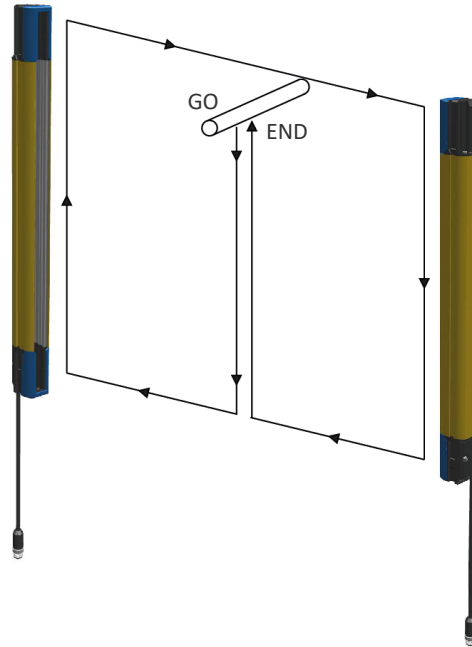


Figure 17: Path of the test piece

- ESPE has to be correctly aligned: press slightly on the product side in both directions, the red LED must not turn on.
- The activation on the TEST function (on TX side) causes the opening of the OSSD outputs (red LED, OSSD on RX side, ON and controlled machine stop).
- The response time at machine STOP, including the ESPE and machine response times, must be included in the limits defined in the calculation of the safety distance (refer to "[Minimum installation distance, starting on page 10](#)").
- The safety distance between the dangerous parts and ESPE must comply with the requirements indicated in [Minimum installation distance, starting 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, ensure that it remains in Normal Operation for at least 10-15 minutes, and placing the specific test piece in the protected area, in the Safe State for the same period.
- Verify the correspondence of all the accessory functions, activating them in the different operating conditions.

CHAPTER 3

MECHANICAL MOUNTING

POSITIONING

The transmitting (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 must be included within the operating range of the model used (see appendix “Technical Data”).

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

The next step is the fine alignment, as shown in the chapter “Alignment Procedure”.

Outfit angled fixing brackets kit for units mounting must be used as described below (see Figure 19).

Adjustable supports for adjusting unit inclinations around the axes are available on request (see appendix “Accessories”).

First beam location

The beams must be positioned on the same direction. For all SH4 models, the first beam is located at the bottom edge of the light curtain, near to connections and the last beam is at the opposite side.

For models without connections SH4-2/3/4-xxxx-x-AP-x(-x) the bottom edge of the light curtain is the one showing the technical data of the unit.

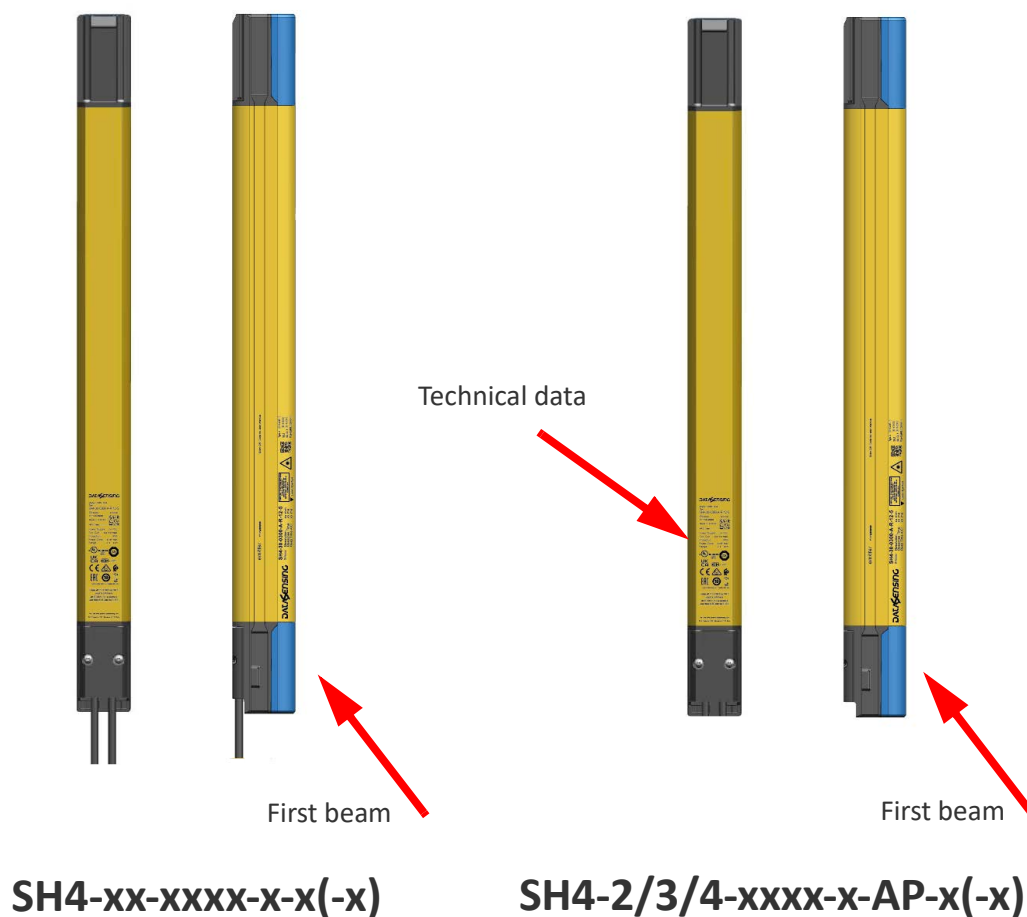


Figure 18: First beam location

FIXING

To mount the angled fixing brackets kit, place the threaded pins metallic insert into the dedicated side seat of the terminator cap side light curtain closing cap (1); slide the insert towards the metallic drawn profile groove (2).

Fix the bracket against the profile by tightening (torque 2.5 Nm) the M5 hexagonal nuts (3-4). It's possible to slide the bracket group along their dedicated rail and fix it once again just working on the above-mentioned nuts.

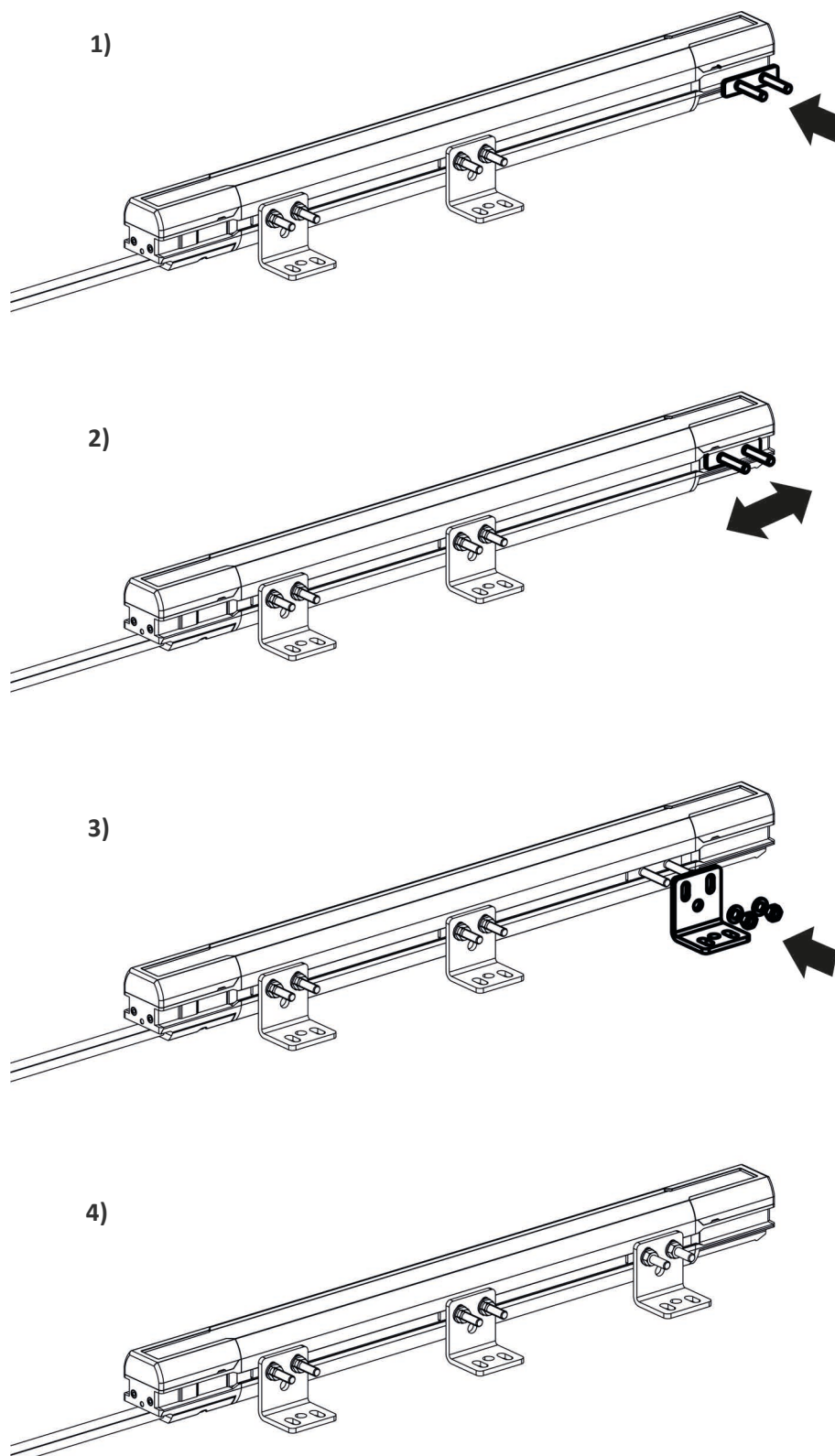


Figure 19: Fixed brackets mounting procedure

The recommended mounting positions according to the light curtain length are shown in Figure 20 and in the following table.

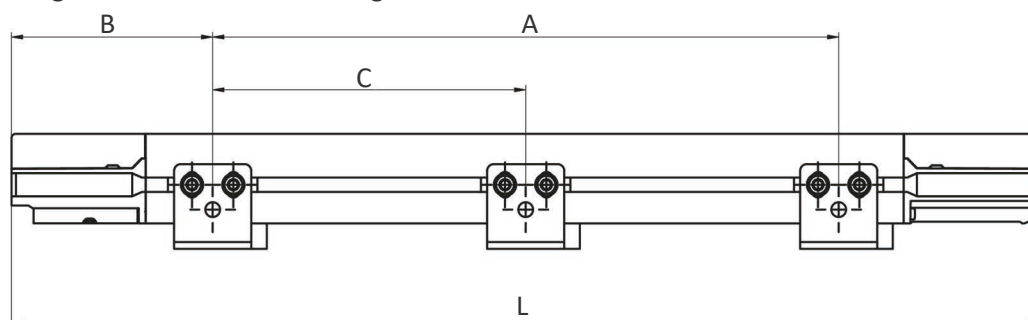


Figure 20 - Light curtain dimensions

MODEL 14 mm	MODEL 30 mm	L	A	B	C
SH4-14-0300-x-x(-x)	SH4-30-0300-x-x(-x)	309	89	110	-
SH4-14-0450-x-x(-x)	SH4-30-0450-x-x(-x)	459	239	110	-
SH4-14-0600-x-x(-x)	SH4-30-0600-x-x(-x)	609	309	150	-
SH4-14-0750-x-x(-x)	SH4-30-0750-x-x(-x)	759	409	175	-
SH4-14-0900-x-x(-x)	SH4-30-0900-x-x(-x)	909	509	200	-
SH4-14-1050-x-x(-x)	SH4-30-1050-x-x(-x)	1059	609	225	-
SH4-14-1200-x-x(-x)	SH4-30-1200-x-x(-x)	1209	909	150	454.5
SH4-14-1350-x-x(-x)	SH4-30-1350-x-x(-x)	1359	1009	175	504.5
SH4-14-1500-x-x(-x)	SH4-30-1500-x-x(-x)	1509	1109	200	554.5
SH4-14-1650-x-x(-x)	SH4-30-1650-x-x(-x)	1659	1209	225	604.5
SH4-14-1800-x-x(-x)	SH4-30-1800-x-x(-x)	1809	1309	250	654.5
SH4-14-1950-x-x(-x)	SH4-30-1950-x-x(-x)	1959	1409	275	704.5
SH4-14-2100-x-x(-x)	SH4-30-2100-x-x(-x)	2109	1509	300	754.5
SH4-14-2250-x-x(-x)	SH4-30-2250-x-x(-x)	2259	1609	325	804.5

MODEL BODY	L	A	B	C
SH4-2-0500-x(-AP)-x(-x)	674	374	150	
SH4-3-0800-x(-AP)-x(-x)	974	574	200	
SH4-4-0900-x(-AP)-x(-x)	1074	624	225	
SH4-4-1200-x(-AP)-x(-x)	1374	1024	175	



NOTE: The measures are in mm.

Fixing on support



NOTE: The screws to attach the brackets to the support are not provided.

It is possible to fix the supports in two ways:

1) Two screws M5 UNI 5739 and two washers J5 UNI 8842 using the two holes:

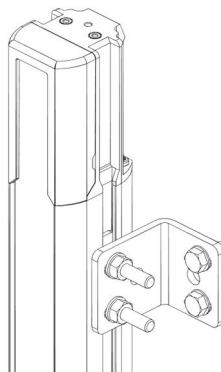


Figure 21: Fixing with two screws

2) A screw M6 UNI 5739 and a washer J6 UNI 8842 using the central hole:

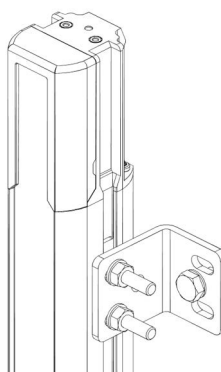


Figure 22: Fixing with a screw

In case of applications with particularly strong vibration, it is recommended to interpose between the bracket and the support the anti-vibration accessory, that can be ordered separately (4 pieces in ST-K4AV, or 6 pieces in ST-K6AV).

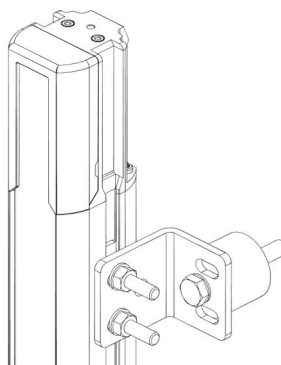


Figure 23: Anti-vibration dampers

CHAPTER 4

CONNECTIONS

ELECTRICAL CONNECTION

Pin-out and configuration pin connection

All electrical connections to the transmitting and receiving units are made through M12 connector(s).

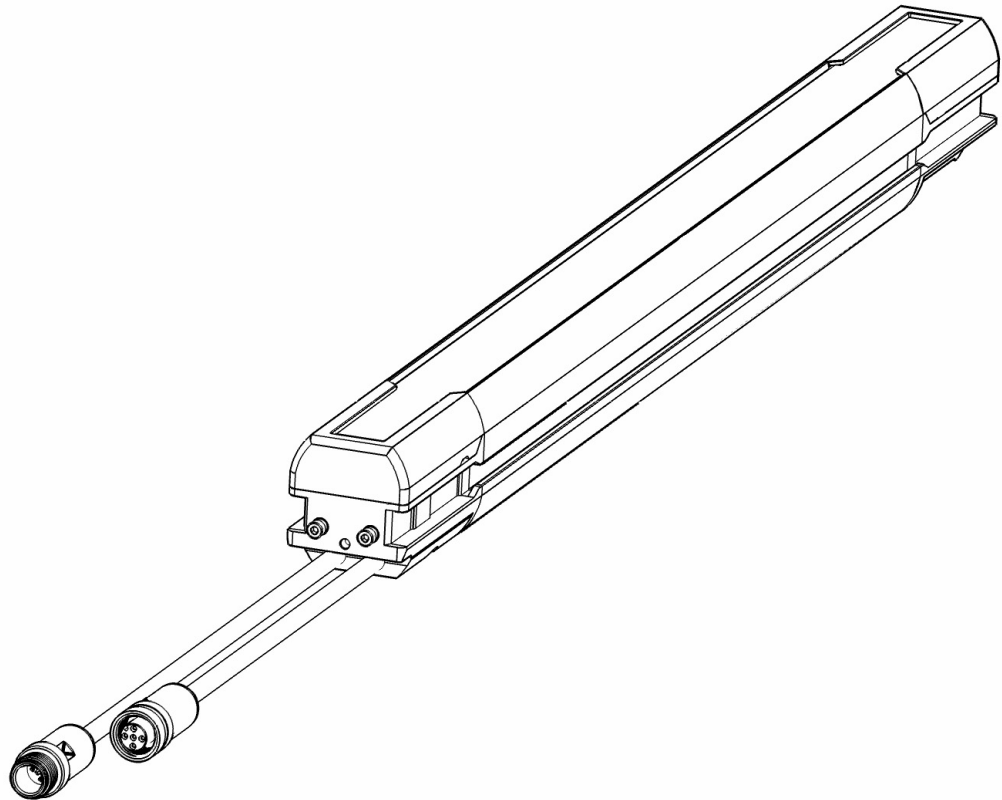
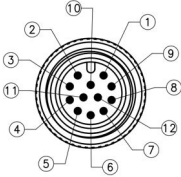
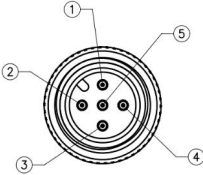


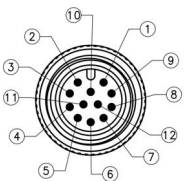
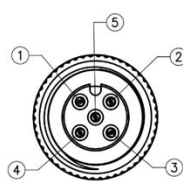
Figure 24: Connections

SH4-xx-xxxx-A-12

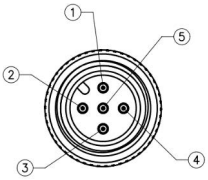
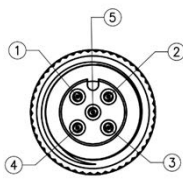
RECEIVER	
M12 male 12 pin	
	
1 - 24V (brown)	
2 - 0V (blue)	
3 - GP_IN1 (white)	
4 - GP_IN2 (green)	
5 - OSSD2 (pink)	
6 - GP_IN3 (yellow)	
7 - GP_IO1 (black)	
8 - OSSD1 (grey)	
9 - GP_IN4 (red)	
10 - GP_IO2 (violet)	
11 - OVR2 (grey-pink)	
12 - GP_IN5 (red-blue)	

TRANSMITTER	
M12 male 5 pin	
	
1 - 24V (brown)	
2 - TEST/(AIMER) (white)	
3 - 0V (blue)	
4 - CODE (black)	
5 - COM (grey)	

SH4-xx-xxxx-A(-AP)-12-5

RECEIVER	
M12 male 12 pin	M12 female 5 pin
	
1 - 24V (brown)	1 - 24V OUT (brown)
2 - 0V (blue)	2 - GP_IN5 (white)
3 - GP_IN1 (white)	3 - 0V OUT (blue)
4 - GP_IN2 (green)	4 - GP_IN6 (black)
5 - OSSD2 (pink)	5 - GP_IO2 (grey) ¹
6 - GP_IN3 (yellow)	
7 - GP_IN4 (black)	
8 - OSSD1 (grey)	
9 - OVR2 (red)	
10 - GP_IO1 (violet)	
11 - GP_IO2 (grey-pink) ²	
12 - NOT CONNECTED (red-blue)	

1. Internally short-circuited with Pin 11 of main connector
2. Must be left floating when used as cascade Main unit

TRANSMITTER (SH4-xx-xxxx-A-12-5 models only)	
M12 male 5 pin	M12 female 5 pin
	
1 - 24V (brown)	1 - 24V OUT (brown)
2 - TEST/(AIMER) (white) ¹	2 - TEST/(AIMER) (white)
3 - 0V (blue)	3 - 0V OUT (blue)
4 - CODE (black) ²	4 - CODE (black)
5 - COM (grey)	5 - CASCOD (grey)

1. Pin 2-2 of male-female connector are internally short-circuited thus should be connected one-side only
2. Pin 4-4 of male-female connector are internally short-circuited thus should be connected one-side only



NOTE: For all body models only (SH4-2/3-xxxx-x), pin 2 of the transmitter (TX) connector is also used for the Emission Range Selection function, refer to “Emission Range Selection (SH4-2/3/4-xxxx-x-x models only)” on page 67.

I/O Configuration

The input and output signals must be assigned to the dedicated pins and configured.



NOTE: In order to configure the I/O, refer to “Input Output Manager” on page 40.

Below is the list of signals that can be configured:

Input signals

- Restart
- EDM
- Muting 1
- Muting 2
- Muting 3
- Muting 4
- Muting Enable
- Override 1
- Teach In
- Beam Tolerance
- Align
- Reset

Output signals

- Lamp
- Override Status

Signals Logic Level

For some signals, it is possible to set the type of logic level **HIGH** or **LOW**. Below is the list of signals for which it is possible to set the logic level:

- Align
- Restart
- Reset
- Muting 1
- Muting 2
- Muting 3
- Muting 4
- Muting Enable
- Teach-in
- Override Status

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.);
- **Do not connect the OSSD wires of different light curtains in the same multi-pole cable.**

- The TEST wire must be connected through a N.O. button to the supply voltage of the ESPE.



CAUTION: The TEST button must be located in such a way that the operator can check the protected area during any test.

The RESET/RESTART/ALIGN button must be located in such a way that the operator can check the protected area during any reset operation.

- The device is already equipped with internal over-voltage and over-current suppression devices.
- **The use of other external components is not recommended.**

Example: connection to the safety relay SE-SR2

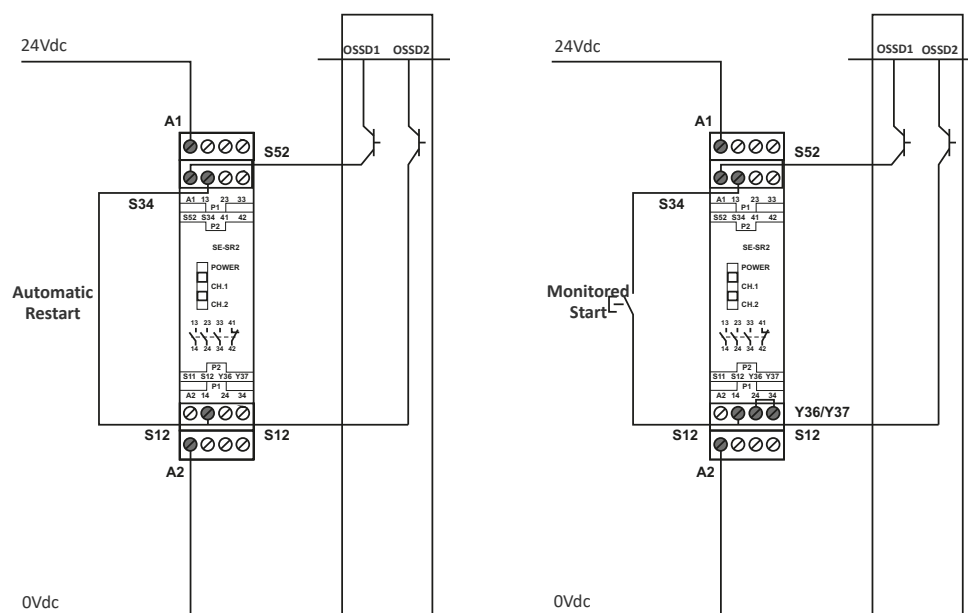


Figure 25: Connection to SE-SR2 Safety Relays

The figure shows the connection between the safety light curtains and the safety relay of the SE-SR2 series functioning in the Automatic Restart mode (left side) and Manual Restart with monitoring (right side).

Do not use varistors, RC circuits or LEDs in parallel at relay inputs or in series at OSSD outputs.

- The OSSD1 and OSSD2 safety contacts cannot be connected in series or in parallel, but can be used separately, conforming to the plant's safety requirements.
- If one of these configurations is erroneously used, the device enters the output failure condition (see chapter "User Interface Dialogue").
- Connect both OSSDs to the device to control.

- Failure to connect an OSSD to the activating device jeopardizes the system safety degree that the light curtain has to control.

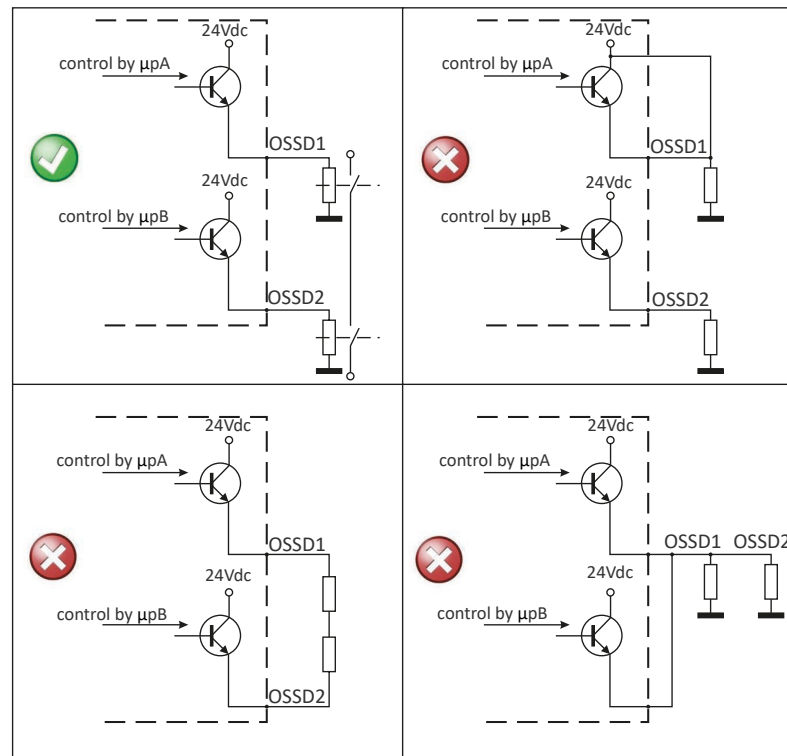


Figure 26: OSSDs connection

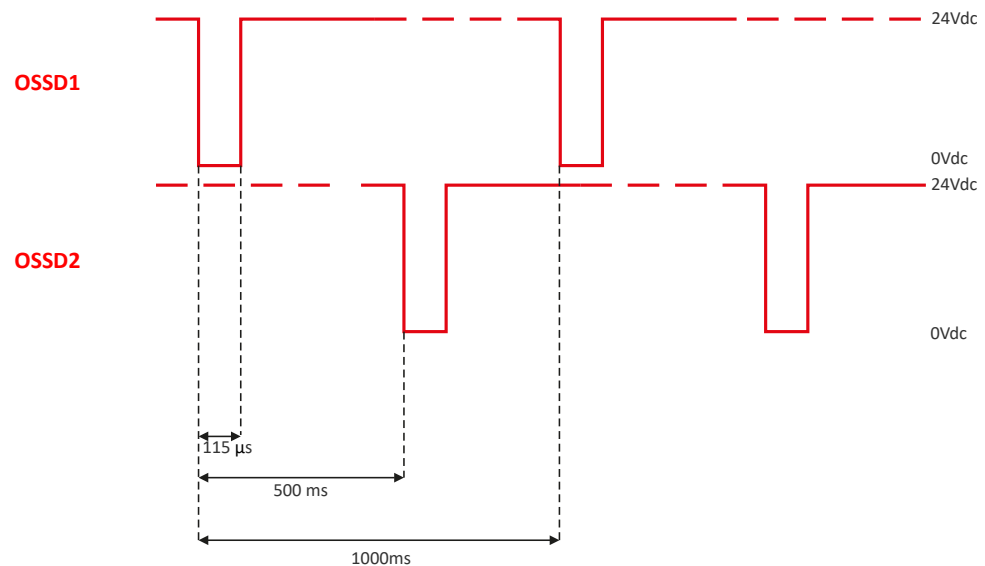


Figure 27: Behavior of OSSDs

CHAPTER 5

SH4 DESIGNER

The user select among advanced functions/advanced parameters by means of a Multi-platform Software App running on PC or mobile devices (Available for RX only).

The App allow users to connect to a Safety Light Curtain by means of a wireless network generated by the light curtain itself.

The Wi-Fi connection is point-to-point: the light curtain generate a wireless network with unique SSID containing it's Serial Number and Model with password encrypted with WPA2.



NOTE: Internet on your device may not be available in this case.

SH4 Designer App for PC or mobile devices allows the user to: set ESPE advanced configuration, firmware update, change device password, change network password, monitoring the device status and restore the default configuration. Many parameters are available to customize ESPE behavior for specific applications.

Since ESPE parameter can be safety critical and PC software cannot be guaranteed as a safety component a safe configuration procedure has to be followed.

Configuration procedure on user interface can be done by authorized personnel only. Such personnel must be sure that protected dangerous machine has no access during configuration procedure.

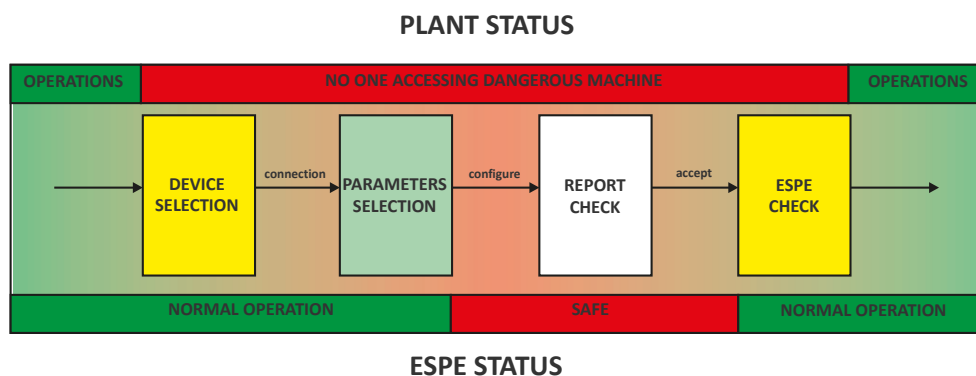


Figure 28: Advanced Configuration Cycle

1. **Device selection:** user connects to the SSID of the Wireless network generated by the light curtain to configure, identified by a unique Serial Number and Model. If the light curtain is set to access a different access point, the user connects to the same, then select one ESPE to configure choosing between devices on the network identified by a unique Serial Number.

2. **Parameters selection:** user set required ESPE configuration.
After selection user send configuration command, ESPE switch to SAFE state, a “configuration in progress” indication is shown on ESPE led interface, old configuration on ESPE is erased.
3. **Report check:** ESPE sends back to UI received configuration, UI produces a printable *Safety System Configuration Report* with all safety related information about configuration in progress (see “Report Check” on page 50). After checking all report contents user can accept configuration: ESPE restarts in normal operation with the new configuration.
4. **ESPE Check:** User checks ESPE is working according to *Safety System Configuration Report* (resolution check with proper test piece, parameters check ...).

GET THE APP

Download SH4 Designer App for PC or mobile devices from the store:

		
Visit www.datasensing.com		

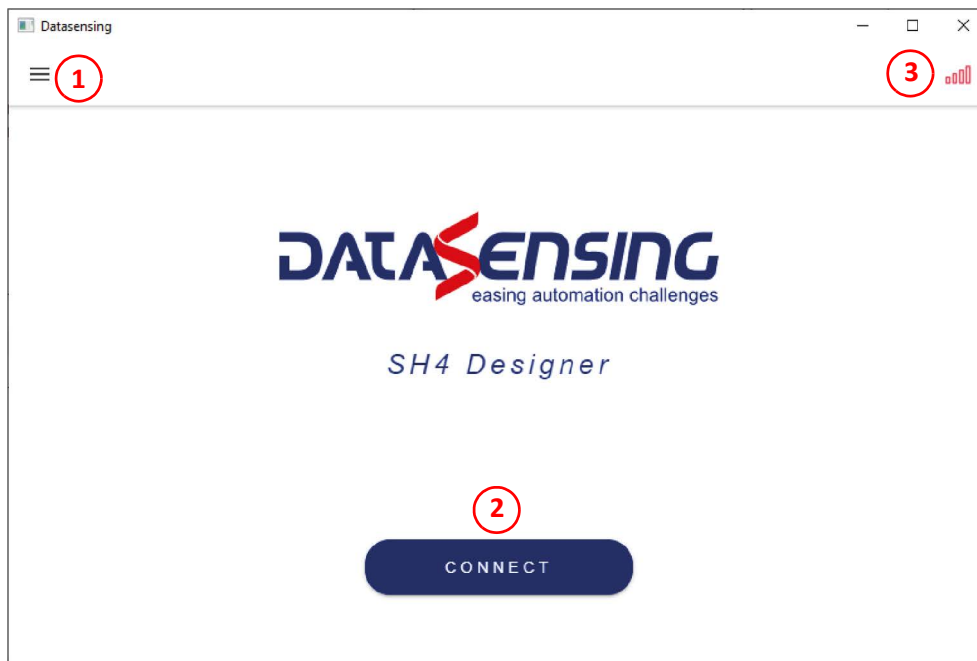
HOW TO CONNECT TO THE ESPE



NOTE: Internet on your device may not be available in this case.

1. Connect the device to the Wi-Fi generated by the ESPE
2. Insert the password (**datasensing**)
3. Launch the SH4 Designer

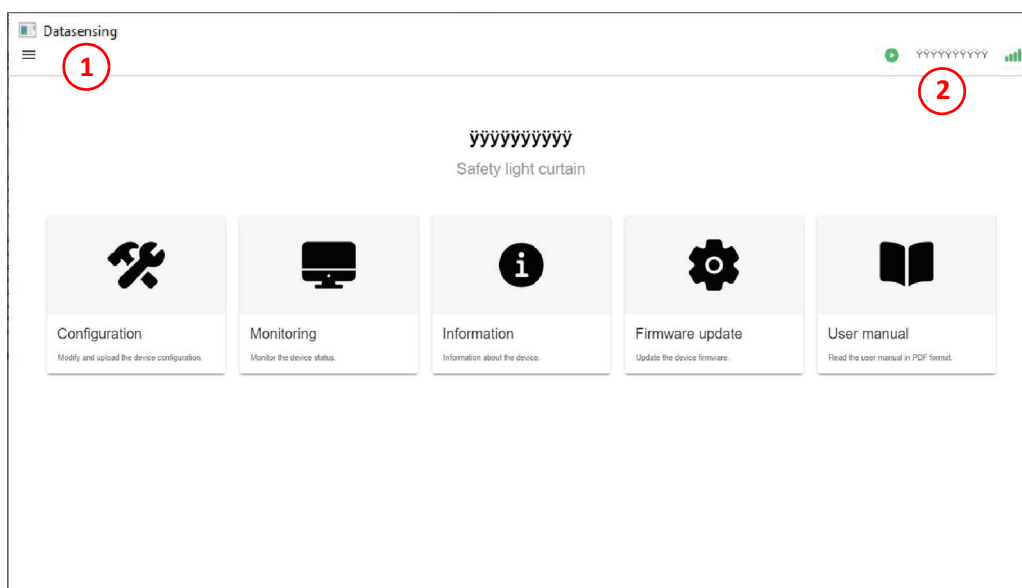
The picture below shows the main window of SH4 Designer when you access it:



AREA	DESCRIPTION
1	Menu toolbar icon: Click the icon to open the menu toolbar. From this menu it is possible to - access the offline configuration and open a previously saved configuration - change language - access the product reference guide - access the help section
2	Connection area: Connect to the device
3	Network connection: Shows the network connection status

USER INTERFACE

The picture below shows the home page window of SH4 Designer when you access it:



AREA	DESCRIPTION
1	Menu toolbar icon: Click the icon to open the menu toolbar
2	Status: Shows the device and network connection status

BUTTON	DESCRIPTION
Configuration	Opens the device configuration window
Monitoring	Allows to receive the device status in real time
Information	Allows to see the information about the connected device
Firmware update	Allows to perform the firmware update
User Manual	Opens the Product Reference Guide

Menu toolbar



COMMAND	DESCRIPTION
Homepage	Opens the home page window
Configuration	Opens the device configuration window
Monitoring	Allows to receive the device status in real time
Information	Allows to see the information about the connected device
Change device password	Allows to change or reset the device password
Change Wi-Fi settings	Allows to change or reset the Wi-Fi settings
Firmware update	Allows to perform the firmware update
Factory reset	Allows to perform the factory reset
Change Language	It lists the available languages for the user interface. Select the language you want to use
User Manual	Opens the Product Reference Guide
Help	Opens the search windows to help the user

Configuration



AREA	DESCRIPTION
1	Device info: Shows the model of the safety light curtain connected, the parameters version, the date of the last configuration upload and the SSID
2	Standard button: This toolbar shows the open\save buttons and the configuration updates. There is also a share button for mobile devices
3	Safety function toolbar: This toolbar shows the safety configuration buttons
4	Configuration area: In this area you can set the basic and advanced safety functions, the topology and the I/O input

Standard button

BUTTON	DESCRIPTION
	It allows to upload a new configuration on the safety light curtain (see How to change configuration, starting on page 41). It also allows to have a report on the configuration set and a report of the differences with the old configuration
	It opens the window that allows saving a configuration
	It opens the window that allows choosing an existing configuration
	It allows to share a configuration (available only for mobile device)

Safety function toolbar

BUTTON	DESCRIPTION
Basic Functions	It allows setting the basic safety function
Advanced Functions	It allows setting the advanced safety function
Topology	This button shows the topology of the system
I/O Manager	It allows to configure the Input and Output signals

Configuration area

Here you can view the system topology and configure:

- “Basic functions”
- “Advanced functions”
- “Input Output Manager”

Basic functions

In this configuration area it is possible to set the Restart mode, the Anti Interference coding AIC (if available) and enable/disable EDM.

Advanced functions

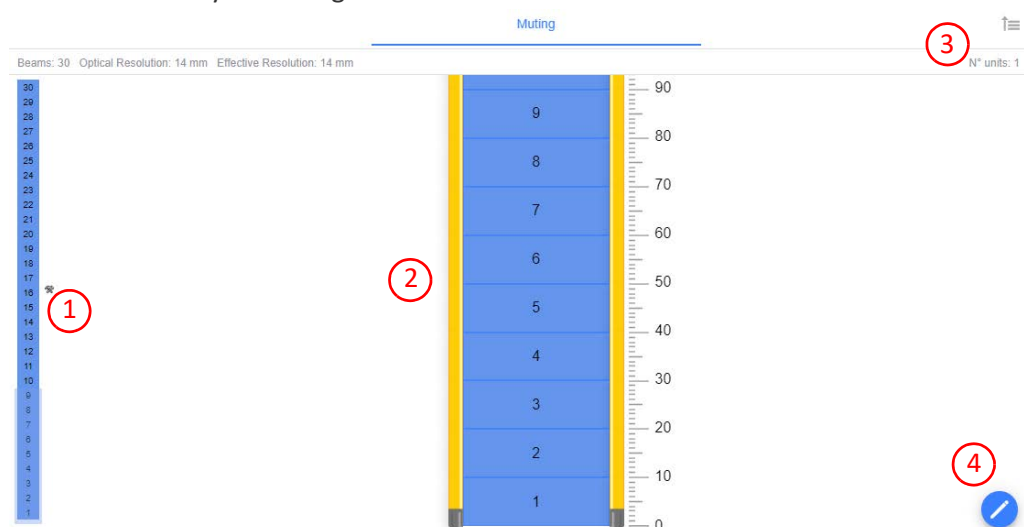
In this configuration area it is possible to set the advanced function (muting, blanking and muting+blanking) and the reduced resolution.

Depending on the muting function selected, some parameters are displayed:

PARAMETER	DESCRIPTION	VALUE [DEFAULT]
T12 Multiplier (m)	Multiplier for calculation of muting duration	1 to 16 [2]
Muting Stop Condition	Condition for stopping muting function	Timer Only/Timer or Light Curtain Free [Timer Only]
T ₁₂ Min Selection (ms)	Minimum time between muting signals	For T Muting - 4 Signals 4 Sensors Time Monitoring: 0 to 1000 [100] For all the other types of Muting: 50 to 1000 [100] for SH4-14/30-xxxx-x-x 10 to 1000 [100] for SH4-2/3/4-xxxx-x(-AP)-x
T ₁₂ Max Selection (s)	Maximum time between muting signals	1 to 16 [4]
T Delay (ms)	Additional muting time at the end of muting sequence	0 to 1000 [0]
Timeout (s)	Maximum muting duration	10 - 57600 [10 min]
Infinite Timeout	Unlimited muting duration	yes/no [no]
Muting Deactivation Filter (ms)	Filter on muting signals deactivation	0 to 1000 [0]
Muting Activation Filter (ms)	Filter on muting signals activation	0 to 1000 [0]
Dynamic Muting <i>NOT available for:</i> - SH4-2/3/4-xxxx-x(-AP)-x models - Cascade system	Teach time (ms): time after which muting is partialized to maximum detected material height	500 to 4000 [2000]
	Beam Tolerance: additional intercepted beams allowed over maximum taught height	Beam tolerance: 0 to 6 [0] Only for SH4-14/30-xxxx-x models.
	Start from top: use if light curtain is installed up-side down	Start from top: yes/no [no]
Muting Lamp Integrity Check	Checks for presence and integrity of external lamp	yes/no [no]
Override Mode Selection	Level trigger: override signals must remain active for all override sequence	
	Edge trigger: override signals are not required to remain active for all override sequence	

PARAMETER	DESCRIPTION	VALUE [DEFAULT]
Override Timeout (min)	Maximum override duration	1 to 256 [2]
Override Restart (when the Manual Restart is selected)	Automatic	At the end of the Override the ESPE remains with the outputs high and monitors if any intrusions occur.
	Manual	At the end of the Override, the ESPE goes into Interlock state and waits for a manual restart signal.

Also, when an advanced function is set, a graphic window is available to select the single beams individually according to the functions used.



AREA	DESCRIPTION
1	Shows an overview of the connected device
2	Shows the beams of the safety light curtain. By selecting the individual beams it is possible to configure one or more zones. When one or more zones are configured, it is possible to change the parameters using the icon
3	This icon allows to choose the beams numbering order
4	Press the icon to delete the entire configuration

Input Output Manager

In order to use the available functions it is necessary to make some electrical connections that must be set on this configuration area.

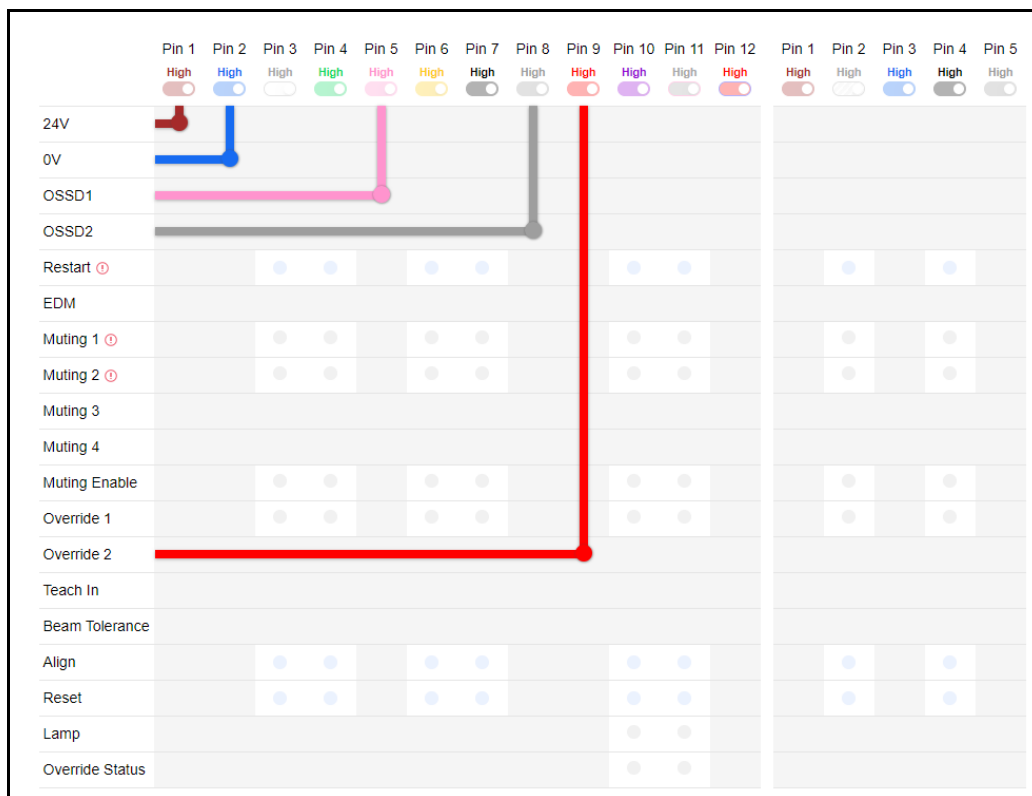


Figure 29: Input Output Manager windows

In this window the connections already set up will be visible while the connections to be made will be highlighted by an alert circle (⚠) .

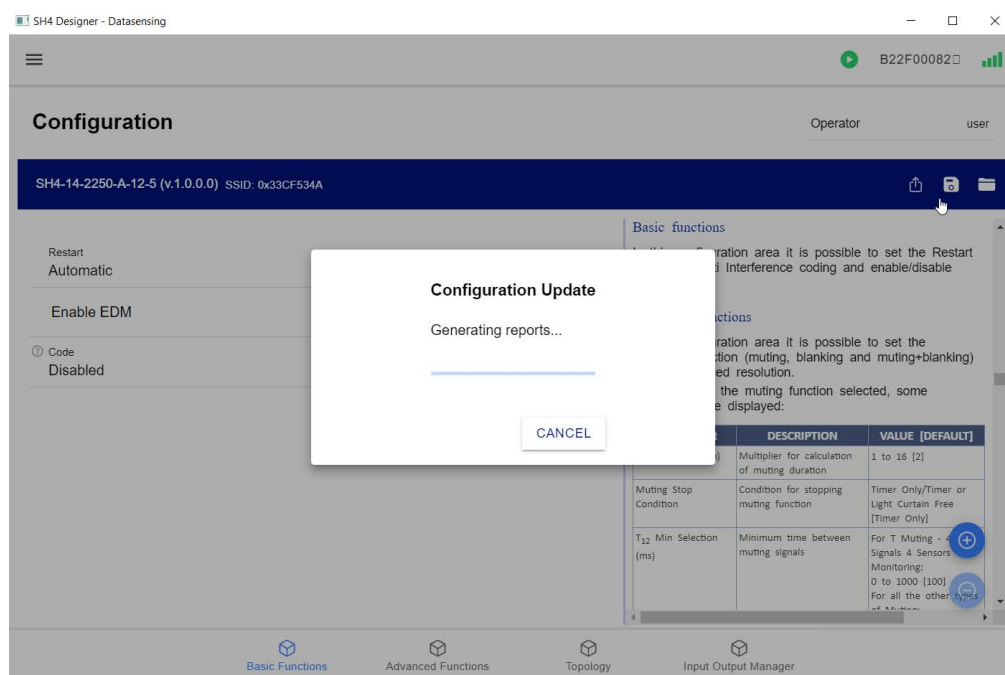


NOTE: Only for some functions it is possible to select the type of signal (HIGH or LOW).

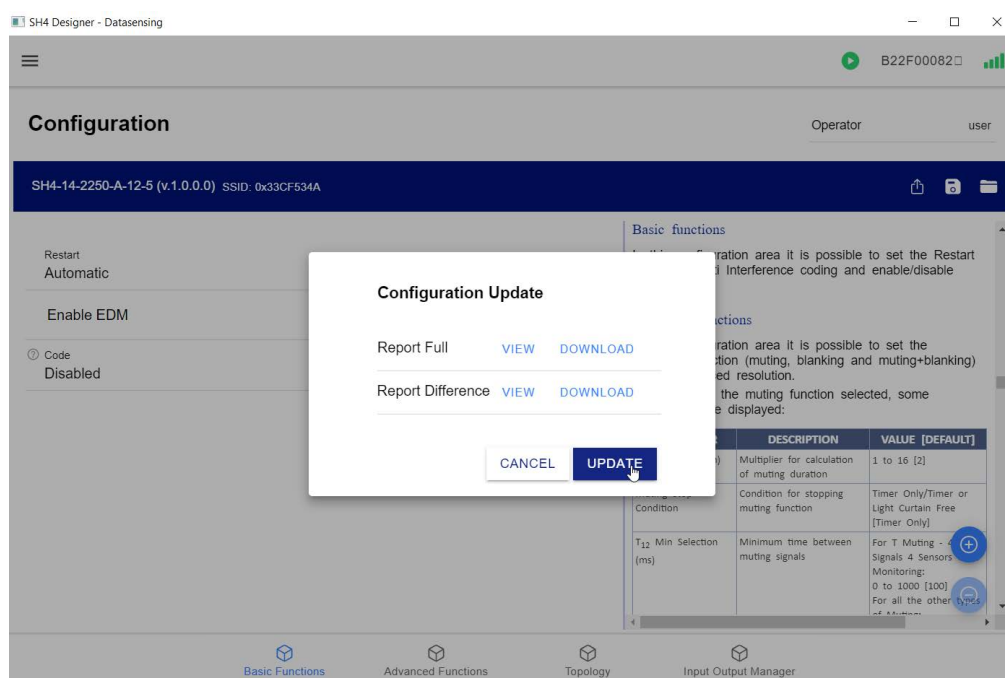
How to change configuration

In order to apply changes to the configuration, it is necessary to follow the steps below:

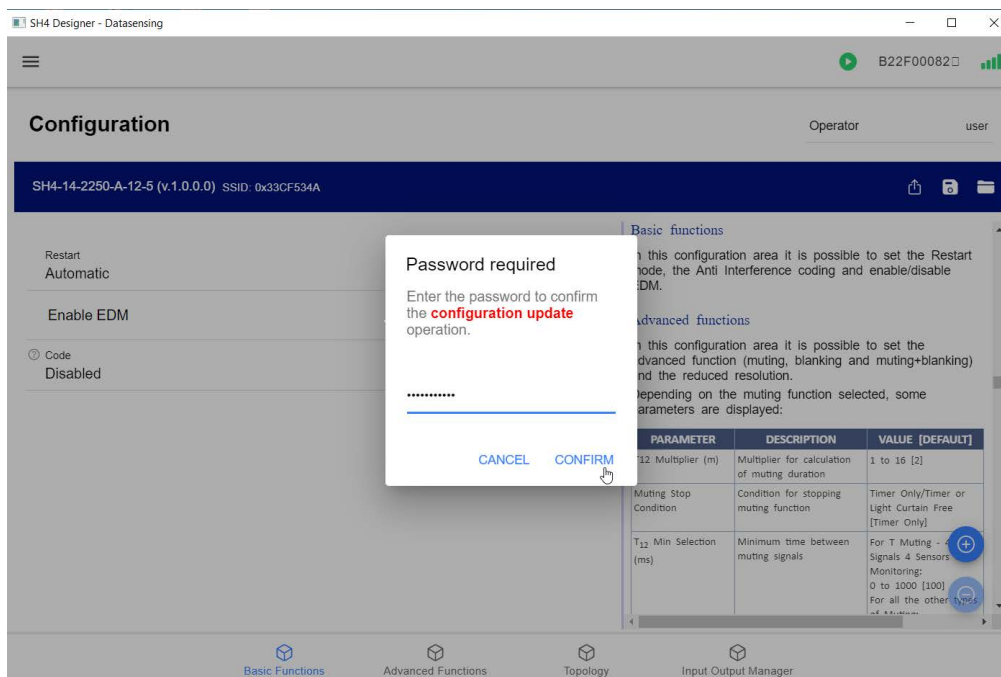
1. Click on the  icon
2. Wait for reports to be generated:



3. It is now possible to view/print the generated reports (see "Report Check" on page 50 for more details) or continue with the upload of the new configuration to the safety light curtain by pressing the "Upload" button:

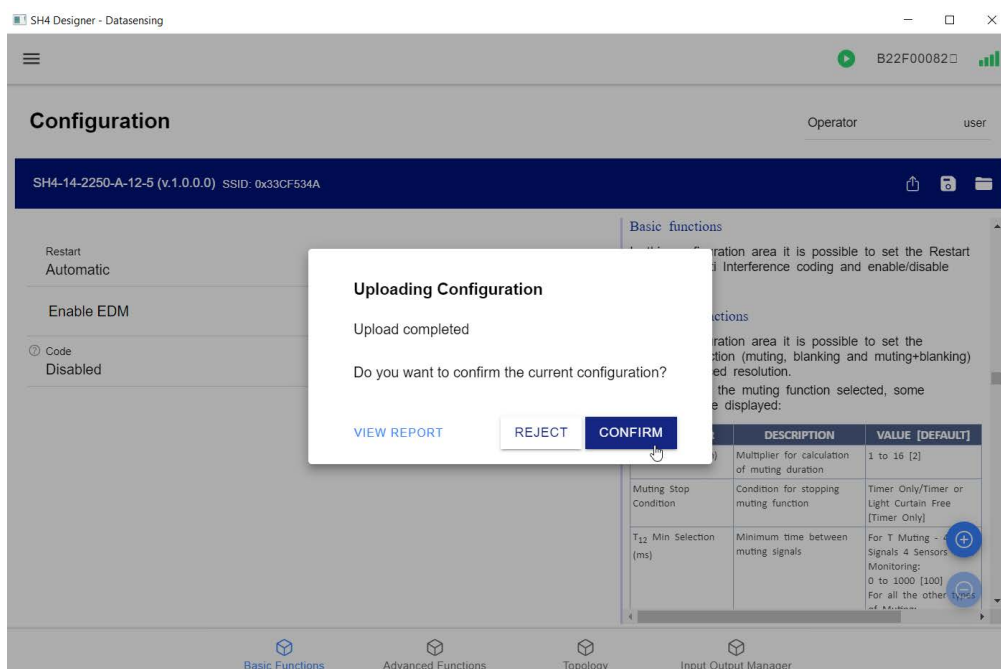


4. Enter the password to confirm the configuration upload:

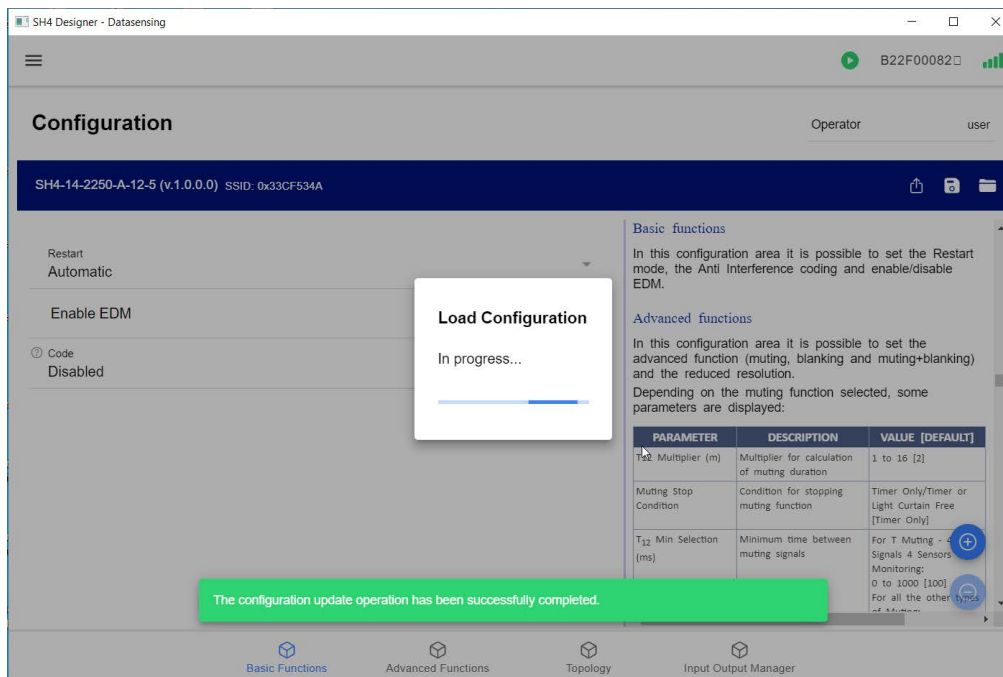


NOTE: The message "GUI configuration pending" is displayed on the safety light curtain. See "GUI Configuration Pending" on page 99 for more information.

5. Confirm or reject the finalization of the upload operation (it is also possible to view the report of the new configuration):

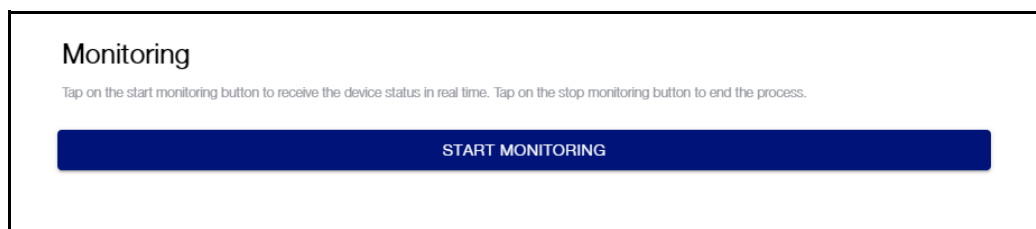


6. When the “Confirm” button is pressed, the new configuration is transferred to the safety light curtain which exits the waiting state and restarts:



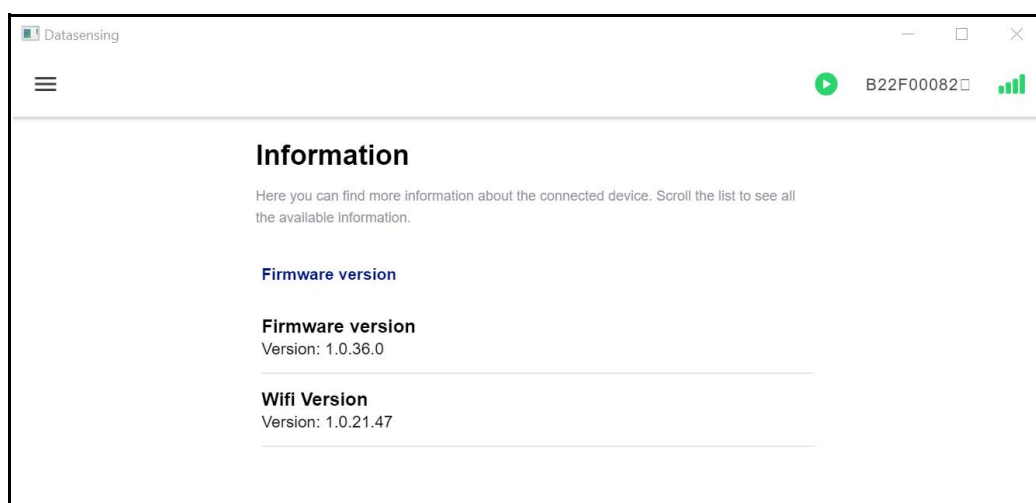
Monitoring

Allows to receive the device status in real time.



Information

More information about the connected device.



INFO	DESCRIPTION
Firmware version	Firmware version
Wifi version	Wifi version

Change device password

You can change your password for security reasons or reset it if you forget it.



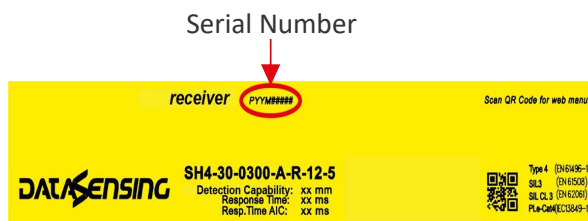
NOTE: A minimum password length of 8 alphanumeric characters is required.



NOTE: For password reset please contact Datasensing Technical Support.

Change Wi-Fi settings

If Wi-Fi password is forgot user can contact Technical Support and ask for a “Wi-Fi unlock password” communicating the light curtain **receiver** serial number visible on the product label.



Firmware update

SH4 Designer App allows to update:

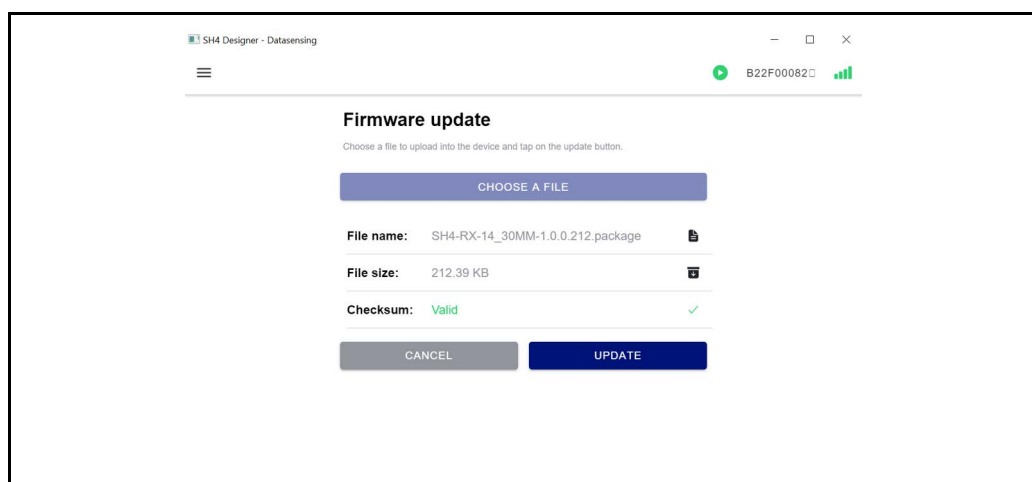
- the Receiver device firmware
- the Receiver Wi-Fi firmware
- the Transmitter device firmware



NOTE: Please contact Datasensing Technical Support for the latest firmware and support on update.

How to update the Receiver device firmware:

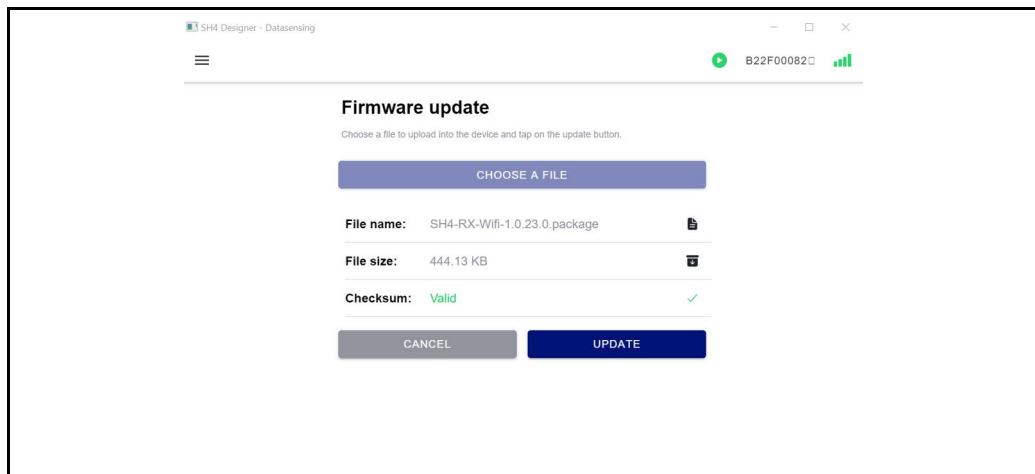
1. Open the “Firmware update” tab.
2. Press “Choose a file” and select the firmware obtained from the Technical Support.



3. If the file checksum passes, press “Update” and proceed with the update.
4. Wait the end of the procedure.

How to update the Receiver Wi-Fi firmware:

1. Open the “Firmware update” tab.
2. Press “Choose a file” and select the firmware obtained from the Technical Support.

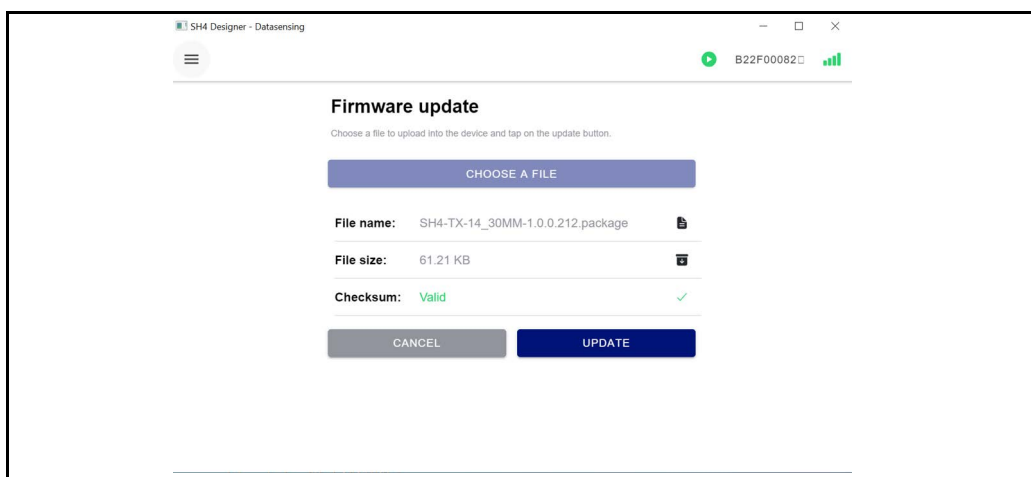


3. If the file checksum passes, press “Update” and proceed with the update.
4. Wait the end of the procedure.
5. Power cycle the device to load the new firmware.

How to update the Transmitter device firmware:

In order to update the Transmitter follow the next procedure.

1. Turn OFF the devices.
2. Connect the Transmitter unit to the Receiver unit as follow:
 - for **SH4-xx-xxxx-x-12-5 models**: directly connect Transmitter 5 poles male connector to Receiver 5 poles female connector or pin 11 (grey-pink) of Receiver 12 poles connector to pin 5 (grey) of Transmitter 5pole connector.
 - for **SH4-xx-xxxx-x-12 models**: connect pin 7 (black) of Receiver 12 poles connector to pin 5 (grey) of Transmitter 5pole connector.
3. Turn ON the devices.
4. Open the “Firmware update” tab.
5. Press “Choose a file” and select the firmware obtained from the Technical Support.



6. If the file checksum passes, press “Update” and proceed with the update.
7. Wait the end of the procedure.
8. Turn OFF the devices.
9. Disconnect the Transmitter unit from the Receiver unit.
10. Turn ON the devices.

Factory Reset

Factory reset allows to:

- Reset automatic cascade topology detection on RX unit, stored in flash for safety reasons.
- Reset advanced configuration stored in flash after Wi-Fi parametrization.

In order to perform the factory reset, enter the required password and wait until the end of the procedure.

Factory Settings

The system configuration in the factory conditions are:

Basic Function:

- Restart - Automatic
- Enable EDM - Disabled
- Code - Disabled (*NOT available for SH4-2/3/4-xxxx-x(-AP)-x models*)

Advanced Function:

- Advanced Function - None
- Reduced resolution - Main Unit [0] (*only for SH4-1 4/30-xxxx-x-x(-x) models*)

Available Function:

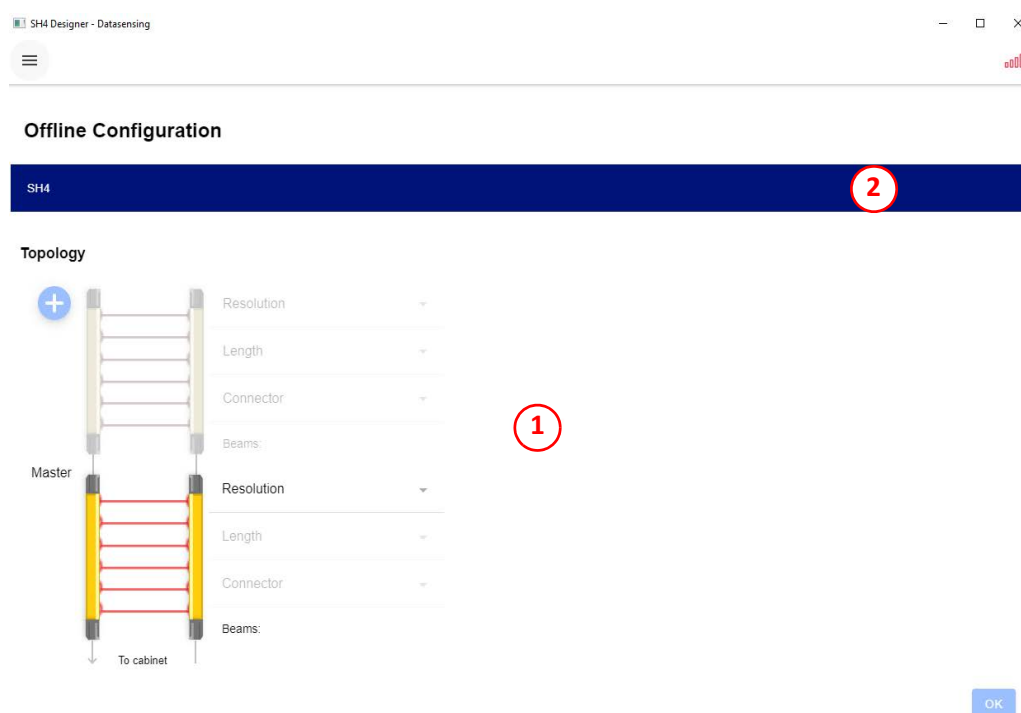
- Reset on PIN 3 (GP_IN1) in logical high level
- Alignment on PIN 3 (GP_IN1) in logical high level

User Manual

Opens the device's Product Reference Guide in PDF format.

Offline Configuration

The SH4 Designer App allows to create a configuration in offline mode. By choosing “Offline configuration” from the menu toolbar (see page 34) it is possible to select the device and the system topology.



AREA	DESCRIPTION
1	Topology: Choose the system topology and individual devices
2	Standard buttons (Offline mode): This toolbar shows the open\save and reset configuration buttons. There is also a share button for mobile devices

Once the system has been defined by selecting the topology, press “OK” button to move on the configuring the functions. The standard buttons will be available in the new screen.

Standard button (Offline mode)

BUTTON	DESCRIPTION
	It allows the user to reset the configuration and return to the offline configuration home page
	It opens the window that allows saving a configuration
	It opens the window that allows choosing an existing configuration
	It allows to share a configuration (available only for mobile device)

Report Check

The SH4 Designer App produces a printable *Safety System Configuration Report* with all safety related information about configuration in progress following the procedure “How to change configuration” on page 41.

Safety system configuration report
SH4-30-300-A-12-5

Created by: User
Created on: 26/08/2022, 10:45:42

Firmware version

MIB: 1.0.37.0
Firmware: 1.0.37.0
Wifi: 1.0.22.48

GUI Version: 1.0.0.209-RTM

Safety system programming ID: 0xda543845
Configuration ID: 0x7334de
System Type: SH4-30-300-A-12-5



DATA SENSING
easing automation challenges

Basic Functions

Restart	Manual
Enable EDM	Disabled
Code	Disabled

Advanced Functions

Advanced Function	Muting
-------------------	--------

Reduced resolution

Master	0
--------	---

Muting Parameters

ATTENTION: this is a safety system configuration report.
Check safety system behaviour is coherent with information contained in this document.

Figure 30: Example of Safety System Configuration Report

If you want to change the configuration, you can generate a report that highlights the differences with the configuration in progress always following the procedure “How to change configuration” on page 41.

Safety system configuration report

SH4-30-300-A-12-5

Created by: User
Created on: 26/08/2022, 10:45:42

Firmware version

MIB: 1.0.37.0
Firmware: 1.0.37.0
Wifi: 1.0.22.48

GUI Version: 1.0.0.209-RTM



- Safety system programming ID: 0x5cc6b7fa
+ Safety system programming ID: 0xda543845
- Configuration ID: 0xe8d9b72b
+ Configuration ID: 0x7334de

System Type: SH4-30-300-A-12-5

Basic Functions

- Restart	Automatic
+ Restart	Manual
Enable EDM	Disabled
Code	Disabled

Advanced Functions

- Advanced Function	None
+ Advanced Function	Muting

Reduced resolution

ATTENTION: this is a safety system configuration report.
Check safety system behaviour is coherent with information contained in this document.

Figure 31: Example of Safety System Configuration Report with differences

CHAPTER 6

ALIGNMENT PROCEDURE

ALIGNMENT

A good alignment between the emitting and the receiving units is necessary to obtain the correct behavior of the light curtain. It avoids a not steady light curtain status (OSSDs flicker ON and OFF and vice versa) due to dust or vibration.

The alignment is perfect if the optic axes of the first and the last emitting unit's beams coincide with the optic axes of the corresponding elements of the receiving unit.

The figure shows that the first beam is located at the bottom edge of the light curtain, near to connections. The last beam is at the opposite side. These two beams are the synchronization beams too.

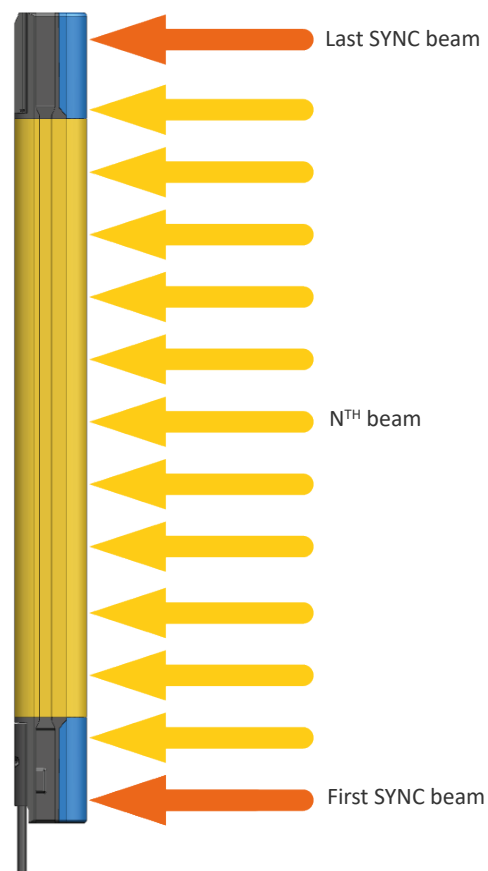


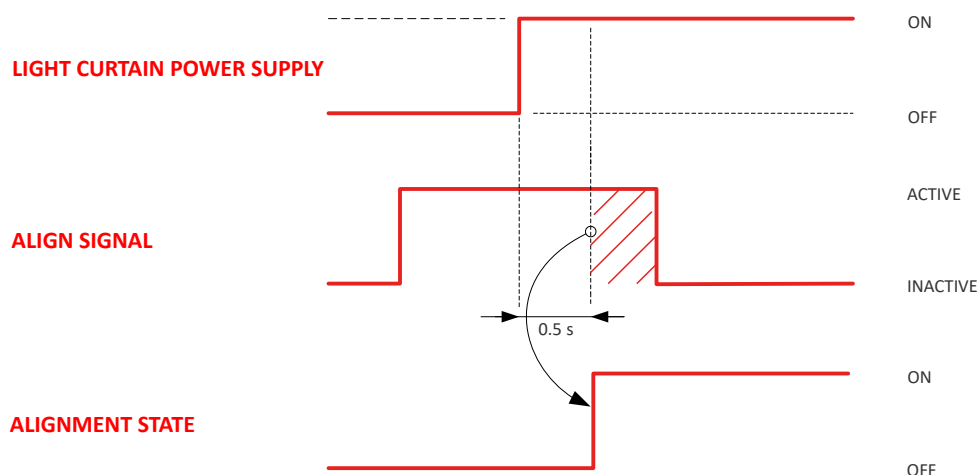
Figure 32: Physical beams position

Alignment Procedure



NOTE: In order to use this function, the ESPE must be configured via SH4 Designer App (a pin must be configured for alignment signal). See “I/O Configuration” on page 29.

The ALIGNMENT function can be activated at power up keeping active the ALIGN input for at least 0.5 seconds, as shown in the following timing diagram. When a good state of alignment is reached a power OFF and a power ON operation carry back the ESPE in normal operation.



In Alignment Mode ESPE is always in Safe State and the OSSDs are kept OFF.

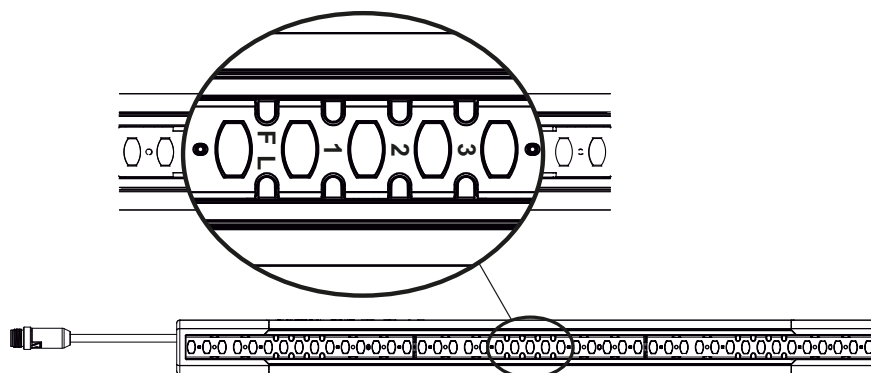
The state of alignment is estimated from RX unit by reading the received signal level of each beam. First and last beam received level gets some more weight.

Before switching to normal operation please ensure to have aligned the light curtain with the best achievable signal, see “User interface indication with light curtain in alignment mode” on page 54.

User interface indication with light curtain in alignment mode

SH4-14/30-xxxx-A-x(-x) models

Level is visualized on LED user interface.



LED meanings

 = ON

 = OFF

 = INDIFFERENT

 = BLINK



NOTE: Alignment level can also be remotely checked with SH4 Designer in monitoring panel.

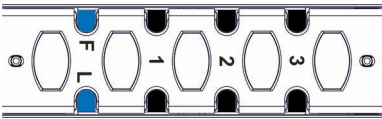
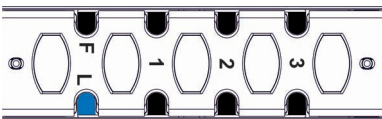
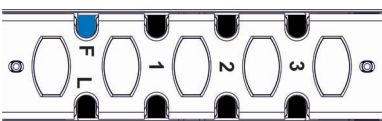
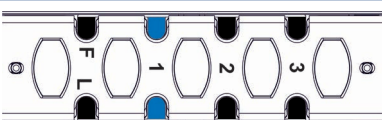
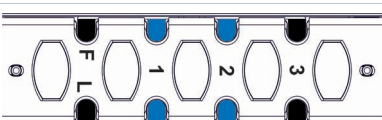
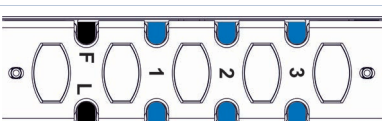
INDICATION	LED CONFIGURATION
Not aligned	
Not aligned Only first sync aligned	
Not aligned Only last sync aligned	
Aligned Minimum Signal Level	
Aligned Medium Signal Level	
Maximum Signal Level	

Table 1: User interface display in alignment mode



NOTE: In normal operation signal level is reported by the same LEDs used in alignment mode but the F/L LED will lit Green/Red depending on the status of optics on the second module.

INDICATION	LED CONFIGURATION	OSSD STATUS RESULT IN NORMAL OPERATION
At least one beam intercepted on second module		OFF
Minimum Signal Level		ON
Medium Signal Level		ON
Maximum Signal Level		ON

Table 2: Alignment signaling in normal operation



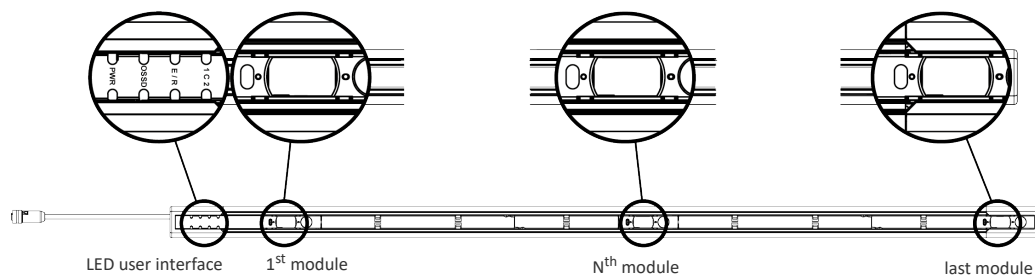
NOTE: On SH4 light curtains each optical module but the first (15 cm segment for 14/30 mm resolution) will signal the status of its optics both in normal operation and alignment mode through a RGB module status LED. Modules with intercepted beams will blink red.

INDICATION	LED CONFIGURATION	OSSD STATUS RESULT IN NORMAL OPERATION
At least one beam of other modules intercepted		OFF
At least one beam of module intercepted		OFF
All beams of module free with good signal		ON
At least one beam of module with minimum signal		ON

Table 3: Single module alignment signaling

SH4-2/3/4-xxxx-A(-AP)-x(-x) models

Level is visualized on LED user interface.



LED meanings

 = ON

 = OFF

 = INDIFFERENT

 = BLINK



NOTE: Alignment level can also be remotely checked with SH4 Designer in monitoring panel.

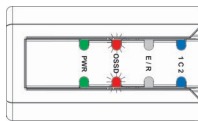
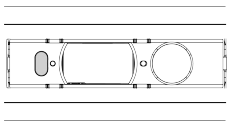
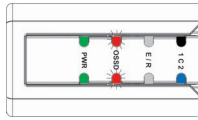
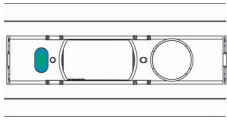
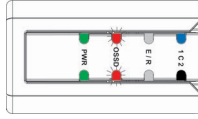
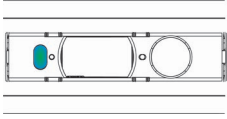
INDICATION	LED CONFIGURATION	
Not aligned		
Not aligned Only first sync aligned		 First module
Not aligned Only last sync aligned		 Last module

Table 4: User interface display in alignment mode (body)

INTEGRATED LASER AIMER (SH4-14/30-xxxx-A-x-x models only)

The class 2 laser aimer can be used to verify the alignment of the light curtain in long distance, or with several deviating mirror.

The aimer is positioned on the front of the Transmitter light curtain (see “Overall Dimensions” on page 114 for more details) and can be activated by connecting the **pin 2** (TEST/AIMER) to the **pin 5** (COM) (see “Electrical Connection” on page 26).



NOTE: The Laser aimer is automatically switched off after 30 minutes from startup.



NOTE: Laser aimer may only be used as visible indication of where Transmitter IR beams are directed so to adjust Transmitter rotation along its vertical axis. It's not granted that if laser beam is targeted on receiver unit TX and RX are perfectly aligned. Please refer to “Alignment Procedure” on page 53 for correct alignment procedure.

INTEGRATED LED AIMER (SH4-2/3/4-xxxx-A-x-x models only)

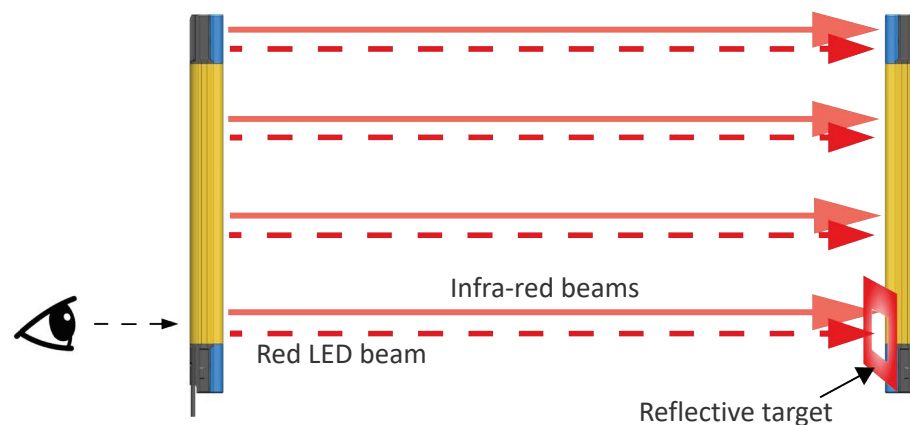
The LED aimers can be used to verify the alignment of the light curtain in long distance, or with several deviating mirrors.

The aimers are positioned on the front of the Transmitter light curtain at the infrared beam outputs (see “Overall Dimensions” on page 114 for more details) and can be activated by connecting the **pin 2** (TEST/AIMER) to the **pin 5** (COM) (see “Electrical Connection” on page 26).



NOTE: The LED aimer is automatically switched off after 30 minutes from startup.

LED aimers need included reflective target to be visible at long distances. As per reflective target characteristics maximum visibility is achieved staring at the reflector from behind the LED aimer.



NOTE: The integrated LED aimer is NOT available for SH4-2/3/4-xxxx-A-AP-x-x models.

CHAPTER 7

FUNCTIONS

This chapter describes all the functions of the light curtain.

The main function of the light curtain is the safe detection: when any object with dimensions equal or greater than the light curtain resolution is placed anywhere within the detection zone, the light curtain will detect it and its safe outputs (OSSDs) shall go to the OFF- state.

SH4 performs this detection function according to IEC EN 61496-2.

RESTART MODE

An opaque object detected by the beams causes the switching of the OSSD outputs (i.e. the opening of the safety contacts - **SAFE** condition).

The restart of the ESPE (i.e. the closing of the OSSD safety contacts - **NORMAL OPERATION**) can be carried-out in two different ways:

- “Automatic Restart” on page 59
- “Manual Restart” on page 60

Automatic Restart

When an opaque object is detected, the ESPE enters in OFF state. Then, after the object has been removed from the controlled area, the ESPE returns in ON state.

The response time is the time between the object introduction in the protected area and the OSSDs achieving the OFF state.

The recovery time is the time within OSSDs go in the ON state after the object is removed.



NOTE: These times are function of length and they'll be treated later (consult the “Available Models and Response Times” for further details).

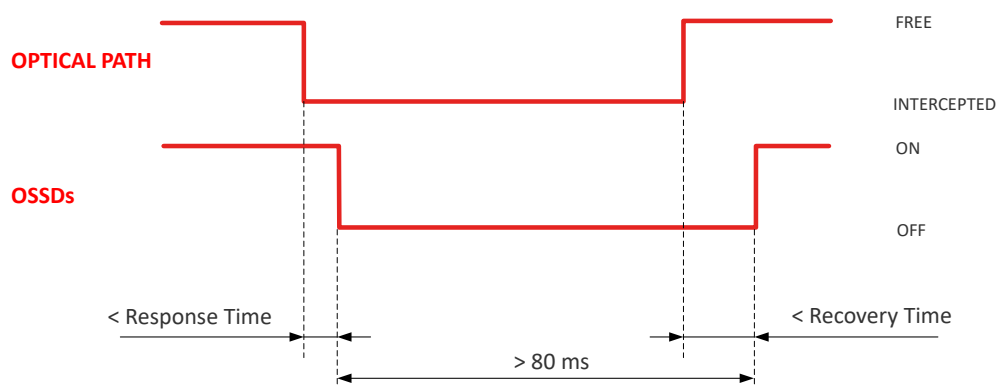


Figure 33: OSSDs behavior in Automatic Restart mode

Manual Restart

After the ESPE has detected an opaque object in the controlled area, the light curtain begins its normal functioning only after the activation of the RESTART signal (usually connected to a normally open push button) and after the object has been removed from the controlled area; see the restart timing diagram below:

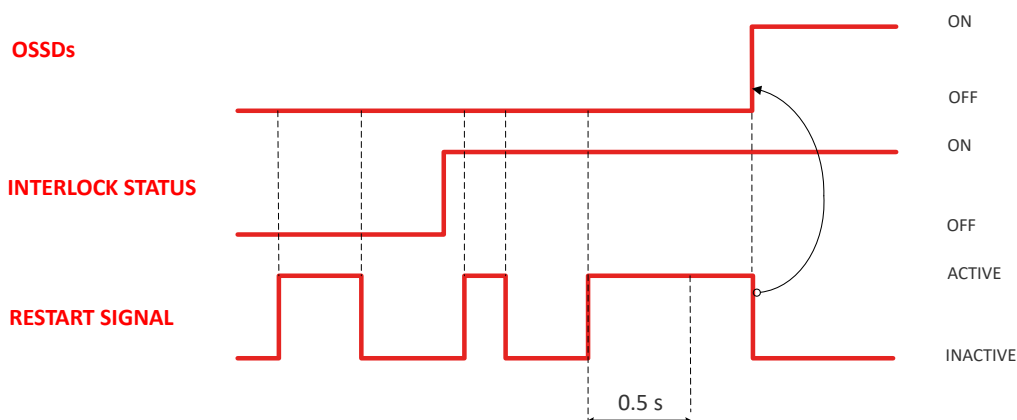


Figure 34: OSSDs behavior in Manual Restart Mode and Restart Pattern

The outputs go ON after a time that is the maximum value between the recovery time and the time of restart high (more or equal to 0.5 s), so this time can be any between 0.5 s and 5 s.

In the timing diagram above the object is already removed.



CAUTION: Carefully assess risk conditions and restart modes. In applications protecting access to dangerous areas, the automatic restart mode is potentially unsafe if it allows the operator to pass completely beyond the sensitive area.

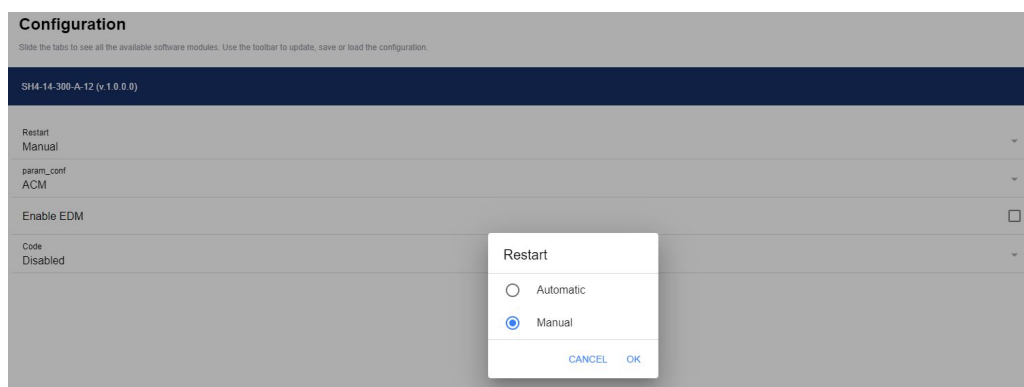
In this case, the manual reset or, for example, the manual restart of the SE-SR2 relay (see “Safety Units” on page 130) is necessary.



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

Configuration of Restart mode

1. In “**Configuration**” tab, choose the “**Restart**” mode by checking the “**Automatic**” or “**Manual**” box.



2. If “**Manual**” mode is selected, an alert pop-up will be displayed under “**Input Output Manager**” because the wiring must be set.



3. Choose “**Input Output Manager**” and provide the wiring indications for the Restart function (see “**Input Output Manager**” on page 40).

RESET

When ESPE locks into failure state user can go back to Normal Operation with a power cycle or the activation of RESET function (non critical failures only).

The RESET function can be activated keeping active the RESET input for at least 5 seconds in non critical failure state.



NOTE: If the activation signal is maintained for more than 10 seconds, the safety light curtain goes into error again.

For all critical failure a power cycle is necessary.

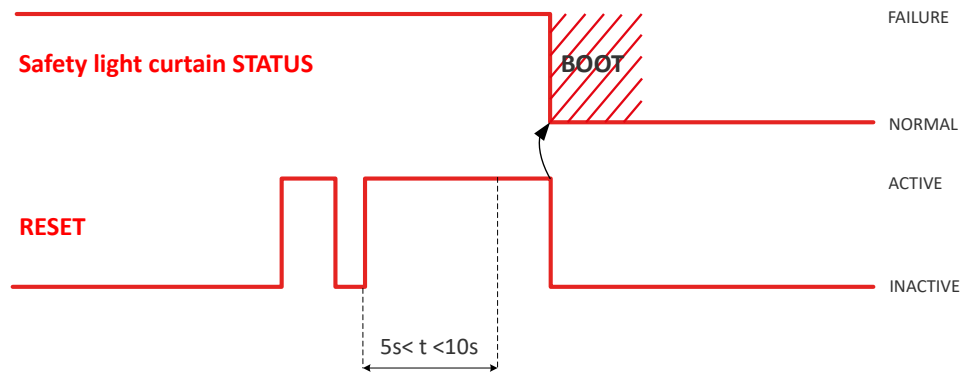


Figure 35: Reset function timing

If the error is not removed, the light curtain goes in failure lockout again.

Also a pin must be configured via software SH4 Designer (see “Input Output Manager” on page 40).

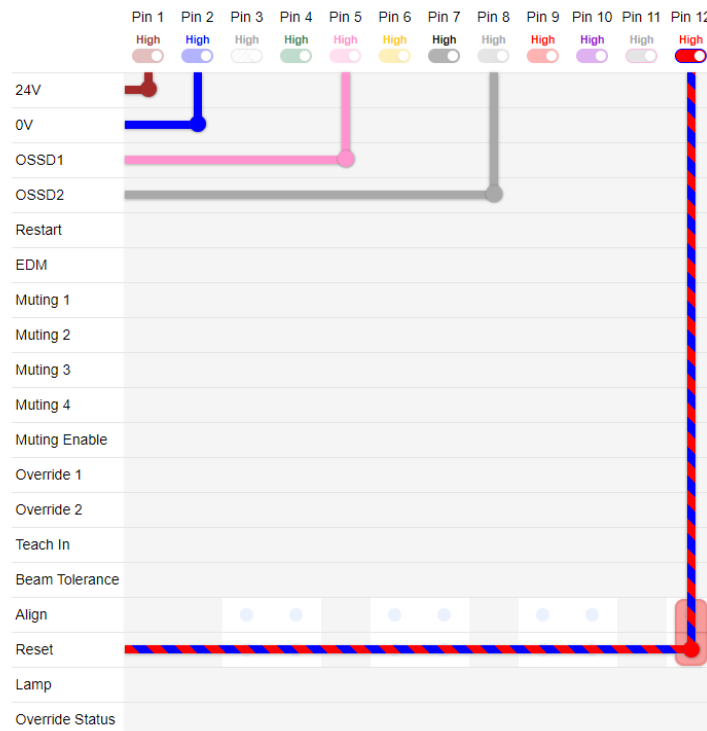


Figure 36: Example of pin configuration

EDM

The External Device Monitoring (EDM) function controls external devices by verifying the OSSDs status. To correctly use this function user must connect EDM input to a N.C. to 24V contact of the device to control (forced guide relay).

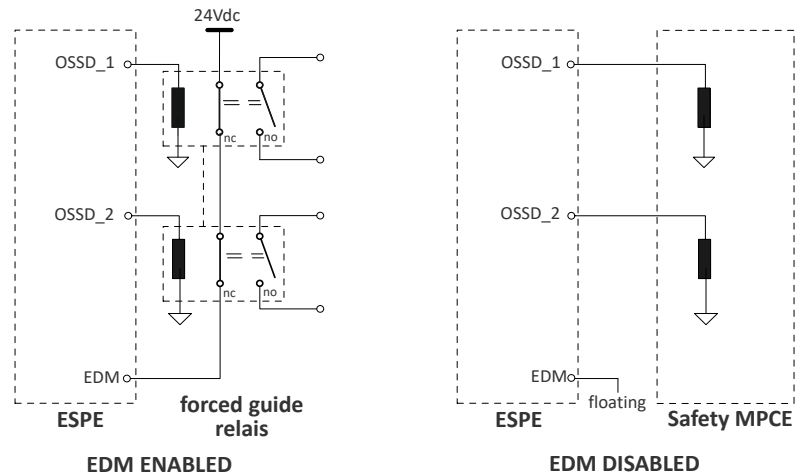


Figure 37: EDM wiring

The function controls the N.C. contact switching according to the changes of the OSSD status.

The timing diagram below explains the relationship between the cause (OSSDs) and the effect (EDM), with the maximum permissible delay.

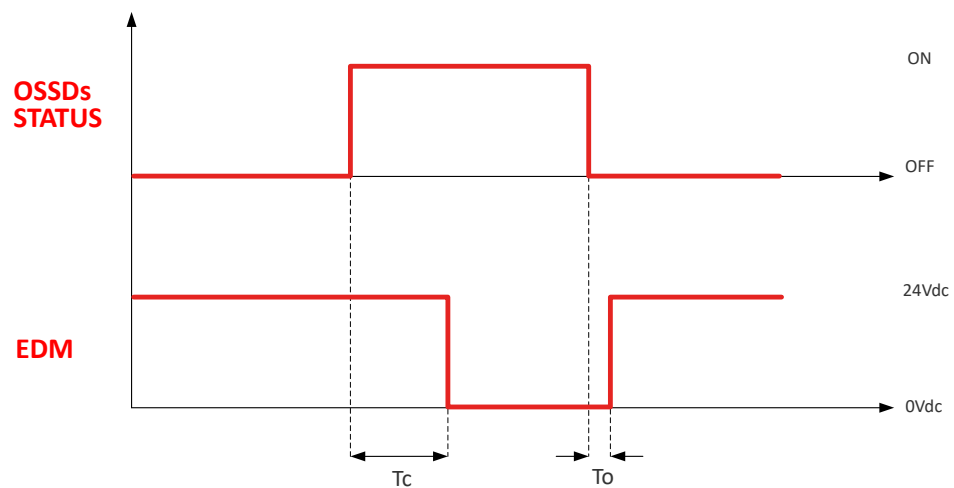


Figure 38: EDM function timing

$T_c \geq 350$ ms (time between OSSD OFF-ON transition and EDM test)

$T_o \geq 100$ ms (time between OSSD ON-OFF transition and EDM test)

(two different times for the mechanical contact driven by a spring)

Configuration

1. In “**Configuration**” tab, check the “**Enable EDM**” box.

Configuration	
SH4-30-300-A-12 (v.1.0.0.0) SSID: 0x	
Restart Automatic	▼
Enable EDM	☒
④ Code Disabled	▼

2. An alert pop-up will be displayed under “**Input Output Manager**” because the wiring must be set.

 Basic Functions	 Advanced Functions	 Topology	 Input Output Manager
--	---	--	---

3. Choose “**Input Output Manager**” and provide the wiring indications for the EDM function (see “Input Output Manager” on page 40).

ANTI-INTERFERENCE CODING (AIC)

Anti-Interference Coding function implemented in SH4 devices allows the user to install two light curtains very close each other without that an interference occurs; this allows the devices to remain in normal operation condition.



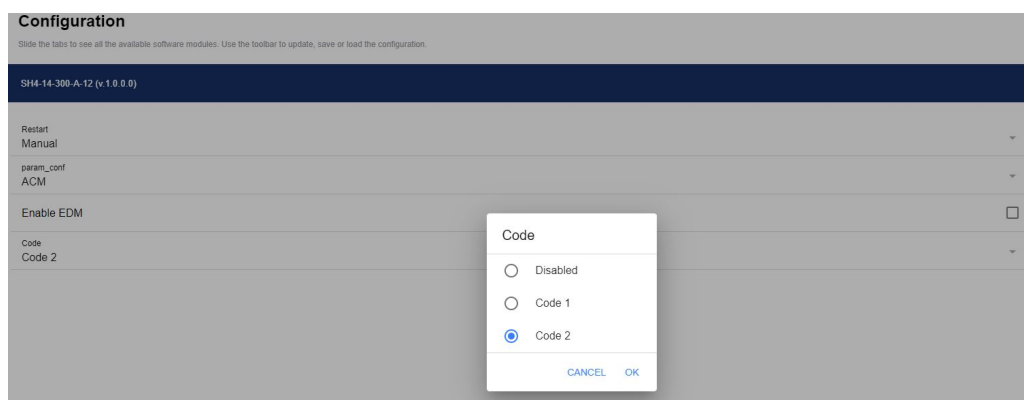
NOTE: For correct light curtain operation both trasmitter and receiver unit must be configured with the same Coding setting.



NOTE: The Anti-Interference Coding (AIC) function is NOT available for SH4-2/3/4-xxxx-x-AP-x-(x) models.

Configuration RX

In “**Configuration**” tab, choose the “**Code**” function by checking the code box desired.



Configuration TX

TX unit will select emission code based on CODE input connection (**pin 4, M12-5 TX connector**) at light curtain startup:

CODE INPUT CONNECTION AT STARTUP	EMISSION CODE
COM	CODE1
0V/FLOAT	NO CODE
24V	CODE 2

TEST

The TEST function can be activated by keeping TEST signal HIGH (pin 2 on TX unit) for at least 0.5 seconds as shown in the following timing diagram.

The TEST disables the emission stage, so the RX side sees interrupted beams (all) and the OSSD goes low within response time. As is shown in the timing diagram below, the OSSDs go OFF (BREAK status) after 0.5 seconds (plus a cycle time) and after the response time of the light curtain.

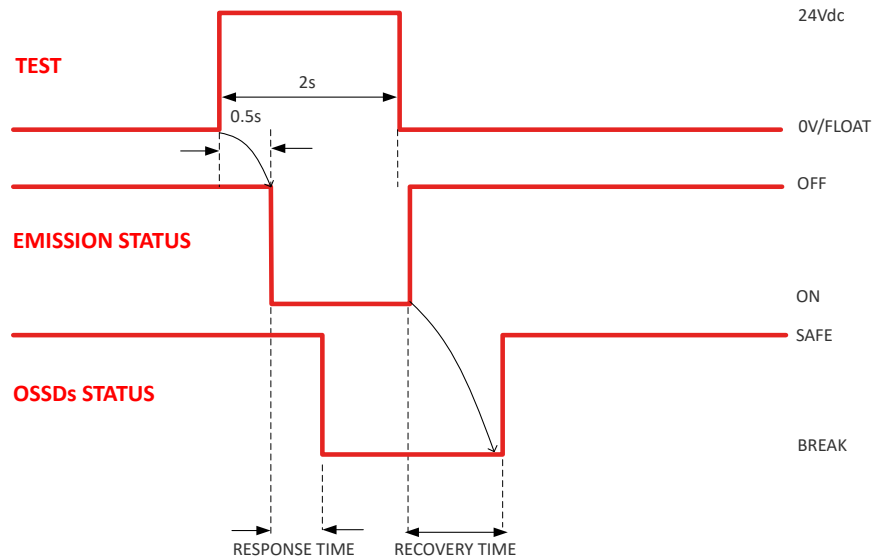


Figure 39: OSSDs timing for test on TX



NOTE: On Body models only, TEST input may be used to set Emission Range. Refer to the next paragraph for more information.



NOTE: Not available on SH4-2/3/4-xxxx-x-AP-x(-x) models.



CAUTION: For SH4-2/3/4-xxxx-x-x(-x) models only. At runtime keep TEST input connected to 24Vdc for more than 2s and less than 5s to change range setting from Long to Short or vice versa. Emission Range setting is kept also after a power cycle. Refer to the next paragraph for more information.

EMISSION RANGE SELECTION (SH4-2/3/4-xxxx-x-x models only)

On Body models only (SH4-2/3/4-xxxx-x-x(-x)), TEST input (Pin 2 on transmitter unit) may be used to set the Emission Range.



NOTA: The Emission Range selection is NOT available for SH4-2/3/4-xxxx-x-AP-x(-x) models.

By default, SHORT Range is selected. To toggle between SHORT and LONG range, following procedure must be followed: at runtime keep pin 2 input connected to 24V for more than 2s and less than 5s to change range setting from Long to Short or viceversa. Emission Range setting is kept also after a power cycle.

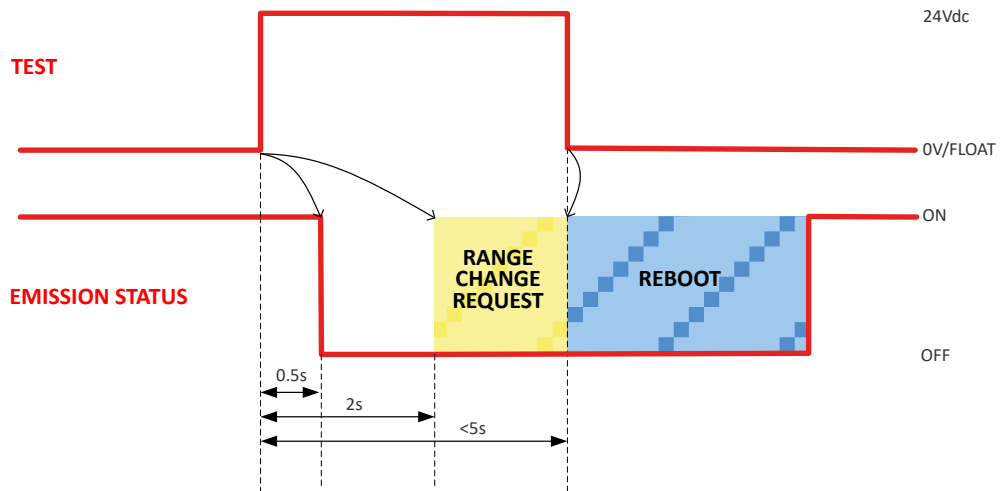


Figure 40: Emission Range Change Request timings

0.5s after rising edge on TEST input emission is disabled, 2s after rising edge on TEST input Range Change Request is activated and both S and L led are lit on user interface.

Range Change Request	
----------------------	--

If a falling edge is detected within 5s from rising edge, trasmitter unit reboots with the new range.

If a falling edge is not detected within 5s from rising edge trasmitter unit locks into Range setting failure Lockout without any change on range setting.



WARNING: When using SH4 Body models with operating distance lower than 5m Short Range must be selected, otherwise safe operation is not guaranteed.



NOTE: Refer to the Technical Data for operating distances of different emission ranges.

MUTING

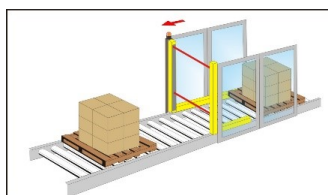
Muting function allows automatic deactivation of the safety function on the whole or part of protected height in order to carry out definite cyclical operations without blocking machine work.

As the pertaining safety requirements demand, ESPE is equipped with up to four muting activation inputs.

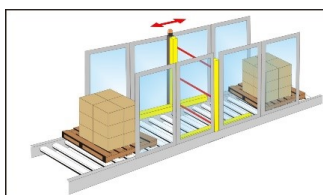
The Muting sensors must be able to recognize the passing material (pallets, vehicles, ...) according to material's length and speed.

In case of different transport speeds in the Muting area, it is necessary to consider their effect on the total Muting duration.

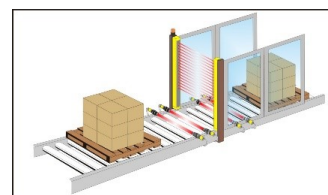
- The Muting function excludes the light curtain during functioning, maintaining active the OSSDs outputs, according to particular operating requirements (see figures below).



L-shaped version with integrated Muting sensors for unidirectional Muting



T-shaped version with integrated Muting sensors for bidirectional Muting



Linear version with external Muting sensors

- On SH4 Advanced up to 4 muting inputs can be configured for the activation of muting function according to the current Standards.
- This function is particularly suitable when an object, but not a person, has to pass through the dangerous area, under certain conditions.
- It is important to remember that the Muting function represents a forced condition of the system and therefore has to be used with the necessary precautions.
- If MUTING activation inputs are activated by Muting sensors or actuators, these should be correctly connected and positioned in order to avoid undesired Muting or potentially dangerous conditions for the operator.
- State of Muting is signaled by an optional external Muting Lamp (connection and integrity check both configurable) and by modules status LEDs on the user interface. When the Muting function is ON the LAMP and the LEDs begin to blink.
- If lamp integrity check is configured and the external lamp is broken and/or not connected, the Muting request causes a SAFE lockout condition and the corresponding failure is signaled.
- If both first and last beams are intercepted by the passing material the light curtain recovery time may be longer.

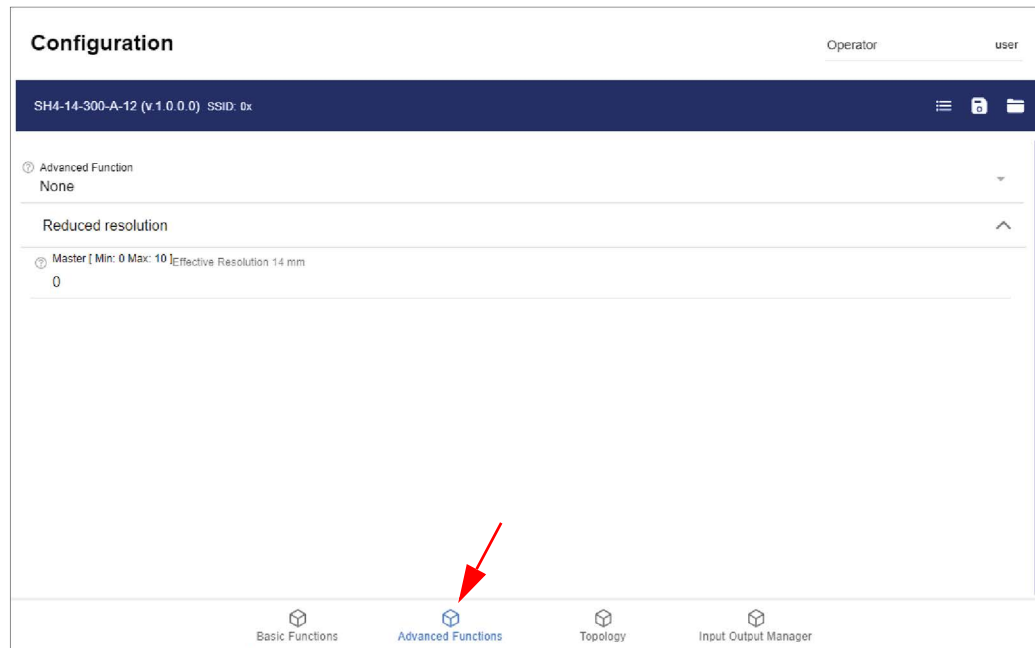


WARNING: Select carefully the configuration, as a wrong configuration can cause the incorrect functioning of the Muting function and a reduction of the safety level.

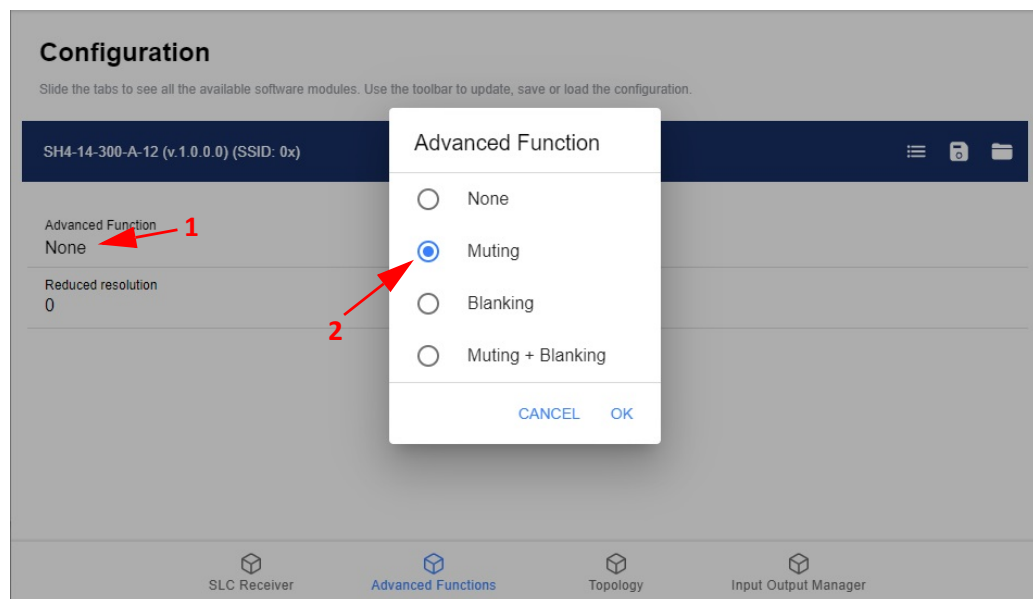
For correct use of Muting, please refer to the relevant reference standards. The Muting sensors must be positioned in such a way that the activation of the Muting function is not possible with the accidental passing of a person. Particular attention must be paid to the use of the one-way L-Muting mode: the external Muting sensors or the SH-L-ARMS Muting arms must be positioned so as to allow only the passage of material coming out of the dangerous area protected by the light curtain.

Configuration:

1. In “Configuration” tab, choose “Advanced Functions”



2. In the “Advanced Functions” window choose “Muting” by clicking on the “Advanced Functions” box.



3. An alert pop-up will be displayed under “Input Output Manager” because the wiring must be set.



4. Choose “Input Output Manager” and provide the wiring indications for the Muting function (see “Input Output Manager” on page 40).

Typical Muting application and safety light curtain connection

The figure below shows a typical Muting application: a protection installed on a conveyor should allow the pack passing-by but not the worker.

The ESPE temporarily suspends its safety function on a correct activation sequence of S1, S2, S3, S4 sensors.

These sensors can be optical, mechanical, proximity sensors etc., **with high output when the object is detected.**

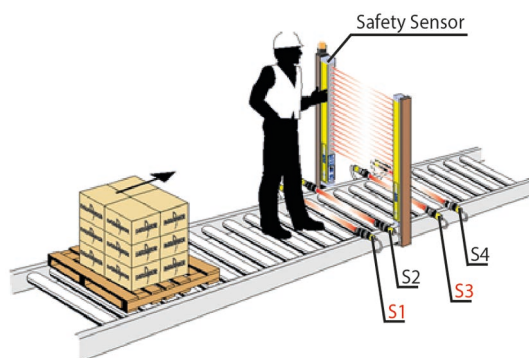


Figure 41: Typical Muting Application

Muting mode selection

The ESPE can be used with both bidirectional (T type, four sensors) and monodirectional (L type, two sensors) Muting.

Bidirectional Muting can be used in those applications in which the packs can move in both directions and mono directional Muting can be used only on those applications in which the packs moves out from the dangerous area.



NOTE: Unintentional activations of muting function are avoided thanks to the correct positioning of muting sensors and proper constraints on signal timings.

The light curtain must be in the ON state to accept the muting request. Then, a muting request is accepted only if signals at MUTING inputs follow the timings shown in next paragraphs depending on selected muting sensor configuration.

Four different muting behavior are possible and 2 or 4 separate signals can be used to trigger muting function.

L muting (2 signals/2 sensors)

As reported in figure below T_{12} activation delay between MUTING1 and MUTING2 must be greater than zero and less than $T_{12}Max$.

T_{12} is measured and then multiplied by a N factor to calculate the muting timer. Muting operations is ceased when $N \times T_{12}$ timer expires, starting from inactivation of the MUTING1 signal. If MUTING2 signal goes inactive before MUTING1, muting is ceased immediately. Muting is optionally ceased also when light curtain is free before the timer expires (Muting stop condition parameter).

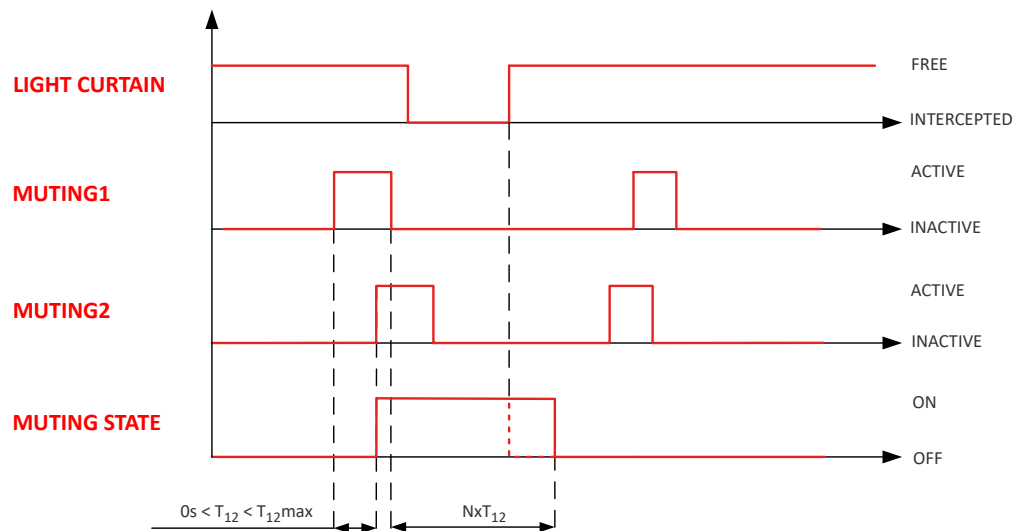


Figure 42: L muting timings

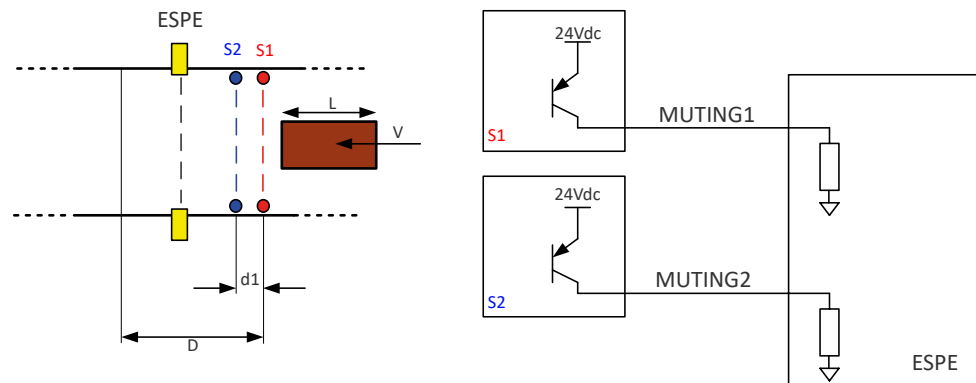


Figure 43: Connection of sensors on MUTING1 and MUTING2 inputs in case of monodirectional (L), two-sensors muting

PARAMETER	DESCRIPTION	VALUE [DEFAULT]
T ₁₂ Min Selection (ms)	Minimum time between muting signals	For T Muting - 4 Signals 4 Sensors Time Monitoring: 0 to 1000 [100] For all the other types of Muting: 50 to 1000 [100] for SH4-14/30-xxxx-x-x 10 to 1000 [100] for SH4-2/3/4-xxxx-x(-AP)-x
T ₁₂ Max Selection (s)	Maximum time between muting signals	1 to 16 [4]
T12 Multiplier (m)	Multiplier for calculation of muting duration	1 to 16 [2]
Timeout (s)	Maximum muting duration	10 - 57600 [10 min]
Infinite Timeout	Unlimited muting duration	yes/no [no]
Muting Deactivation Filter (ms)	Filter on muting signals deactivation	0 to 1000 [0]
Muting Activation Filter (ms)	Filter on muting signals activation	0 to 1000 [0]
Dynamic Muting <i>NOT available for:</i> - SH4-2/3/4-xxxx-x(-AP)-x models - Cascade system	Teach time (ms): time after which muting is partialized to maximum detected material height	500 to 4000 [2000]
	Beam Tolerance: additional intercepted beams allowed over maximum taught height	Beam tolerance: 0 to 6 [0] Only for SH4-14/30-xxxx-x-x models
	Start from top: use if light curtain is installed up-side down	Start from top: yes/no [no]
Muting Stop Condition	Condition for stopping muting function	Timer Only/Timer or Light Curtain Free
Muting Lamp Integrity Check	Checks for presence and integrity of external lamp	yes/no [no]
Override Mode Selection	Level trigger: override signals must remain active for all override sequence	
	Edge trigger: override signals are not required to remain active for all override sequence	
Override Timeout (min)	Maximum override duration	1 to 256 [2]
Override Restart (when the Manual Restart is selected)	Automatic	At the end of the Override the ESPE remains with the outputs high and monitors if any intrusions occur.
	Manual	At the end of the Override, the ESPE goes into Interlock state and waits for a manual restart signal.

T muting (2 signals/4 sensors)

As reported in figure below T_{12} activation delay between MUTING1 and MUTING2 must be greater than zero and less than $T_{12}Max$.



NOTE: Muting operations is ceased as soon as the signal on MUTING1 or MUTING2 goes inactive. An optional additional muting time T_{delay} may be set.

For T_{12} both a minimum and a maximum value may be configured.

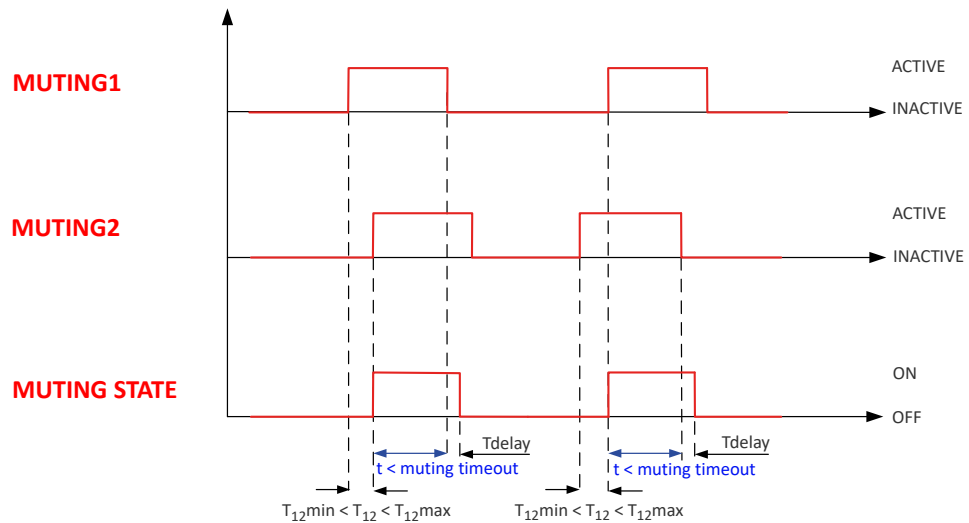


Figure 44: T muting timings

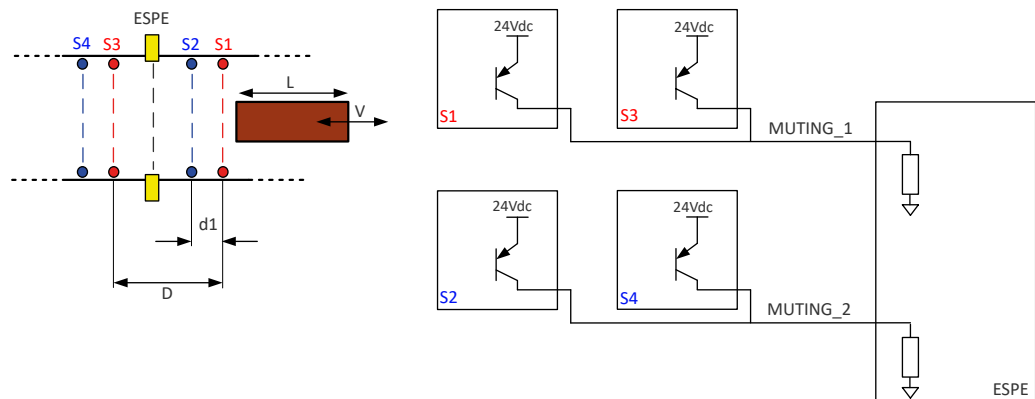


Figure 45: Connection of sensors on MUTING1 and MUTING2 inputs in case of bidirectional (T), four-sensors muting

PARAMETER	DESCRIPTION	VALUE [DEFAULT]
T ₁₂ Min Selection (ms)	Minimum time between muting signals	For T Muting - 4 Signals 4 Sensors Time Monitoring: 0 to 1000 [100] For all the other types of Muting: 50 to 1000 [100] for SH4-14/30-xxxx-x-x 10 to 1000 [100] for SH4-2/3/4-xxxx-x(-AP)-x
T ₁₂ Max Selection (s)	Maximum time between muting signals	1 to 16 [4]
T Delay (ms)	Additional muting time at the end of muting sequence	0 to 1000 [0]
Timeout (s)	Maximum muting duration	10 - 57600 [10 min]
Infinite Timeout	Unlimited muting duration	yes/no [no]
Muting Deactivation Filter (ms)	Filter on muting signals deactivation	0 to 1000 [0]
Muting Activation Filter (ms)	Filter on muting signals activation	0 to 1000 [0]
Dynamic Muting <i>NOT available for:</i> - SH4-2/3/4-xxxx-x(-AP)-x models - Cascade system	Teach time (ms): time after which muting is partialized to maximum detected material height	500 to 4000 [2000]
	Beam Tolerance: additional intercepted beams allowed over maximum taught height	Beam tolerance: 0 to 6 [0] Only for SH4-14/30-xxxx-x-x models
	Start from top: use if light curtain is installed up-side down	Start from top: yes/no [no]
Muting Lamp Integrity Check	Checks for presence and integrity of external lamp	yes/no [no]
Override Mode Selection	Level trigger: override signals must remain active for all override sequence	
	Edge trigger: override signals are not required to remain active for all override sequence	
Override Timeout (min)	Maximum override duration	1 to 256 [2]
Override Restart (when the Manual Restart is selected)	Automatic	At the end of the Override the ESPE remains with the outputs high and monitors if any intrusions occur.
	Manual	At the end of the Override, the ESPE goes into Interlock state and waits for a manual restart signal.

T muting (4 signals/4 sensors; time or sequence monitoring)

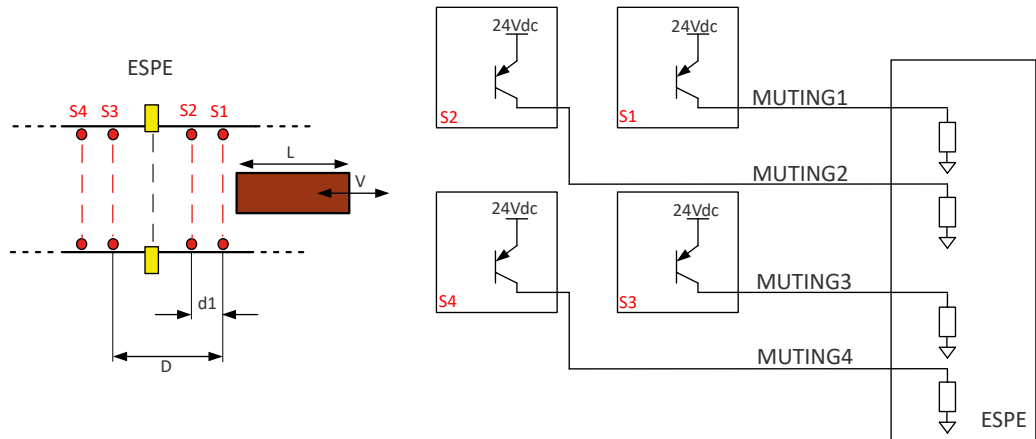


Figure 46: Connection of 4 sensors on MUTING1-4 inputs in case of 4 signal/4 sensors muting

T (bidirectional) muting timings with time monitoring

The activation of the Muting function occurs as a result of the interruption of the sensors S1 and S2 (the order is not relevant) within a time of T_{12max} or S4 and S3 with material moving in the opposite direction. When the delay time of T_{12max} is exceeded muting function immediately stops.



NOTE: Muting operations is ceased as soon as the signal from S3 (S2 in the opposite direction) goes inactive. An optional additional muting time T_{delay} may be set.



WARNING: If $T_{12 Min}$ is set to 0 the light curtain cannot detect a short circuit between MUTING1 and MUTING2 input. USE ONLY if risk assessment allows or if additional diagnostic measure are implemented (eg. Mute Enable signal configured).

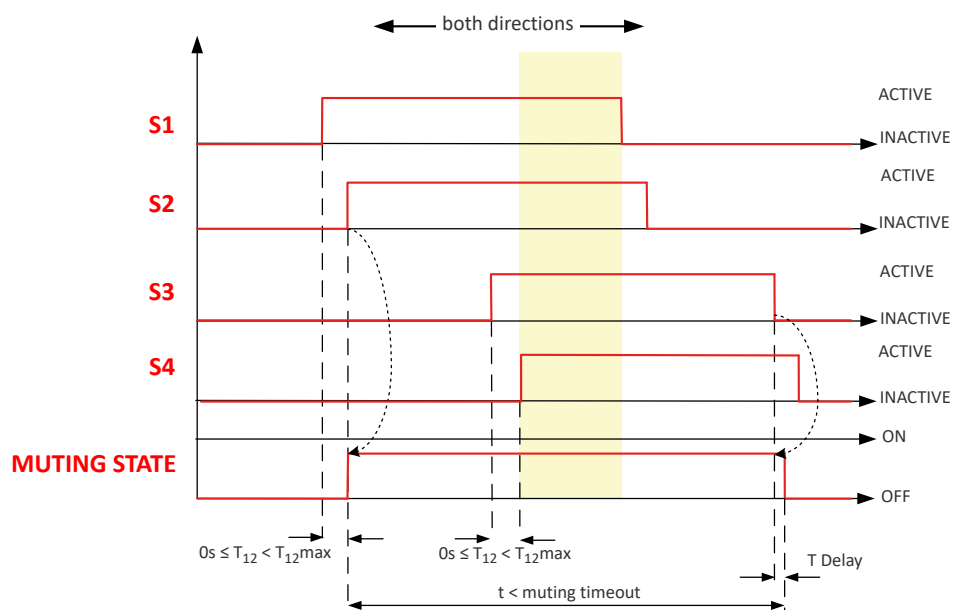


Figure 47: 4 signals T Muting Timings (time monitoring)

PARAMETER	DESCRIPTION	VALUE [DEFAULT]
T ₁₂ Min Selection (ms)	Minimum time between muting signals	For T Muting - 4 Signals 4 Sensors Time Monitoring: 0 to 1000 [100] For all the other types of Muting: 50 to 1000 [100] for SH4-14/30-xxxx-x-x 10 to 1000 [100] for SH4-2/3/4-xxxx-x(-AP)-x
T ₁₂ Max Selection (s)	Maximum time between muting signals	1 to 16 [4]
T Delay (ms)	Additional muting time at the end of muting sequence	0 to 1000 [0]
Timeout (s)	Maximum muting duration	10 - 57600 [10 min]
Infinite Timeout	Unlimited muting duration	yes/no [no]
Muting Deactivation Filter (ms)	Filter on muting signals deactivation	0 to 1000 [0]
Muting Activation Filter (ms)	Filter on muting signals activation	0 to 1000 [0]
Dynamic Muting <i>NOT available for:</i> - SH4-2/3/4-xxxx-x(-AP)-x models - Cascade system	Teach time (ms): time after which muting is partialized to maximum detected material height	500 to 4000 [2000]
	Beam Tolerance: additional intercepted beams allowed over maximum taught height	Beam tolerance: 0 to 6 [0] Only for SH4-14/30-xxxx-x-x models
	Start form top: use if light curtain is installed up-side down	Start from top: yes/no [no]
Muting Lamp Integrity Check	Checks for presence and integrity of external lamp	yes/no [no]
Override Mode Selection	Level trigger: override signals must remain active for all override sequence	
	Edge trigger: override signals are not required to remain active for all override sequence	
Override Timeout (min)	Maximum override duration	1 to 256 [2]
Override Restart (when the Manual Restart is selected)	Automatic	At the end of the Override the ESPE remains with the outputs high and monitors if any intrusions occur.
	Manual	At the end of the Override, the ESPE goes into Interlock state and waits for a manual restart signal.

T (bidirectional) muting timings with sequence monitoring

The activation of the Muting function occurs following the sequential interruption of the sensors S1 and S2, and the sensors S3 and S4. If the pallet proceeds in an opposite direction the correct sequence is: S4, S3, S2, S1. Thus contemporary activation of S1-S2 is not allowed, neither any sequence other than S1, S2, S3, S4 or S4, S3, S2, S1. Whenever a wrong sequence is detected Muting function immediately stops.



NOTE: Muting operations is ceased as soon as the signal from S3 (S2 in the opposite direction) goes inactive. An optional additional muting time Tdelay may be set.

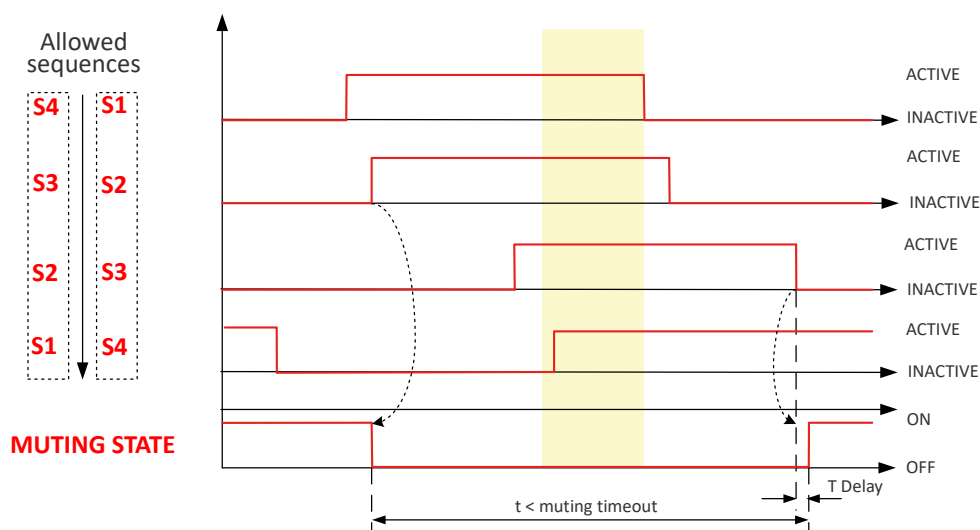


Figure 48: 4 signals T Muting Timings (sequence monitoring)

PARAMETER	DESCRIPTION	VALUE [DEFAULT]
T Delay (ms)	Additional muting time at the end of muting sequence	0 to 1000 [0]
Timeout (s)	Maximum muting duration	10 - 57600 [10 min]
Infinite Timeout	Unlimited muting duration	yes/no [no]
Muting Deactivation Filter (ms)	Filter on muting signals deactivation	0 to 1000 [0]
Muting Activation Filter (ms)	Filter on muting signals activation	0 to 1000 [0]
Dynamic Muting <i>NOT available for:</i> - SH4-2/3/4-xxxx-x(-AP)-x models - Cascade system	Teach time (ms): time after which muting is partialized to maximum detected material height	500 to 4000 [2000]
	Beam Tolerance: additional intercepted beams allowed over maximum taught height	Beam tolerance: 0 to 6 [0] Only for SH4-14/30-xxxx-x models
	Start form top: use if light curtain is installed up-side down	Start from top: yes/no [no]
	Muting Lamp Integrity Check	Checks for presence and integrity of external lamp yes/no [no]
Override Mode Selection	Level trigger: override signals must remain active for all override sequence	
	Edge trigger: override signals are not required to remain active for all override sequence	
Override Timeout (min)	Maximum override duration	1 to 256 [2]
Override Restart (when the Manual Restart is selected)	Automatic	At the end of the Override the ESPE remains with the outputs high and monitors if any intrusions occur.
	Manual	At the end of the Override, the ESPE goes into Interlock state and waits for a manual restart signal.

Partial Muting

User can chose to limit muting function effect to selected beam zones. Partial Muting can be useful in those applications in which the user wants to limit the Muting function effect to selected zones only.

For each beam it's possible to freely choose whether to exclude from muting or not (Muting Zone). By default, all beams are affected by muting function (total muting).



NOTE: Partial Muting may even be set together with Blanking but with some restrictions.



NOTE: Partial Muting cannot be configured including both the synchronism beams.

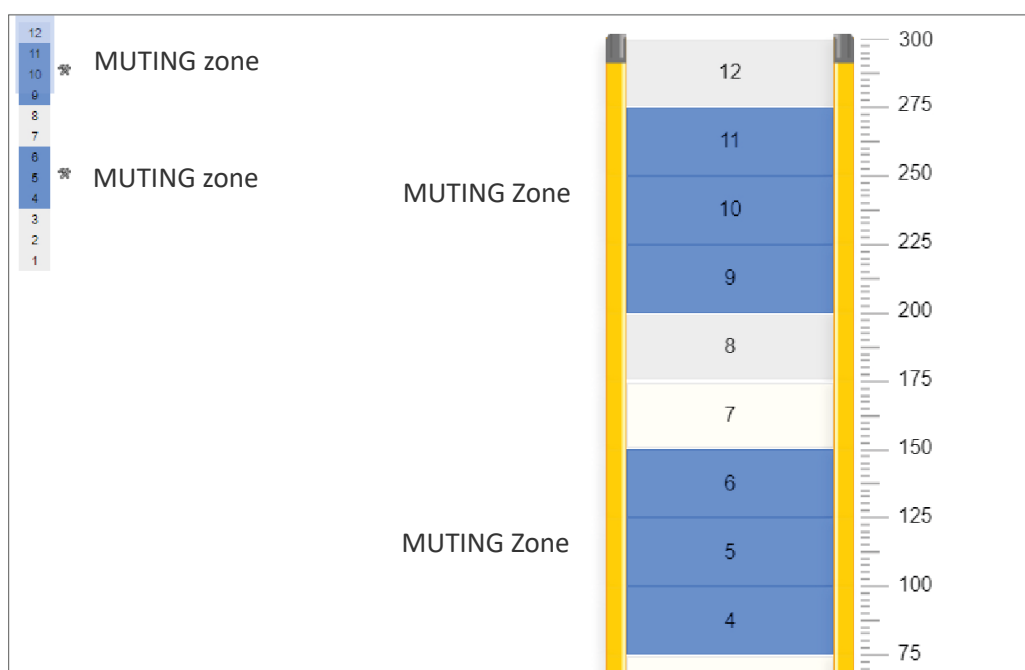


Figure 49: Partial muting

Auto-Dynamic Partial Muting

Auto-Dynamic Partial Muting automatically configures a muting zone when muting is active and after moving goods has intercepted the light curtain for 2 seconds (configurable).

Muting starts with full detection zone muted, then is restricted to the maximum number of beams intercepted during the first 2 seconds of goods blocking the light curtain.

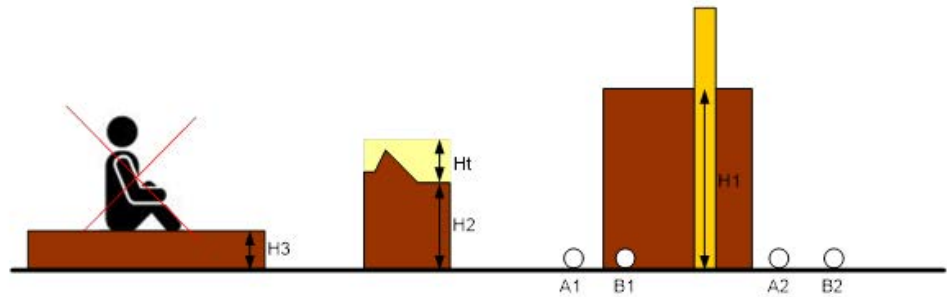


Figure 50: Auto Dynamic Partial Muting

A tolerance H_t may be set to allow irregular shaped goods.

Partial Muting Zone can be set to start from top beam if light curtain is upside-down mounted.

Auto-Dynamic Partial Muting is independent from sensors configuration so it can be activated with all muting types.

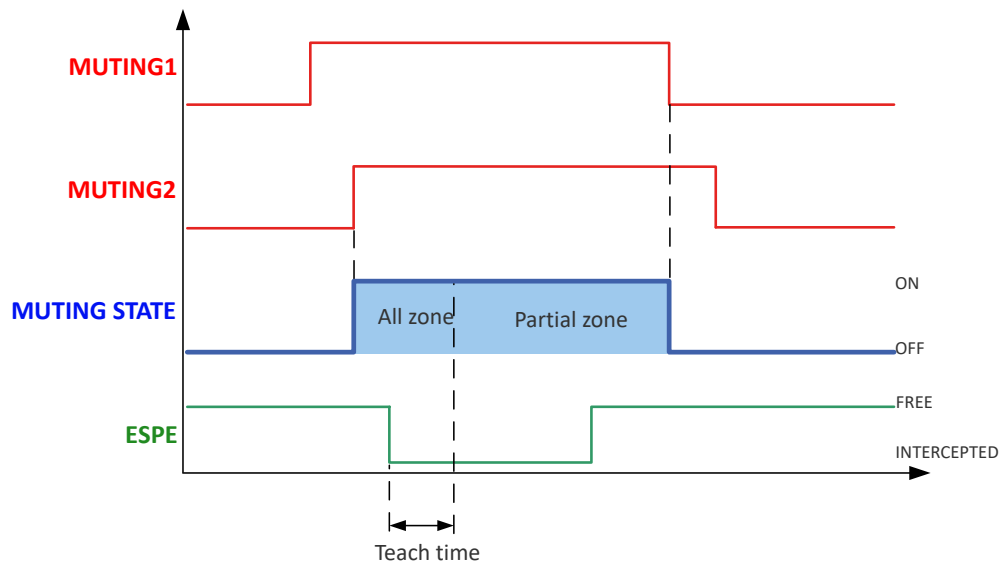


Figure 51: Auto Dynamic Partial Muting Timings

PARAMETER	DESCRIPTION	VALUE [DEFAULT]
Dynamic Muting	Teach time (ms): time after which muting is partialized to maximum detected material height	500 to 4000 [2000]
	Beam Tolerance: additional intercepted beams allowed over maximum taught height	Beam tolerance: 0 to 6 [0] Only for SH4-14/30-xxxx-x-x models.
	Start form top: use if light curtain is installed up-side down	Start from top: yes/no [no]

Muting enabling

An optional muting enable signal can be associated to a light curtain input via SH4 Designer. Then only when muting enable signal is active Muting requests will be accepted at the MUTING inputs.

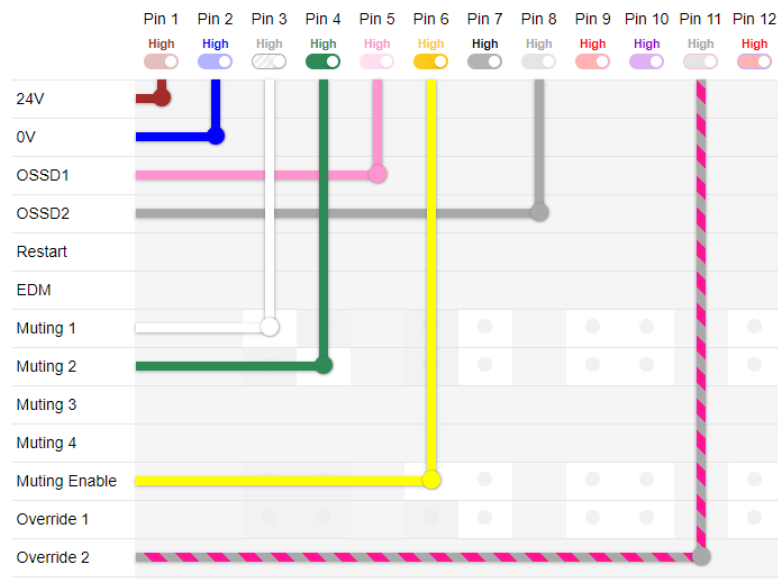


Figure 52: Example of pin configuration

Muting inputs filter

When signals at MUTING inputs are not stable (eg. irregular material shape or reflective wrappings that may fool photoelectric sensors) muting filters may be optionally configured on SH4 Designer.

Two separate filters for signals activation and deactivation can be set from 0 (no filter) up to 1000 ms.

Muting Deactivation Filter (ms)
100
Muting Activation Filter (ms)
100

Figure 53: SH4 Designer Muting inputs filter settings

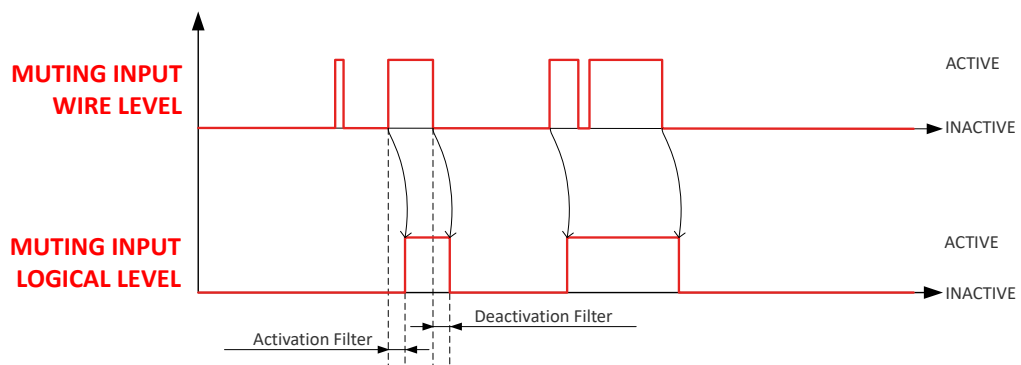


Figure 54: Muting inputs filter timings

Muting signaling devices

In some application a mute indication shall be provided. When the light curtain receiver unit is visible from the dangerous access point, light curtain user interface can be used as signaling device, otherwise an external lamp must be connected to an auxiliary output (pin GP_IO1 or GP_IO2).



NOTE: Both incandescent and LED lamps are allowed. Proper polarity must be respected for the latter.



NOTE: Use the app SH4 Designer in order to configure the LAMP output signal (pin GP_IO1 or GP_IO2) and activate the Lamp Integrity check.



Figure 55: Lamp integrity check activation via SH4 Designer

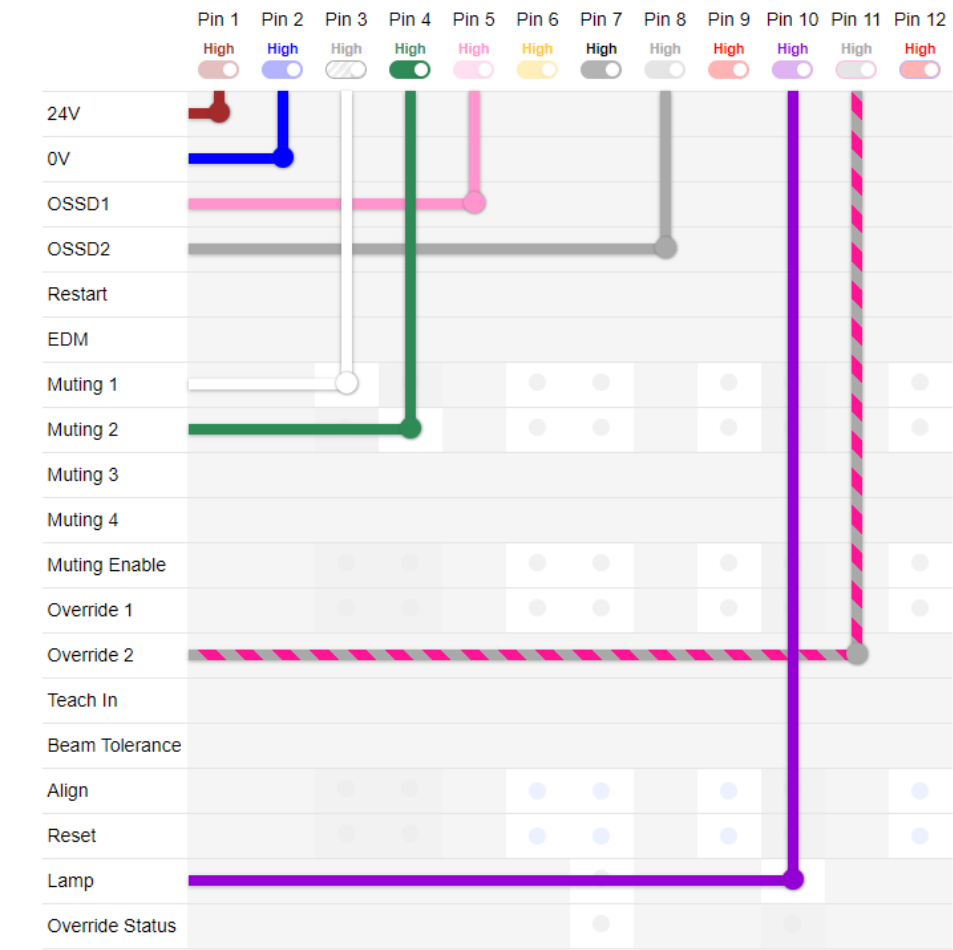


Figure 56: LAMP output signal configuration

With Lamp Integrity check is active, if a lamp break is detected, ESPE goes in Lamp Failure Lock-Out state and shows the related message on the display (refer to Appendix A for information about the auxiliary output).

Electrical Connection

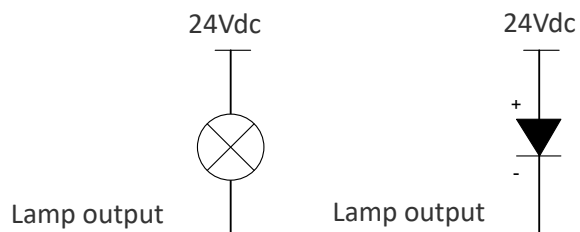


Figure 57: Muting Signaling Device connection

OVERRIDE

Override functions allows to force safety function deactivation whenever it's necessary to restart the machine despite one or more ESPE beams being intercepted. The aim is clearing protected area of any working materials blocked ahead of ESPE because of (i.e.) a cycle anomaly.

Supposing that a pallet is intercepting one or more beams, the conveyor belt can't be restarted because of ESPE detecting intercepted beams. With Override activation normal operation is restored.



NOTE: Two separate redundant inputs (OVR1 and OVR2) have to be connected through one normally open contact to 24Vdc and one normally open contact to 0V thus to provide complementary inputs.

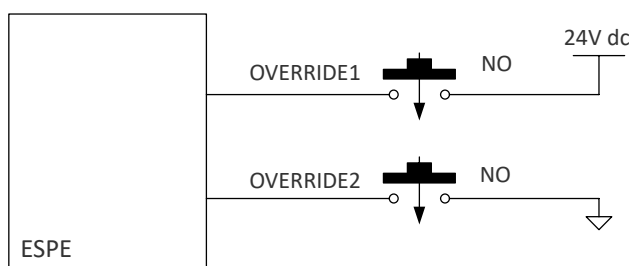
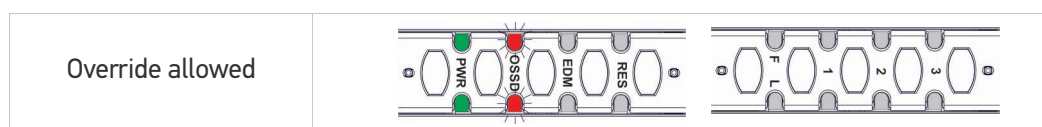


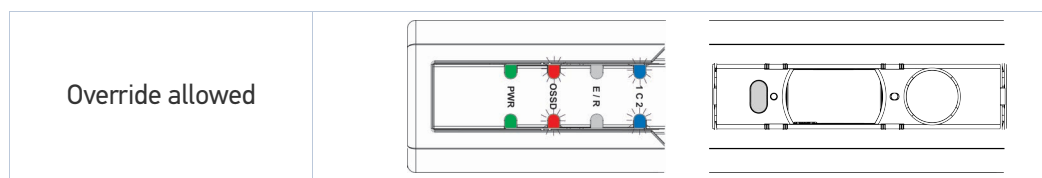
Figure 58: Override connection

Necessary condition for override request to be accepted is: ESPE is in OFF state and at least one muting sensor is intercepted.

When such condition is verified user interface visualizes “Override allowed” with both red OSSD LEDs for the SH4-14/30-xxxx-x-x models:



or with both red OSSD and blue 1C2 LEDs for the SH4-2/3/4-xxxx-x-x models:



Then, an override request is accepted only if signals at OVERRIDE inputs follow the timings shown below.

Two types of override trigger sequence are accepted on external inputs:

- Level Trigger: override engaged until both contacts are closed and at least one muting sensor is intercepted (high input).

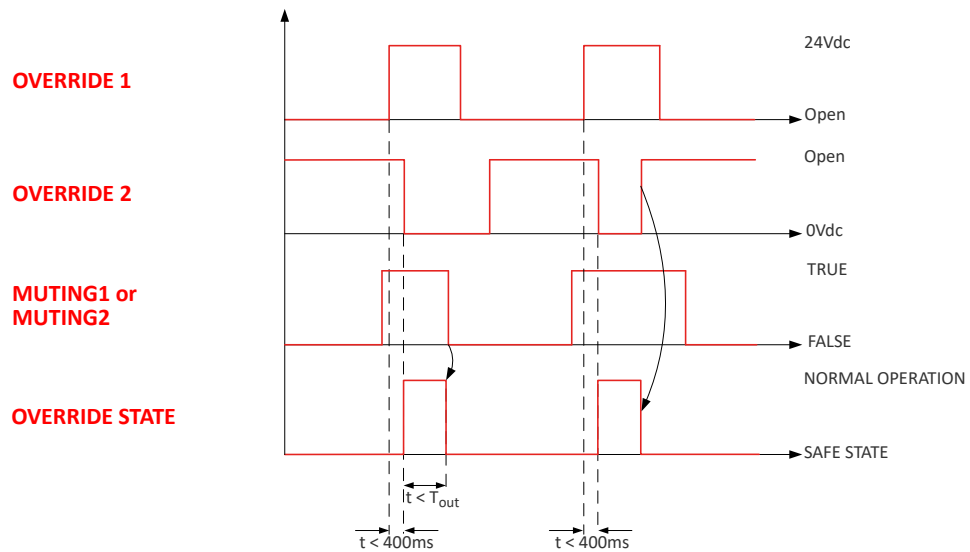


Figure 59: Level Triggered Override Timings

- Edge Trigger: override engaged on contacts closing until at least one muting sensor is intercepted.

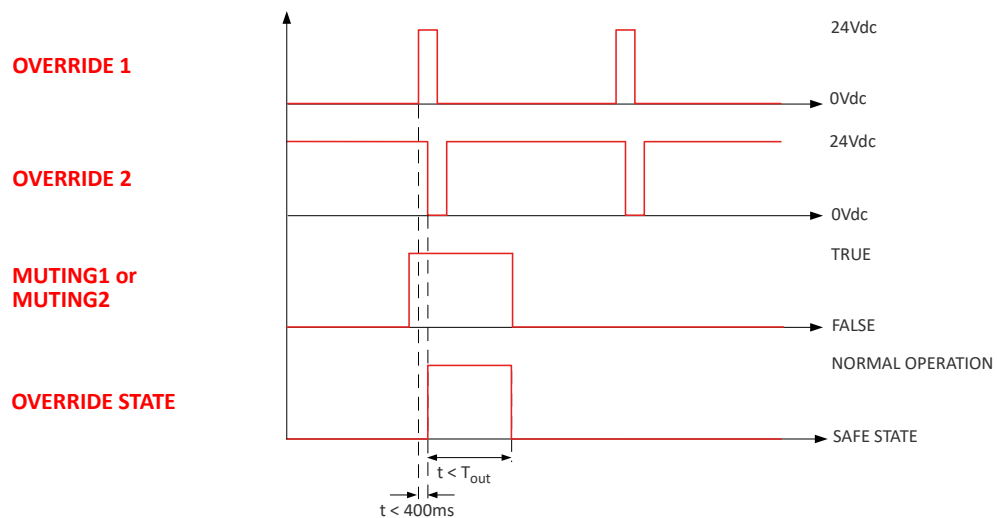


Figure 60: Edge Triggered Override Timings

BLANKING (SH4-14/30-xxxx-x-x models only)

Blanking is an auxiliary function of safety light curtains for which the introduction of an opaque object inside part of the light curtain's protection field is allowed without going in OFF status. Blanking is only possible in the presence of determined safety conditions and in accordance with a configurable operating logic.

The blanking function is therefore particularly useful when the light curtain's protection field must be inevitably intercepted by the material being worked or by a fixed or mobile part of the machine. In practice, it is possible to keep the light curtain's safety outputs in ON status, even if a pre-determined number of beams within the protection fields is being intercepted.



NOTE: A maximum of 5 blanking zones may be defined on light curtain.

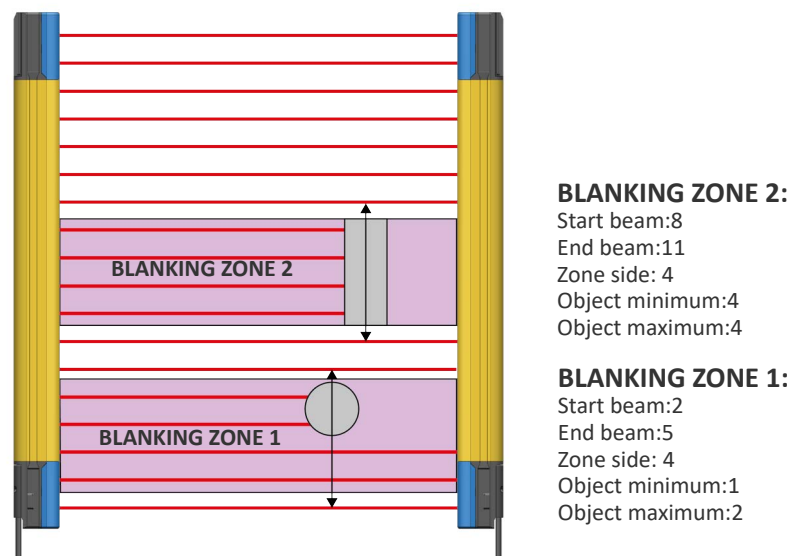


Figure 61: Blanking Zones



NOTE: Each blanking zone is defined by a starting beam and a Zone size.



NOTE: The first or the last beam of the light curtain must be excluded from the blanking zones.

Inside each blanking zone only one object intercepting adjacent beams can be present without triggering the safety function.

For each blanking zone two parameters (minimum size and maximum size) characterize the object that can be inserted in the zone without triggering the safety function. If the object is smaller or larger than these two parameters, it will trigger the safety function.

When maximum and minimum size are equal (thus, there is no tolerance on the size of the object) light curtain effective resolution remains the same as the optical resolution.



NOTE: Effective resolution can be calculated as:

For 14 mm = 14 + (max size - min size)*10

For 30 mm = 30 + (max size - min size)*25

When object size is less than zone size it can move freely inside the blanking zone.

When minimum size is 0 it means that the object size is less than the optical resolution or the object can be removed from the blanking zone.

In figure below three examples are provided with different blanking zone parameters. Where blanking zone is represented in red color, OSSDs are LOW because of objects not matching blanking settings.

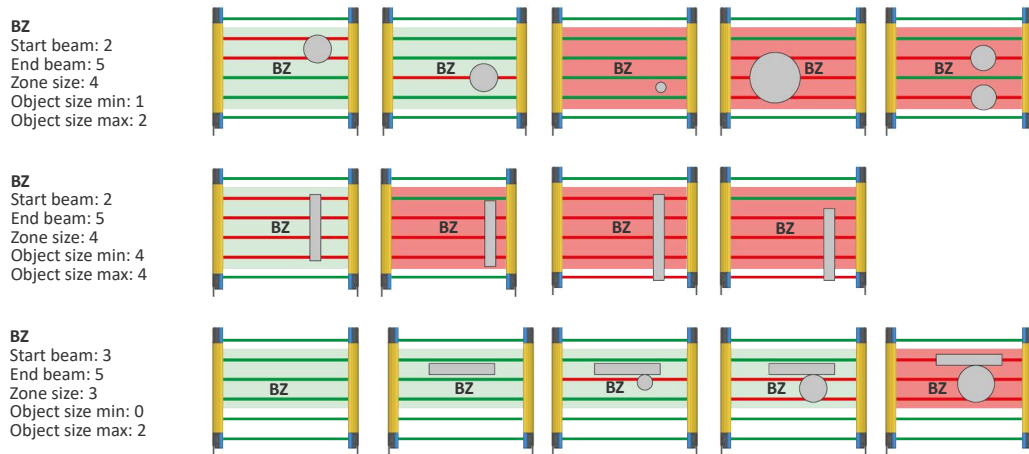
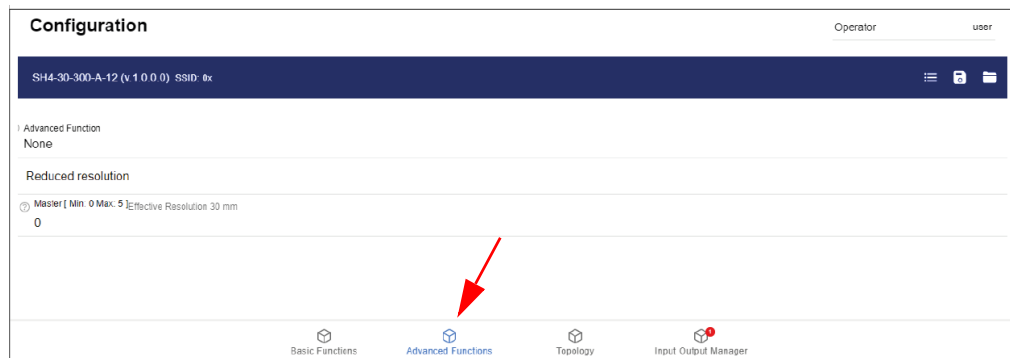


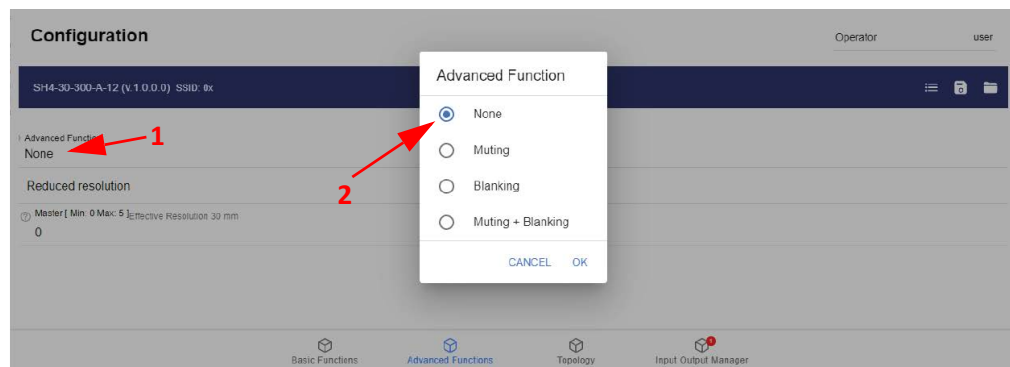
Figure 62: Blanking zones examples

Configuration:

1. In “Configuration” tab, choose “Advanced Functions”



2. In the “Advanced Functions” window choose “Blanking” by clicking on the “Advanced Functions” box.



External Teach-In Blanking (SH4-14/30-xxxx-x-x models only)

Blanking zones configured with SH4 Designer requires a re-parametrization from the software itself to change blanking zones.

With External Teach-In Blanking it's possible to configure blanking zones from an external input at run-time.



NOTE: External Teach-in Blanking is only possible when Blanking Zones are not configured via SH4 Designer.

The Teach-in can be activated at keeping the Teach-in pin configured active for at least 3 seconds while one or more objects intercepts the area to be blanked (see See “Input Output Manager” on page 40. to configure the pin). The blanking zones become active after the Teach-in contact has been released. A maximum of 5 objects can be taught.

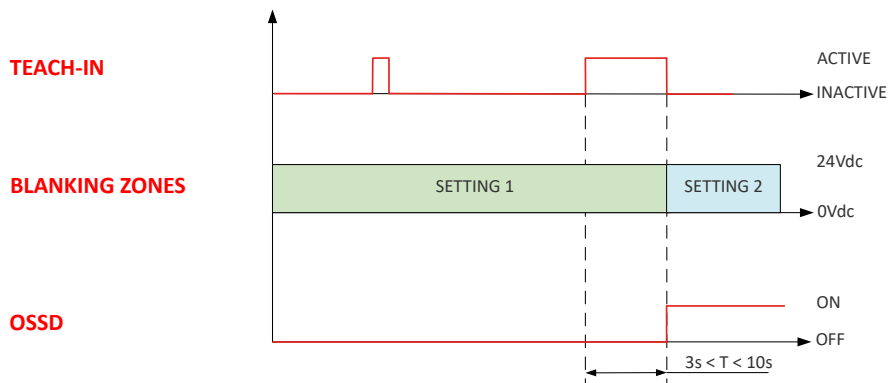


Figure 63: External teach-In blanking

If Teach-in input is kept active for a time greater than 10s the light curtain goes in a lock-out failure.

For teach zones a position and dimension tolerance are set based on Beam Tolerance pin connection detected at the moment of teach-in request as follow:

Beam Tolerance floating	Zone position = taught object start beam
	Zone size = taught object size
	Minimum Object = taught object size
	Maximum Object = taught object size
Beam Tolerance connected to OSSD1	Zone position = taught object start beam -1
	Zone size = taught object size +2
	Minimum Object = taught object size -1
	Maximum Object = taught object size +1

For Teach-in with Beam Tolerance a minimum of two free beams must be present between objects.

When Teach-in conditions are not respected (more than 5 objects or non-sufficient separation beams) light curtain will signal a Teach-in failure (no lockout), old teach settings will still be active, a new teach procedure will be possible.



NOTE: Effective resolution with tolerance active:
For 14 mm = 34
For 30 mm = 80

Blanking Signaling

The blanking signaling will switch on if blanking is violated when detected object size < Minimum Object configured.

The User Interface Dialogue will signal any potential risks from blanking (see “Invalid Blanking/ Partial Muting” on page 94). An external lamp can be added as a signaling device (LAMP output, “see “Electrical Connection” on page 82).

In addition, the light curtain UI will signal (see “Blanking Active” on page 94) if the blanking function is active and the OSSDs are ON.

REDUCED RESOLUTION (SH4-14/30-xxxx-x-x models only)

Reduced resolution can be used if Blanking is not configured. A reduced resolution can be set to allow objects smaller than a certain size to interrupt the light curtain without triggering safety function.

REDUCED RESOLUTION SETTING	MINIMUM CONTIGUOUS BEAMS THAT WILL TRIGGER SAFETY FUNCTION	DETECTION CAPABILITY (FOR SH4-14-*) IN mm	DETECTION CAPABILITY (FOR SH4-30-*) IN mm
0	1	14	30
1	2	24	55
2	3	34	80
3	4	44	105
4	5	54	130
5	6	64	155
6	7	74	n/a
7	8	84	n/a
8	9	94	n/a
9	10	104	n/a
10	11	114	n/a



NOTE: Effective resolution can be calculated as:

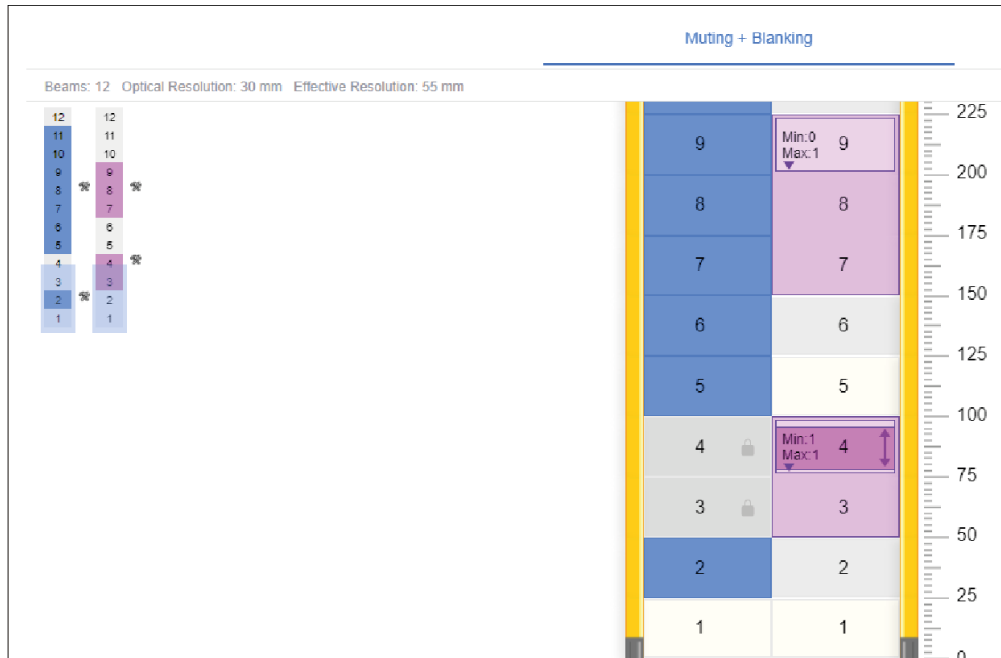
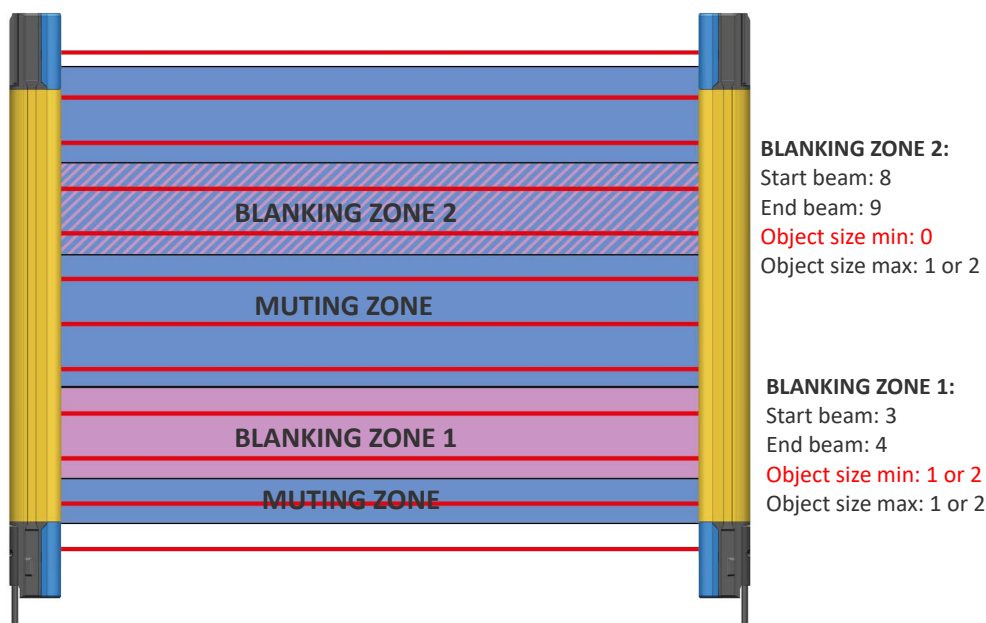
For 14 mm = 14 + Reduced Resolution*10

For 30 mm = 30 + Reduced Resolution*25

MUTING+BLANKING (SH4-14/30-xxxx-x-x models only)

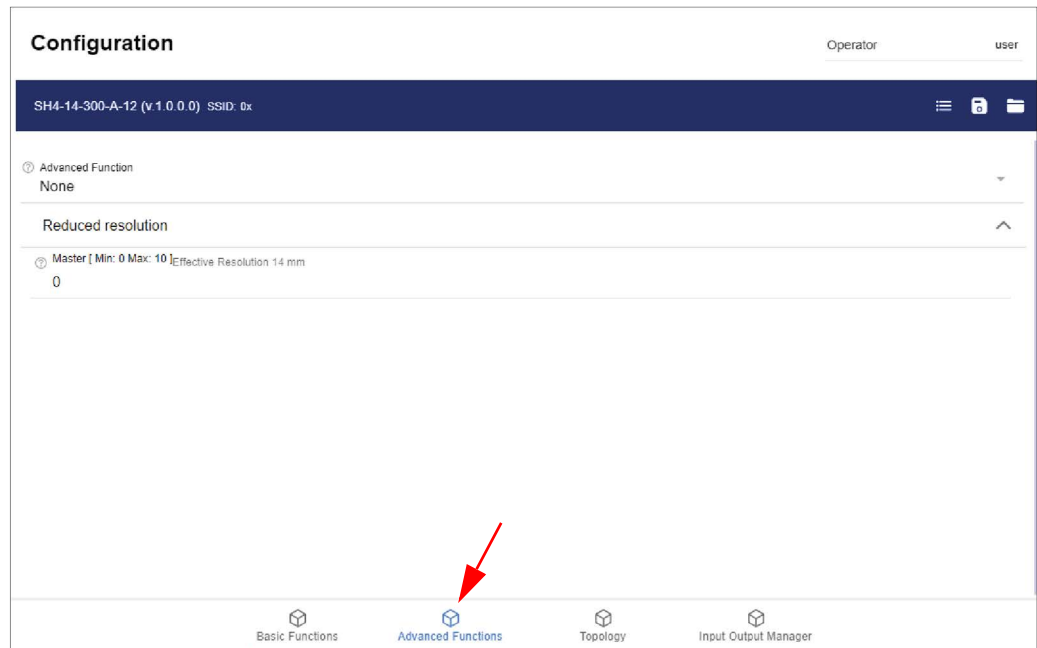
It is possible to configure muting and blanking together with the following limitation: if a Blanking Zone is configured for an object always present (Minimum Object > 0) all its beams are excluded from muting. SH4 Designer does not allow to include those beams inside Muting Zone.

If instead a Blanking Zone is configured for an object that can also be absent (Minimum Object = 0) then its beams can be also muted.

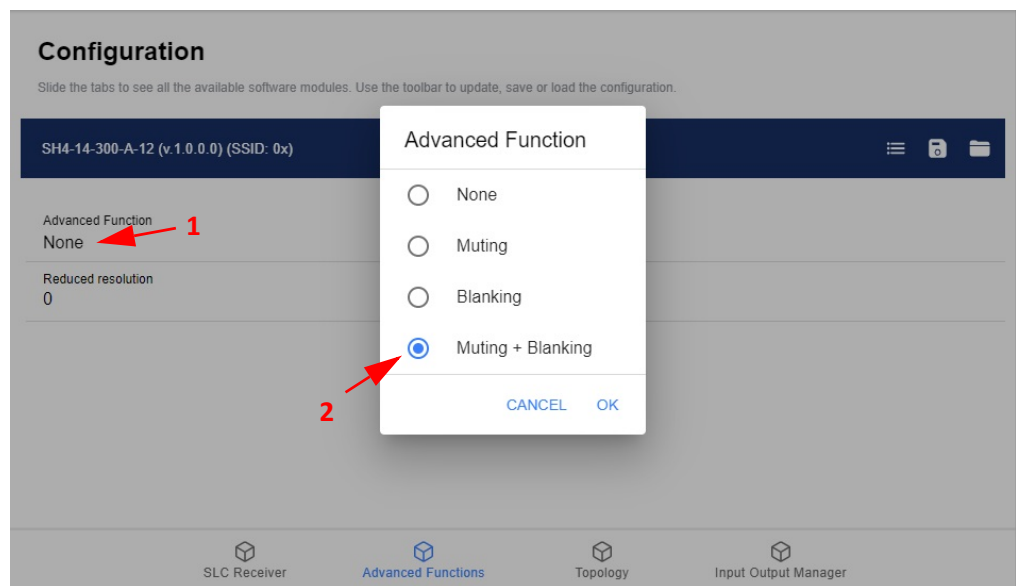


Configuration:

1. In “Configuration” tab, choose “Advanced Functions”



2. In the “Advanced Functions” window choose “Muting+Blanking” by clicking on the “Advanced Functions” box.



3. An alert pop-up will be displayed under “Input Output Manager” because it is necessary to report the wirings.



4. Choose “Input Output Manager” and provide the wiring indications for the Muting function (see “Input Output Manager” on page 40).

CHAPTER 8

USER INTERFACE DIALOGUE

SH4-14/30-xxxx-A-12-(5) MODELS

A user interface of 16 on Receiver (RX) or 8 on Transmitter (TX) LEDs helps customer to control and check the state of the light curtain, for alignment mode, normal operation and for troubleshooting activity.

For each optical module on both RX and TX unit an RGB led will inform about single module status and light curtain operation.

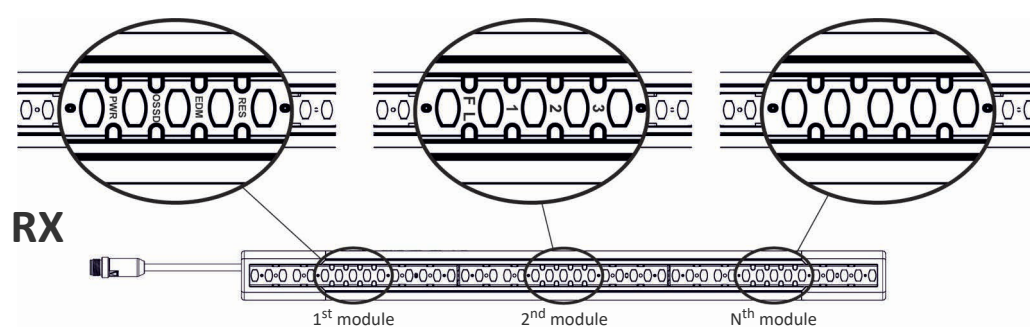


Figure 64: Receiver LED interface

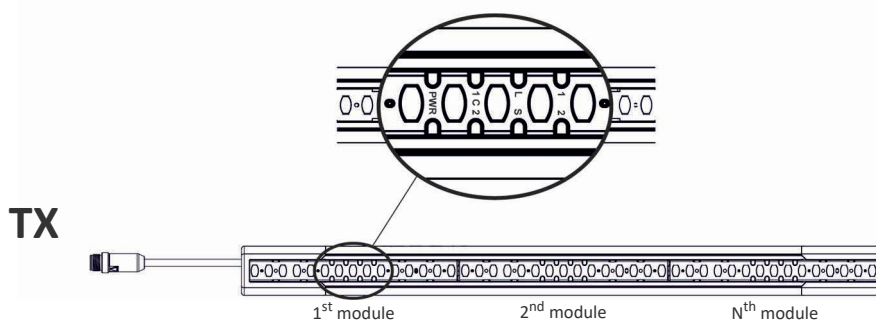


Figure 65: Transmitter LED interface

LED meanings

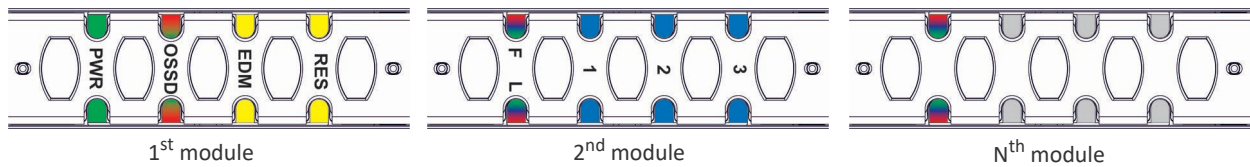
■ = ON

■ = OFF

■ = INDIFFERENT

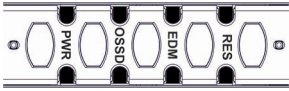
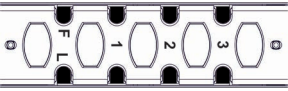
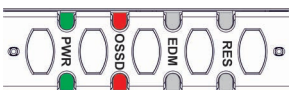
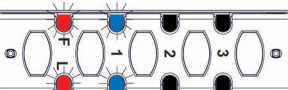
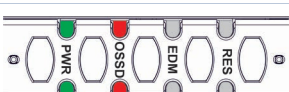
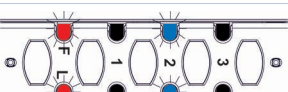
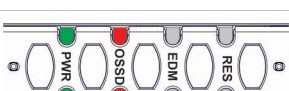
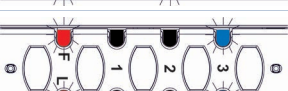
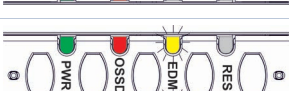
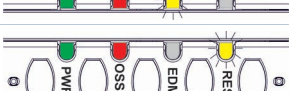
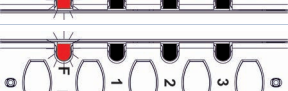
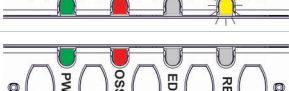
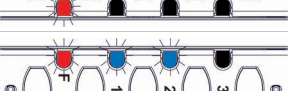
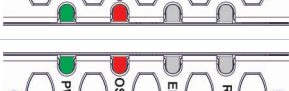
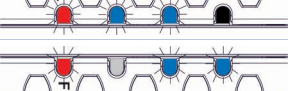
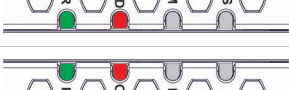
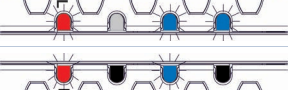
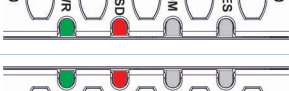
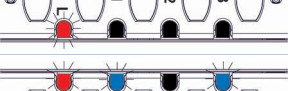
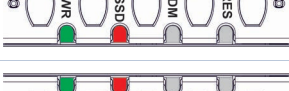
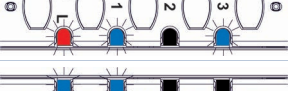
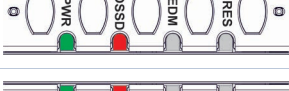
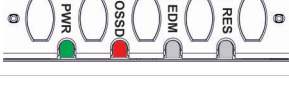
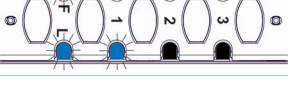
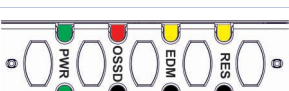
■ = BLINK

RX Side dialogue

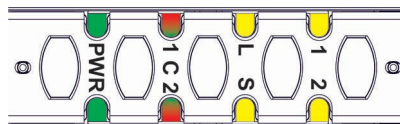


ESPE WORKING MODE	INDICATION	LED CONFIGURATION
Alignment NOTE: the LEDs F and L change color according to the anti-interference code set: BLUE: NO CODE RED: CODE1 GREEN: CODE 2	Not aligned	
	Not aligned Only first sync aligned	
	Not aligned Only last sync aligned	
	Aligned Minimum Signal Level	
	Aligned Medium Signal Level	
	Aligned Maximum Signal Level	
Module signal status (from 2 nd module)	Good Signal on modules, no optics intercepted	
	Low Signal on modules, no optics intercepted	
	At least one optic intercepted on modules with blinking red light	
	(eg.) Modules with different signal levels	
Normal Operation Manual Restart Only	Manual Restart configured	
	Interlock, free beams, restart required	
Normal Operation	EDM Active	

Normal Operation OSSD OFF	CODE1	
	CODE2	
	NO CODE	
	Invalid Blanking/ Partial Muting	 On models longer than 1200 only even modules blinking yellow
	Override allowed	
Normal Operation OSSD ON	Minimum Signal Level	
	Good Signal Level	
	Maximum Signal Level	
	Muting Active	
	Override Active	
	Blanking Active	
Configuration	Wi-Fi connection Active	
	GUI Configuration Pending	

Failure (Lockout)	Power Supply Failure		
	F11 OSSDs failure		
	F22 Microprocessor Failure		
	F33 Optics Failure		
	EDM Failure		
	Restart Failure		
	F1122 Cascade Failure		
	F2233 Configuration Failure		
	F20 Lamp Failure		
	F1133 Input Failure		
Failure (NO Lockout)	F10 Override Failure		
	F01 Teach in Failure		
TX firmware update	TX Update Ongoing		
	TX Update Completed		

TX Side dialogue



ESPE WORKING MODE	INDICATION	LED CONFIGURATION
Normal Operation Emission Active	NO CODE	
	CODE1	
	CODE2	
Test, Emission OFF	Test	
Failure	F1 Failure on microprocessor	
	F2 Failure on optics	
	FL Cascade Failure	
FW Update	Ongoing Update	
	Update Completed	

SH4-2/3/4-xxxx-A-12-(5) MODELS

A user interface of 8 LEDs helps customer to control and check the state of the light curtain, for alignment mode, normal operation and for troubleshooting activity.

For each optical module on both RX and TX unit an RGB led will inform about single module status and light curtain operation.

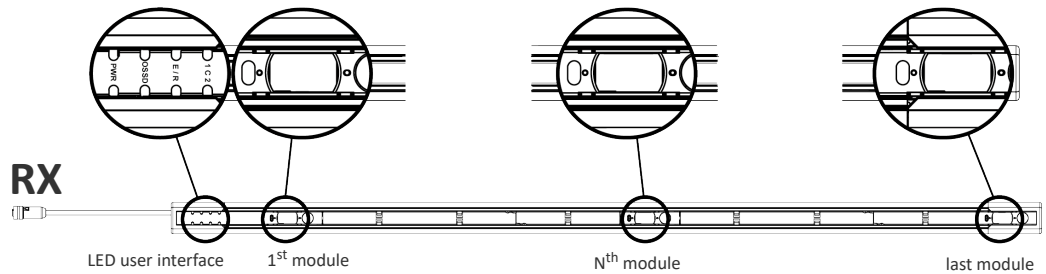


Figure 66: Receiver LED interface

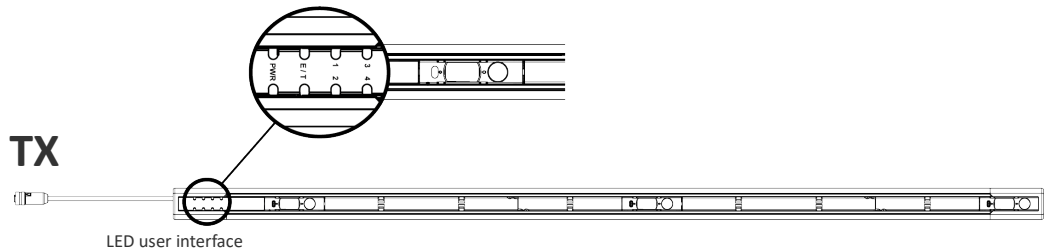


Figure 67: Transmitter LED interface

LED meanings

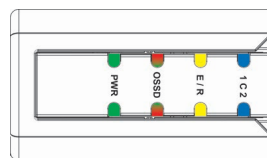
■ = ON

■ = OFF

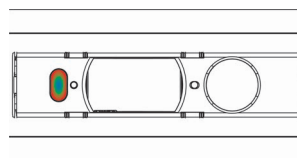
■ = INDIFFERENT

■ = BLINK

RX Side dialogue

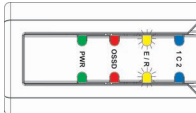
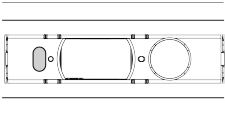
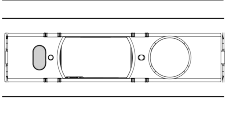
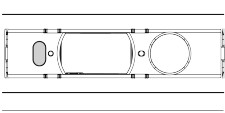


LED user interface

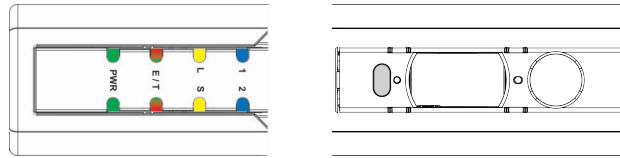
Nth module

ESPE WORKING MODE	INDICATION	LED CONFIGURATION	
Alignment	Not aligned		
	Not aligned Only first sync aligned		First module
	Not aligned Only last sync aligned		Last module
Alignment/ Normal Operation Single Optic	No Signal Level on N th optic		N th module
	Low Signal Level on N th optic		N th module
	Good Signal Level on N th optic		N th module
Normal Operation Manual Restart Only	Manual Restart configured		
	Interlock, free beams, restart required		
Normal Operation	EDM Active		
	CODE1		
	CODE2		
	NO CODE		

Normal Operation OSSD OFF	At least one beam intercepted			
	Override allowed			
	Partial Muting Active. At least one beam outside muting zones intercepted			Not intercepted beams or intercepted beams in muting zone. Intercepted beams outside the muting zone.
Normal Operation OSSD ON	Muting Active			All beams
	Override Active			All beams
Configuration	GUI Connection Active			First module
	GUI Configuration Pending			All beams
Failure (Lockout)	Power Supply Failure			
	FER OSSDs failure			
	F1 Microprocessor Failure			
	F2 Optics Failure			
	FE EDM Failure			
	FR Reset/Restart Failure			
	F12E Lamp Failure			

Failure (NO Lockout)	ER Override Failure		
TX firmware update	TX Update Ongoing		
	TX Update Completed		

TX Side dialogue



ESPE WORKING MODE	INDICATION	LED CONFIGURATION	
Normal Operation Emission Active	NO CODE		
	CODE1		
	CODE2		
	SHORT Range		
	LONG Range		
Emission OFF	Test		
	Range Change Request		
Failure	F1 Failure on microprocessor		
	F2 Failure on optics		
	FLS Range setting failure		
FW Update	Ongoing Update		
	Update Completed		

SH4-2/3/4-xxxx-A-AP-12-5 MODELS

A user interface of 8 LEDs helps customer to control and check the state of the light curtain, for alignment mode, normal operation and for troubleshooting activity.

For each optical module on both RX and TX unit an RGB led will inform about single module status and light curtain operation.

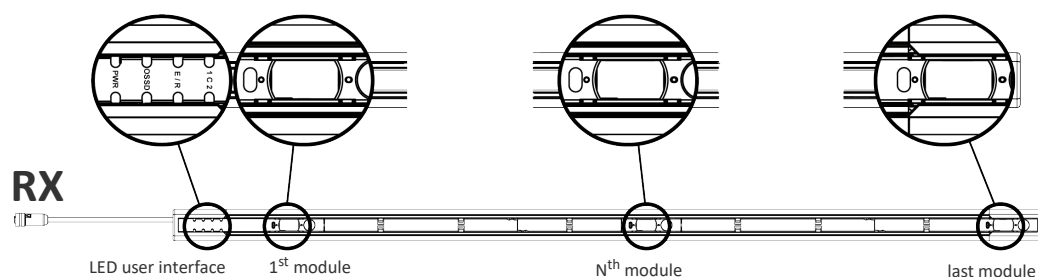


Figure 68: Receiver LED interface

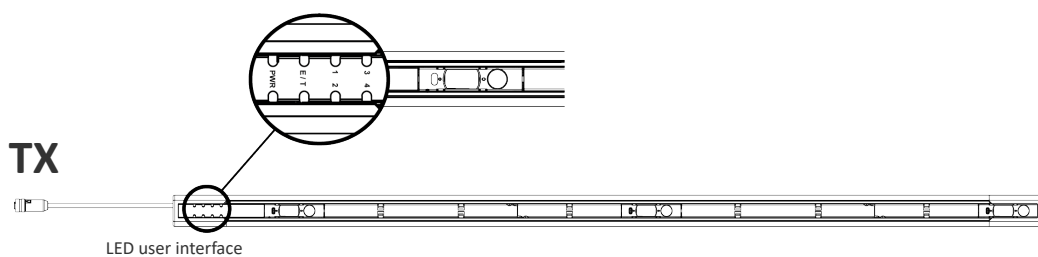


Figure 69: Transmitter LED interface

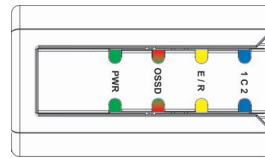
LED meanings

■ = ON

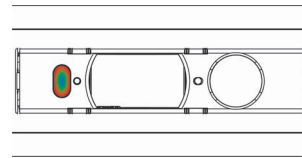
■ = OFF

■ = INDIFFERENT

☀ = BLINK

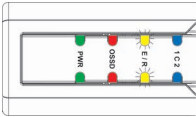
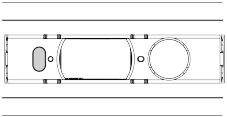


LED user interface

Nth module

ESPE WORKING MODE	INDICATION	LED CONFIGURATION	
Alignment SH4-2 models only has 1 beam path SH4-3/4 models have 2 beam paths	Not aligned		
	1 st beam path free		First and second module
	2 nd beam path free		Third and fourth module
Alignment/ Normal Operation Single Optic TX optics shows same status of corresponding RX optic	No Signal Level on N th optic		N th module
	Low Signal Level on N th optic		N th module
	Good Signal Level on N th optic		N th module
Normal Operation Manual Restart Only	Manual Restart configured		
	Interlock, free beams, restart required		
Normal Operation SH4-2 models only has 1 beam path SH4-3/4 models have 2 beam paths	EDM Active		
	1 st beam path free		First and second module
	2 nd beam path free		Third and fourth module

Normal Operation OSSD OFF	At least one beam intercepted			
	Override allowed			
	Partial Muting Active. At least one beam outside muting zones intercepted			Not intercepted beams or intercepted beams in muting zone. Intercepted beams outside the muting zone.
Normal Operation OSSD ON	Muting Active			All beams
	Override Active			All beams
Configuration	GUI Connection Active			First module
	GUI Configuration Pending			All beams
Failure (Lockout)	Power Supply Failure			
	FER OSSDs failure			
	F1 Microprocessor Failure			
	F2 Optics Failure			
	FE EDM Failure			
	FR Reset/Restart Failure			
	F12E Lamp Failure			

Failure (NO Lockout)	ER Override Failure	 
-------------------------	------------------------	--

CHAPTER 9

PERIODICAL CHECKS

The following is a list of recommended check and maintenance operations that should be periodically carried-out by qualified personnel (see "[Controls after first installation](#)" on [page 20](#)).

Check that:

- The ESPE remains in Safe State (Red OSSD LED ON) during beam interruption along The ESPE stays in SAFE state during beam interruption along the entire protected area, using the specific Test Piece (TP-14 or TP-30).
- The ESPE is correctly aligned. Press slightly product side, in both directions and the red LED (named OSSD on RX side) must not turn ON.
- Enabling the TEST function (on TX side), the OSSD outputs should open (the red LED, OSSD on RX side, is ON and the controlled machine stops).
- 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 "[Installation](#)" on [page 5](#)).
- The safety distance between the dangerous areas and the ESPE are in accordance with the instructions included in "[Installation](#)" on [page 5](#).
- Access of a person between ESPE and machine dangerous parts is not possible, nor it is 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.

GENERAL INFORMATION AND USEFUL DATA



NOTE: 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, Datasensing is at your disposal to carry out 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 Datasensing Repair Service Department.

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

CHAPTER 10

DEVICE MAINTENANCE

Datasensing 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**

PRODUCT DISPOSAL

Under current Italian and European laws, Datasensing is not obliged to take care of product disposal at the end of its life.

Datasensing recommends disposing of the product in compliance with local laws or contact authorized waste collection centers.

APPENDIX A

TECHNICAL DATA

ELECTRICAL DATA	
Power supply	24 Vdc $\pm$ 20% ¹
Transmitter consumption (TX)	3.5 W max
Receiver consumption (RX)	5.5 W max (without load)
Active Unit consumption *SH4-2/3/4-xxxx-x-AP-x(-x) models	2 W max (without load)
Outputs	2 OSSDs Outputs for all models 2 Auxiliary Outputs for SH4-xx-xxxx-A-x(-x) models only 1 Lamp Output for SH4-xx-xxxx-SM-8 models only
Output current	250 mA max / each output 500 mA total max current
Output voltage - ON min	Power supply value less 1 V
Output voltage - OFF max	0.2 V
Output capacitive load	1 μ F at 24 Vdc
Leakage current	< 1 mA
Response times (AIC disabled)	from 7 to 16 ms for SH4-30-xxxx-x-x(-x) models from 9 to 28 ms for SH4-14-xxxx-x-x(-x) models from 12 to 15 ms for SH4-2/3/4-xxxx-x-x(-x) models 15 ms for SH4-2/3/4-xxxx-x-AP-x(-x) models
Protected height	From 300 to 2250 mm (single unit)
Safety category	Type 4 (ref. EN IEC 61496-1)
Auxiliary functions * (depending on the model)	Restart / Test / EDM Reset / EDM selection / auto-man selection Muting / Override Blanking Anti-interference coding (AIC)
Electrical protection	Class III
Connections	M12 5; 8; 12 poles *(depending on the model)
Cable length (for power supply)	30 m max.
Pollution degree	2

1. The external voltage supply must be able to bridge main power failure of 20ms as specified in IEC 60240-1.

OPTICAL DATA	
Light source	Infrared LED (850 nm wavelength)
Resolution	14 mm - 30 mm - Body
Operating distance	0.2 to 10 m for SH4-14-xxxx-x-x(-x) models 0.2 to 20 m for SH4-30-xxxx-x-x(-x) models 0.5 to 15 m for SH4-2/3/4-xxxx-x-x(-x) models (SHORT range) 5 to 70 m for SH4-2/3/4-xxxx-x-x(-x) models (LONG range) 0.5 to 8 m for SH4-2/3-xxxx-x(-AP)-x(-x) models 0.5 to 8 m for SH4-4-1200-x(-AP)-x(-x) models 0.5 to 6 m for SH4-4-0900-x(-AP)-x(-x) models
EAA angle	< ±2.5° at 3 meters
Ambient light rejection	EN 61496-2-2020

MECHANICAL AND ENVIRONMENTAL DATA	
Operating temperature	-30...+55 °C
Storage temperature	-30...+70 °C
Temperature class	T6
Humidity	15...95% (no condensation)
Altitude during operation	< 2000 m
Mechanical protection	IP67, IP65 (EN 60529)
Vibrations	10 mm / 3g, 5 to 150 Hz frequency, (EN 60068-2-6 / Class 3M7 IEC TR 60721-4-3)
Shock resistance	25g x 6 ms x 600 (EN 60068-2-27 / Class 3M7 IEC TR 60721-4-3)
Housing material	Painted aluminum (yellow RAL 1003)
Caps material	PBT Valox 553 black
Caps cover material	PBT 1403g3 blue (pantone 072C)
Frontal cover material	MAKROLON AR 7099 Clear
Weight	1.4 Kg/mt (single bar - without packaged)

SAFETY CATEGORY	
Type 4 (rif. EN 61496-1: 2020)	
SIL 3 (rif. EN 61508)	
SIL CL 3 (rif. EN 62061:2021)	
PL e, Cat. 4 (rif. EN ISO 13849-1: 2015)	
PFHd [1/h] = $2.62 \cdot 10^{-8}$ (ref. EN 61508)	
MTTFd [years] = 43 (ref. EN ISO 13849-1 2015)	
Life Span = 20 years	
DCAvg (Average Diagnostic Coverage) = 99%	
SFF (Safe Failure Fraction) = 99.5%	
HTF (Hardware Fault Tolerance) = 1	

APPENDIX B

AVAILABLE MODELS AND RESPONSE TIMES

MODELS

MODEL SINGLE CONNECTOR	ORDERING NUMBER	MODEL DUAL CONNECTOR	ORDERING NUMBER	RESOLUTION	PROTECTED HEIGHT (mm)
SH4-14-0300-A-12	957920147	SH4-14-0300-A-12-5	957920161	14 mm FINGER PROTECTION 	300
SH4-14-0450-A-12	957920148	SH4-14-0450-A-12-5	957920162		450
SH4-14-0600-A-12	957920149	SH4-14-0600-A-12-5	957920163		600
SH4-14-0750-A-12	957920150	SH4-14-0750-A-12-5	957920164		750
SH4-14-0900-A-12	957920151	SH4-14-0900-A-12-5	957920165		900
SH4-14-1050-A-12	957920152	SH4-14-1050-A-12-5	957920166		1050
SH4-14-1200-A-12	957920153	SH4-14-1200-A-12-5	957920167		1200
SH4-14-1350-A-12	957920154	SH4-14-1350-A-12-5	957920168		1350
SH4-14-1500-A-12	957920155	SH4-14-1500-A-12-5	957920169		1500
SH4-14-1650-A-12	957920156	SH4-14-1650-A-12-5	957920170		1650
SH4-14-1800-A-12	957920157	SH4-14-1800-A-12-5	957920171		1800
SH4-14-1950-A-12	957920158	SH4-14-1950-A-12-5	957920172		1950
SH4-14-2100-A-12	957920159	SH4-14-2100-A-12-5	957920173		2100
SH4-14-2250-A-12	957920160	SH4-14-2250-A-12-5	957920174		2250
SH4-30-0300-A-12	957920189	SH4-30-0300-A-12-5	957920203	30 mm HAND PROTECTION 	300
SH4-30-0450-A-12	957920190	SH4-30-0450-A-12-5	957920204		450
SH4-30-0600-A-12	957920191	SH4-30-0600-A-12-5	957920205		600
SH4-30-0750-A-12	957920192	SH4-30-0750-A-12-5	957920206		750
SH4-30-0900-A-12	957920193	SH4-30-0900-A-12-5	957920207		900
SH4-30-1050-A-12	957920194	SH4-30-1050-A-12-5	957920208		1050
SH4-30-1200-A-12	957920195	SH4-30-1200-A-12-5	957920209		1200
SH4-30-1350-A-12	957920196	SH4-30-1350-A-12-5	957920210		1350
SH4-30-1500-A-12	957920197	SH4-30-1500-A-12-5	957920211		1500
SH4-30-1650-A-12	957920198	SH4-30-1650-A-12-5	957920212		1650
SH4-30-1800-A-12	957920199	SH4-30-1800-A-12-5	957920213		1800
SH4-30-1950-A-12	957920200	SH4-30-1950-A-12-5	957920214		1950
SH4-30-2100-A-12	957920201	SH4-30-2100-A-12-5	957920215		2100
SH4-30-2250-A-12	957920202	SH4-30-2250-A-12-5	957920216		2250

MODEL SINGLE CONNECTOR	ORDERING NUMBER	MODEL DUAL CONNECTOR	ORDERING NUMBER	RESOLUTION	PROTECTED HEIGHT (mm)
		SH4-2-0500-A-12-5	957920231	BODY PROTECTION 	500
		SH4-3-0800-A-12-5	957920232		800
		SH4-4-0900-A-12-5	957920233		900
		SH4-4-1200-A-12-5	957920234		1200
		SH4-2-0500-A-AP-12-5	957920239		500
		SH4-3-0800-A-AP-12-5	957920240		800
		SH4-4-0900-A-AP-12-5	957920241		900
		SH4-4-1200-A-AP-12-5	957920242		1200

Pairing table

PAIR MODEL	RECEIVER MODEL	TRANSMITTER MODEL
SH4-14-xxxx-A-12	SH4-14-xxxx-A-R-12	SH4-14-xxxx-TP-5
SH4-14-xxxx-A-12-5	SH4-14-xxxx-A-R-12-5	SH4-14-xxxx-TP-5-5
SH4-30-xxxx-A-12	SH4-30-xxxx-A-R-12	SH4-30-xxxx-TP-5
SH4-30-xxxx-A-12-5	SH4-30-xxxx-A-R-12-5	SH4-30-xxxx-TP-5-5
SH4-2/3/4-xxxx-A-12-5	SH4-2/3/4-xxxx-A-R-12-5	SH4-2/3/4-xxxx-TP-5-5

RESPONSE TIME

Next tables resumes the response time values of every SH4 models related to the number of beams and the protected height.

The response time is a function of the protected height, the resolution of the light curtain and Anti Interference Coding (AIC) selection.

SH4-14-xxxx-x-x(-x) models

MODEL	PROTECTED HEIGHT (mm)	NO. BEAMS	RESPONSE TIME (ms) AIC DISABLE ¹	RESPONSE TIME (ms) AIC ENABLE
SH4-14-0300-x-x(-x)	300	30	9	14
SH4-14-0450-x-x(-x)	450	45	10	18
SH4-14-0600-x-x(-x)	600	60	12	22
SH4-14-0750-x-x(-x)	750	75	13	26
SH4-14-0900-x-x(-x)	900	90	15	30
SH4-14-1050-x-x(-x)	1050	105	16	33
SH4-14-1200-x-x(-x)	1200	120	18	37
SH4-14-1350-x-x(-x)	1350	135	20	41
SH4-14-1500-x-x(-x)	1500	150	21	45
SH4-14-1650-x-x(-x)	1650	165	23	49
SH4-14-1800-x-x(-x)	1800	180	24	52
SH4-14-1950-x-x(-x)	1950	195	26	56
SH4-14-2100-x-x(-x)	2100	210	27	60
SH4-14-2250-x-x(-x)	2250	225	29	64

1. These values are also valid as recovery time values.

SH4-30-xxxx-x-x(-x) models

MODEL	CONTROLLED HEIGHT (mm)	NO. BEAMS	RESPONSE TIME (ms) AIC DISABLE ¹	RESPONSE TIME (ms) AIC ENABLE
SH4-30-0300-x-x(-x)	300	12	7	10
SH4-30-0450-x-x(-x)	450	18	8	12
SH4-30-0600-x-x(-x)	600	24	9	13
SH4-30-0750-x-x(-x)	750	30	9	15
SH4-30-0900-x-x(-x)	900	36	10	17
SH4-30-1050-x-x(-x)	1050	42	11	18
SH4-30-1200-x-x(-x)	1200	48	12	20
SH4-30-1350-x-x(-x)	1350	54	12	22
SH4-30-1500-x-x(-x)	1500	60	13	23
SH4-30-1650-x-x(-x)	1650	66	14	25
SH4-30-1800-x-x(-x)	1800	72	14	27
SH4-30-1950-x-x(-x)	1950	78	15	28
SH4-30-2100-x-x(-x)	2100	84	16	30
SH4-30-2250-x-x(-x)	2250	90	17	32

1. These values are also valid as recovery time values.

SH4-2/3/4-xxxx-x(-AP)-x(-x) models

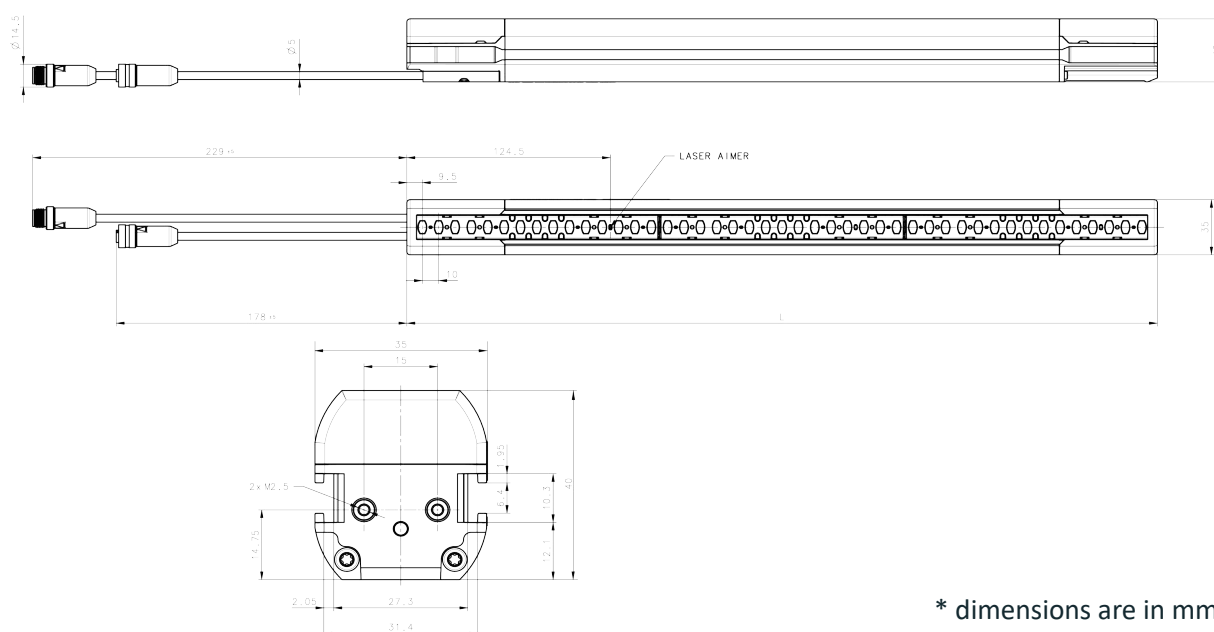
MODEL	CONTROLLED HEIGHT (mm)	NO. BEAMS	RESPONSE TIME (ms) AIC DISABLE ¹	RESPONSE TIME (ms) AIC ENABLE
SH4-2-0500-x-x(-x)	500	2	12	23
SH4-3-0800-x-x(-x)	800	3	15	27
SH4-4-0900-x-x(-x)	900	4	15	29
SH4-4-1200-x-x(-x)	1200	4	15	29
SH4-2-0500-x-AP-x(-x)	500	2	15	N/A
SH4-3-0800-x-AP-x(-x)	800	3	15	N/A
SH4-4-0900-x-AP-x(-x)	900	4	15	N/A
SH4-4-1200-x-AP-x(-x)	1200	4	15	N/A

1. These values are also valid as recovery time values.

APPENDIX C

OVERALL DIMENSIONS

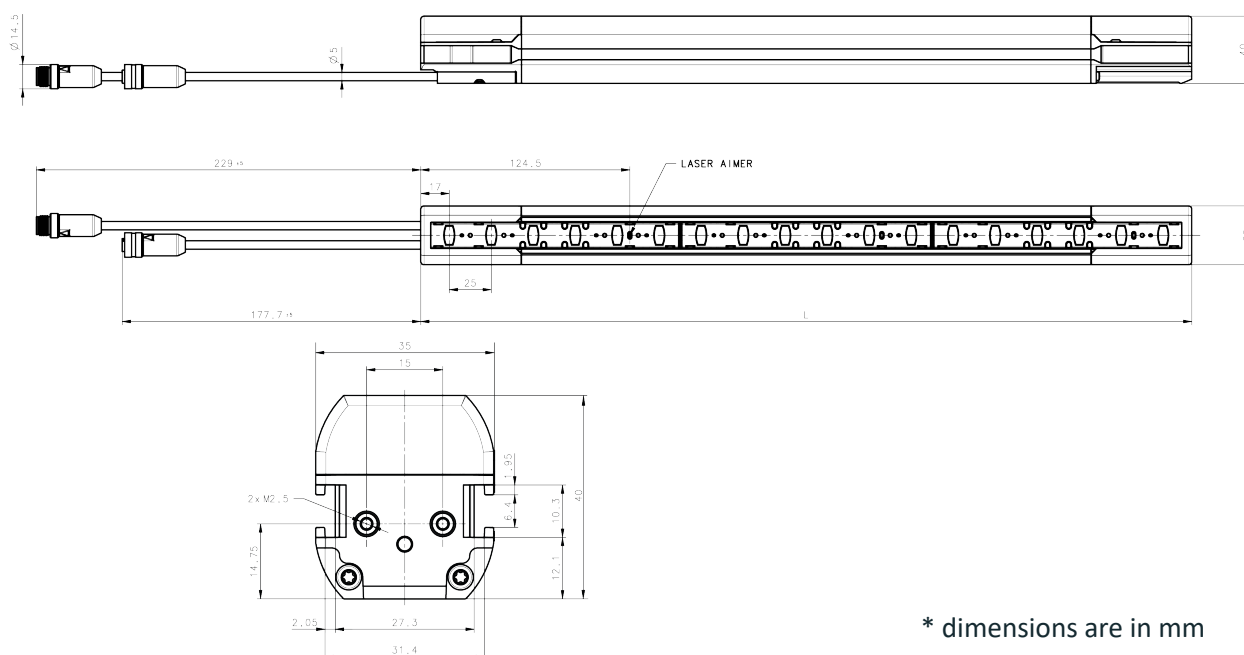
SH4-14-xxxx-x-x(-x)



* dimensions are in mm

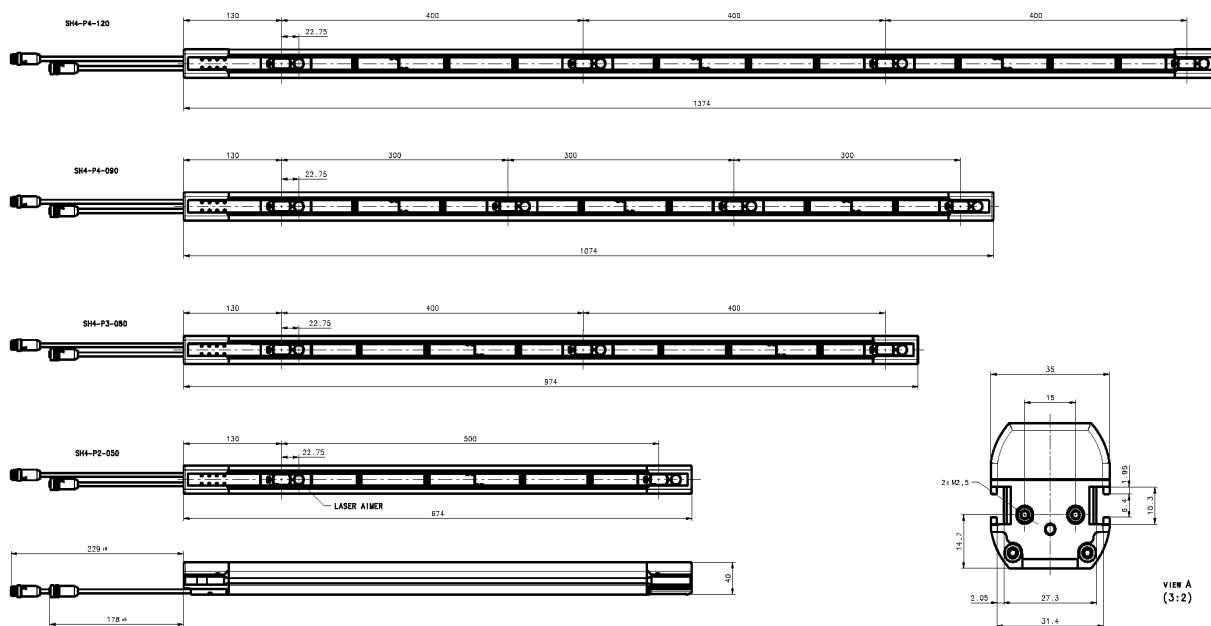
MODEL	L (mm)
SH4-14-0300-x-x(-x)	309
SH4-14-0450-x-x(-x)	459
SH4-14-0600-x-x(-x)	609
SH4-14-0750-x-x(-x)	759
SH4-14-0900-x-x(-x)	909
SH4-14-1050-x-x(-x)	1059
SH4-14-1200-x-x(-x)	1209
SH4-14-1350-x-x(-x)	1359
SH4-14-1500-x-x(-x)	1509
SH4-14-1650-x-x(-x)	1659
SH4-14-1800-x-x(-x)	1809
SH4-14-1950-x-x(-x)	1959
SH4-14-2100-x-x(-x)	2109
SH4-14-2250-x-x(-x)	2259

SH4-30-xxxx-x-x(-x)



MODEL	L (mm)
SH4-30-0300-x-x(-x)	309
SH4-30-0450-x-x(-x)	459
SH4-30-0600-x-x(-x)	609
SH4-30-0750-x-x(-x)	759
SH4-30-0900-x-x(-x)	909
SH4-30-1050-x-x(-x)	1059
SH4-30-1200-x-x(-x)	1209
SH4-30-1350-x-x(-x)	1359
SH4-30-1500-x-x(-x)	1509
SH4-30-1650-x-x(-x)	1659
SH4-30-1800-x-x(-x)	1809
SH4-30-1950-x-x(-x)	1959
SH4-30-2100-x-x(-x)	2109
SH4-30-2250-x-x(-x)	2259

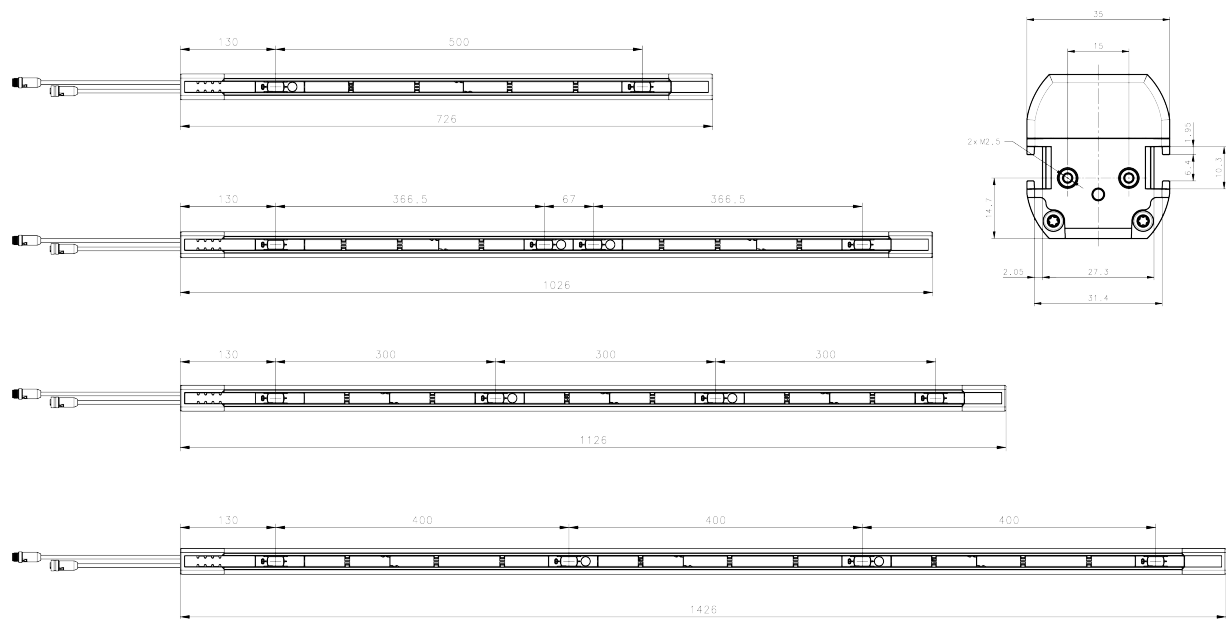
SH4-2/3/4-xxxx-x-x(-x)



* dimensions are in mm

MODEL	L (mm)
SH4-2-0500-x-x(-x)	674
SH4-3-0800-x-x(-x)	974
SH4-4-0900-x-x(-x)	1074
SH4-4-1200-x-x(-x)	1374

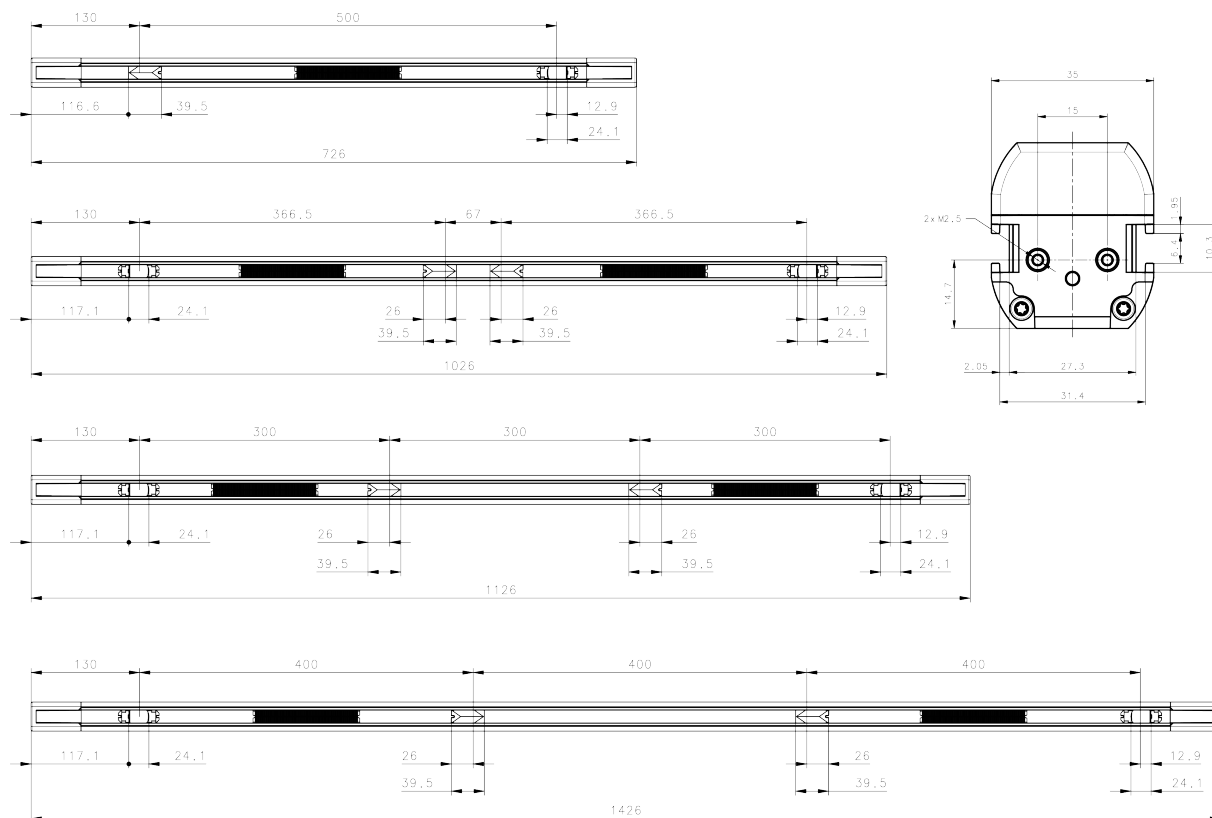
SH4-2/3/4-xxxx-x-AP-x(-x) (active unit)



* dimensions are in mm

MODEL	L (mm)
SH4-2-0500-x-AP-x(-x)	726
SH4-3-0800-x-AP-x(-x)	1026
SH4-4-0900-x-AP-x(-x)	1126
SH4-4-1200-x-AP-x(-x)	1426

SH4-2/3/4-xxxx-x-AP-x(-x) (passive unit)



* dimensions are in mm

MODEL	L (mm)
SH4-2-0500-x-AP-x(-x)	726
SH4-3-0800-x-AP-x(-x)	1026
SH4-4-0900-x-AP-x(-x)	1126
SH4-4-1200-x-AP-x(-x)	1426

APPENDIX D

INCLUDED ACCESSORIES

METAL ANGLED FIXING BRACKET

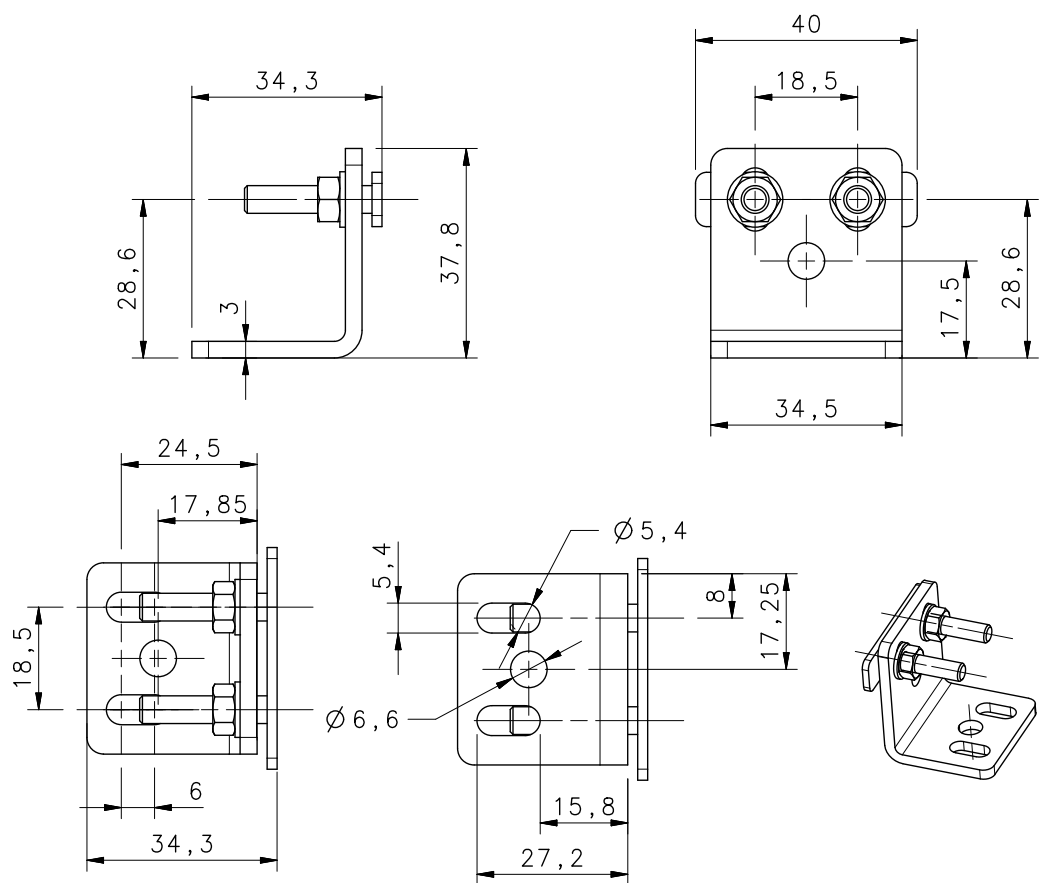


Figure 70 - Metal Angled fixing Bracket



NOTE: Dimensions are in mm.

APPENDIX E

ACCESSORIES

BRACKETS

Metal Angled Fixing Bracket

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

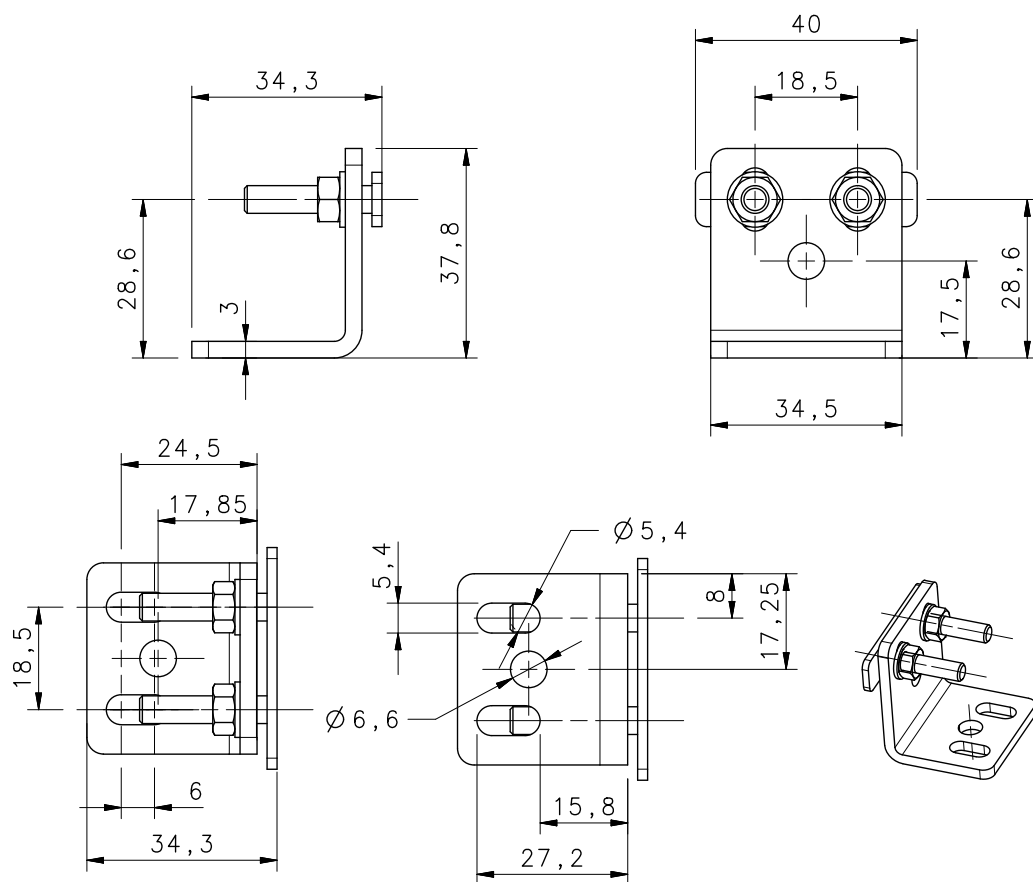


Figure 71 - ST-KSTD



NOTE: Dimensions are in mm.

Angled Fixing Bracket mounting with orientable and anti-vibration supports

MODEL	DESCRIPTION	CODE
ST-K40R	Orientable supports (4 pcs kit)	95ACC1680
ST-K60R	Orientable supports (6 pcs kit)	95ACC1690
ST-K4AV	Anti-vibration supports (4 pcs kit)	95ACC1700
ST-K6AV	Anti-vibration supports (6 pcs kit)	95ACC1710

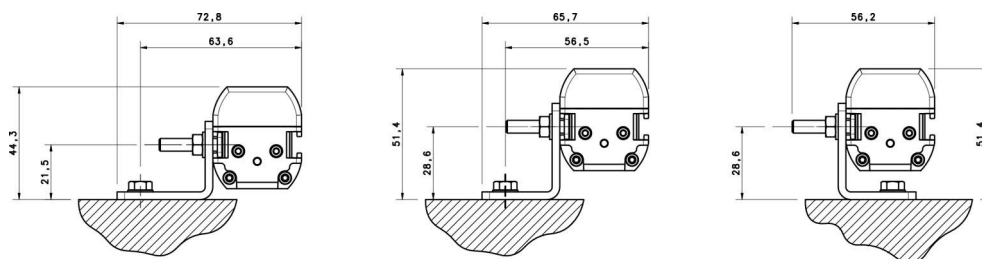


Figure 72 - Angled fixing bracket

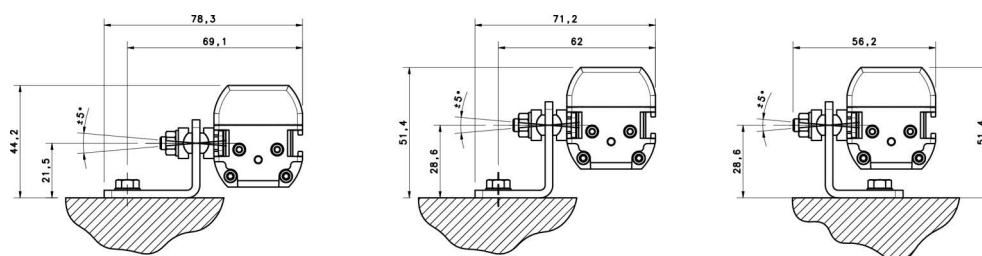


Figure 73 - Angled fixing bracket + Orientable support

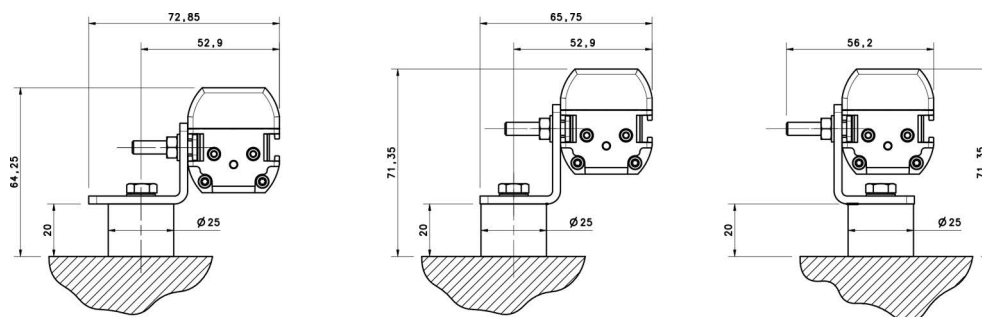


Figure 74 - Angled fixing bracket + Anti-vibration support

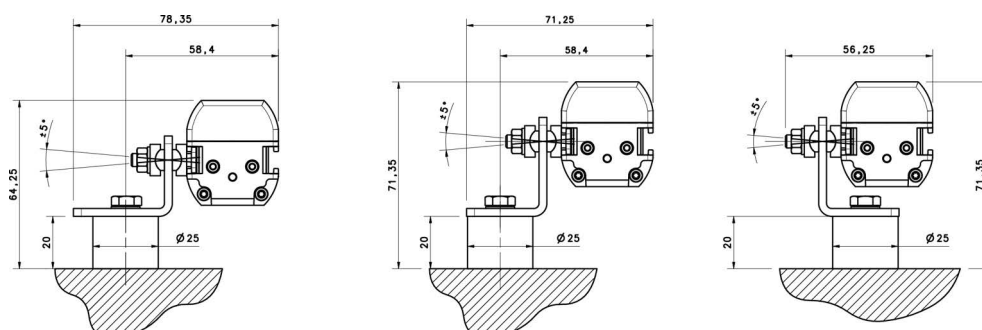


Figure 75 - Angled fixing bracket + Orientable support + Anti-vibration support



NOTE: Dimensions are in mm.

Rotating Bracket

MODEL	DESCRIPTION	CODE
ST-K4ROT-SH	Metal top-bottom rotating fixing brackets kit (4 brackets) for SH4	95ASE0042

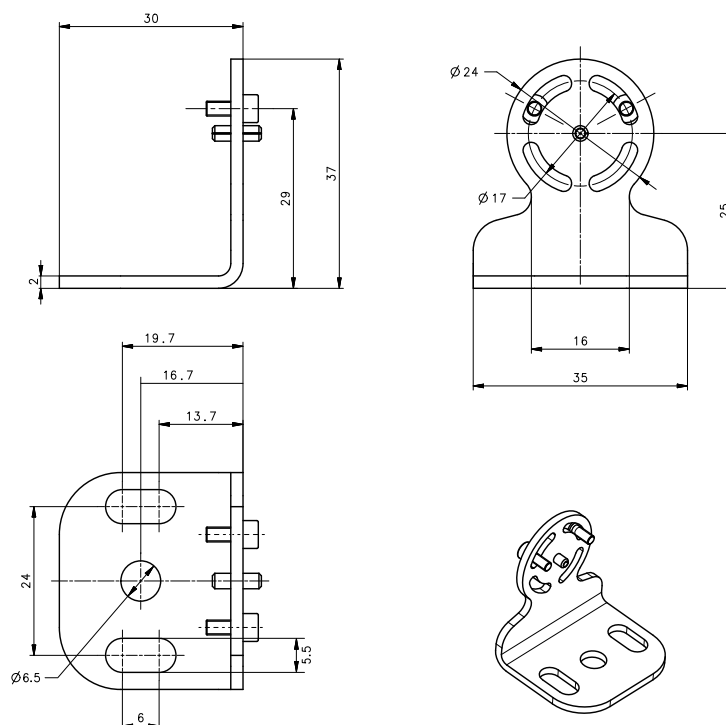


Figure 76 - ST-K4ROT-SH



NOTE: Dimensions are in mm.

Rotating Bracket mounting

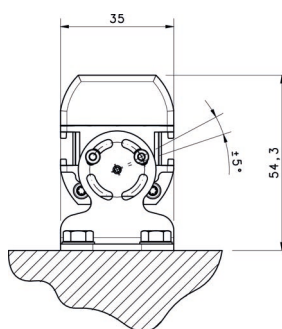


Figure 77 - Straight mounting

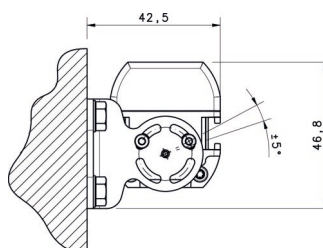


Figure 78 - Rotating 90° mounting

PROTECTIVE STANDS

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

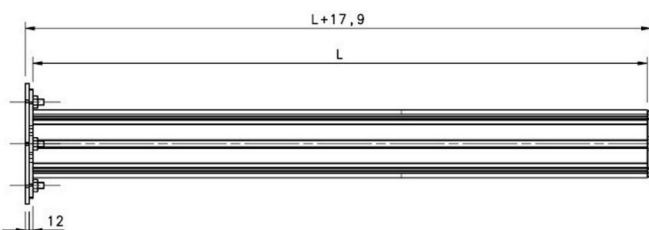
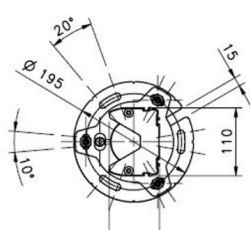


Figure 79 - Protective Stands



NOTE: Dimensions are in 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

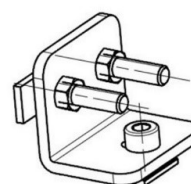
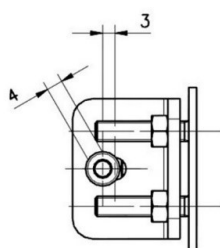
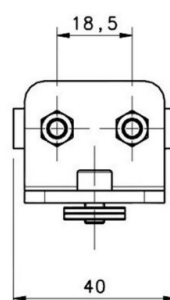
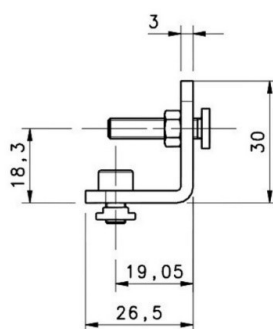


Figure 80 - Mounting kit



NOTE: Dimensions are in mm.

Plate Kit for Protective Stands

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

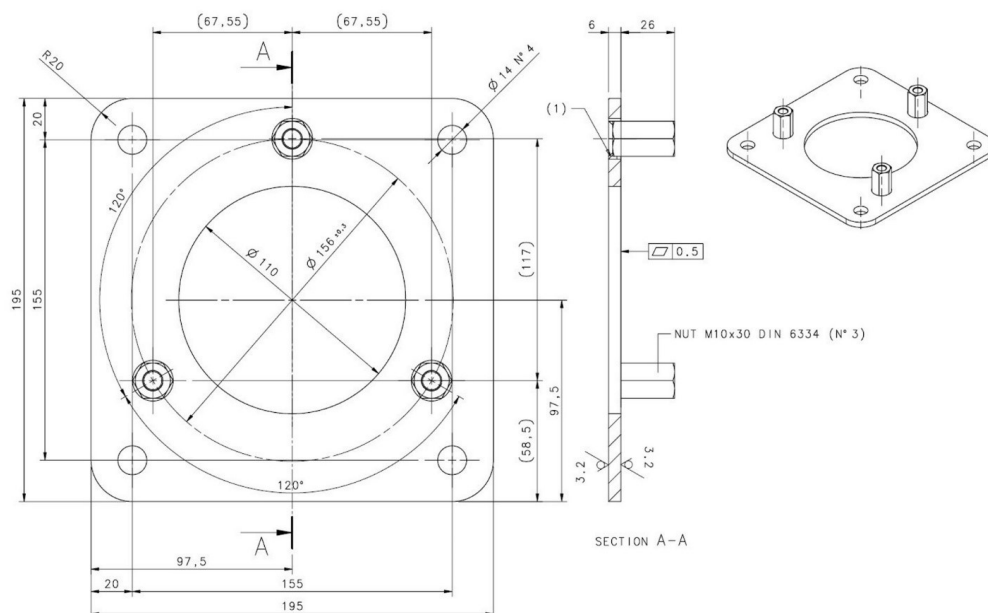


Figure 81 - Plate kit



NOTE: Dimensions are in mm.

Mounting with SG-P SB

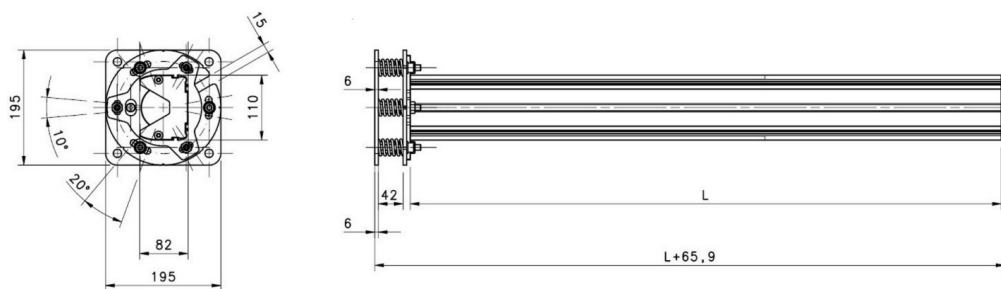


Figure 82 - Mounting with SG-P SB



NOTE: Dimensions are in mm.

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

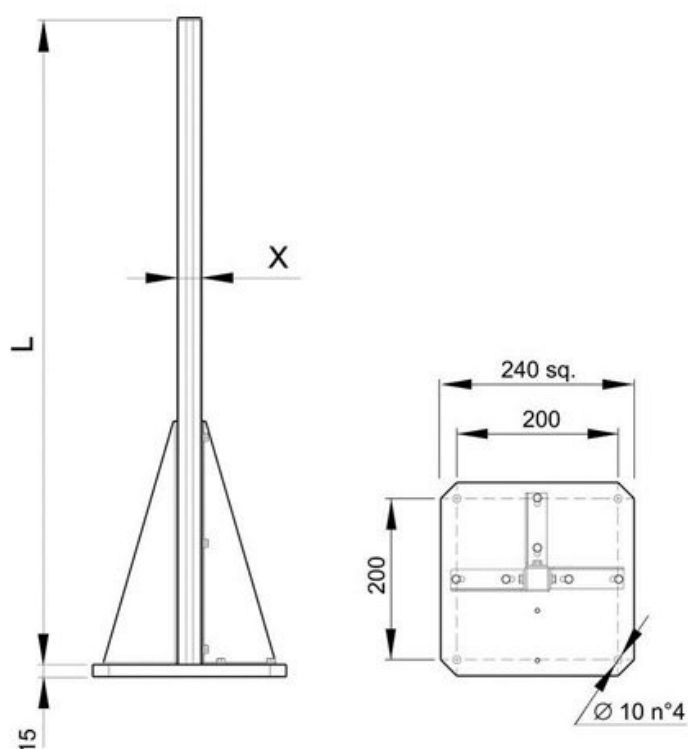


Figure 83 - Dimensions (mm)

MIRRORS

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

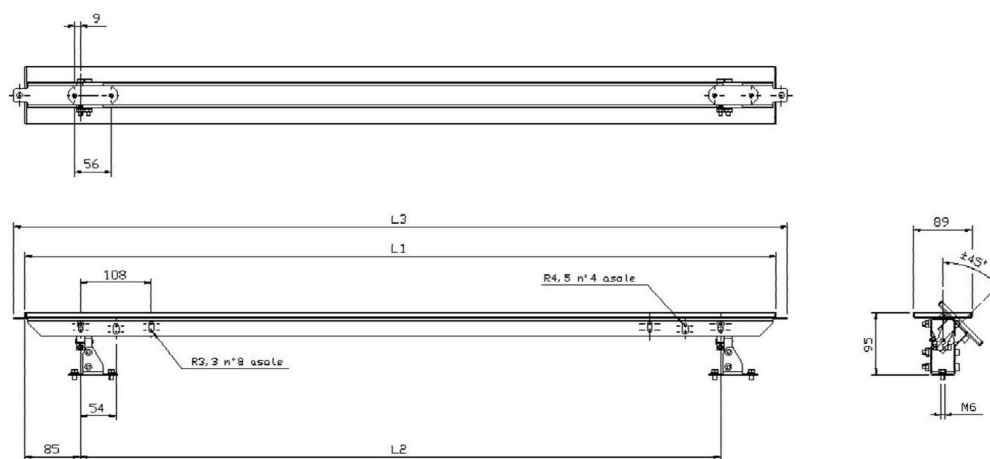


Figure 84 - Deviating mirrors (mm)



NOTE: 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

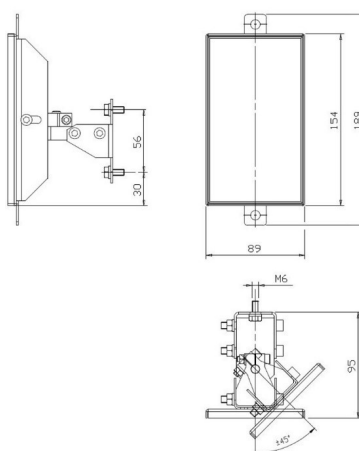


Figure 85 - SG-DM 150 (mm)



NOTE: 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

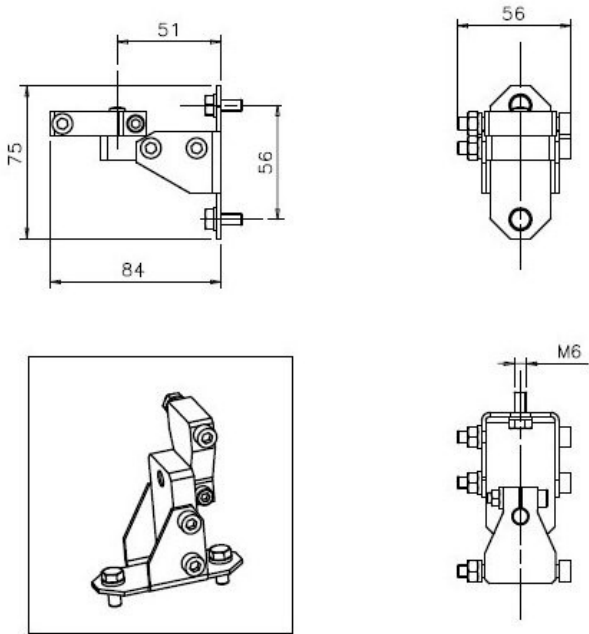


Figure 86 - Mounting kit



NOTE: 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-units)	95ASE1770

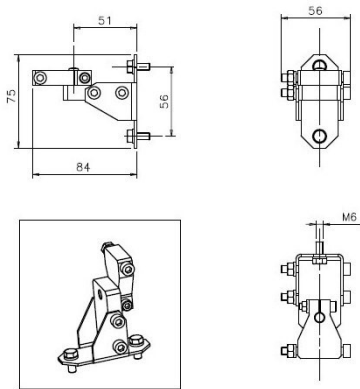


Figure 87 - Mounting kit



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

CONNECTION CABLES

12-poles M12 cables (Receiver main connector)

MODEL	DESCRIPTION	CODE
CS-A1-10-U-03	12-pole M12 cable (axial) 3 m UL2464	95A252720
CS-A1-10-U-05	12-pole M12 cable (axial) 5 m UL2464	95A252730
CS-A1-10-U-10	12-pole M12 cable (axial) 10 m UL2464	95A252740
CS-A1-10-U-15	12-pole M12 cable (axial) 15 m UL2464	95A252750
CS-A1-10-U-25	12-pole M12 cable (axial) 25 m UL2464	95A252760
CS-A1-10-U-50	12-pole M12 cable (axial) 50 m UL2464	95A252770

5-poles M12 cables (Transmitter main connector)

MODEL	DESCRIPTION	CODE
CS-A1-03-U-03	5-pole M12 cable (axial) 3 m UL2464	95ASE1170
CS-A1-03-U-05	5-pole M12 cable (axial) 5 m UL2464	95ASE1180
CS-A1-03-U-10	5-pole M12 cable (axial) 10 m UL2464	95ASE1190
CS-A1-03-U-15	5-pole M12 cable (axial) 15 m UL2464	95ASE1200
CS-A1-03-U-25	5-pole M12 cable (axial) 25 m UL2464	95ASE1210
CS-A1-03-U-50	5-pole M12 cable (axial) 50 m UL2464	95A252700

5-poles M12 cables (Receiver/Transmitter secondary connector)

MODEL	DESCRIPTION	CODE
CD12M/0B-050B1	5-pole M12 cable (axial) 5 m UL2464	CD12M/0B-050B1
CD12M/0B-100B1	5-pole M12 cable (axial) 10 m UL2464	CD12M/0B-100B1

Cascade cables (5-poles M12 male/female)

MODEL	DESCRIPTION	CODE
CS-H2-03-B-01	Cascade cable 1M	95ASE0031
CS-H2-03-B-03	Cascade cable 3M	95ASE0032
CS-H2-03-B-10	Cascade cable 5M	95ASE0033

LASER POINTER

MODEL	DESCRIPTION	CODE
SH-LP	Laser pointer	95ASE0030

The laser pointer of the SH-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).

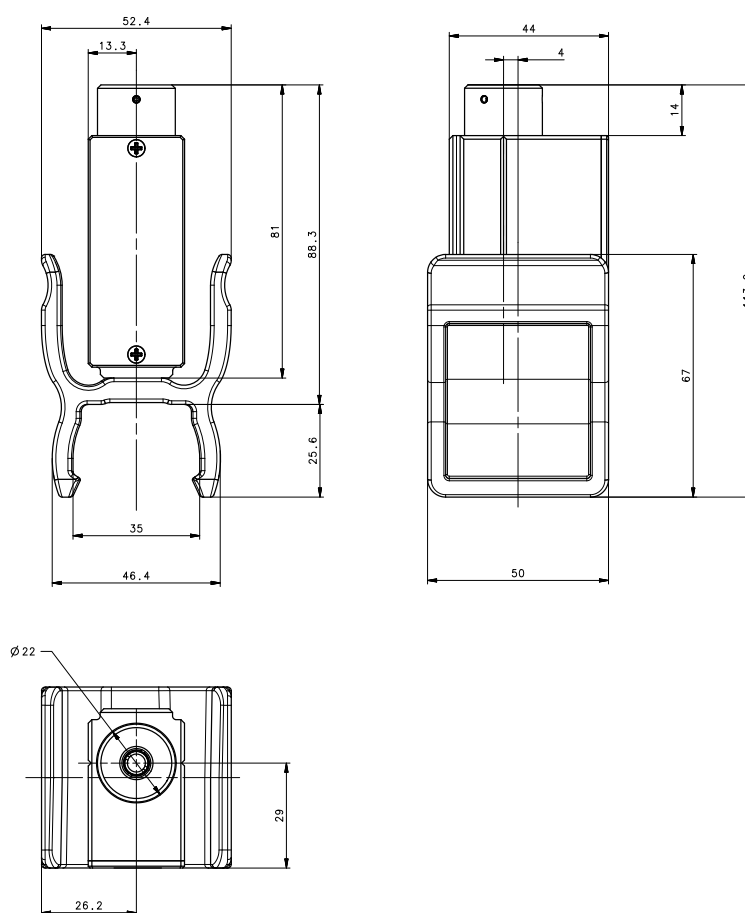


Figure 88 - Dimensions (mm)

SAFETY UNITS

Safety unit

MODEL	DESCRIPTION	CODE
SE-SR2	Type 4 safety relay - 3 NQ 1 NC	95ACC6170

The drawing shows the connection between the safety light curtain and the Type 4 safety relay of the SE-SR2 series operating in the automatic Restart mode.

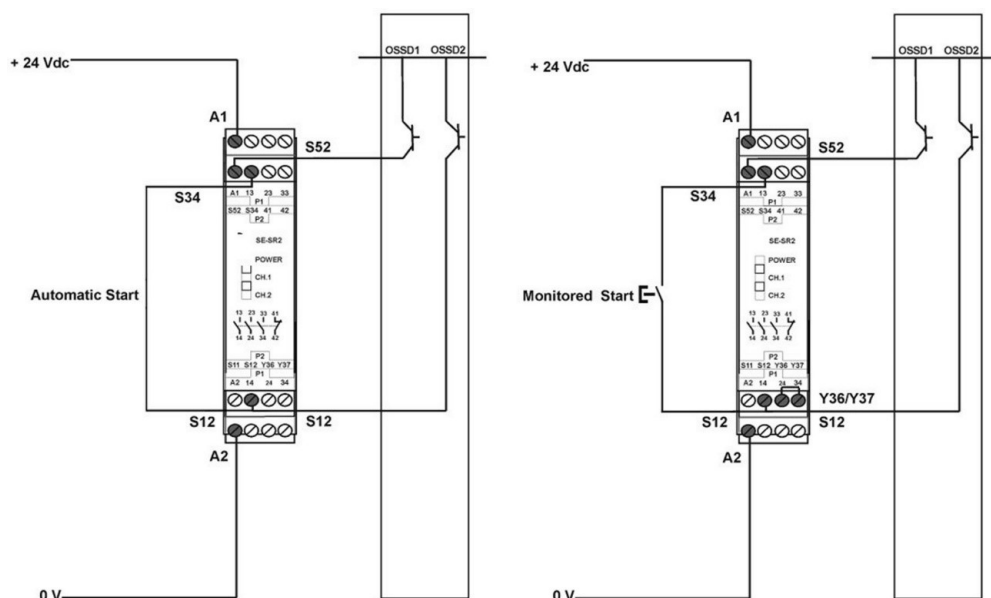


Figure 89 - Safety relay

EDM relay box

MODEL	DESCRIPTION	CODE
CSME-03VU24-Y14	EDM relay	95ASE1270

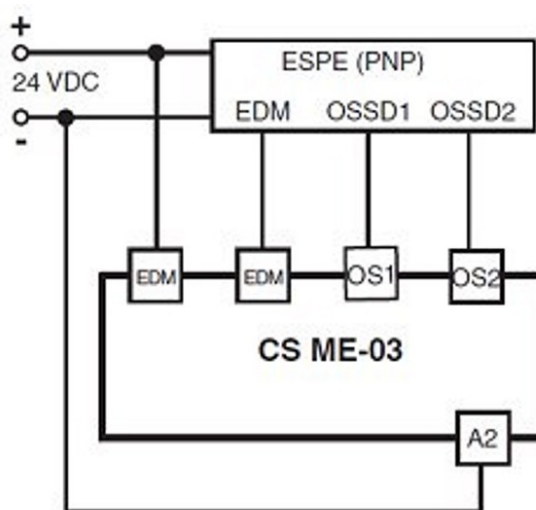


Figure 90 - EDM relay

ACCESSORIES FOR MUTING

External Muting Lamps

MODEL	DESCRIPTION	CODE
LMS	Muting lamp	95ASE1830
LMS-1	Modular Muting lamp	95ACC1990
LMS-2	Muting lamp - horizontal mounting	95ACC2000
LMS-3	Muting lamp - vertical mounting	95ACC2010
SU-LMS-1A	Basic support for LMS-1	95ACC2020
SU-LMS-1B	Tower module for LMS-1	95ACC2030

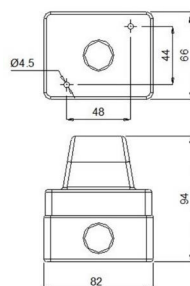


Figure 91: Lamp LMS

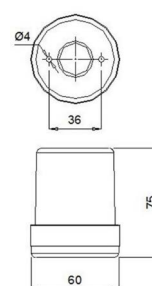


Figure 92: Lamp LMS-2

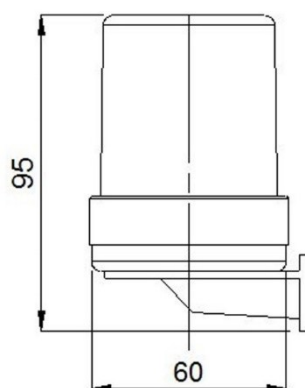


Figure 93: Lamp LMS-3

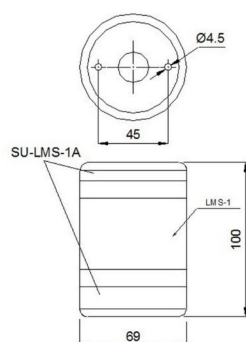
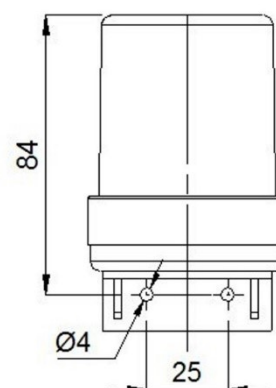


Figure 94: Module SU-LMS-1A + LMS-1

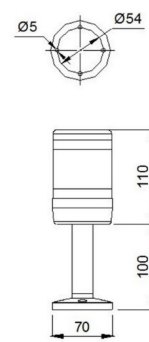


Figure 95: Module SU-LMS-1B + LMS-1

Muting cables

T Muting cable

MODEL	DESCRIPTION	CODE
CV-Y4-02-B-007	M12 4P T MUTING CABLE SH4	95ASE0037

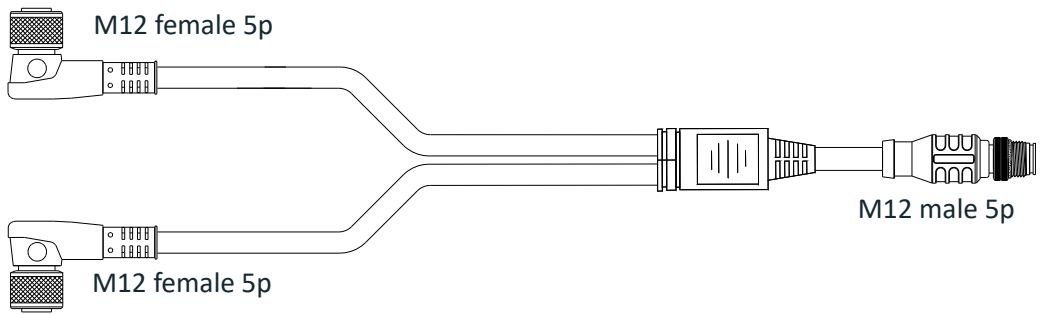


Figure 96: T muting cable

L Muting cable

MODEL	DESCRIPTION	CODE
CV-L2-02-B-007	M12 4P L MUTING CABLE SH4	95ASE0038

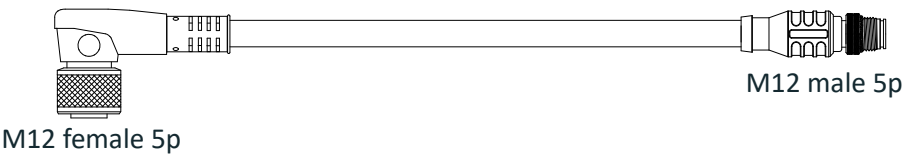


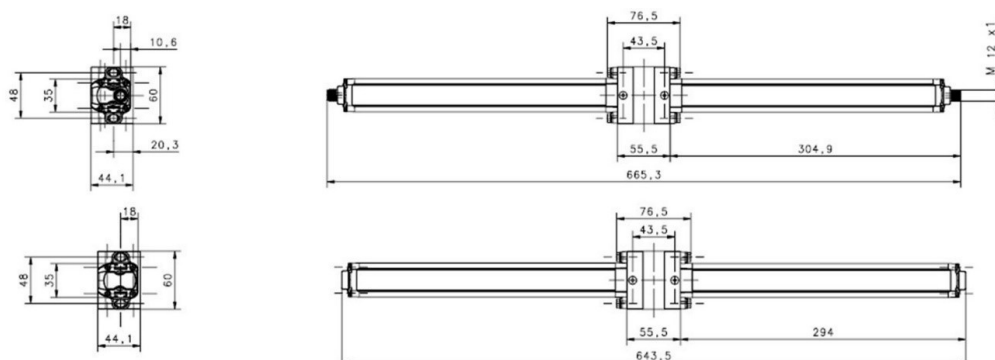
Figure 97: L muting cable

Couple arms

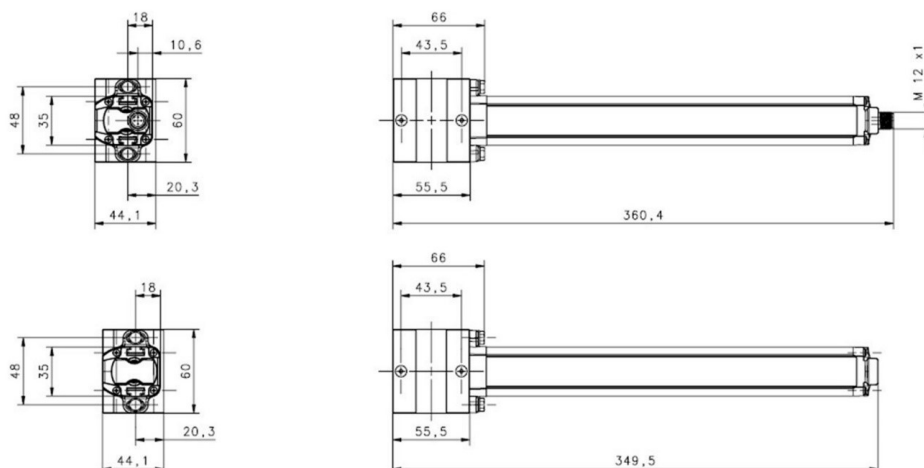
MODEL	DESCRIPTION	CODE
SH-T-ARMS	T COUPLE ARMS	95ASE0035
SH-L-ARMS	L COUPLE ARMS	95ASE0036

The following figures show respectively the dimensions of single active arms with fixing bracket mounted, of single passive arms with fixing bracket mounted, of double active arms with fixing bracket mounted, and of double passive arms with fixing bracket mounted.

SH-T-ARMS



SH-L-ARMS



Connection Box

MODEL	DESCRIPTION	CODE
SH-M-CB	CONNECTION BOX	95ASE0039

The SH-M-CB Connection box can be used to connect SH4 Standard and Advanced to SG-M muting accessories. For further information refer to the documentation of SG-M muting accessories.

Muting sensors can be connected to SH-M-CB Connection box via M12 cables.

The signals are connected to safety light curtain dedicated muting connector via approx. 0.5m long pigtail cable with M12 female connector.

Aside from the green LEDs¹ (to indicated sensors output status), the SH-M-CB does not contain any electronic elements and is therefore not subject to any safety classification.

Features:

- Supply and switching voltage +24Vdc
- M12 connection
- Simple connection to safety light curtains

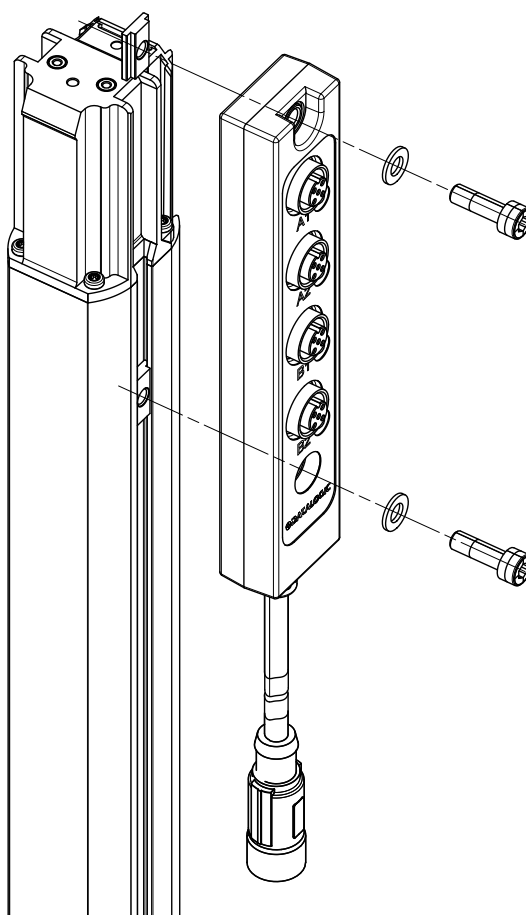


Figure 98 - Connection box

1. For correct operation of LED indicators, it is mandatory to connect identical sensors to the four M12 sockets.

MODEL	DESCRIPTION	CODE
SH-M-CB	Connection box	95ASE2500
SG-M-CB-KIT	Mounting kit	95ASE2830

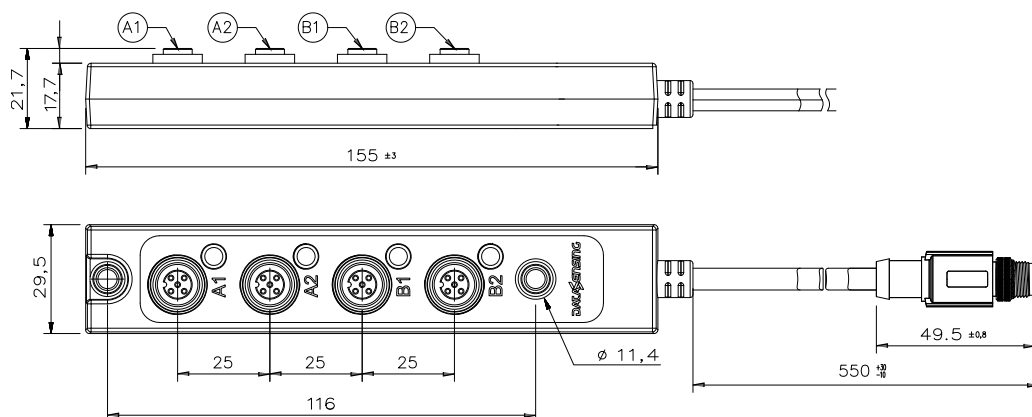


Figure 99 - Dimensions (mm)

Power supply & Switching voltage	+24 Vcc $\pm$ 20%
Current load max.	1 A
Insulating resistance	$> 10^9 \Omega$
Mechanical protection	IP 67
Operating temperature	-10° C ... +55° C
Storage temperature	-25° C ... +70° C
Housing material	PVC, Black (UL Recognized)
Housing cable (C2)	PVC, Black (UL Recognized)
Housing connector (C1)	Plug M12-5P A-Coding Male
Housing connectors (A1, A2, B1, B2)	Sockets M12-5P A-Coding Female



NOTE: For each muting system kit the use of the same sensor type is recommended.

APPENDIX F

CASCADE SYSTEM

OVERVIEW

This document describes the implementation of multiple light curtains in a system. The result of this system is defined as cascade.

Up to three SH4 unit (SH4-14/30-xxxx-x-x-(x) models only) can be connected in series as a cascade system.

Cascading is when two or more light curtains are connected to each other, resulting in one system that functions as a single light curtains.

Advantages of cascading are better monitoring of dangerous areas with presence detection beyond the vertical detection zone and space and cost savings by using a single safety unit.

A cascade system will work as a single long unit where optic scan is synchronized between units in order to avoid mutual interferences. A single couple of OSSDs outputs will reflect the status of all connected units.



NOTE: OSSDs are physically connected to Main unit only; only the Main unit can control their status.

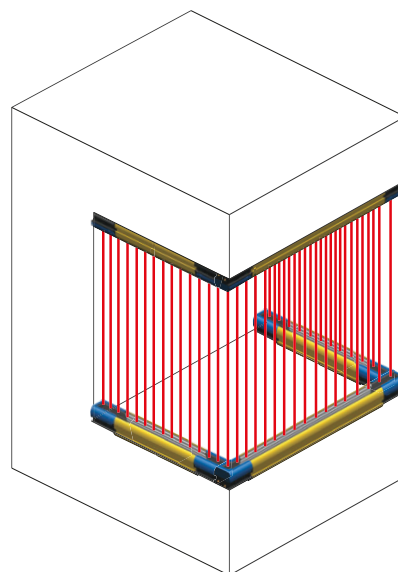


Figure 100: Application example

A cascade system is composed by:

- One Main unit with dual connector (can be chosen among SH4-14/30-xxxx-SM-8-5 or SH4-14/30-xxxx-A-12-5)
- One LAST UNIT unit (can be chosen among SH4-14/30-xxxx-B-5 or SH4-14/30-xxxx-C-5-5)
- Optionally one MIDDLE UNIT (must be a SH4-14/30-xxxx-C-5-5 unit)

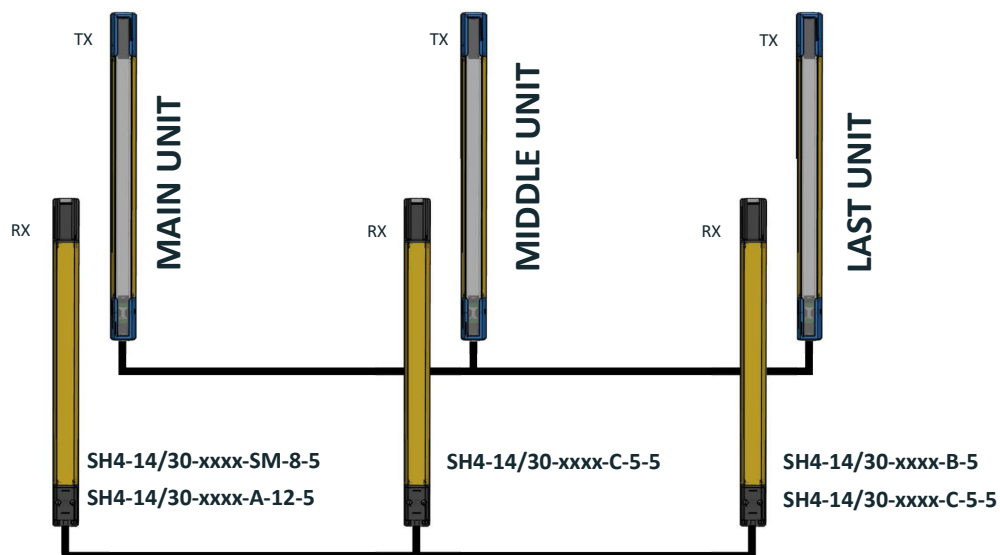


Figure 101: Cascade system

CONNECTION

In order to connect SH4 units in a cascade system, follow the steps below:

1. Connect the M12-5 poles **female** connector of the Main unit to the M12-5 poles **male** connector of following unit.
2. Same way a Last unit can be connected to the Middle unit.



NOTE: When the distance between units doesn't allow a direct connection an optional M12 male to M12 female 5 pole cable may be used up to 10 m cable length. Refer to Accessories appendix to see the available models.

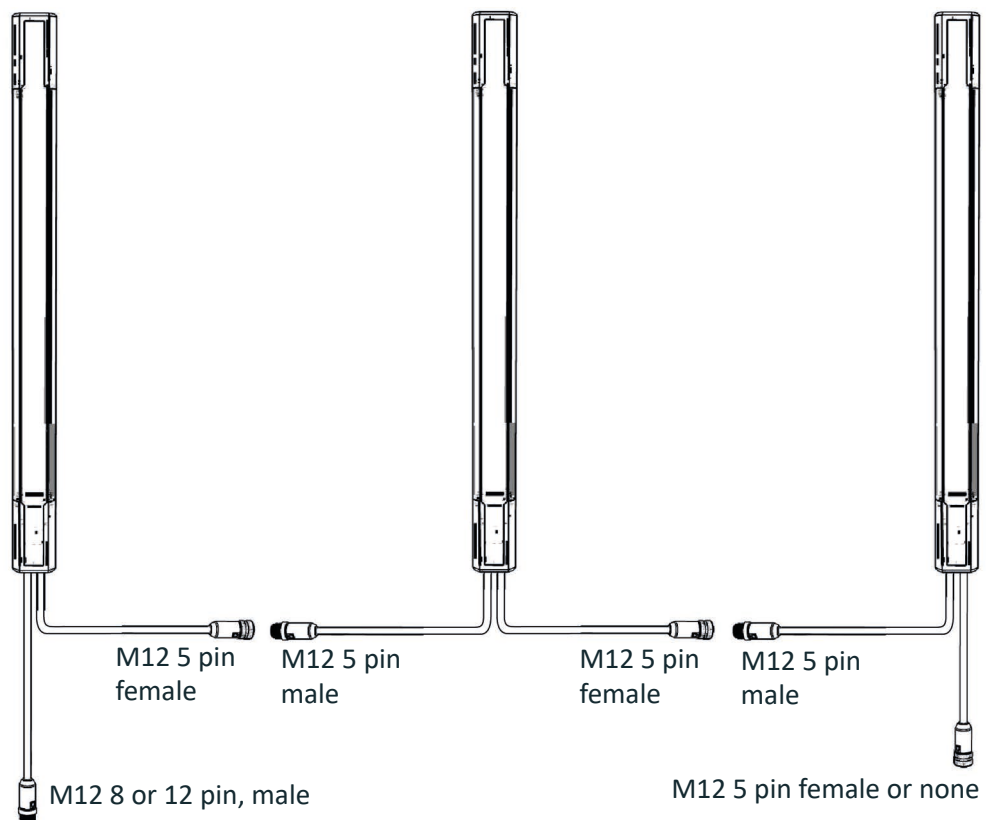


NOTE: When using a SH4-14/30-xxxx-C-5-5 model as Last unit the M12 female connector will provide muting inputs with same pinout of Main unit (depending on the configuration for advanced models). For more details please refer to SH4-14/30-xxxx-SM-8-5 or SH4-14/30-xxxx-A-12-5 connections on the respective Product Reference Guide.



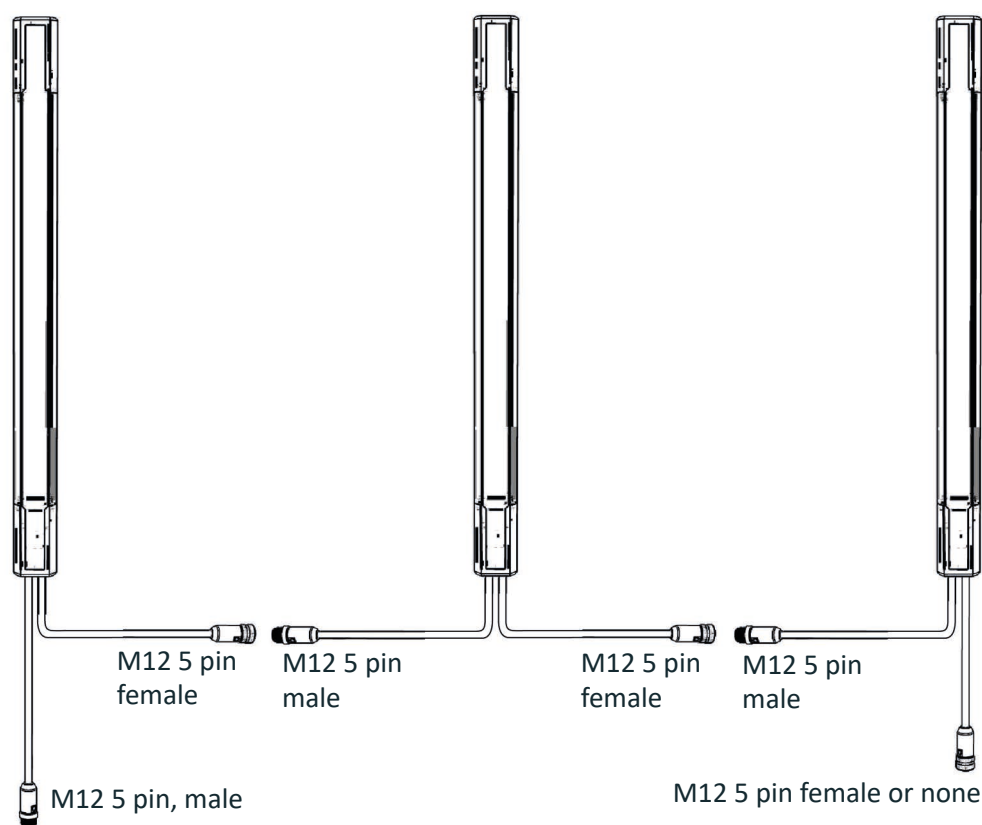
NOTE: When using an SH4-14/30-xxxx-A-12-5 model as Main unit, pin 11 (GP_I02) from 12 poles male connector must be left floating.

RX connection



NOTE: See chapter “Connections” for consult the connector’s pin-out.

TX connection



NOTE: See chapter “Connections” for consult the connector’s pin-out.



NOTE: A safe auto-recognition procedure at startup is implemented; it automatically detects cascade topology and correctly address units.

PROTECTED AREA

When installing a cascade system detection capability at the edge of each unit depends on how cascade units are linked with each other. If the proper cascade brackets are used detection capability at the edges can be calculated according to brackets documentation. In both 30mm and 14mm resolution unit user can always achieve less than 40mm resolution.

OPERATION

A proprietary transmission protocol is used to communicate within cascade system safety related information and status info.

OSSDs are connected to (and thus controlled by) Main unit only.

The redundancy of information and a series of data integrity checks guarantee that safety critical parameters are correctly transferred between cascade units. If that transmission fails due to a stuck-at fault or a signal degradation all cascade units stop into Communication Failure Lockout.

A maximum of three units (Main unit+Middle unit+Last unit) can be connected in a cascade.

14mm and 30mm resolution can be mixed in a cascade system and as described in the previous chapter, cascade system must have the following topology:

UNIT	ALLOWED SH4 MODELS
MAIN	SH4-14/30-xxxx-SM-8-5 Standard Muting SH4-14/30-xxxx-A-12-5 Advanced
MIDDLE (optional)	SH4-14/30-xxxx-C-5-5
LAST	SH4-14/30-xxxx-B-5 ^a SH4-14/30-xxxx-C-5-5 (for muting connection)

- a. Only for Advanced models and depending on their configuration, it is possible to have muting connections.

Cascade Topology (units' number, length and resolution) is auto-detected at start-up and stored in light curtain memory for safety reasons. If topology is changed, a Reset to Factory Configuration must be performed for SH4-14/30-xxxx-SM-8-5 Main unit models or a new GUI parametrization for SH4-14/30-xxxx-A-12-5 Advanced Main unit models before the new cascade can be operated.



NOTE: Refer to paragraph “Factory Reset” on page 48 to reset the Advanced Main unit models.

USER INTERFACE DIALOGUE

A user interface of 16 on Receiver (RX) or 8 on Transmitter (TX) LEDs helps customer to control and check the state of the light curtain, for alignment mode, normal operation and for troubleshooting activity.

For each optical module on both RX and TX unit an RGB led will inform about single module status and light curtain operation.

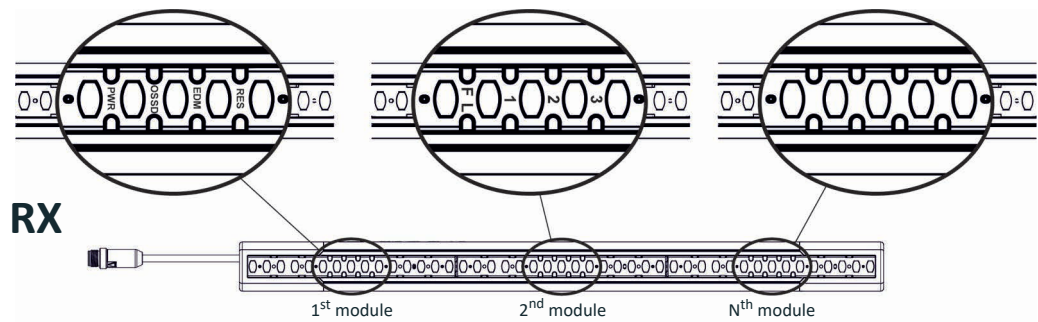


Figure 102: Receiver LED interface

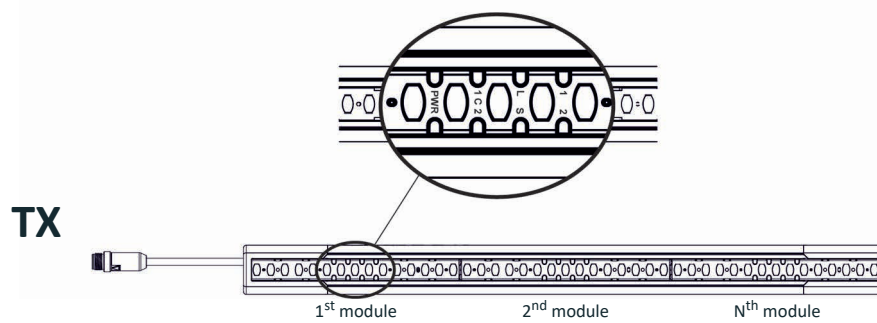


Figure 103: Transmitter LED interface

LED meanings

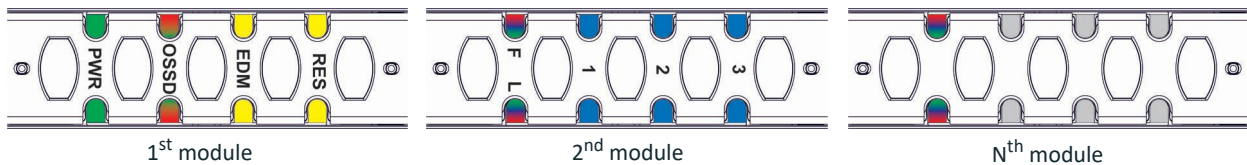
■ = ON

■ = OFF

■ = INDIFFERENT

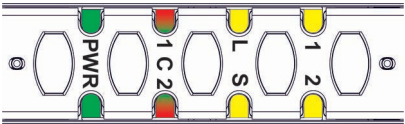
■ = BLINK

RX Side dialogue



ESPE WORKING MODE	INDICATION	LED CONFIGURATION
Normal Operation	Good Signal on modules, no optics intercepted	
	Low Signal on modules, no optics intercepted	
	At least one optic intercepted on modules with blinking red light	
	(eg.) Modules with different signal levels	
	Minimum Signal Level	
	Maximum Signal Level	
Normal Operation OSSD OFF	Invalid Blanking (current unit) or Muting Active or Override Active	 On models longer than 1200 only even modules blinking yellow
	Blanking on current unit Active	
Configuration	GUI Configuration Pending	
Failure Lockout Middle and Last units only show their error code	F22 Microprocessor Failure	
	F33 Optics Failure	
	F1122 Cascade Failure	

TX Side dialogue

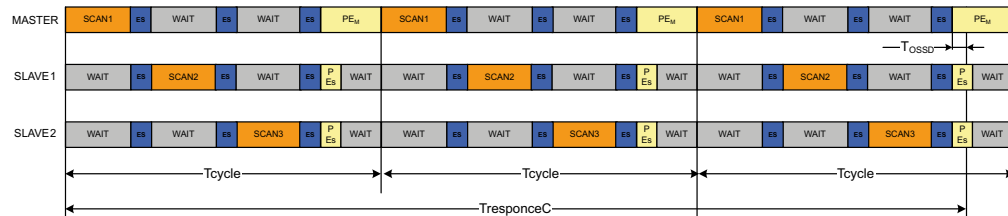


ESPE WORKING MODE	INDICATION	LED CONFIGURATION
Normal Operation Emission Active	NO CODE	
	CODE1	
	CODE2	
Failure	F1 Failure on microprocessor	
	F2 Failure on optics	
	FL Cascade Failure	

RESPONSE TIME

Cascade operation is composed by a serialized optic scanning of all cascade units, then the same post-Elaboration (optic scan analysis and self-testing) of single unit operation. Then response time can be calculated in the same way of single unit case considering Tscan as the time to scan all cascade units (comprehensive of communication messages for units sync purpose).

$$T_{\text{responceC}} = 3 \times T_{\text{scanC}} + 2T_{\text{post-elabC}} + T_{\text{OSSD}}$$



Cascade response time can also be computed from single units' response times with following formulas:

2 UNITS CASCADE: Sum of units' response times + 1ms

3 UNITS CASCADE: Sum of units' response times - 1ms

RECOVERY TIME

In cascade operation only receiver Main unit synchronize with transmitter Main unit by means of two sync optics and respective unique patterns, while T_{SCAN} and T_{SELF-TEST} depend on all units operation. The recovery time is equal to response time or 80ms whichever is greater.

APPENDIX G

GLOSSARY

AOPD (Active optoelectronic protective device)

Its detection function is achieved thanks to the use of optoelectronic receivers and transmitters 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 transmitter-receiver mode and in retro-reflective light curtains.

Block condition (=BREAK)

Status of the light curtain taking place when a suitably-sized opaque object interrupts one or several light curtain beams.

Under these conditions, OSSD1 and OSS2 light curtain outputs are simultaneously switched OFF within the device response time.

Crossing hazard

Situation under which an operator crossing the area controlled by the safety device and this latter 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.

Transmitter (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.

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.O.

Normally opened

N.C.

Normally closed

Normal Operation

Operating state of ESPE when all beams are free, OSSD LED lit GREEN in SL light curtain OSSD1 and OSSD2 are switched ON.

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 photo transistors. 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 (OSSD) 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, OSSD LED lit RED in SLIM light curtain. OSSD1 and OSSD2 are both switched OFF.

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: 2020) defines the minimum requirements needed for ESPE design, manufacturing and testing.

Working point

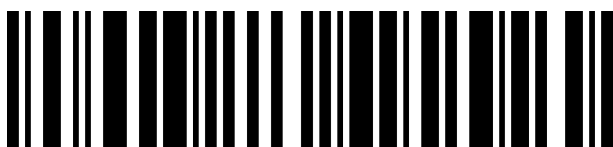
Machine position where the material or semi finished product is worked.

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