SH4 STANDARD MUTING

PRODUCT REFERENCE GUIDE

Safety Light Curtains

DATASENSING

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Patents

See www.patents.datalogic.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)

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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 laser marker:

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.

TECHNICAL SUPPORT

Support Through the Website

Datasensing provides several services as well as technical support through its website. Log on to (www.datasensing.com).

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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 61508-4: 2010	Functional safety of electrical/electronic/programmable electronic safety-related systems. Part 4: Definitions and abbreviations.
EN 62061:2005/A2:2015	Safety of machinery. Functional safety of electrical/ electronic/programmable electronic safety-related control systems.

The device, consisting 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 emitter 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 emitter, 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, Intralogistic 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.

Emitter 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.

SH4 - xx - xxxx - x - x - x

Detection capability or n. of beams	Monitored height in mm	Functionality	Rx main connector	Rx secondary connector
14 mm	300 to 2250	B = Base	5 pin M12	5 pin M12
30 mm		S = Standard	8 pin M12	none
2 beams		SM = Standard Muting	12 pin M12	
3 beams		A= Advanced		
4 beams		C = Cascade		

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)	
		Muting input filtering and timeout setting	
		Anti-interference coding	
			4-signals Muting
			Dynamic partial muting
			Partial Muting (at beams level)
			Fixed Blanking[a]
			External signal fixed[b] blanking teach-in
			Floating Blanking
			Reduced resolution
			Integrated aimer
CONFIGURATION			
-	By wiring	By Dip-Switch	By APP via Wi-Fi

a. 1 Up to 5 simultaneous fixed or floating blanking zones can be used.
b. The response time depends on model height and the activation of anti interference code: for details refer to Response times table

NOTE: For Advanced 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.

CHAPTER 2
INSTALLATION

PACKAGE CONTENTS

Package contains the following objects:

- Receiver (RX)
- Emitter (TX)
- Quick Guide of safety light curtain
- Periodical checklist and maintenance schedule
- 4 angled fixing brackets and specific fasteners
- 2 additional angled fixing brackets for models with heights 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 62061:2005/A2: 2015.

- Use only matched emitter and receiver pairs with same serial no.
- 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 Technical Data, starting on page 73.
- 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 Datasensing 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

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 mm	Finger protection	
R = 30 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.

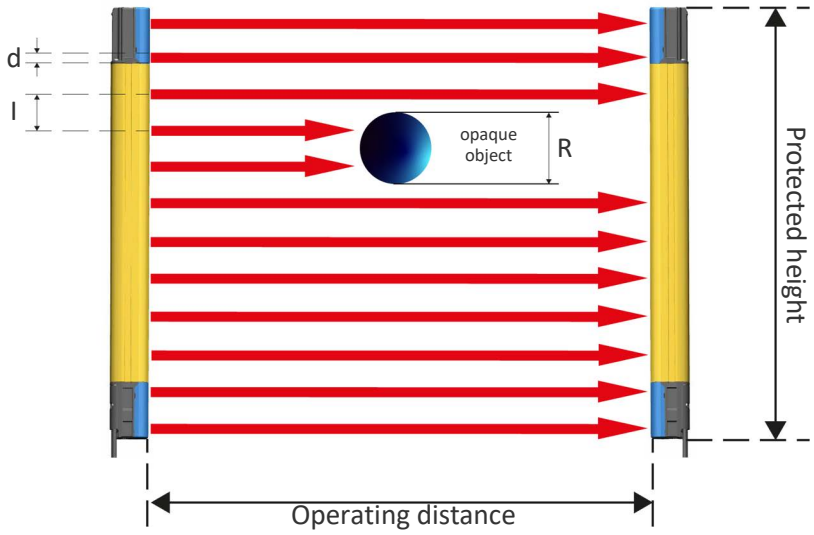


Figure 1: Detection capability

The resolution value is obtained applying the following formula:

R = l + d

where:

l = Interaxes between two adjacent optics

d = Lens diameter

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.

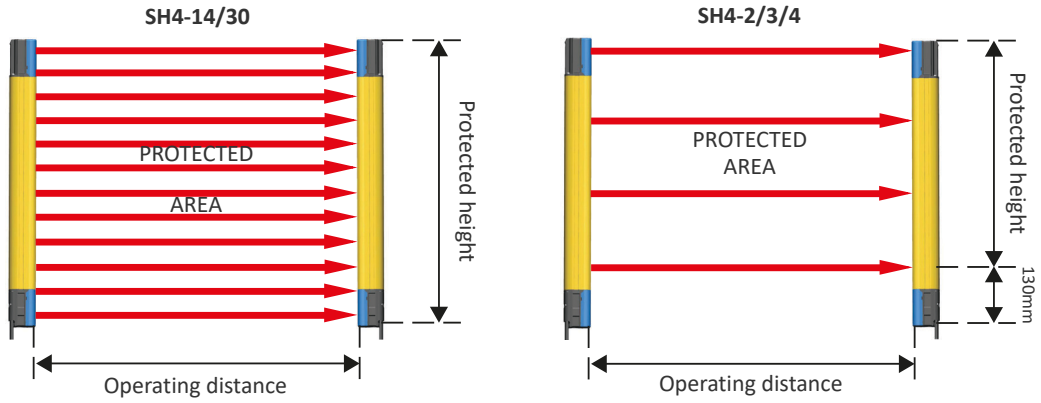


Figure 2: Detection zone

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

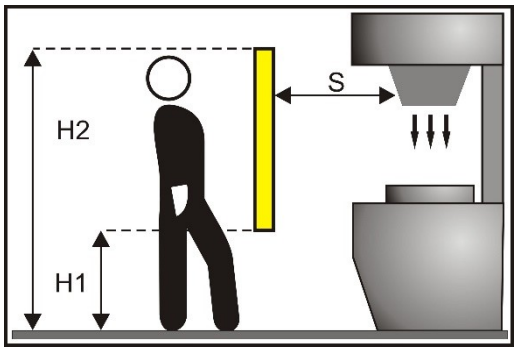


Figure 3: Installation distance (vertical positioning)

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

$$S = K (t1 + t2) + C$$

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 mm/s (t1 + t2) + 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

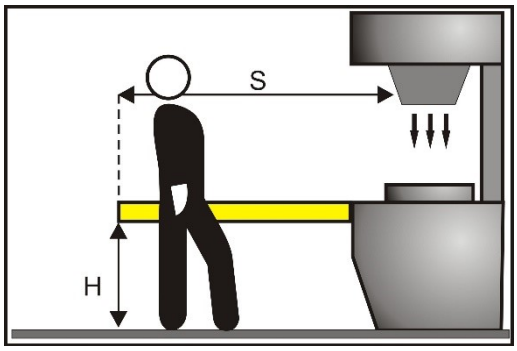


Figure 4: Installation distance (horizontal positioning)

Practical examples

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

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

S = K*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.

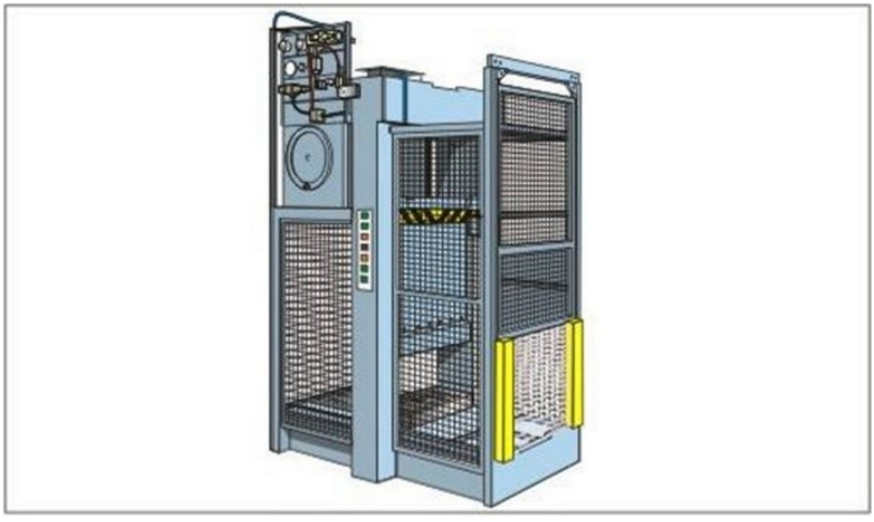
Example 2: Bending presses

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.



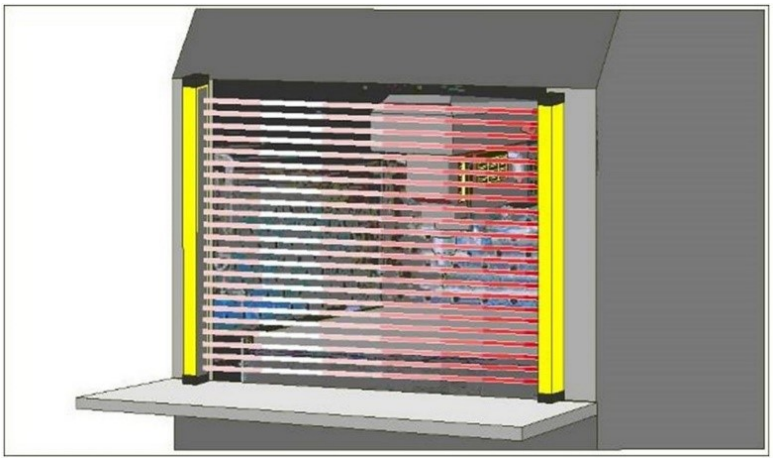
Example 3: Paper cutting machines

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.

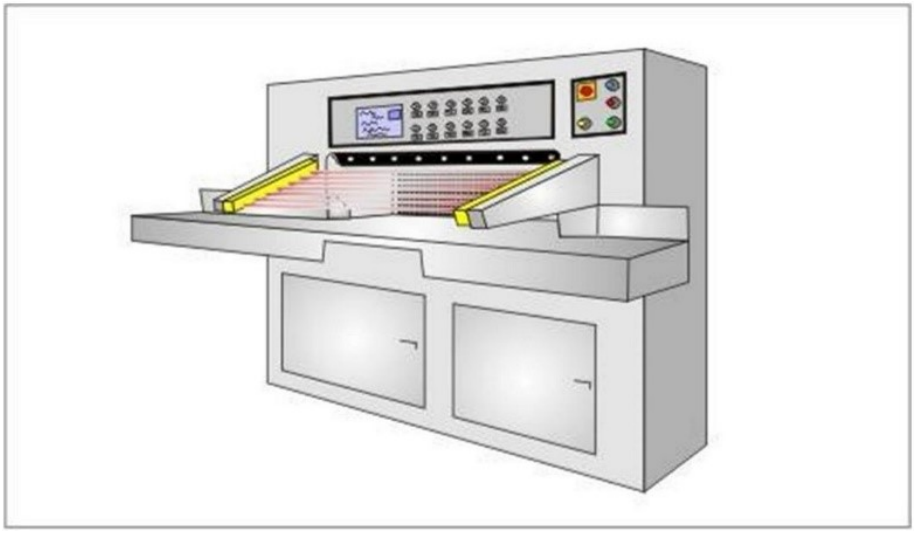


Example 4: Milling machines

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 6, "Mechanical Mounting" on page 22, "Connections" on page 26, "Alignment Procedure" on page 31) 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 6).
- 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.

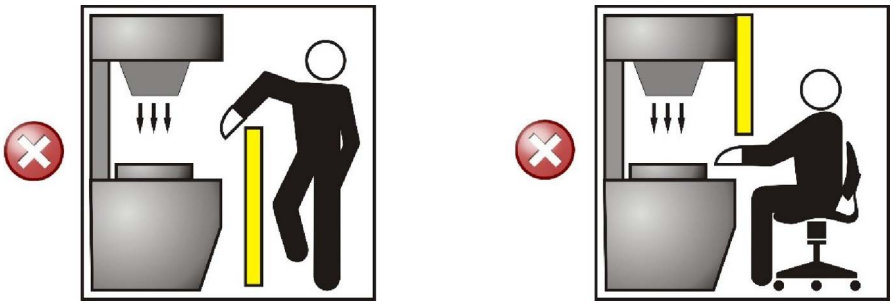


Figure 5: Wrong light curtain positioning

Figure 6: 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.

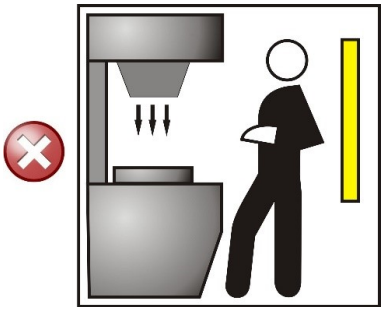


Figure 7: Wrong light curtain positioning

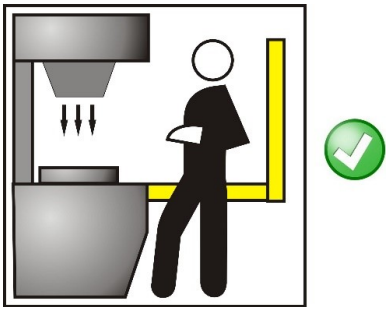


Figure 8: Correct light curtain positioning

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.

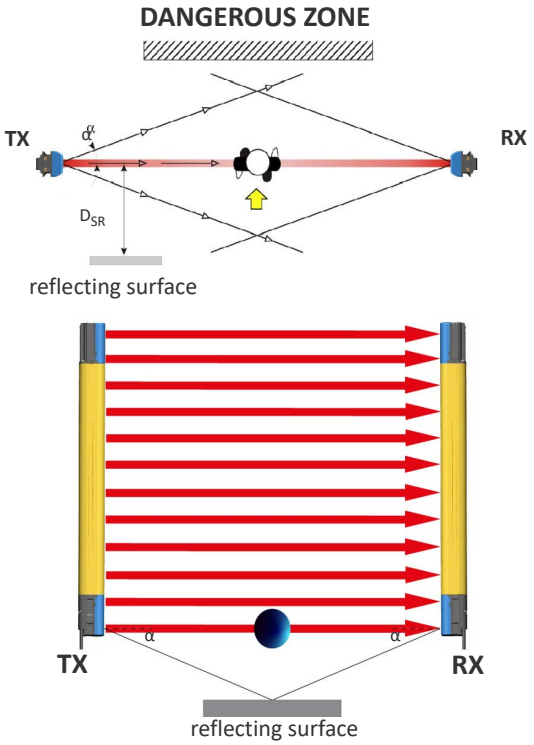


Figure 9: Distances from reflective surfaces

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

for ESPE Type 4 EAA = ±2.5°

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

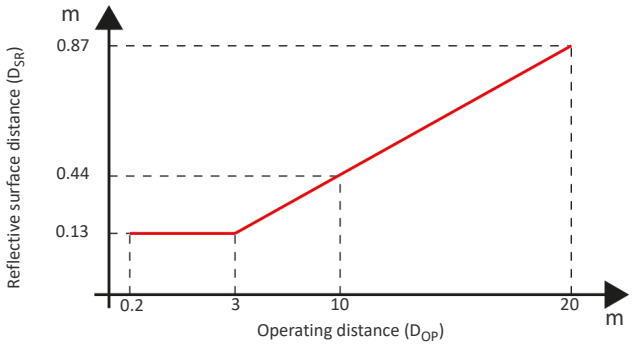


Figure 10: Minimum distance from reflective surface

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

D_{SR} (m) = 0.13 for operating distance < 3 m

D_{SR} (m) = operating distance (m) x tan (2.5°) for operating distance ≥ 3 m

Distance between homologous devices

The following graphic shows the distance from the interfering devices (Ddo) according to the operating distance (Dop) of the couple (TXA – RXA).

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

The TXB interfering device must be positioned outside a minimum Ddo distance from the TXA – RXA emitter-receiver couple axis.

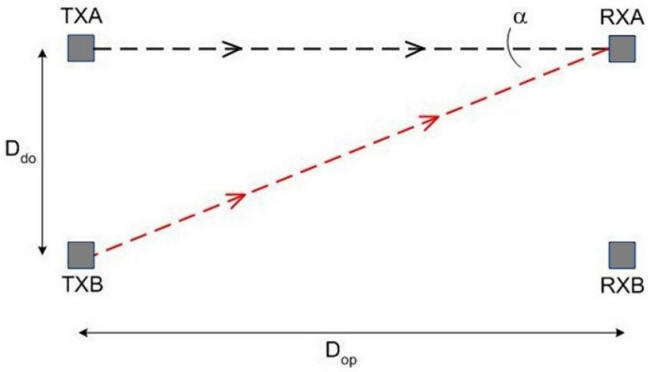


Figure 11: Distance between homologous devices

This minimum Ddo distance depends on:

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

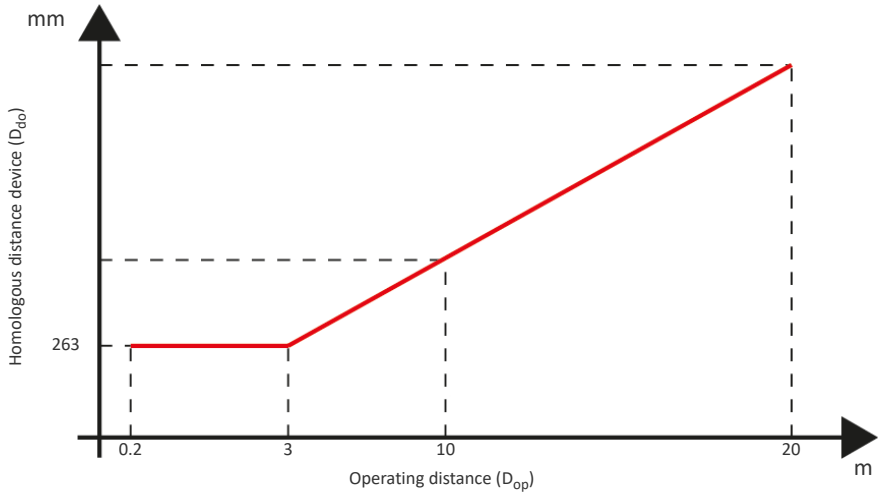


Figure 12 - ESPE Type 4

The formula to get Ddo is the following:

Ddo (mm) = 263	for operating distance < 3 m
Ddo (m) = operating distance (m) x tg 5°	for operating distance ≥ 3 m

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

The figure provides two examples:

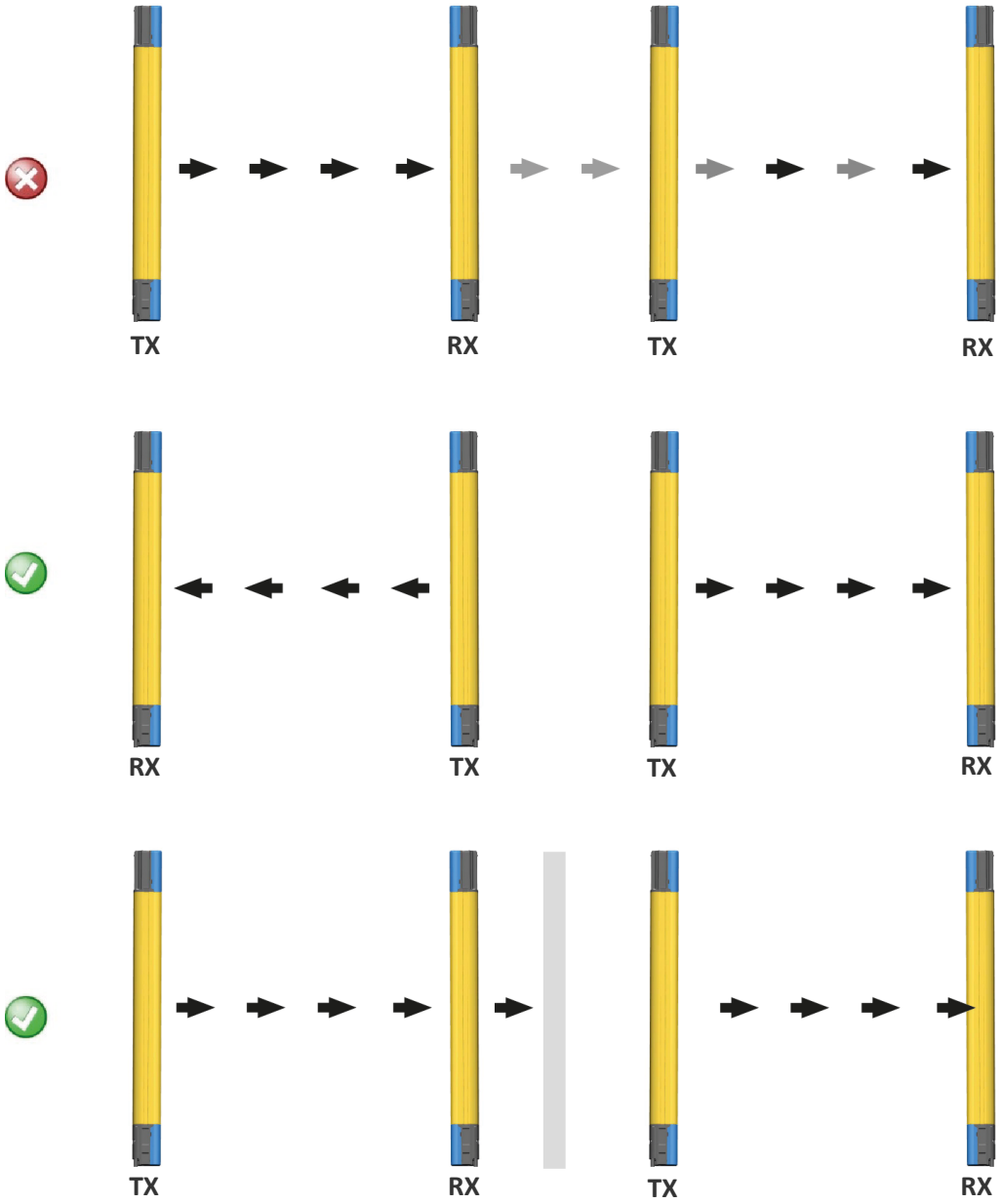


Figure 13: Recommended positioning for homologous devices

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

Emitter and receiver orientation

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

The configurations shown in the figure must be avoided:

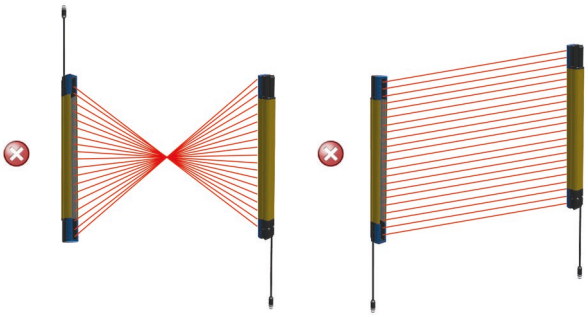


Figure 14: Wrong light curtain TX-RX orientations

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.

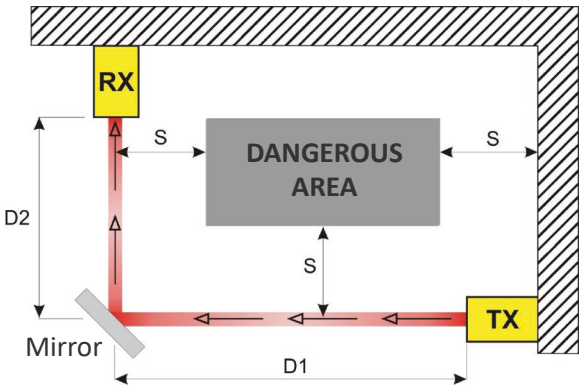


Figure 15: Use of deviating mirrors

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

- The alignment of the emitter and the receiver can be a very critical operation when deviating mirrors are used. Even very small displacements of the mirror is enough to lose alignment.
- The use of 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 (TC-14, TP-30), following the scheme shown in Figure 16.

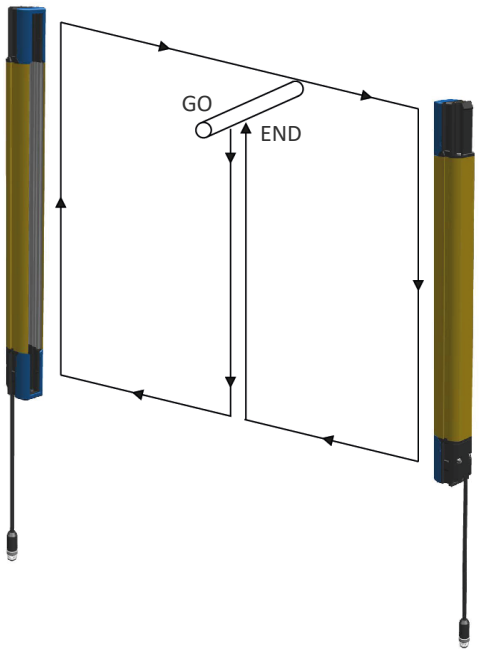


Figure 16: Path of the test piece

- 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

The emitting (TX) and receiving (RX) units must be installed with the relevant sensitive surfaces facing each other.

The connectors must be positioned on the same side and the distance 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 17).

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

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 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.

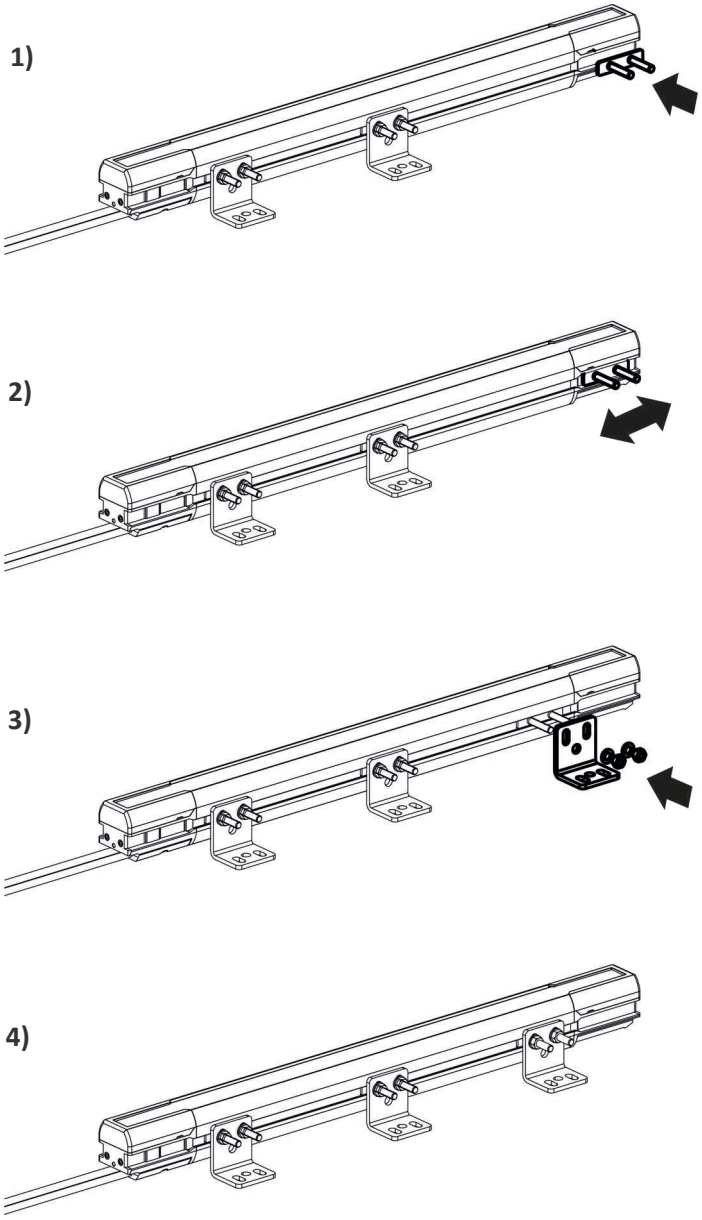


Figure 17: Fixed brackets mounting procedure

In case of applications with particularly strong vibrations, vibration dampers, together with mounting brackets, are recommended to reduce the impact of the vibrations.

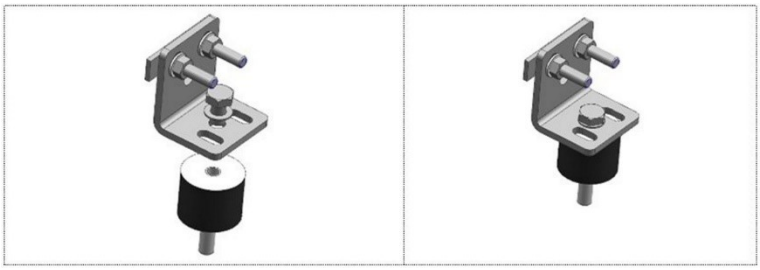


Figure 18: Anti-vibration dampers

The recommended mounting positions according to the light curtain length are shown in Figure 19 and in the following table.

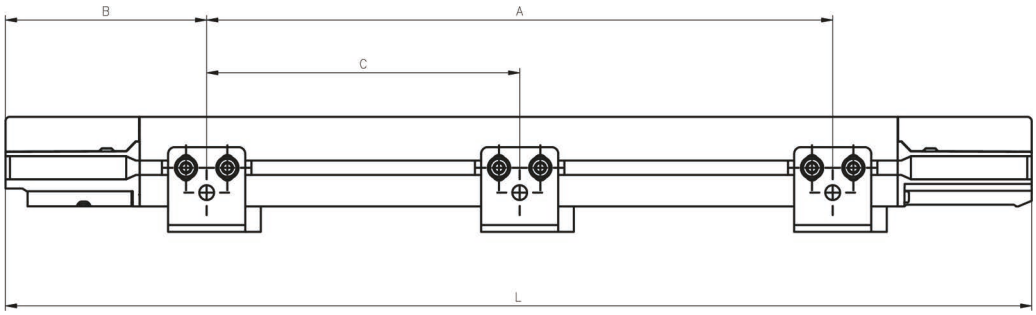


Figure 19 - Light curtain dimensions

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

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

CHAPTER 4
CONNECTIONS

ELECTRICAL CONNECTION

Pin-out and configuration pin connection

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

.

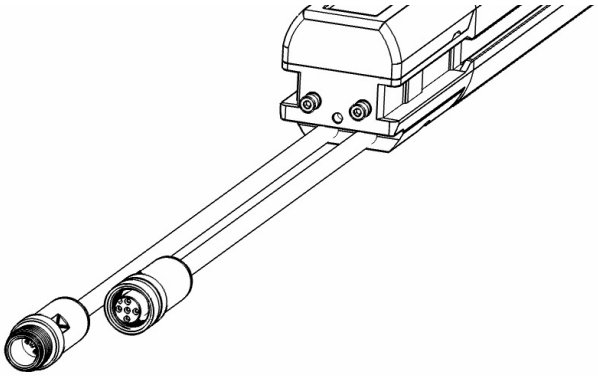
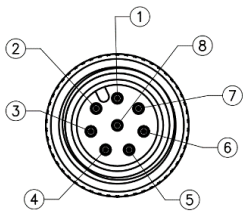
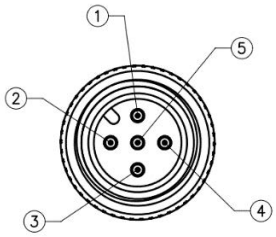


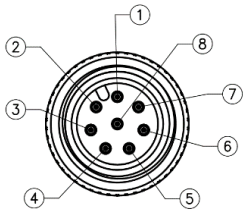
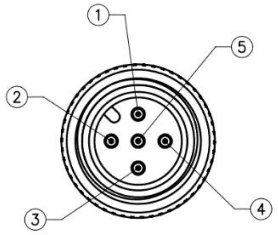
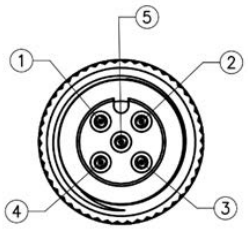
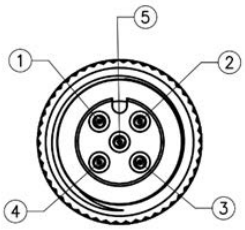
Figure 20: Connections

SH4-X-XXXX-SM-8

RECEIVER
RX M12 MALE 8 PIN

1 - RESET/RESTART/EDM/OVERRIDE (white)
2 - 24V (brown)
3 - MUTING1 (green)
4 - MUTING2 (yellow)
5 - OSSD1 (grey)
6 - OSSD2 (pink)
7 - 0V (blue)
8 - LAMP (red)

EMITTER
TX M12 MALE 5 PIN

1 - 24V (brown)
2 - TEST (white)
3 - 0V (blue)
4 - CODE (black)
5 - COM (grey)

SH4-X-XXXX-SM-8-5

RECEIVER DUAL CONNECTOR	EMITTER DUAL CONNECTOR
RX M12 MALE 8 PIN	**TX M12 MALE 5 PIN**
	
1 - RESET/RESTART (white)	1 - 24V (brown)
2 - 24V (brown)	2 - TEST (white)[1]
3 - OVR1 (green)	3 - 0V (blue)
4 - EDM (yellow)	4 - CODE (black)[2]
5 - OSSD1 (grey)	5 - COM (grey)
6 - OSSD2 (pink)	
7 - 0V (blue)	
8 - OVR2(red)	
RX M12 FEMALE 5 PIN	**TX M12 FEMALE 5 PIN**
	
1 - 24V OUT (brown)	1 - 24V OUT (brown)
2 - MUT2 (white)	2 - TEST (white)
3 - 0V OUT (blue)	3 - 0V OUT (blue)
4 - MUT1 (black)	4 - CODE (black)
5 - COM (grey)	5 - NOT CONNECTED (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

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

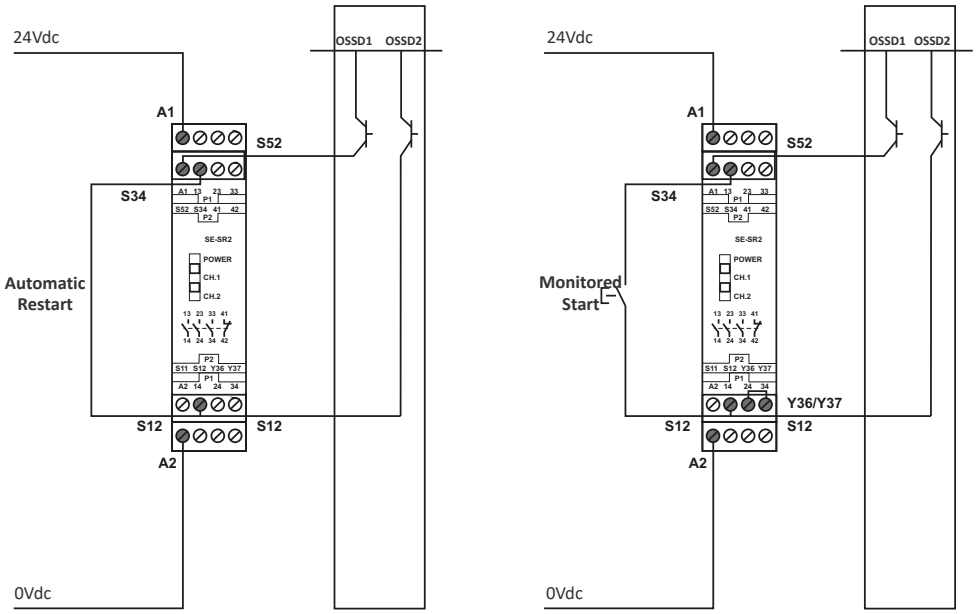


Figure 21: Connection to SE-SR2 Safety Relays

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.

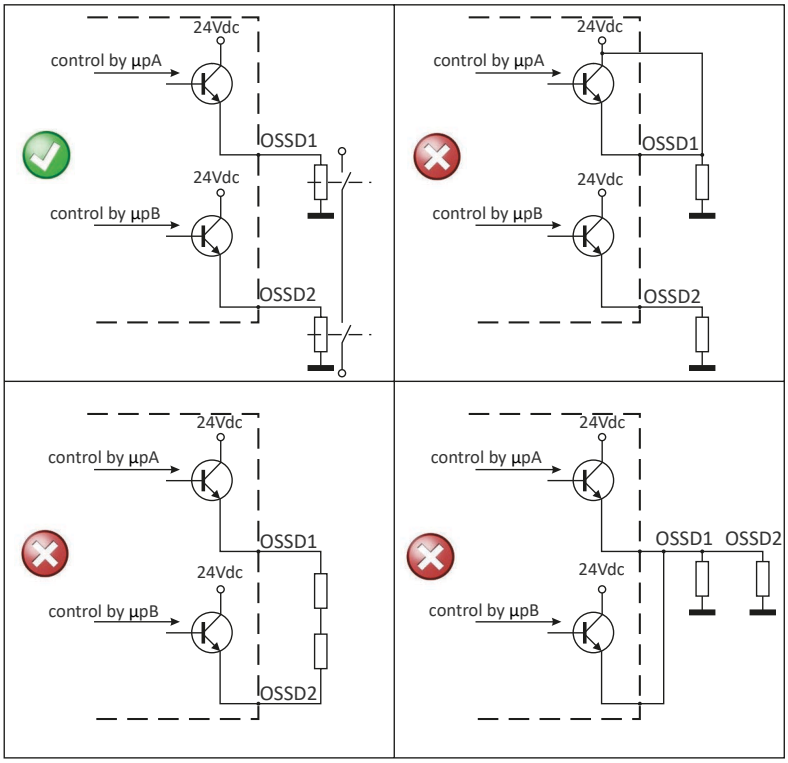


Figure 22: OSSDs connection

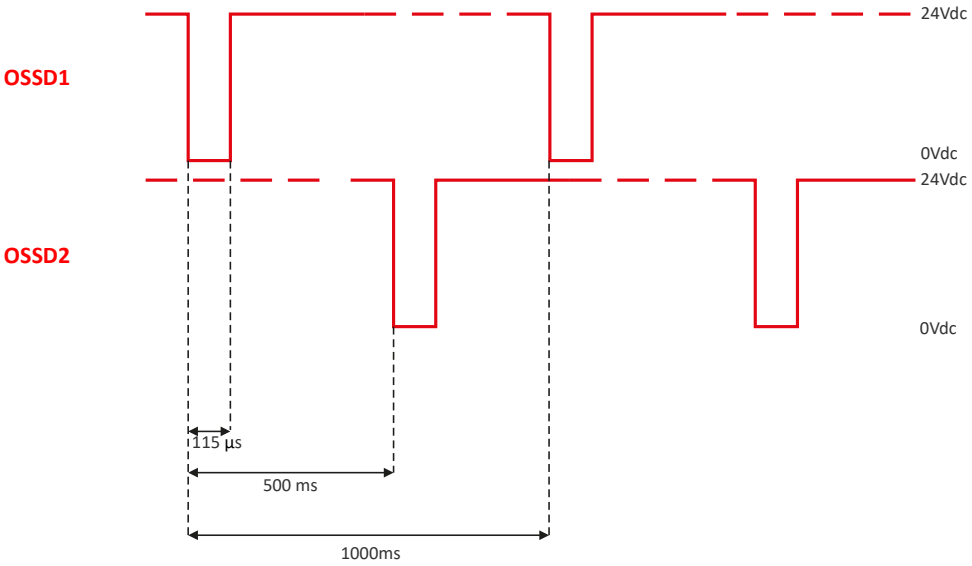


Figure 23: Behavior of OSSDs

CHAPTER 5
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.

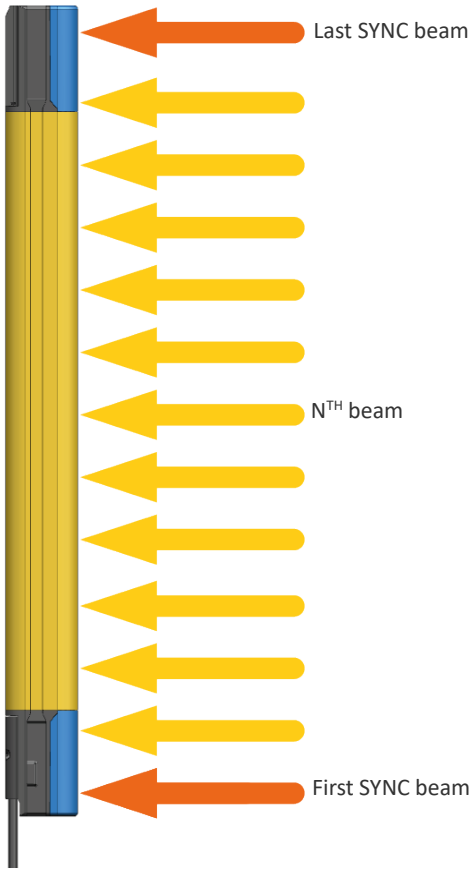
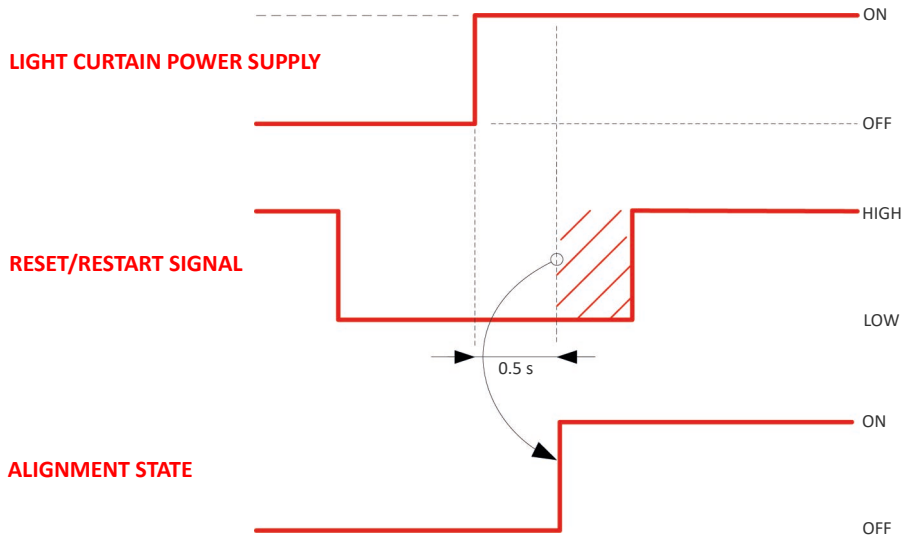


Figure 24: Description of the beams

Alignment Procedure

SH4-X-XXXX-SM-8 models

The ALIGNMENT function can be activated at power up keeping the RESET/RESTART signal (pin 1) **LOW** 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.

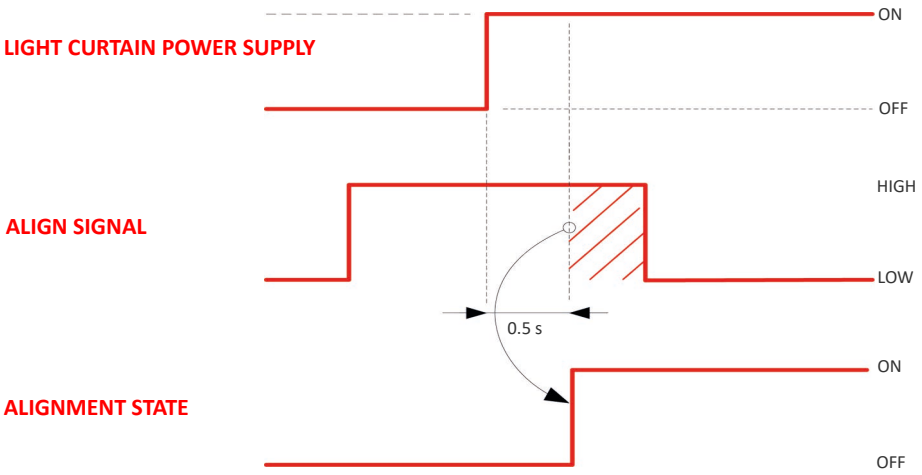


In Alignment Mode ESPE is always in Safe State and the OSSDs are kept OFF.

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.

SH4-X-XXXX-SM-8-5 models

The ALIGNMENT function can be activated at power up keeping the RESET/RESTART signal (pin 1) **HIGH** 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.



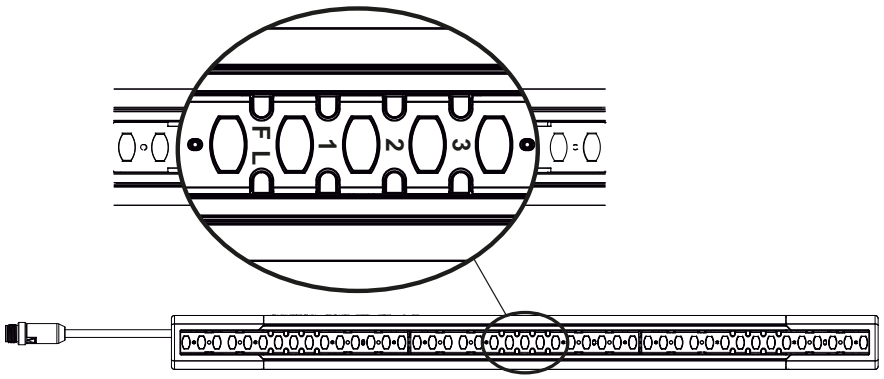
In Alignment Mode ESPE is always in Safe State and the OSSDs are kept OFF.

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.

User interface indication with light curtain in alignment mode

SH4-XX-XXXX-SM-X models

Level is visualized on LED user interface.



LED meanings

= ON

= OFF

= INDIFFERENT

= BLINK

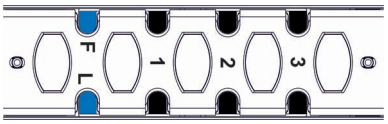
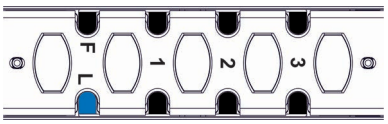
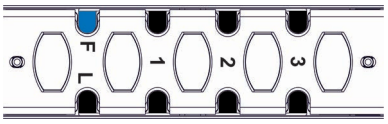
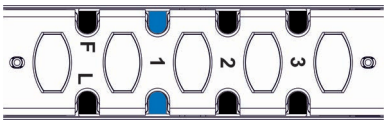
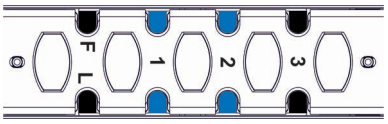
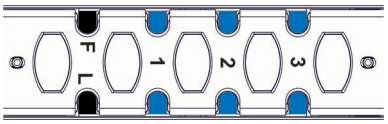
INDICATION	LED CONFIGURATION
Not aligned	
Not aligned Only first sync aligned	
Not aligned Only last sync aligned	
Aligned Minimum Signal Level	
Aligned Medium Signal Level	
Maximum Signal Level	

Table 1: User interface display in alignment mode

User interface indication with light curtain in normal operation

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.

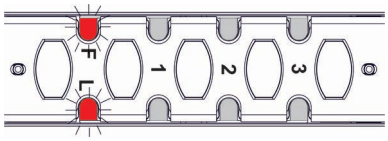
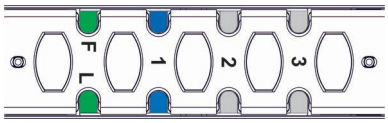
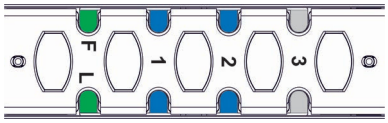
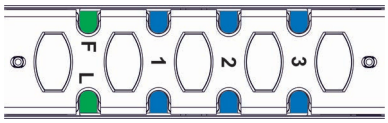
INDICATION	LED CONFIGURATION	OSSD STATUS
At least one beam intercepted on second module		OFF
Minimum Signal Level (weaker beam analog level <2.5V)		ON
Medium Signal Level (weaker beam analog level <3V)		ON
Maximum Signal Level (weaker beam analog level >3V)		ON

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.

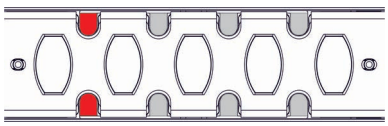
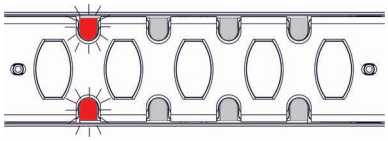
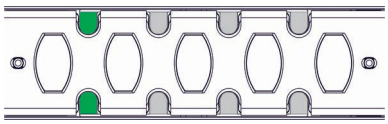
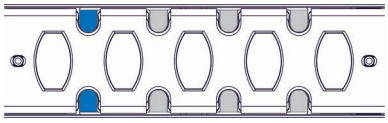
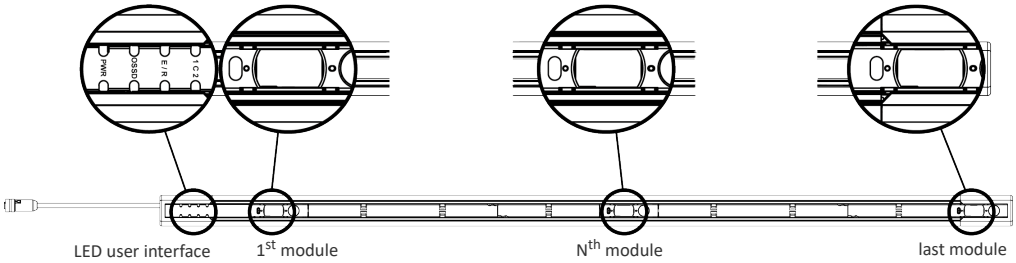
INDICATION	LED CONFIGURATION	OSSD STATUS
At least one beam of other modules intercepted		OFF
At least one beam of module intercepted		OFF
All beams of module free with good signal		ON
At least one beam of module with minimum signal		ON

Table 3: Single module alignment signaling

SH4-X-XXXX-SM-X models

Level is visualized on LED user interface.



LED meanings

= ON

= OFF

= INDIFFERENT

= BLINK

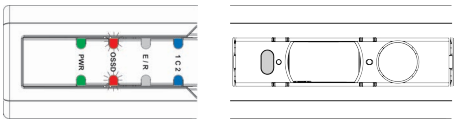
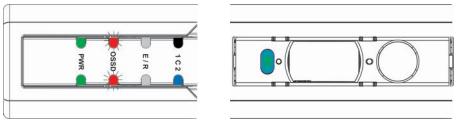
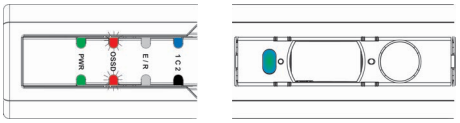
INDICATION	LED CONFIGURATION
Not aligned	
Not aligned Only first sync aligned	 First module
Not aligned Only last sync aligned	 Last module

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

CHAPTER 6
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.

The user can configure basic functions/basic parameters by means of dip switches located inside connection pig-tails thereon referred as “SmartPlug”. Dip switches are present on RX unit only.

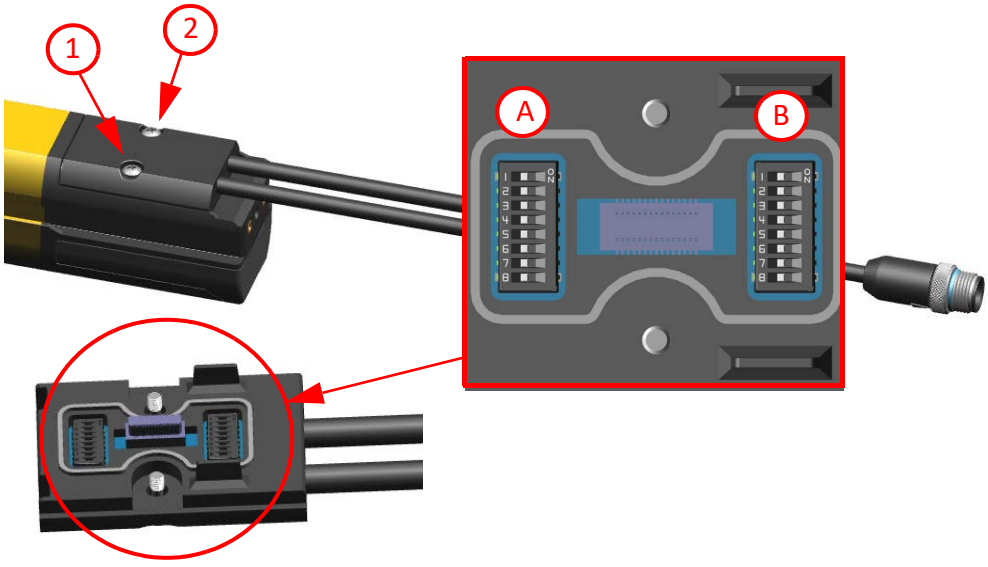
S-8 Models have a single 8 poles M12 connector with 2 muting signals inputs and override on a single wire.

S-8-5 Models have 2 connectors with 2 override signals inputs on main connector, 2 muting signals inputs and power supply output for muting sensors on secondary connector. Can be also used as master in cascade configurations.

DIP SWITCHES

To access the Dip switches it is necessary to remove the rear panel screws located on the Receiver (RX) unit.

Dip switches are redundant: 2 series of 8. For any configuration the Dip switches banks A and B must have the same setting. If the setting are different the light curtain goes in configuration failure (see "F2233 Configuration Failure" on page 63)



SH4-XX-XXXX-SM-8 Dip Switches Settings

FUNCTION	DIP	SETTINGS (DEFAULT IN BOLD)
Partial Muting	1	**OFF: Total Muting** ON: Partial Muting
Code	2 - 3	**OFF - OFF: no code** OFF - ON: code 1 ON - OFF: code 2 ON - ON: not used (*Configuration Failure if set*)
EDM	4	**OFF: Disabled** ON: Enabled
Restart Mode	5	**OFF: Automatic** ON: Manual
Muting Direction	6	**OFF: T** ON: L
Muting Timeout	7	**OFF: 10 min** ON: infinite
Muting Filter	8	**OFF: 100ms muting filter** ON: no muting filter

SH4-XX-XXXX-SM-8-5 Dip Switches Settings

FUNCTION	DIP	SETTINGS (DEFAULT IN BOLD)
Override Trigger[1]	1	**OFF: Level** ON: Edge
Code	2 - 3	**OFF - OFF: no code** OFF - ON: code 1 ON - OFF: code 2 ON - ON: not used (*Configuration Failure if set*)
EDM	4	**OFF: Disabled** ON: Enabled
Restart Mode	5	**OFF: Automatic** ON: Manual
Muting Direction	6	**OFF: T** ON: L
Muting Timeout	7	**OFF: 10 min** ON: infinity
Muting Filter (100ms)	8	**OFF: 100ms muting filter** ON: no muting filter

1. When Restart Mode is Manual a RESTART signal is requested at the end of Override sequence.

FACTORY RESET

Factory reset allows to reset automatic cascade topology detection on Receiver (RX) unit, stored in flash for safety reasons.

To perform a factory reset follow the next steps:

1. Turn OFF the Safety Light Curtain
2. Set dip switch bank A all OFF
3. Set dip switch bank B all ON
4. Power ON the Safety Light Curtain
5. The Factory Reset signal is shown (See “User Interface Dialogue” on page 61.)
6. Power OFF the Safety Light Curtain
7. Setting the Dip-switches (bank A and bank B) according to the desired configuration (see “Dip Switches” on page 36)
8. Power ON the Safety Light Curtain

When reset is performed relative user interface indication is visualized.

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 39
- “Manual Restart” on page 40

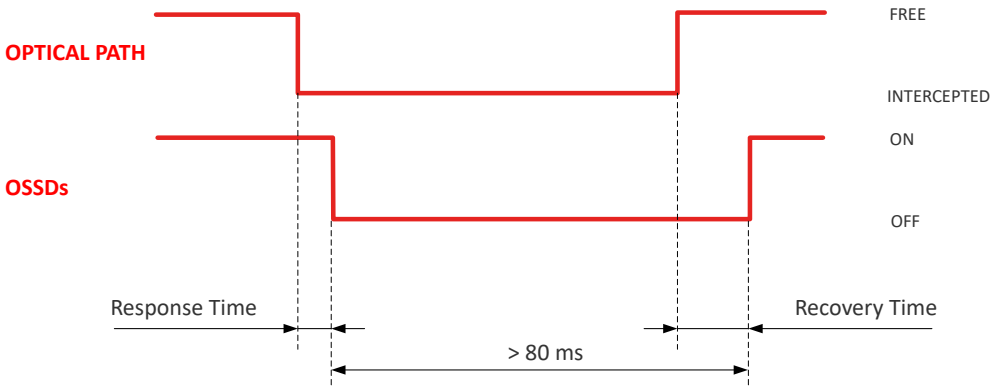
Automatic Restart

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).



Manual Restart

After the ESPE has detected an opaque object in the controlled area, the light curtain begins its normal functioning only after a proper signal pattern on RESTART input (**pin 1**, 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:

SH4-X-XXXX-SM-8 models

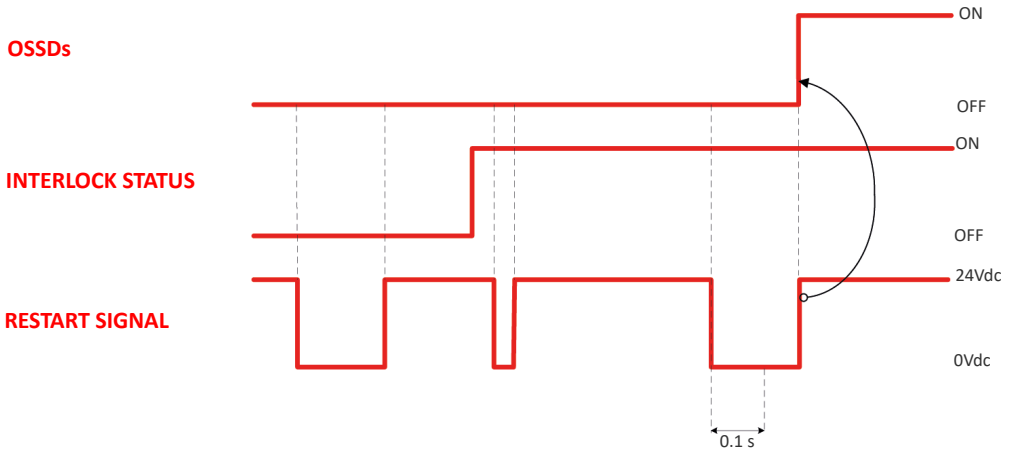


Figure 25: OSSDs behavior in Manual Restart Mode and Restart Pattern (SM-8)

The outputs go high after a time that is the maximum value between the recovery time and the time of restart low (more or equal to 100 ms), so this time can be any between 0.1 s and 5 s.

SH4-X-XXXX-SM-8-5 models

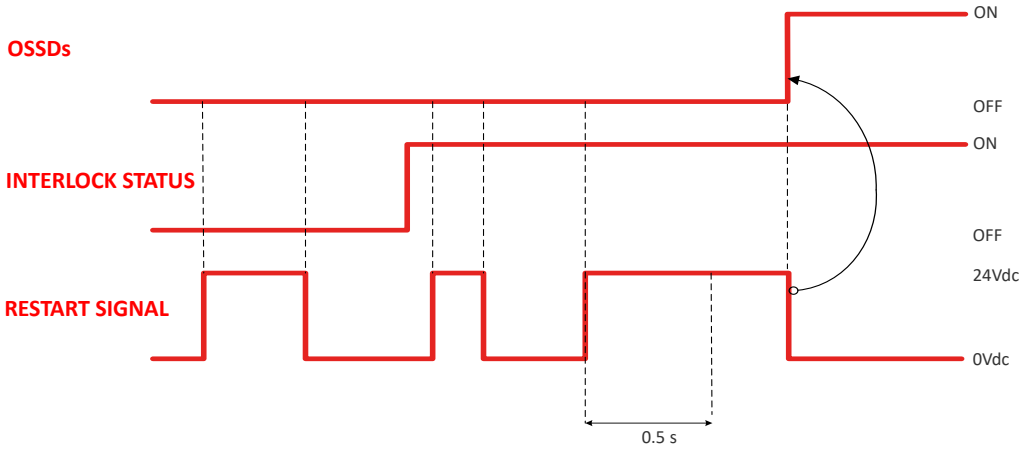


Figure 26: OSSDs behavior in Manual Restart Mode and Restart Pattern (SM-8-5)

The outputs go high after a time that is the maximum value between the recovery time and the time of restart high (more or equal to 500 ms), so this time can be any between 0.5 s and 5 s.

NOTE: In the previous timing diagrams the objects are already removed.

CAUTION

Carefully assess risk conditions and reset modes. In applications protecting access to dangerous areas, the automatic reset 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 reset of the SE-SR2 relay (see “Safety Units” on page 96) is necessary.

Configuration

Set the Dip switch according to the chosen configuration:

Restart Mode	5	**OFF: Automatic** ON: Manual	

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).

To activate RESET function the button connected to RESET input (**pin 1**) has to be kept pressed for at least 5 seconds in non critical failure state.

For all critical failure a power cycle is necessary.

SH4-X-XXXX-SM-8 models

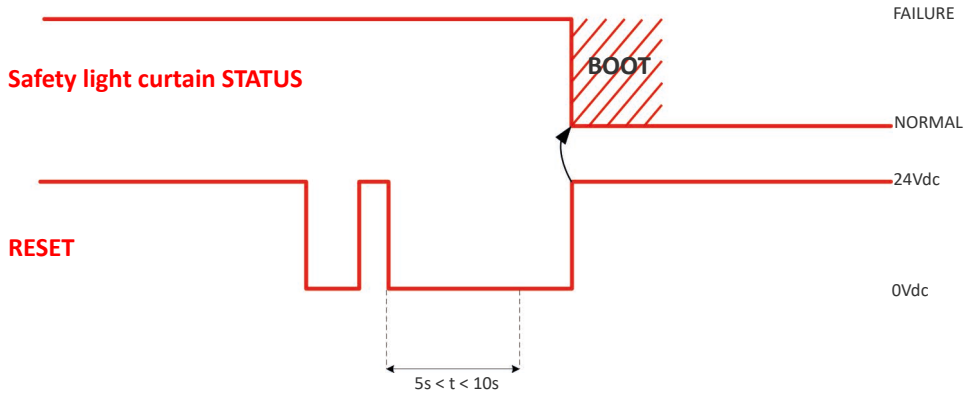


Figure 27: Reset function timing (SM-8)

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

For a RESET to be performed two signal edge must be detected. A timeout of 10s on the low RESET will cycle back the ESPE in lockout.

SH4-X-XXXX-SM-8-5 models

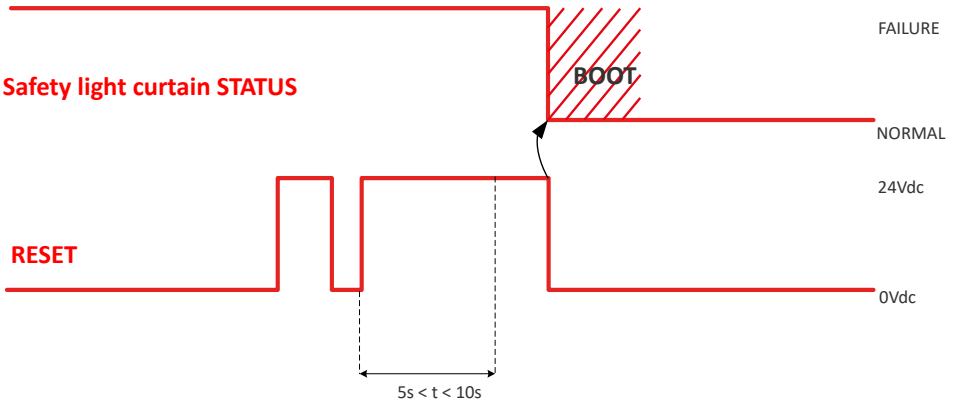


Figure 28: Reset function timing (SM-8-5)

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

For a RESET to be performed two signal edge must be detected. A timeout of 10s on the high RESET will cycle back the ESPE in lockout.

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).

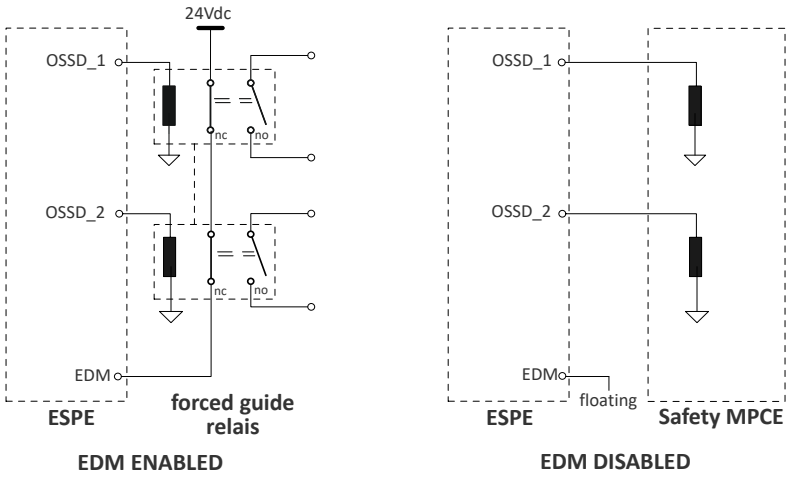


Figure 29: EDM wiring

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.

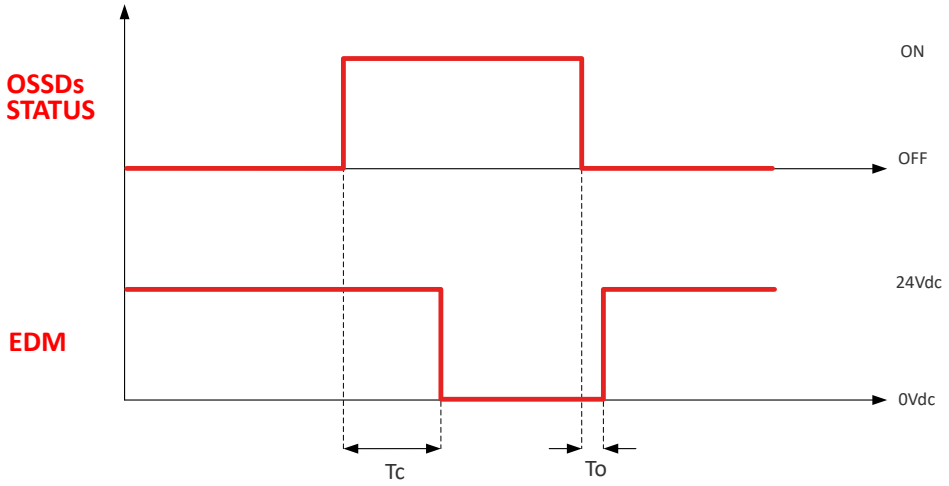


Figure 30: EDM function timing

$T_c \geq 350$ ms (time between OSSD OFF-ON transition and EDM test)
$T_0 \geq 100$ ms (time between OSSD ON-OFF transition and EDM test)

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

Configuration

Set the Dip switch according to the chosen configuration:

EDM	4	**OFF: Disabled** ON: Enabled	

ANTI INTERFERENCE CODING

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 emitter and receiver unit must be configured with the same Coding setting.

Configuration RX

On RX unit set the Dip switch according to the chosen configuration:

Code	2 - 3	**OFF - OFF: no code** OFF - ON: code 1 ON - OFF: code 2 ON - ON: not used[1]	

1. *Configuration Failure if set*

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 0.5s (plus a cycle time) and after the response time of the light curtain.

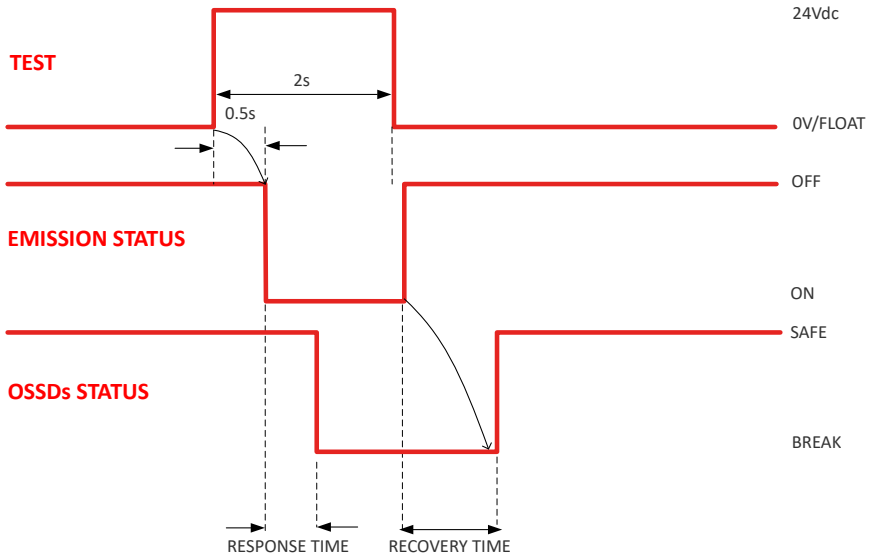


Figure 31: OSSDs timing for test on TX

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

CAUTION: 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-X-XXXX-X models only)

On Body models only (SH4-X-XXXX-X), TEST input (**Pin 2** on transmitter unit) may be used to set the Emission Range.

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.

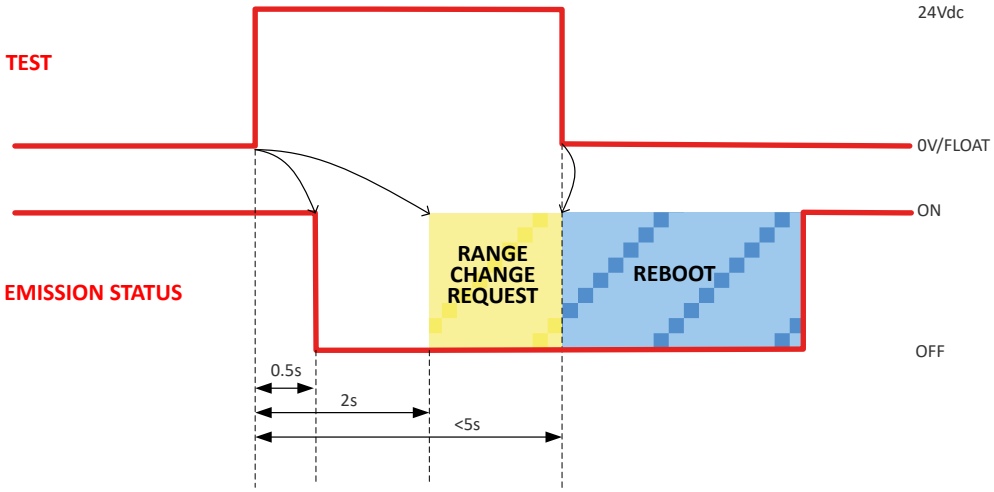
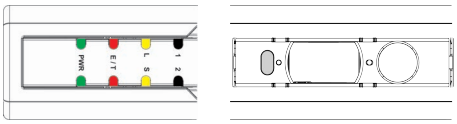


Figure 32: Emission Range Change Request timings

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, emitter unit reboots with the new range.

If a falling edge is not detected within 5s from rising edge emitter 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.

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 two 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)

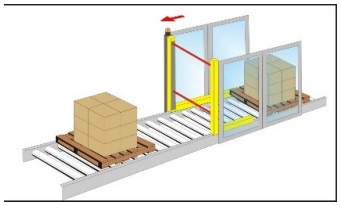


Figure 33: L-shaped version with integrated Muting sensors for unidirectional Muting

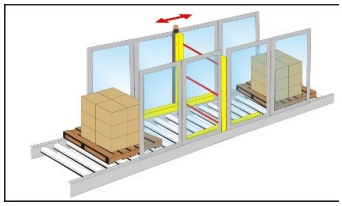


Figure 34: T-shaped version with integrated Muting sensors for bidirectional Muting

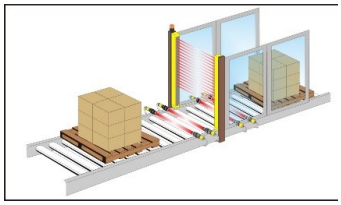


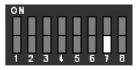
Figure 35: Linear version with external Muting sensors

- The safety light curtain is equipped with two inputs (MUTING1 and MUTING2) for the activation of this function, according to the current Standards.
- This function is particularly suitable when an object, but not a person, has to pass through the 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 two Muting sensors or actuators, these should be correctly connected and positioned in order to avoid undesired Muting or potentially dangerous conditions for the operator.
- MUTING1 and MUTING2 can't be activated simultaneously.
- State of Muting is signaled by an optional external Muting Lamp and by modules status LEDs on the user interface. When the Muting function is ON the LAMP and the LEDs begin to blink.
- If both first and last beams are intercepted by the passing material the light curtain recovery time may be longer.

WARNING: 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 of Muting

Set the Dip switch according to the chosen configuration:

Muting Direction	6	**OFF: T** ON: L	
Muting Timeout	7	**OFF: 10 min** ON: infinity	
Muting Filter (100ms)	8	**OFF: 100ms muting filter** ON: no muting filter	

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, S21, S3, S4 sensors.

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

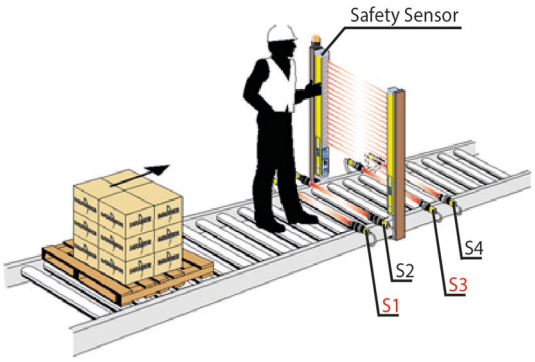


Figure 36: Typical Muting Application

Muting mode selection

The ESPE can be used with both bidirectional (T type, two 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.

L muting (2 signals/2 sensors)

The activation of the Muting function occurs as a result of a rising edge on MUTING1 and MUTING2 inputs. As reported in figure below T_{12} activation delay between MUTING1 and MUTING2 must be greater than response time and less than 4s.

NOTE: See "Response Times" on page 78.

T_{12} is measured and then multiplied by 2 to calculate the muting timer. Muting operations is ceased when $2xT_{12}$ timer expires, starting from falling edge on MUTING1 input. If MUTING2 input goes low before MUTING1 muting is ceased immediately. Muting is optionally ceased also when light curtain is free before the timer expires (Muting stop condition parameter).

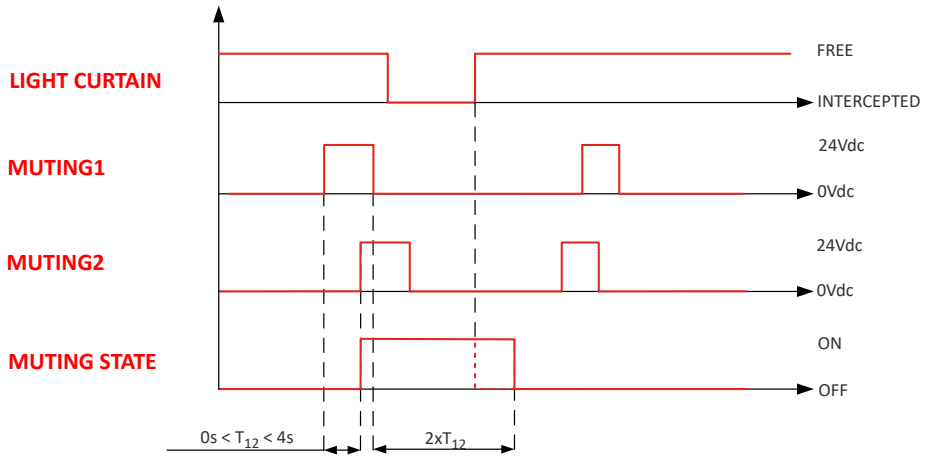


Figure 37: L muting timings

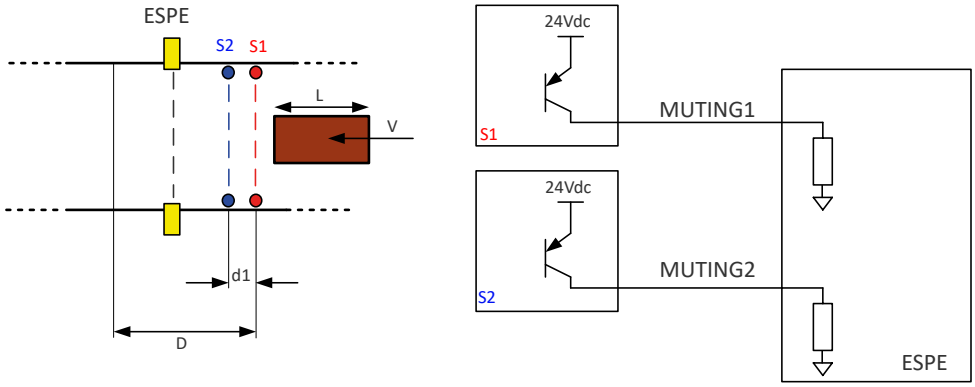


Figure 38: Connection of sensors on MUTING1 and MUTING2 inputs in case of monodirectional (L), two-sensors muting

T muting (2 signals/4 sensors)

The activation of the Muting function occurs as a result of a rising edge on MUTING1 and MUTING2 inputs (the order depends on material direction). As reported in figure below T_{12} activation delay between MUTING1 and MUTING2 must be greater than response time and less than 4s.

NOTE: See "Response Times" on page 78.

NOTE: Muting operations is ceased as soon as the signal on MUTING1 or MUTING2 goes low.

.

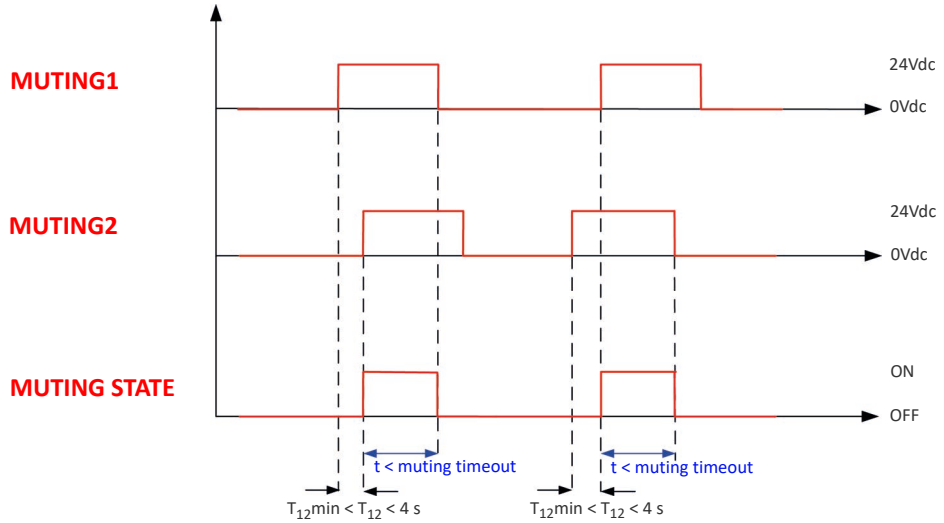


Figure 39: T muting timings

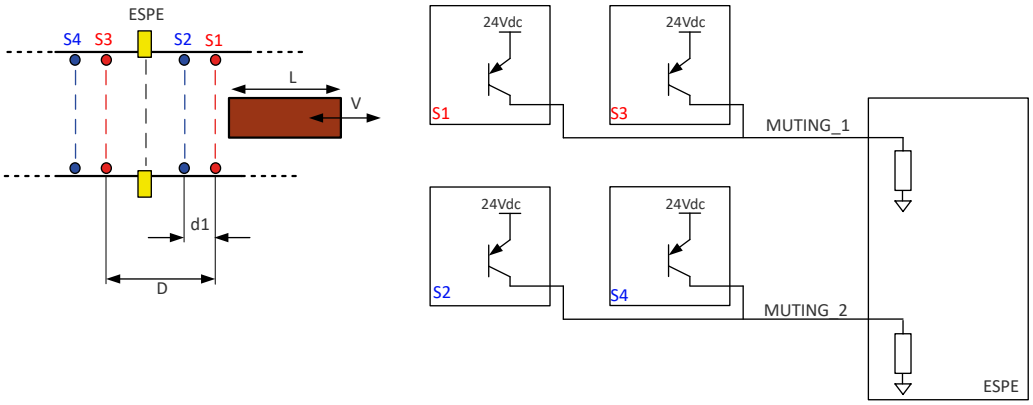


Figure 40: Connection of sensors on MUTING1 and MUTING2 inputs in case of bidirectional (T), four-sensors muting

Partial Muting (SH4-X-XXXX-SM-8 models only)

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 effects to selected zones only.

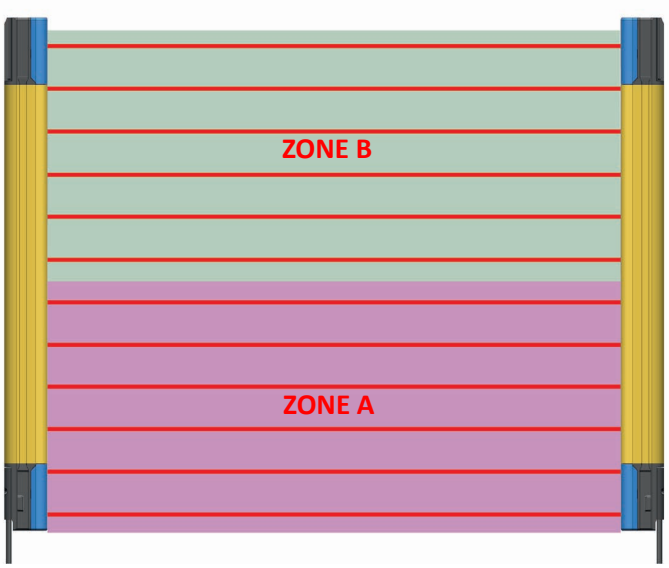
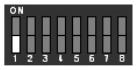


Figure 41: Partial muting

Configuration

Set the Dip switch according to limit muting function effect to selected beam zones:

Partial Muting	1	**OFF: Total Muting** ON: Partial Muting	

Muting signaling devices (SH4-X-XXXX-SM-8 models only)

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 LAMP output (**pin 8**).

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

When a lamp is connected, if a break is detected, ESPE goes in Lamp Failure Lock-Out state and shows the related message on the display (refer to “Technical Data” on page 101 for information about the lamp output).

Electrical Connection

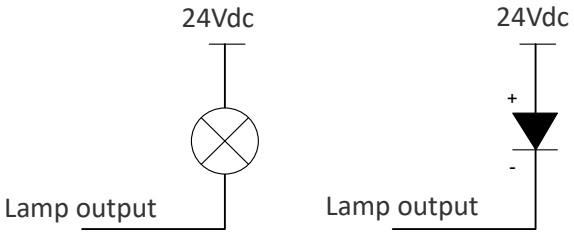


Figure 42: Muting Signaling Device connection

NOTE: If an external muting lamp is not used, LAMP output (pin 8) must be connect to 24Vdc to disable the integrity check.

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: For the SH4-X-XXXX-SM-8-5 models, two separate redundant inputs (pin 3-OVR1 and pin 8-OVR2) have to be connected through one normally open contact to 24Vdc and one normally open contact to 0V thus to provide complementary inputs (see “SH4-X-XXXX-SM-8-5 models” on page 54).

NOTE: For the SH4-X-XXXX-SM-8 models, a single override input (pin 1) is provided for compatibility with SG-N and SE models but a specific signal pattern must be read at the input for override activation (see “SH4-X-XXXX-SM-8 models” on page 57).

SH4-X-XXXX-SM-8-5 models

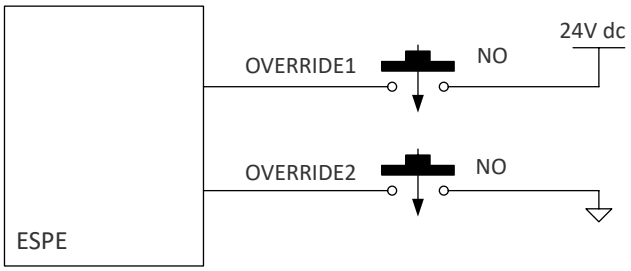
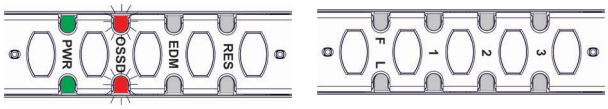


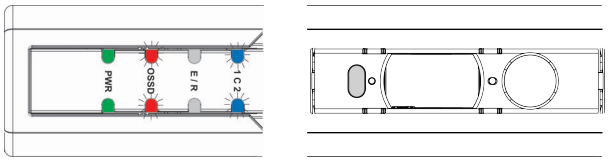
Figure 43: Override connection for SM-8-5 models

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-XX-XXXX-X models:

Override allowed	

or with both red OSSD and blue 1C2 LEDs for the SH4-X-XXXX-X models:

Override allowed	

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” on page 55
- “Edge Trigger” on page 55

Level Trigger

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

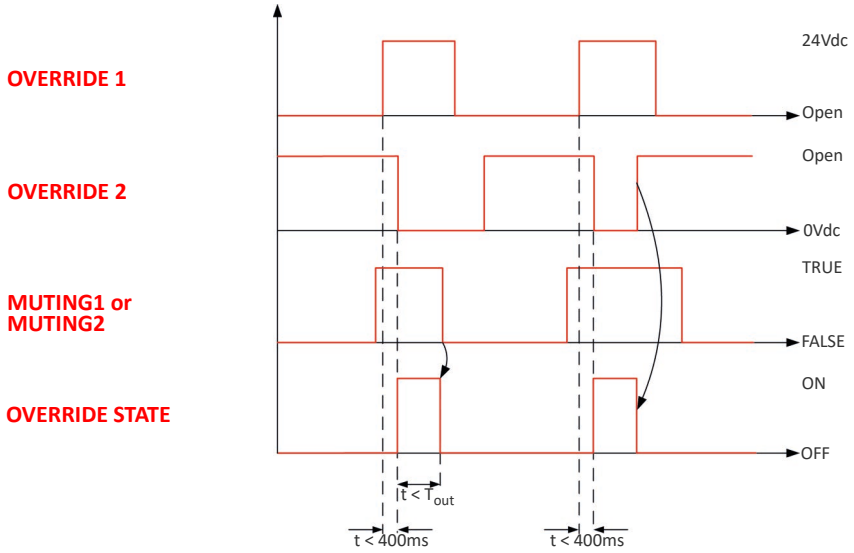


Figure 44: Level Triggered Override Timings

Edge Trigger

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

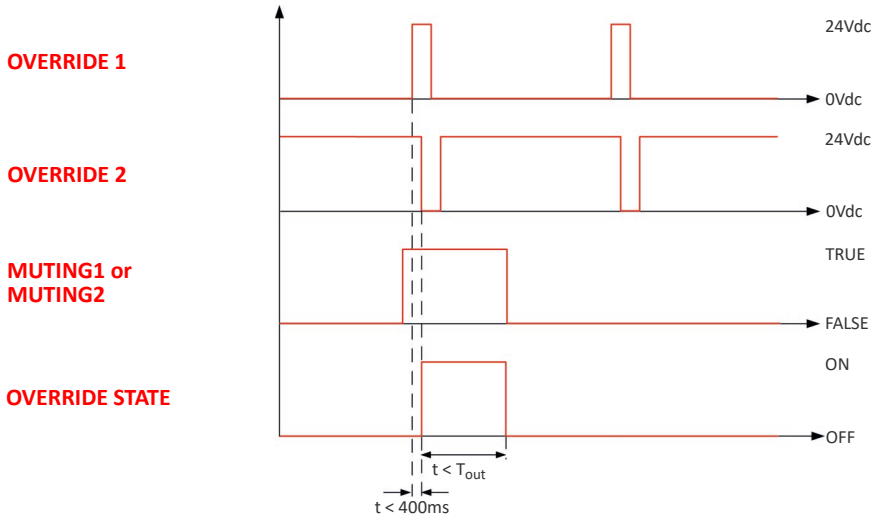
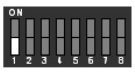


Figure 45: Edge Triggered Override Timings

Configuration

Set the Dip switch according to the chosen configuration:

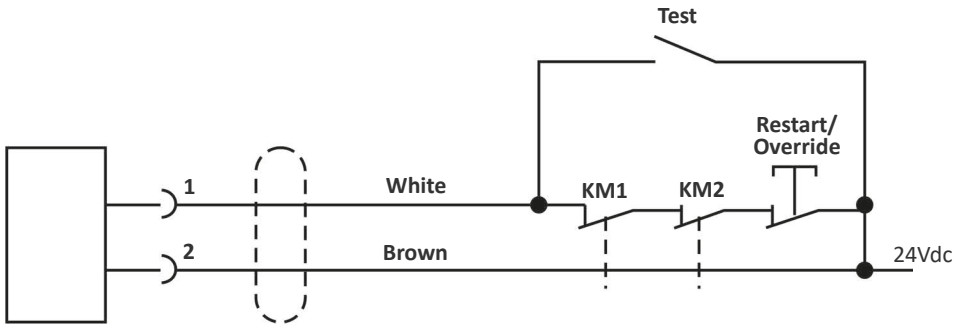
Override Trigger[1]	1	**OFF: Level** ON: Edge	

1. When Restart Mode is Manual a RESTART signal is requested at the end of Override sequence.

SH4-X-XXXX-SM-8 models

Override can be activated by a single input, provided that a specific signal pattern is respected.

The Override input (**pin 1**) is shared with EDM feedback and Restart.



Two different way of starting OVERRIDE are provided:

- “Override at Startup” on page 58
- “Override at Runtime” on page 59

Override at Startup

To activate override RESTART button must be pressed (signal **LOW**) between 5 and 9 seconds after startup and kept pressed for more than 5 seconds for override to start.

At least one beam must be intercepted for override request to be accepted.

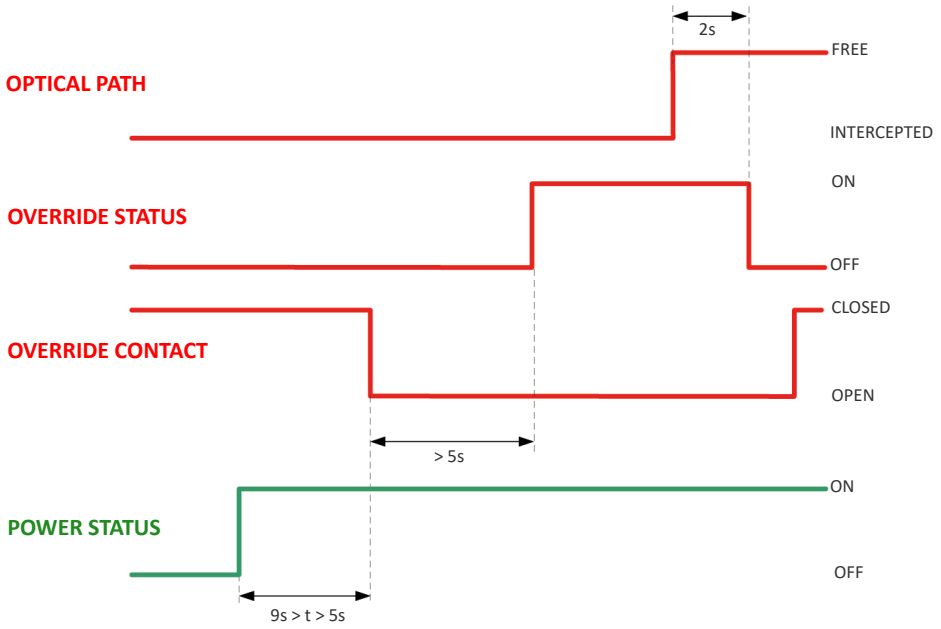


Figure 46: Override at startup timings

Override ends on any of the following conditions (OR):

- TEST button press/release
- 2s after all beams are free
- After 10min timeout

NOTE: External lamp flashes when Override is active and user interface visualizes Override Active signals (see “Override Active” on page 63).

NOTE: When Automatic Restart is selected OSSDs remains activated after Override ends.

NOTE: When Manual Restart is selected restart contact must be open and closed again to reactivate OSSDs.

Override at Runtime

To activate override without a power cycle a complex pattern is required on OVERRIDE input (pin 1).

At least one beam must be intercepted and one muting signal must be active for override request to be accepted.

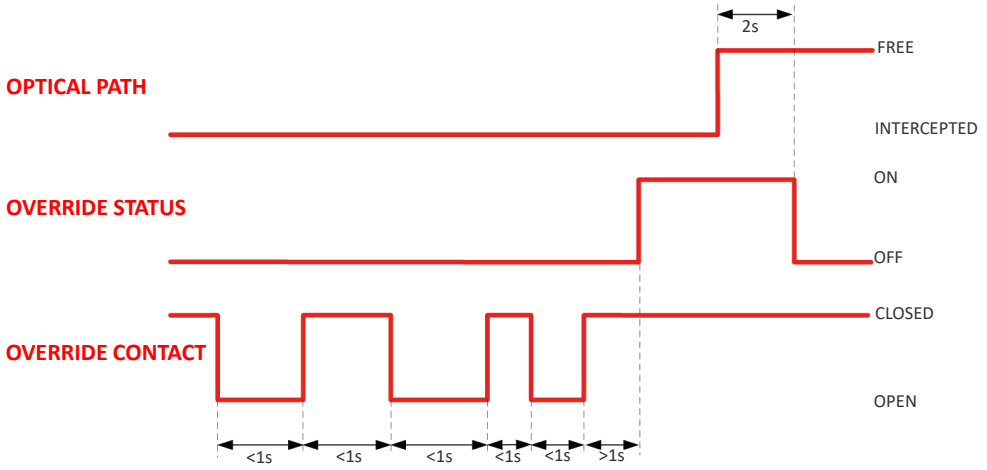


Figure 47: Override at Runtime timings

Override ends on any of the following conditions (OR):

- TEST button press/release
- 2s after all beams are free
- After 10min timeout

NOTE: External lamp flashes when Override is active and user interface visualizes Override Active signals (see “Override Active” on page 63).

NOTE: When Automatic Restart is selected OSSDs remains activated after Override ends.

NOTE: When Manual Restart is selected restart contact must be open and closed again to reactivate OSSDs.

CHAPTER 7
USER INTERFACE DIALOGUE

SH4-XX-XXXX-SM-8-(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.

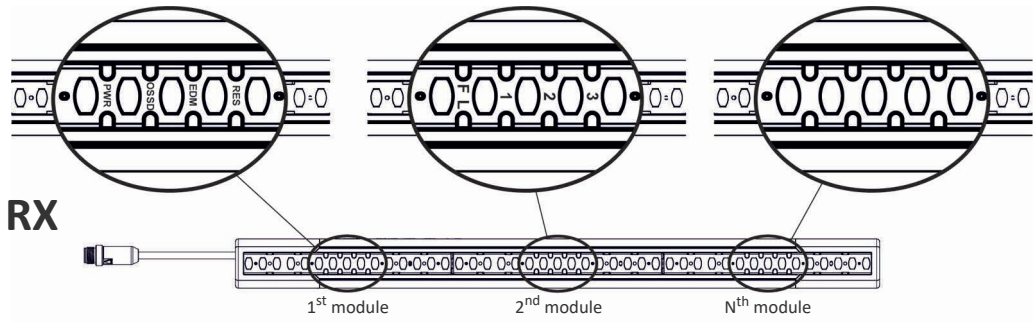


Figure 48: Receiver LED interface

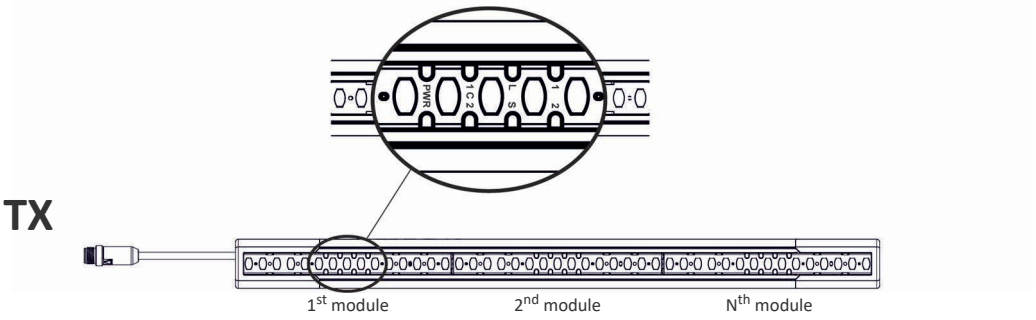


Figure 49: Emitter LED interface

LED meanings

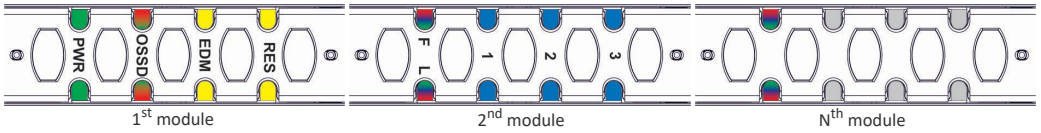
= ON

= OFF

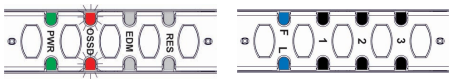
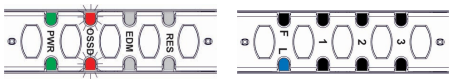
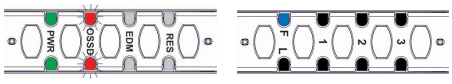
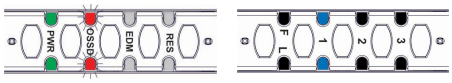
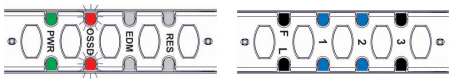
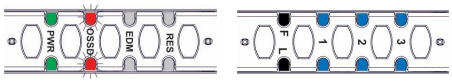
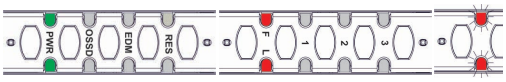
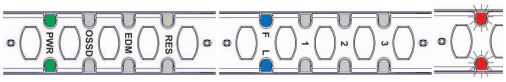
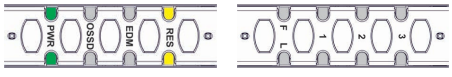
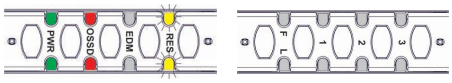
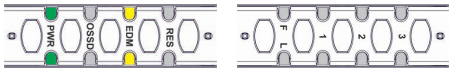
= INDIFFERENT

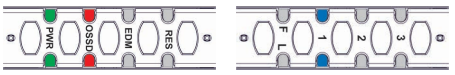
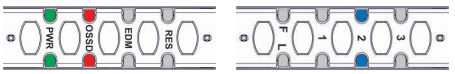
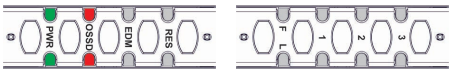
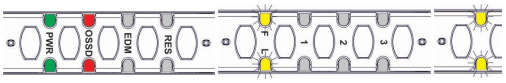
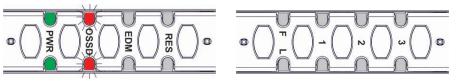
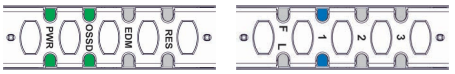
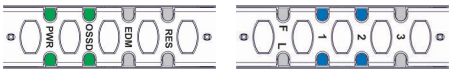
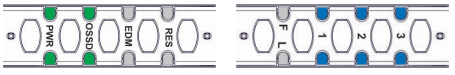
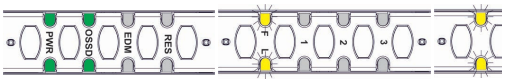
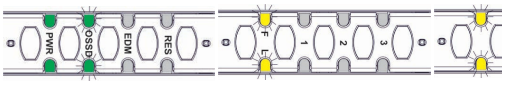
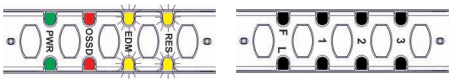
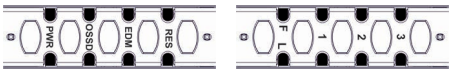
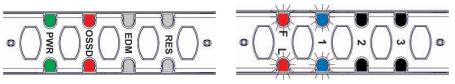
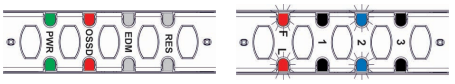
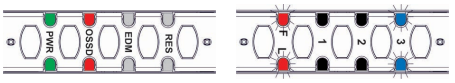
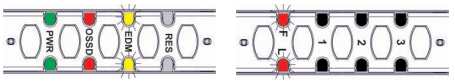
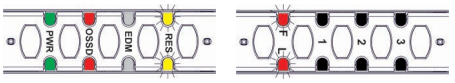
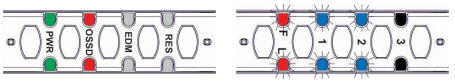
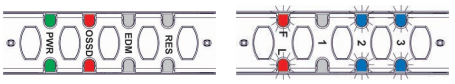
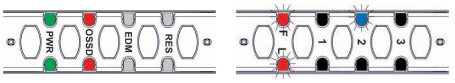
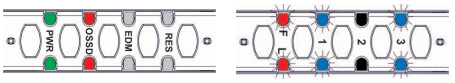
= BLINK

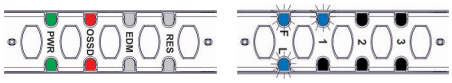
RX Side dialogue



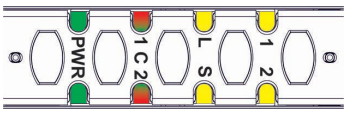
1st module 2nd module Nth module

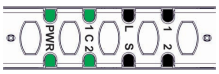
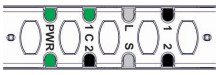
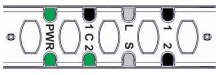
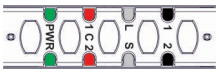
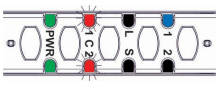
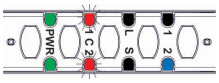
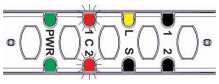
ESPE WORKING MODE	INDICATION	LED CONFIGURATION
Alignment NOTE: the LEDs F and L change color according to the anti-interference code set: BLUE: NO CODE RED: CODE1 GREEN: CODE 2	Not aligned	
	Not aligned Only first sync aligned	
	Not aligned Only last sync aligned	
	Aligned Minimum Signal Level	
	Aligned Medium Signal Level	
	Aligned Maximum Signal Level	
Module signal status (from 2nd 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	
	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	
Configuration	Reset Default Performed	
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	

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	

SH4-X-XXXX-8-(X) 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.

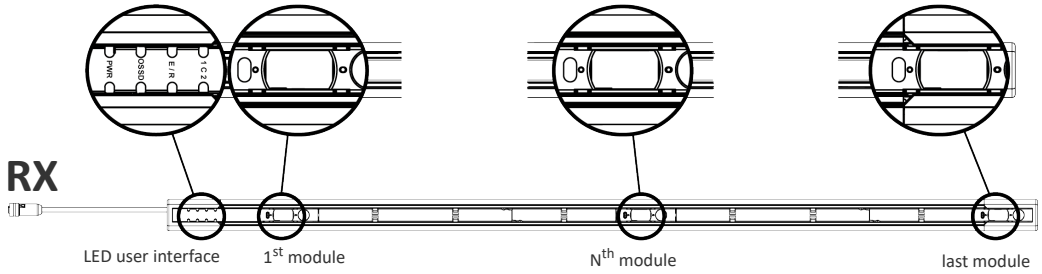


Figure 50: Receiver LED interface

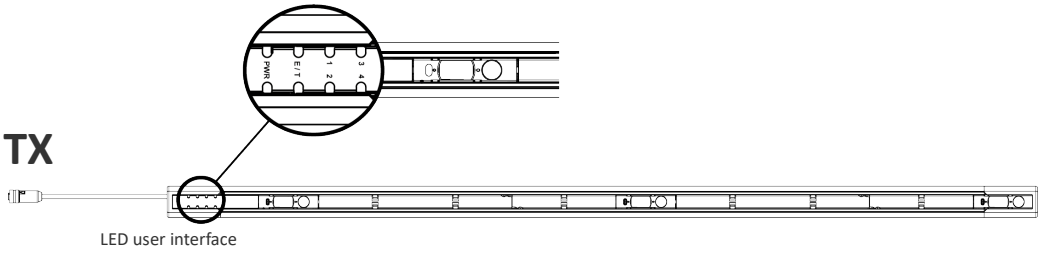


Figure 51: Emitter LED interface

LED meanings

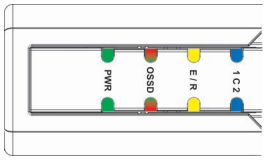
= ON

= OFF

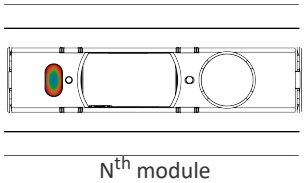
= INDIFFERENT

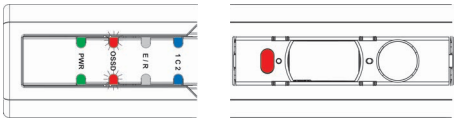
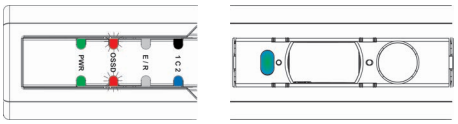
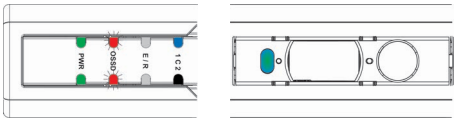
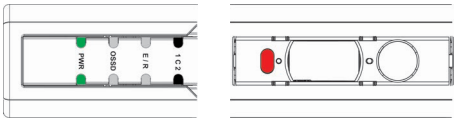
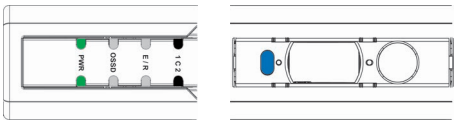
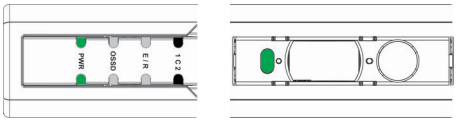
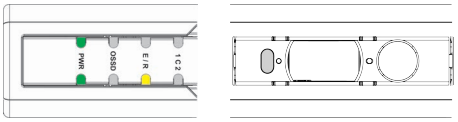
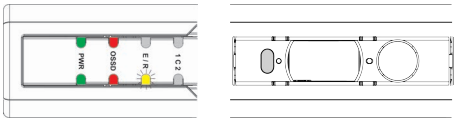
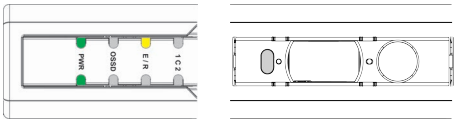
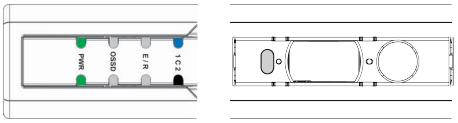
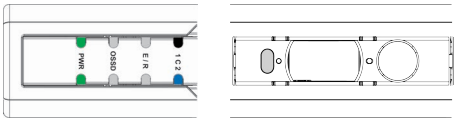
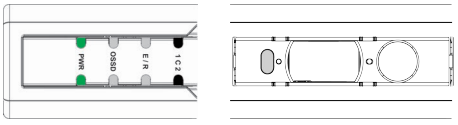
= BLINK

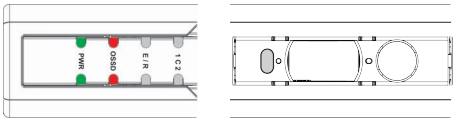
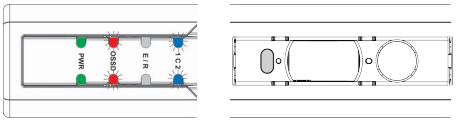
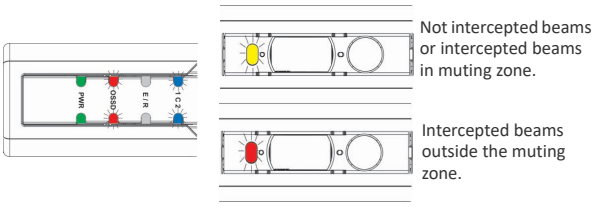
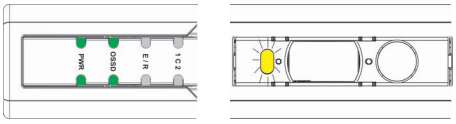
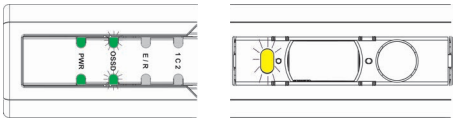
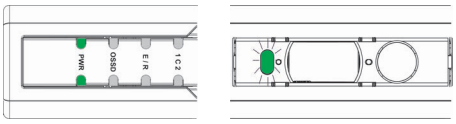
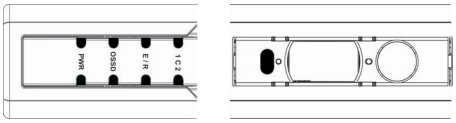
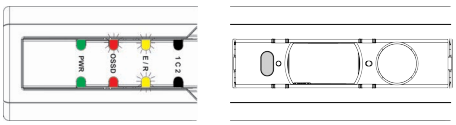
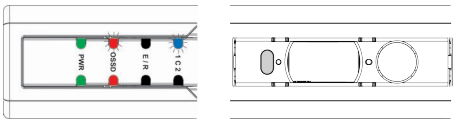
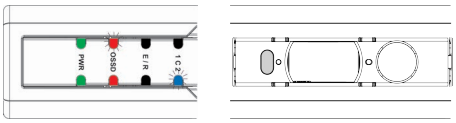
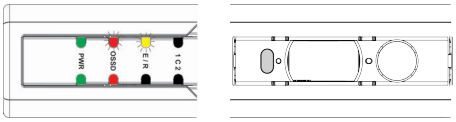
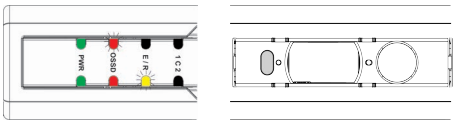
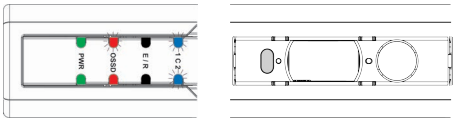
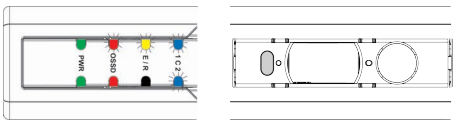
RX Side dialogue

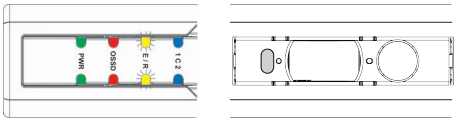


LED user interface

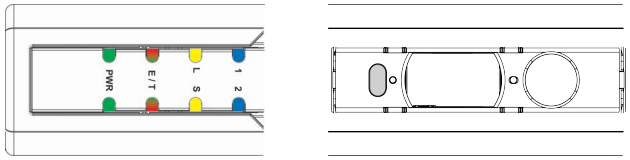

N^{th} module

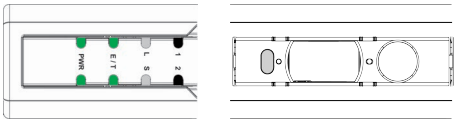
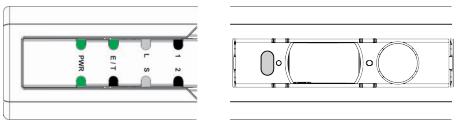
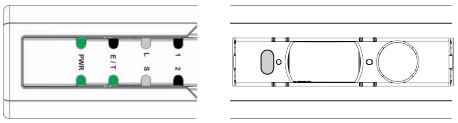
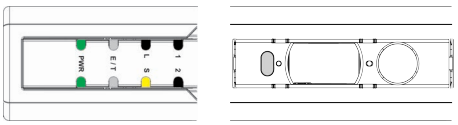
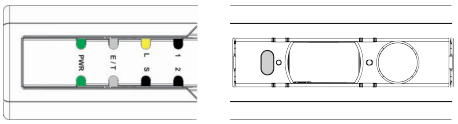
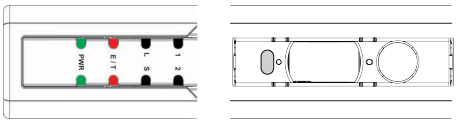
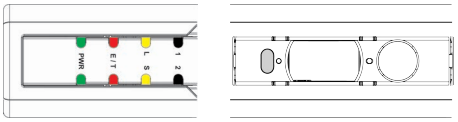
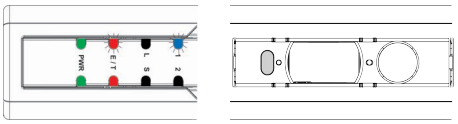
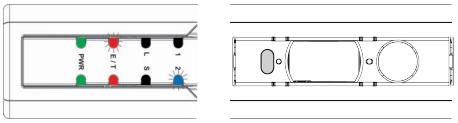
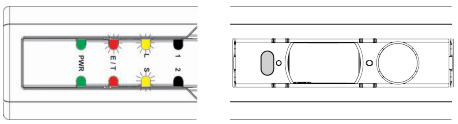
ESPE WORKING MODE	INDICATION	LED CONFIGURATION
Alignment	Not aligned	
	Not aligned Only first sync aligned	 First module
	Not aligned Only last sync aligned	 Last module
Alignment/ Normal Operation Single Optic	No Signal Level on N^{th} optic	 N^{th} module
	Low Signal Level on N^{th} optic	 N^{th} module
	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	
Normal Operation OSSD ON	Muting Active	 All beams
	Override Active	 All beams
Configuration	Reset Default Performed	 First module
Failure (Lockout)	Power Supply Failure	
	FER OSSDs failure	
	F1 Microprocessor Failure	
	F2 Optics Failure	
	FE EDM Failure	
	FR Reset/Restart Failure	
	F12 Configuration Failure (Dip switch)	
	F12E Lamp Failure	

Failure (NO Lockout)	ER Override Failure	

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	

CHAPTER 8
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 6).
- The safety distance between the dangerous areas and the ESPE are in accordance with the instructions included in "Installation" on page 6.
- 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 9
DEVICE MAINTENANCE

DATALOGIC safety light curtains do not require special maintenance operations.

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

Use soft cotton cloths damped 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

SAFETY CATEGORY
Type 4 (rif. EN 61496-1: 2020)
SIL 3 (rif. EN 61508)
SIL CL 3 (rif. EN 62061:2005/A2: 2015)
PL e, Cat. 4 (rif. EN ISO 13849-1: 2015)
PFHd [1/h] = $2.62*10^{-8}$ (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

ELECTRICAL DATA	
Power supply	24 Vdc ± 20%[a]
Emitter consumption (TX)	3.5 W max
Receiver consumption (RX)	5.5 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 capacitative load	1 µF at 24 Vdc
Leakage current	< 1 mA
Response times	from 7 to 16 ms (30mm res uncoded) from 9 to 28 ms (14mm res uncoded)
Protected height	From 300 to 2250 mm (single unit)
Safety category	Type 4 (ref. EN IEC 61496-1)

ELECTRICAL DATA	
Auxiliary functions * (depending on the model)	Restart / Test / EDM Reset / EDM selection /auto-man selection Muting / Override Blanking Anti-interference coding
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

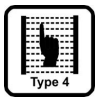
a. The external voltage supply must be able to bridge main power failure of 20ms as specified in IEC 60240-1.

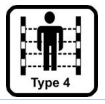
OPTICAL DATA	
Light source	Infrared LED (850 nm wavelength)
Resolution	14 mm - 30 mm - Body
Operating distance	0.2 to10 m for 14 mm res 0.2 to 20 m for 30 mm res 0.5 to 15 m for body (SHORT range) 5 to 70 m for body (LONG range)
EAA angle	< ±2.5° at 3 meters
Ambient light rejection	EN 61496-2-2020

MECHANICAL AND ENVIRONMENTAL DATA	
Operating temperature	-30...+55 °C
Storage temperature	-30...+60 °C
Temperature class	T6
Humidity	15...95% (no condensation)
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)

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-SM-8	957920043	SH4-14-0300-SM-8-5	957920565	14 mm FINGER PROTECTION 	300
SH4-14-0450-SM-8	957920044	SH4-14-0450-SM-8-5	957920566		450
SH4-14-0600-SM-8	957920045	SH4-14-0600-SM-8-5	957920567		600
SH4-14-0750-SM-8	957920046	SH4-14-0750-SM-8-5	957920568		750
SH4-14-0900-SM-8	957920047	SH4-14-0900-SM-8-5	957920569		900
SH4-14-1050-SM-8	957920048	SH4-14-1050-SM-8-5	957920570		1050
SH4-14-1200-SM-8	957920049	SH4-14-1200-SM-8-5	957920571		1200
SH4-14-1350-SM-8	957920050	SH4-14-1350-SM-8-5	957920572		1350
SH4-14-1500-SM-8	957920051	SH4-14-1500-SM-8-5	957920573		1500
SH4-14-1650-SM-8	957920052	SH4-14-1650-SM-8-5	957920574		1650
SH4-14-1800-SM-8	957920053	SH4-14-1800-SM-8-5	957920575		1800
SH4-14-1950-SM-8	957920054	SH4-14-1950-SM-8-5	957920576		1950
SH4-14-2100-SM-8	957920055	SH4-14-2100-SM-8-5	957920577		2100
SH4-14-2250-SM-8	957920056	SH4-14-2250-SM-8-5	957920578		2250
SH4-30-0300-SM-8	957920099	SH4-30-0300-SM-8-5	957920085	30 mm HAND PROTECTION 	300
SH4-30-0450-SM-8	957920100	SH4-30-0450-SM-8-5	957920086		450
SH4-30-0600-SM-8	957920101	SH4-30-0600-SM-8-5	957920087		600
SH4-30-0750-SM-8	957920102	SH4-30-0750-SM-8-5	957920088		750
SH4-30-0900-SM-8	957920103	SH4-30-0900-SM-8-5	957920089		900
SH4-30-1050-SM-8	957920104	SH4-30-1050-SM-8-5	957920090		1050
SH4-30-1200-SM-8	957920105	SH4-30-1200-SM-8-5	957920091		1200
SH4-30-1350-SM-8	957920106	SH4-30-1350-SM-8-5	957920092		1350
SH4-30-1500-SM-8	957920107	SH4-30-1500-SM-8-5	957920093		1500
SH4-30-1650-SM-8	957920108	SH4-30-1650-SM-8-5	957920094		1650
SH4-30-1800-SM-8	957920109	SH4-30-1800-SM-8-5	957920095		1800
SH4-30-1950-SM-8	957920110	SH4-30-1950-SM-8-5	957920096		1950
SH4-30-2100-SM-8	957920111	SH4-30-2100-SM-8-5	957920097		2100
SH4-30-2250-SM-8	957920112	SH4-30-2250-SM-8-5	957920098		2250

MODEL SINGLE CONNECTOR	ORDERING NUMBER	MODEL DUAL CONNECTOR	ORDERING NUMBER	RESOLUTION	PROTECTED HEIGHT (mm)
SH4-2-0500-SM-8	957920139	SH4-2-0500-SM-8-5	957920135	BODY PROTECTION 	500
SH4-3-0800-SM-8	957920140	SH4-3-0800-SM-8-5	957920136		800
SH4-4-0900-SM-8	957920141	SH4-4-0900-SM-8-5	957920137		900
SH4-4-1200-SM-8	957920142	SH4-4-1200-SM-8-5	957920138		1200

Pairing table

PAIR MODEL	RECEIVER MODEL	EMITTER MODEL
SH4-14-XXXX-SM-8	SH4-14-XXXX-SM-R-8	SH4-14-XXXX-T-5
SH4-14-XXXX-SM-8-5	SH4-14-XXXX-SM-R-8-5	SH4-14-XXXX-T-5-5
SH4-30-XXXX-SM-8	SH4-30-XXXX-SM-R-8	SH4-30-XXXX-T-5
SH4-30-XXXX-SM-8-5	SH4-30-XXXX-SM-R-8-5	SH4-30-XXXX-T-5-5
SH4-2/3/4-XXXX-SM-8	SH4-2/3/4-XXXX-SM-R-8	SH4-2/3/4-XXXX-T-5
SH4-2/3/4-XXXX-SM-8-5	SH4-2/3/4-XXXX-SM-R-8-5	SH4-2/3/4-XXXX-T-5-5

RESPONSE TIMES

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 models

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

SH4-30-XXXX-X-X models

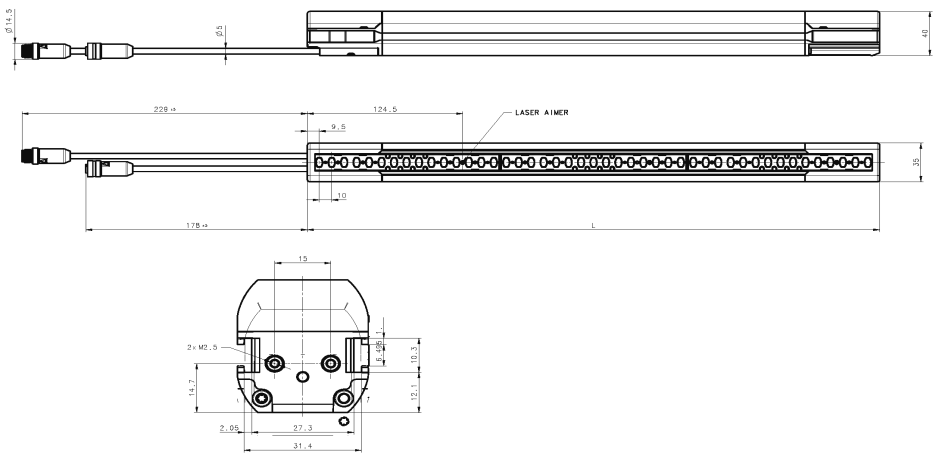
MODEL	CONTROLLED HEIGHT (mm)	NO. BEAMS	RESPONSETIME (ms) AIC DISABLE	RESPONSETIME (ms) AIC ENABLE
SH4-30-0300-x-x	300	12	7	10
SH4-30-0450-x-x	450	18	8	12
SH4-30-0600-x-x	600	24	9	13
SH4-30-0750-x-x	750	30	9	15
SH4-30-0900-x-x	900	36	10	17
SH4-30-1050-x-x	1050	42	11	18
SH4-30-1200-x-x	1200	48	12	20
SH4-30-1350-x-x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

SH4-2/3/4-XXXX-X-X models

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

APPENDIX C
OVERALL DIMENSIONS

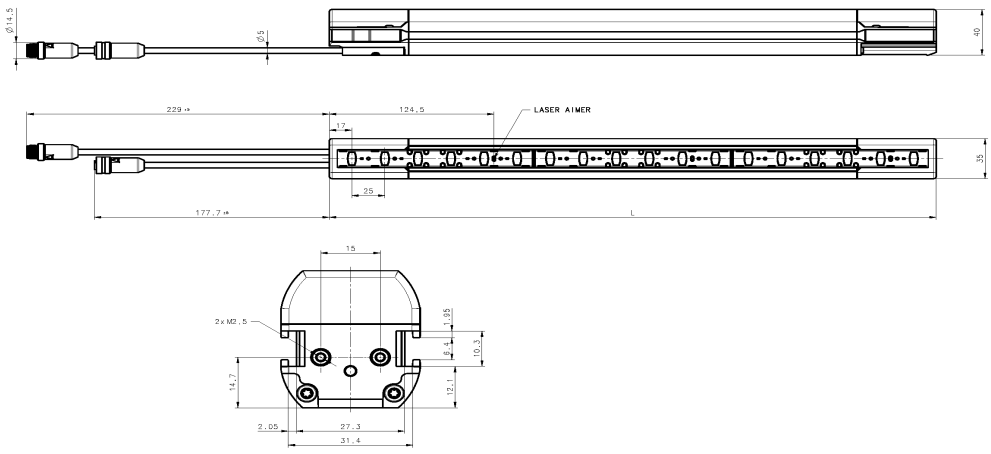
SH4-14-XXXX-X-X



* dimensions are in mm

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

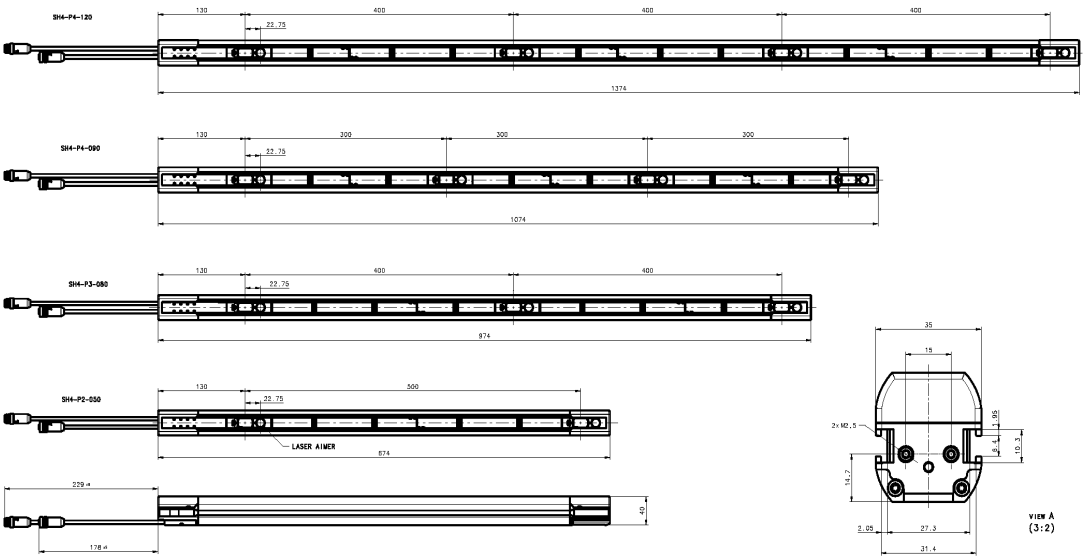
SH4-30-XXXX-X-X



* dimensions are in mm

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

SH4-2/3/4-XXXX-X-X



* dimensions are in mm

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

APPENDIX D
INCLUDED ACCESSORIES

METAL ANGLED FIXING BRACKET

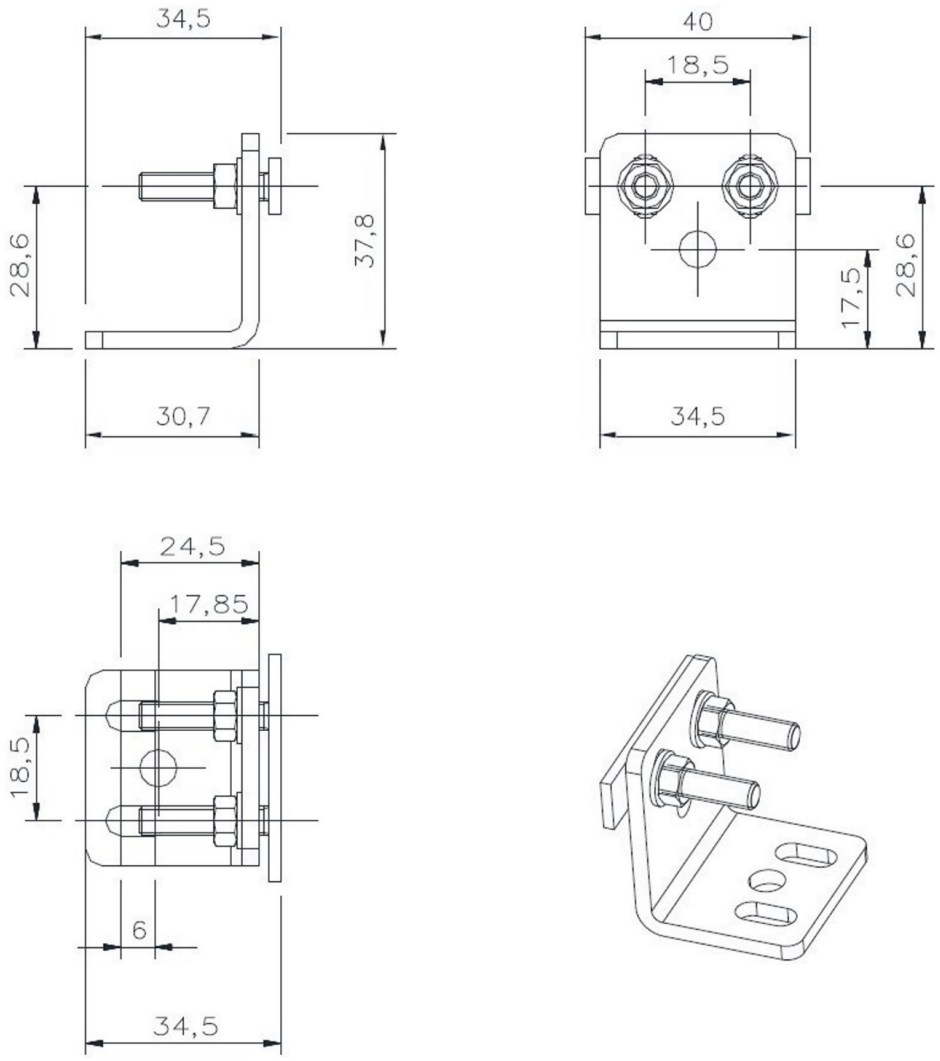


Figure 52 - Metal Angled fixing Bracket

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

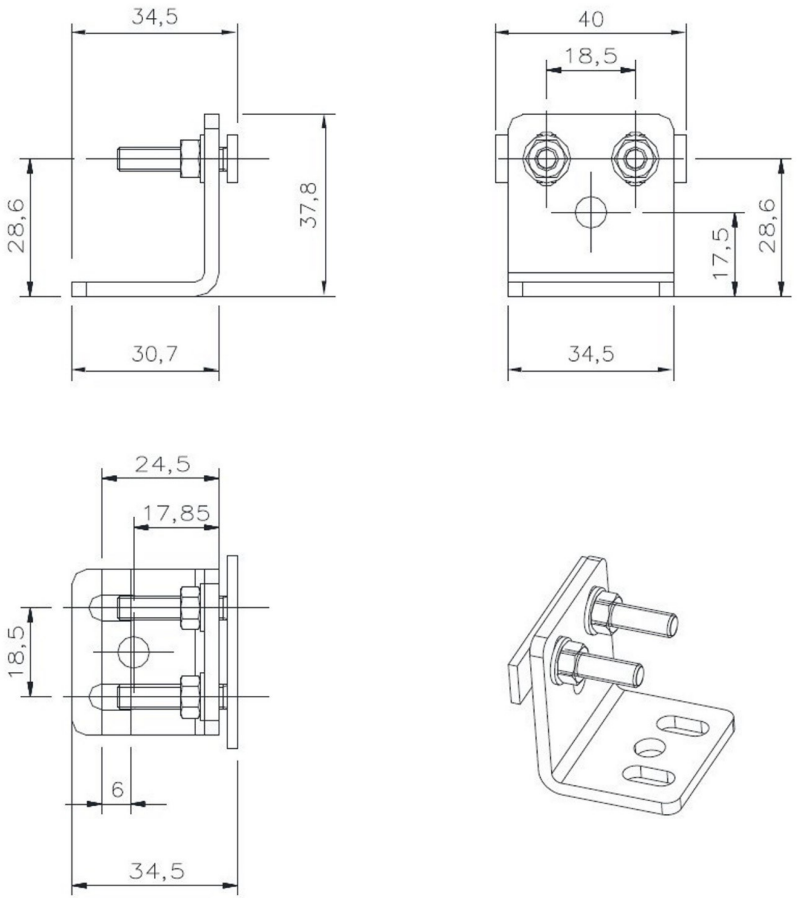


Figure 53 - ST-KSTD

NOTE: Dimensions are in mm.

Angled fixing bracket mounting with orientable and anti-vibration supports

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

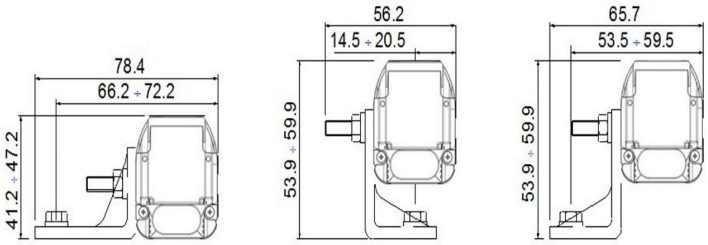


Figure 54 - Angled fixing bracket

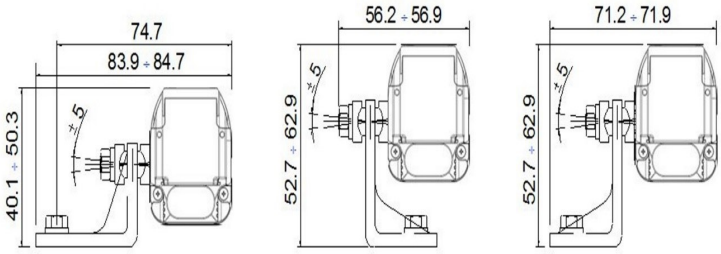


Figure 55 - Angled fixing bracket + Orientable support

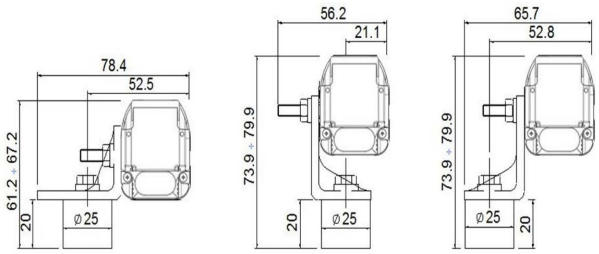


Figure 56 - Angled fixing bracket + Anti-vibration support

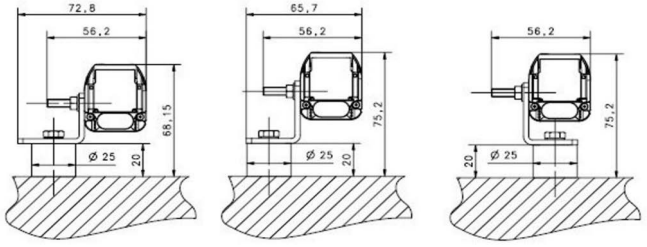


Figure 57 - Angled fixing bracket + Orientable support + Anti-vibration support

NOTE: Dimensions are in mm.

Rotating Bracket

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

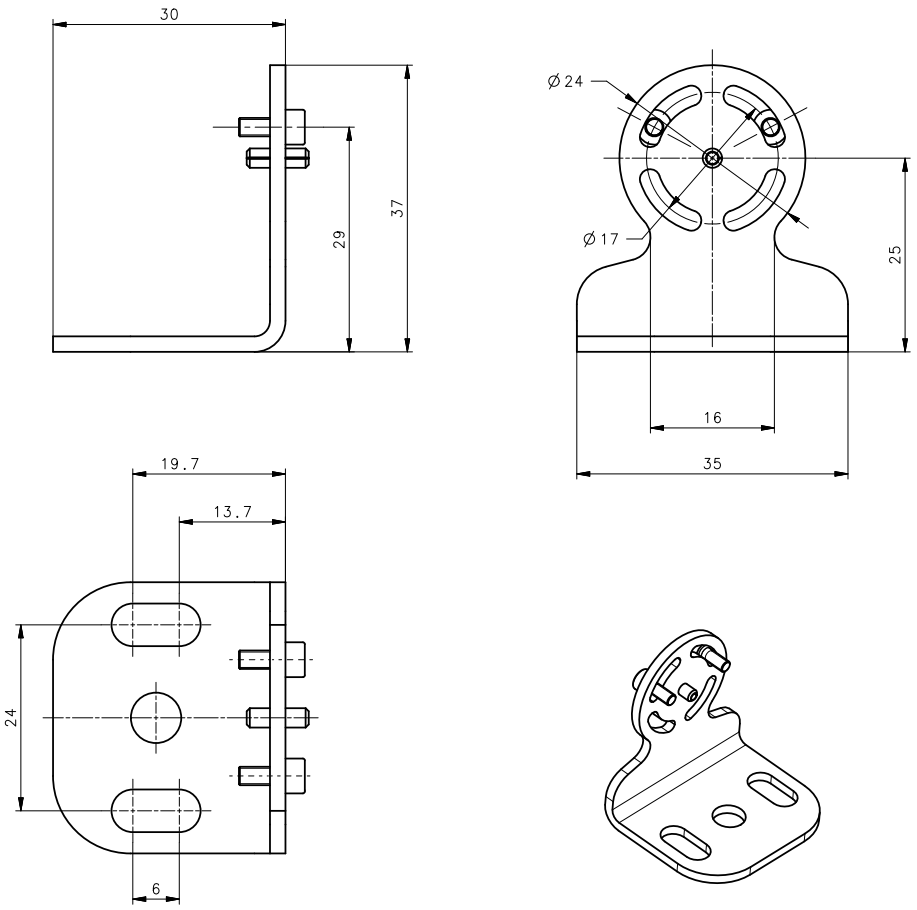


Figure 58 - ST-K4ROT-SH

NOTE: Dimensions are in mm.

PROTECTIVE TUBES AND 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

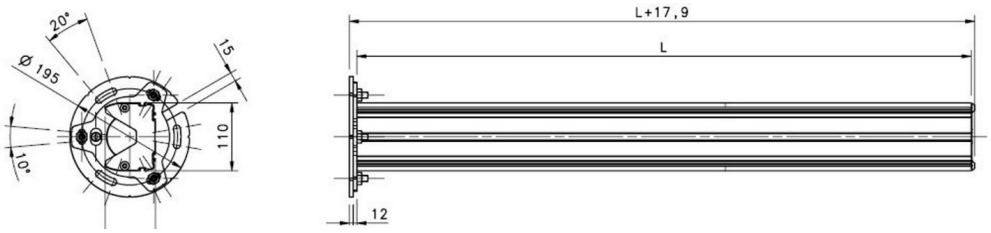


Figure 59 - Protective Stands

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

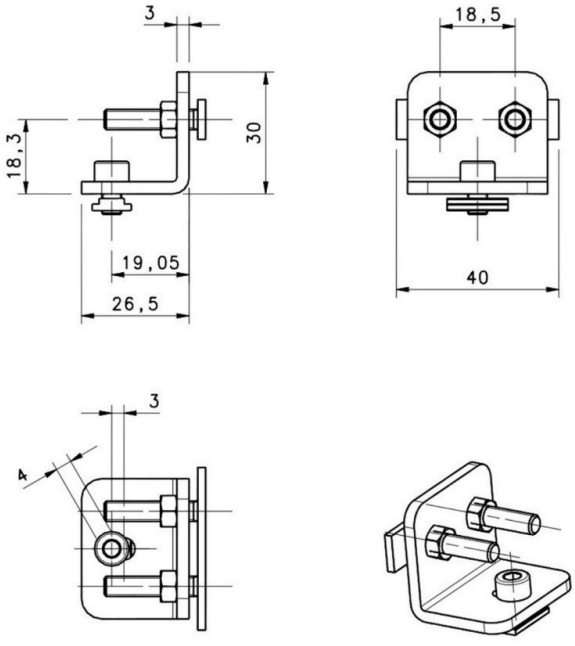


Figure 60 - Mounting kit

NOTE: Dimensions are in mm.

Plate Kit for Protective Stands

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

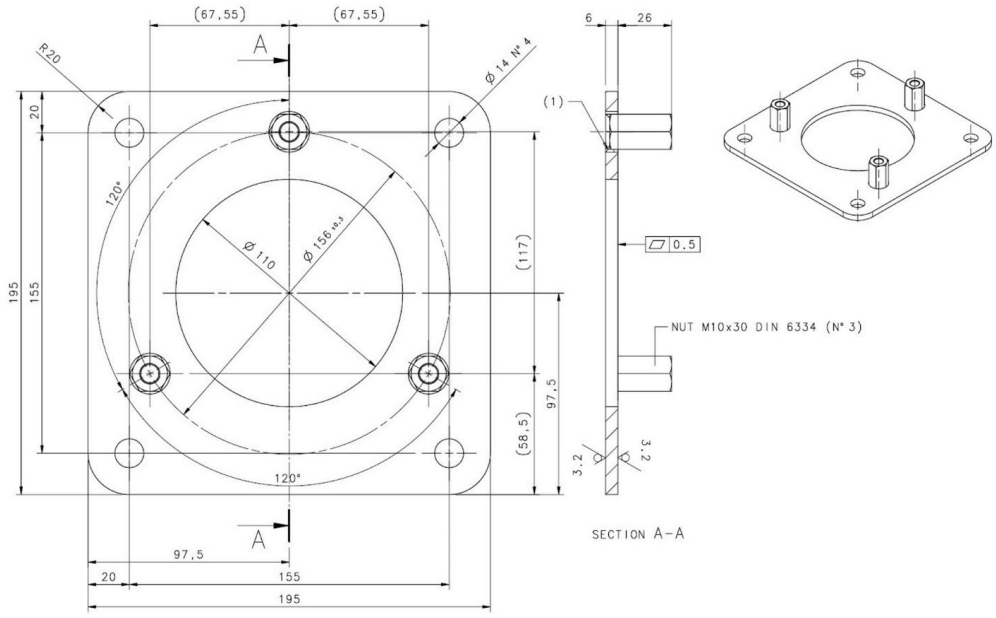


Figure 61 - Plate kit

NOTE: Dimensions are in mm.

Mounting with SG-P SB

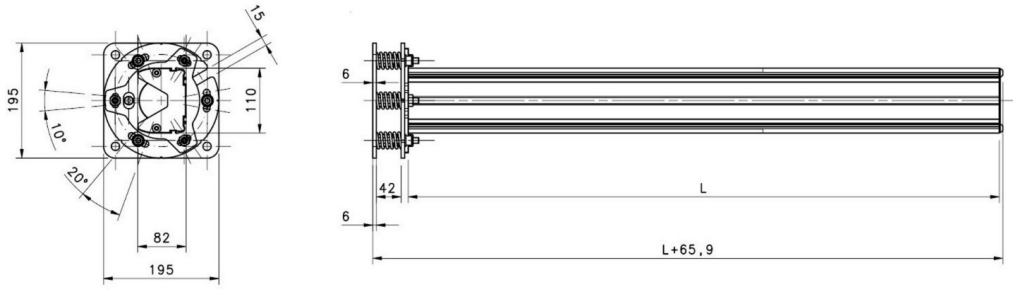


Figure 62 - Mounting with SG-P SB

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

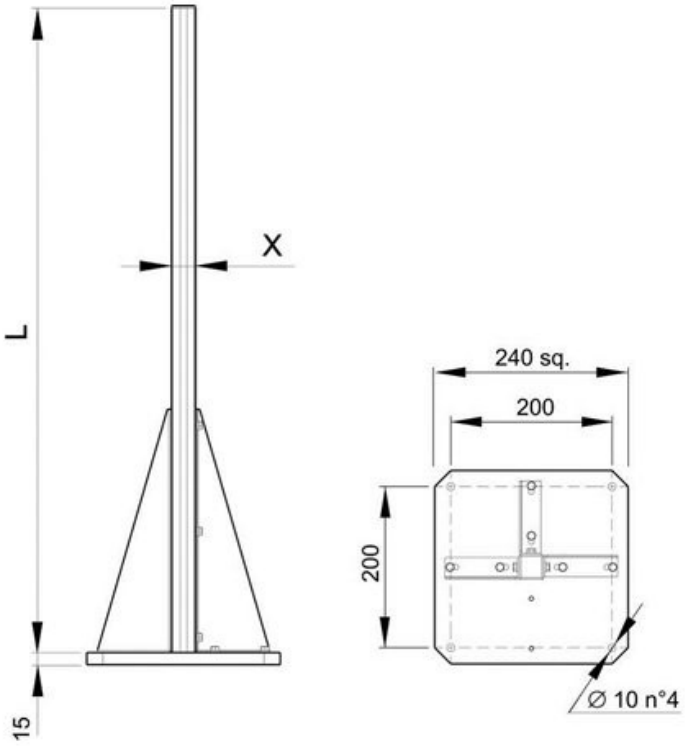


Figure 63 - Dimensions (mm)

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

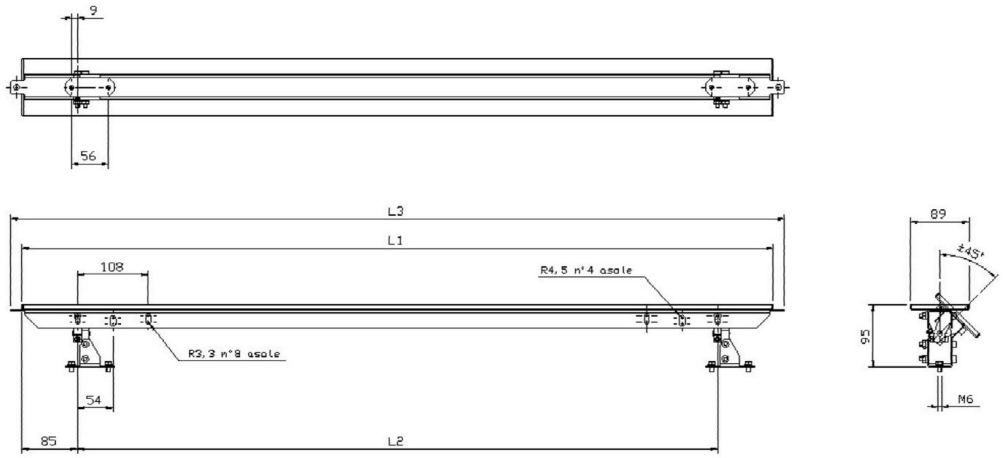


Figure 64 - Deviating mirrors (mm)

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

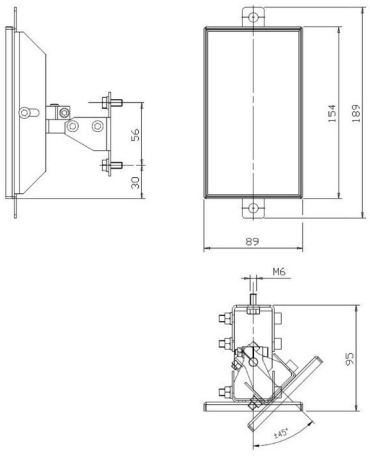


Figure 65 - SG-DM 150 (mm)

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

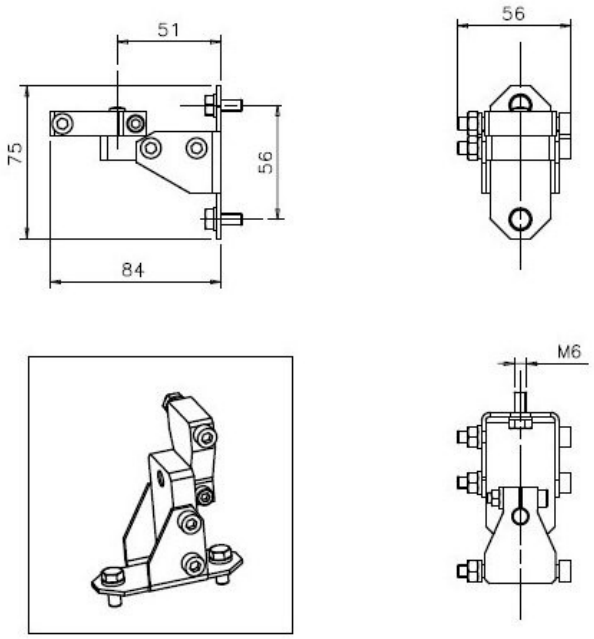


Figure 66 - Mounting kit

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

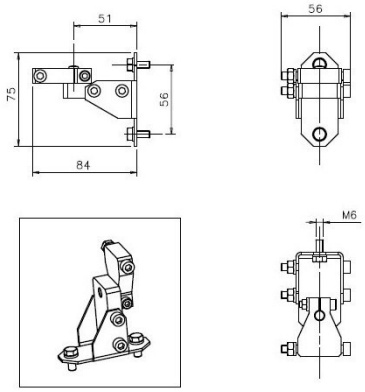


Figure 67 - Mounting kit

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

CONNECTION CABLES

8-pole M12 cables (Receiver main connector)

MODEL	DESCRIPTION	CODE
CS-A1-06-U-03	8-pole M12 cable (axial) 3 m UL2464	95ASE1220
CS-A1-06-U-05	8-pole M12 cable (axial) 5 m UL2464	95ASE1230
CS-A1-06-U-10	8-pole M12 cable (axial) 10 m UL2464	95ASE1240
CS-A1-06-U-15	8-pole M12 cable (axial) 15 m UL2464	95ASE1250
CS-A1-06-U-25	8-pole M12 cable (axial) 25 m UL2464	95ASE1260
CS-A1-06-U-50	8-pole M12 cable (axial) 50 m UL2464	95A252710

5-pole 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-pole 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

SH-LP) 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).

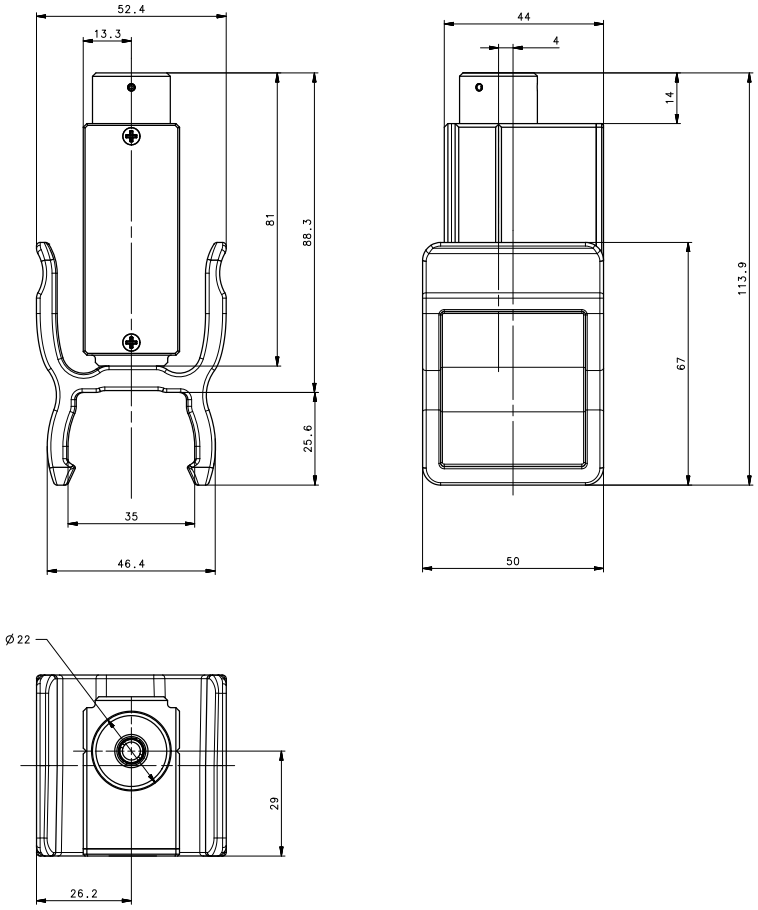


Figure 68 - Dimensions (mm)

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.

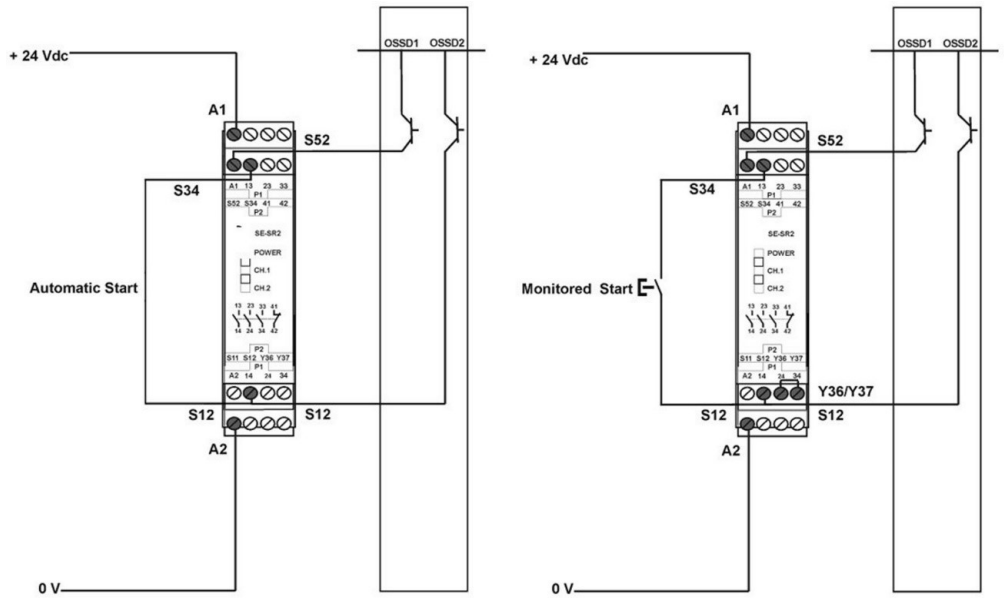


Figure 69 - Safety relay

EDM relay box

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

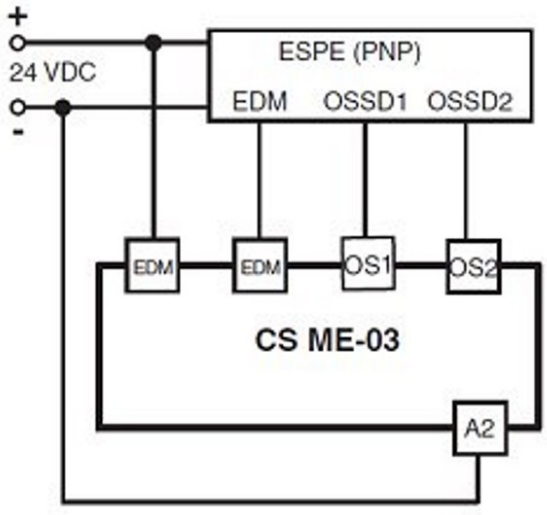


Figure 70 - EMD relay

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

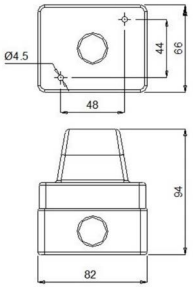


Figure 71 - Lamp LMS

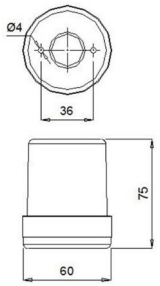
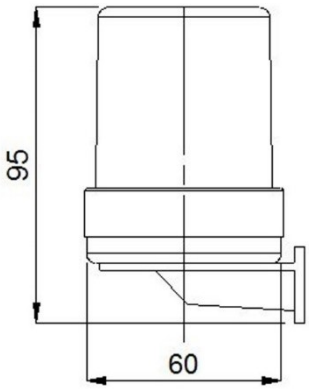


Figure 72 - Lamp LMS-2



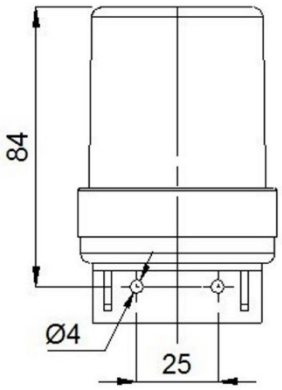


Figure 73 - Lamp LMS-3

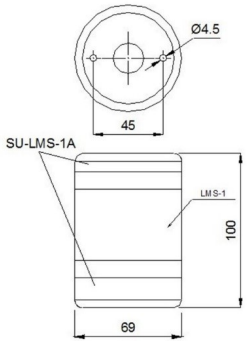


Figure 74 - Module SU-LMS-1A + LMS-1

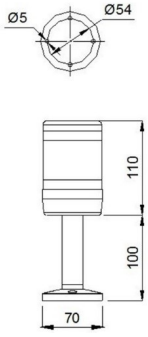


Figure 75 - Module SU-LMS-1B + LMS-1

Muting cables

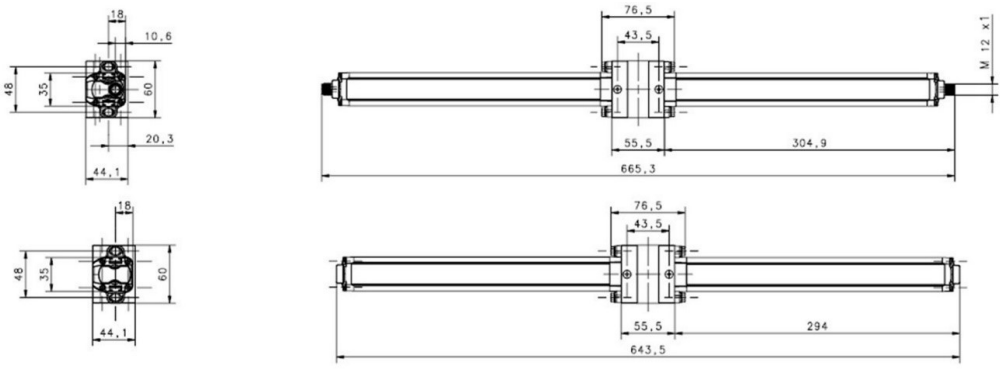
MODEL	DESCRIPTION	CODE
CV-Y4-02-B-007	M12 4P T MUTING CABLE SH4	95ASE0037
CV-L2-02-B-007	M12 4P L MUTING CABLE SH4	95ASE0038

Couple arms

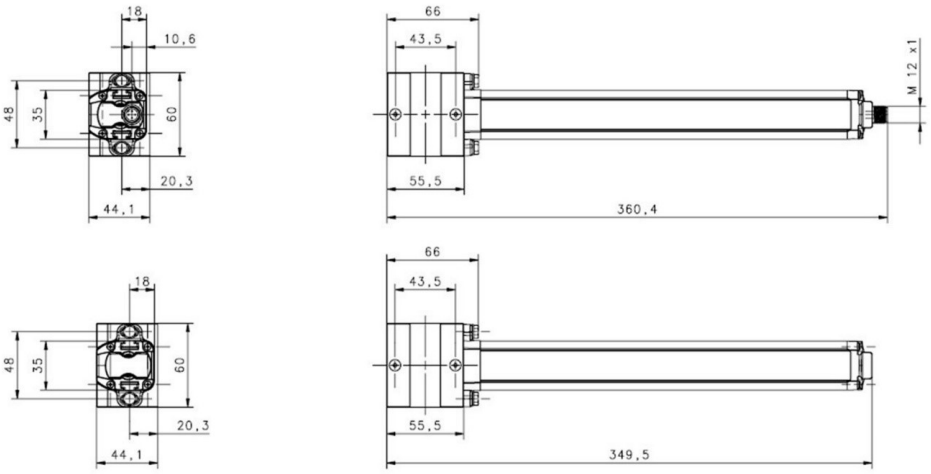
MODEL	DESCRIPTION	CODE
SH-T-ARMS	T COUPLE ARMS	95ASE0035
SH-L-ARMS	L COUPLE ARMS	95ASE0036

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 LEDs[1] (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

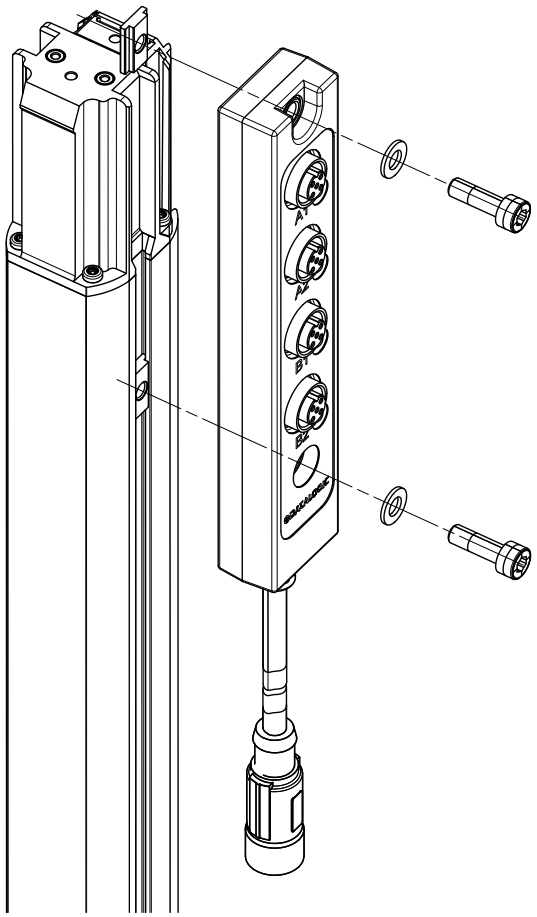


Figure 76 - Connection box

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

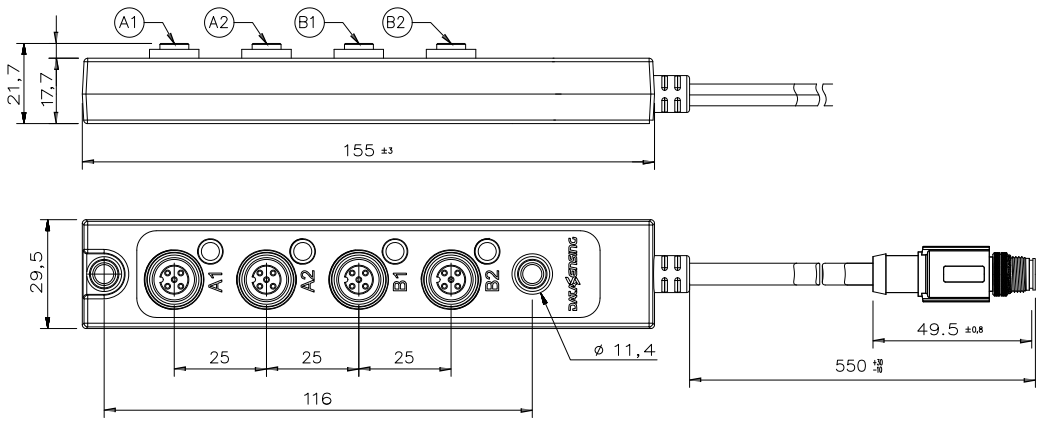


Figure 77 - Dimensions (mm)

Power supply & Switching voltage	+24 Vcc ± 20%
Current load max.	1 A
Insulating resistance	> 10^9 Ω
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 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 master unit only; only the master unit can control their status.

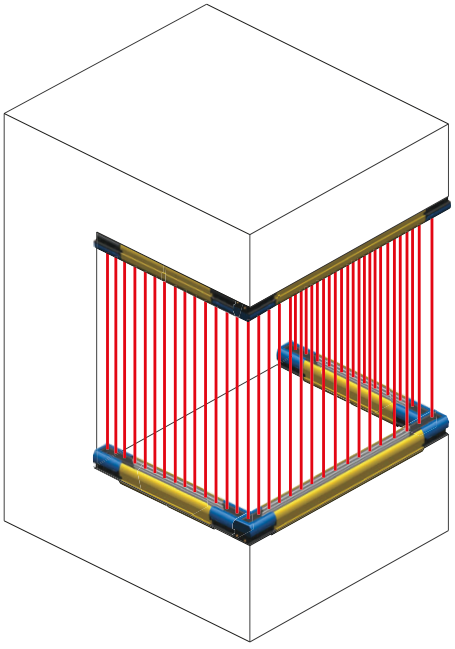


Figure 78: Application example

A cascade system is composed by:

- One MASTER unit with dual connector (can be chosen among SH4-XX-XXXX-SM-8-5 or SH4-XX-XXXX-A-12-5)
- One LAST SLAVE unit (can be chosen among SH4-XX-XXXX-B-5 or SH4-XX-XXXX-C-5-5)
- Optionally one MID SLAVE UNIT (must be a SH4-XX-XXXX-C-5-5 unit)

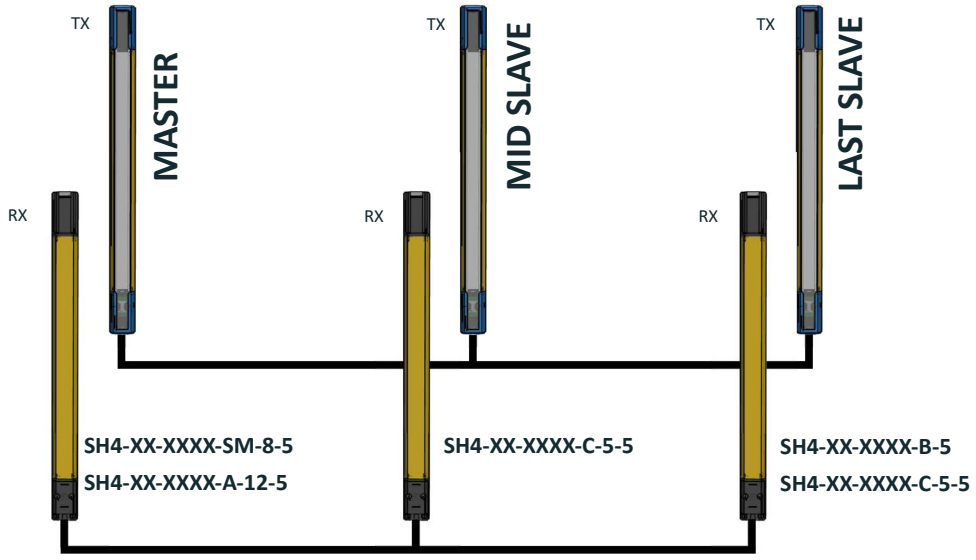


Figure 79: Cascade system

CONNECTION

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

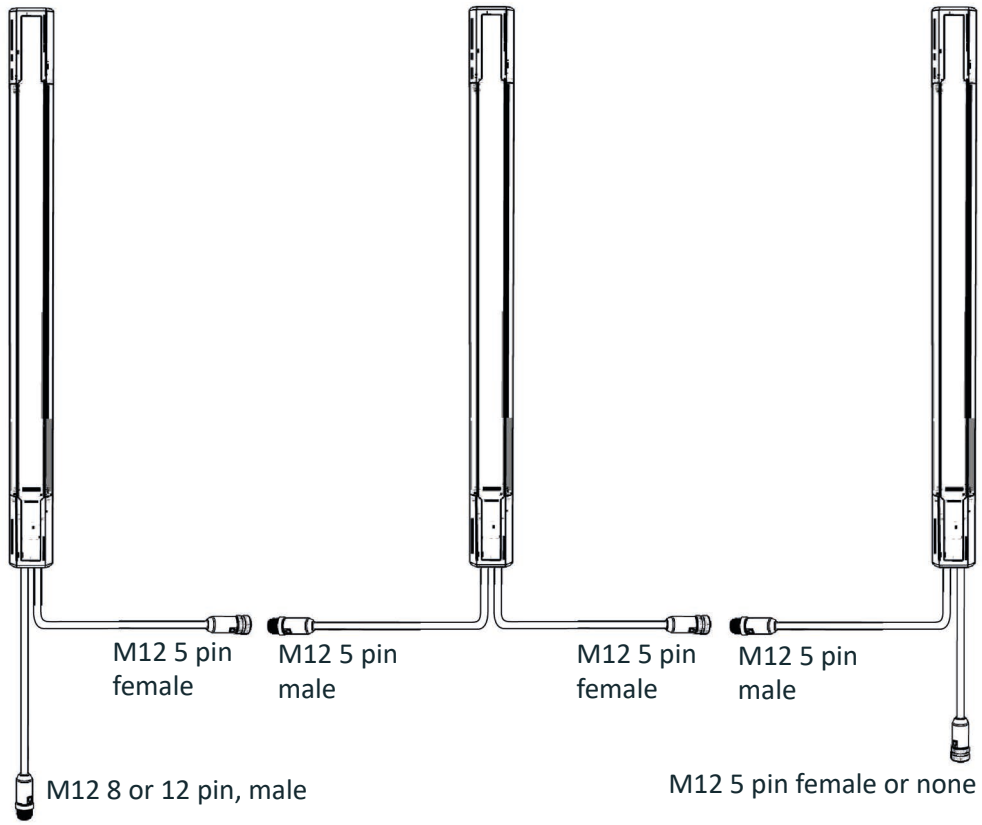
1. Connect the M12-5 poles **female** connector of the MASTER unit to the M12-5 poles **male** connector of following slave unit.
2. Same way a LAST SLAVE can be connected to the MID SLAVE.

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-XX-XXXX-C-5-5 model as LAST SLAVE the M12 female connector will provide muting inputs with same pinout of MASTER unit (depending on the configuration for advanced models). For more details please refer to SH4-XX-XXXX-SM-8-5 or SH4-XX-XXXX-A-12-5 connections on the respective Product Reference Guide.

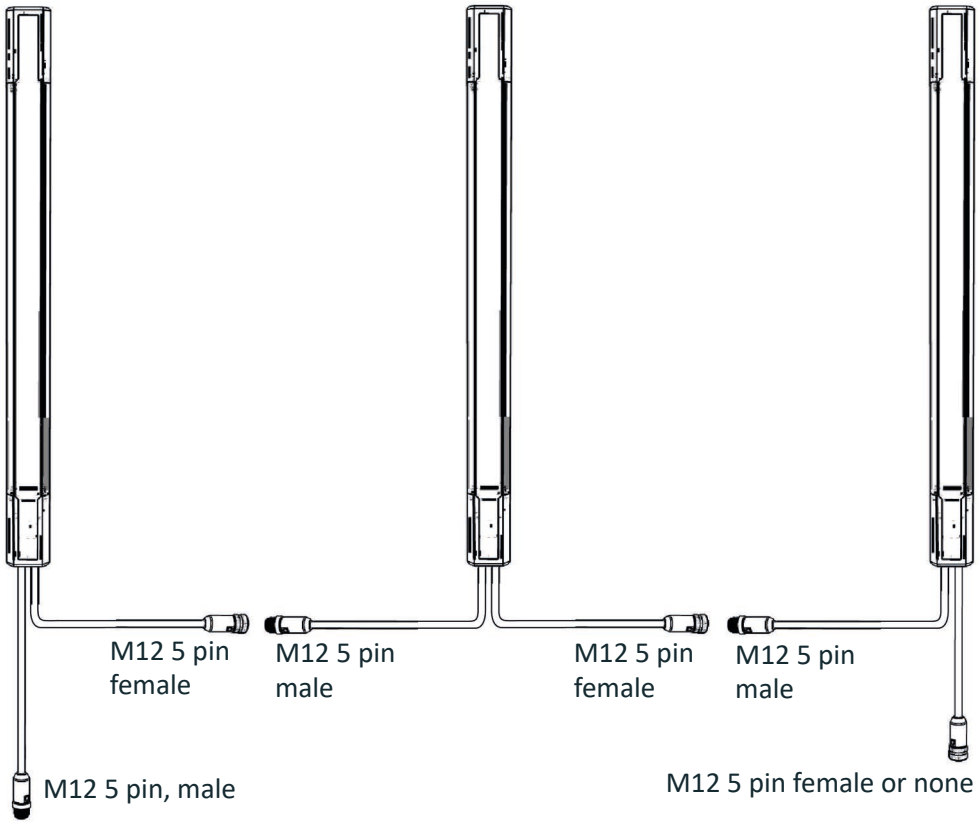
NOTE: When using an SH4-XX-XXXX-A-12-5 model as MASTER unit, pin 11 (GP_IO2) from 12 poles male connector must be left floating.

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 then 40mm resolution.

OPERATION

A proprietary transmission protocol is used to communicate both Slaves safety related information and status info.

OSSDs are connected to (and thus controlled by) Master 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 both master and slaves unit stops into Communication Failure Lockout.

A maximum of one master and two slave units ($M+S_1+S_2$) 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
MASTER	SH4-XX-XXXX-SM-8-5 Standard Muting SH4-XX-XXXX-A-12-5 Advanced
MID SLAVE (optional)	SH4-XX-XXXX-C-5-5
LAST SLAVE	SH4-XX-XXXX-B-5[a] SH4-XX-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 Standard Muting master models or a new GUI parametrization for Advanced master models before the new cascade can be operated.

NOTE: Refer to paragraph “Factory Reset” on page 38 to reset the Standard Muting master 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.

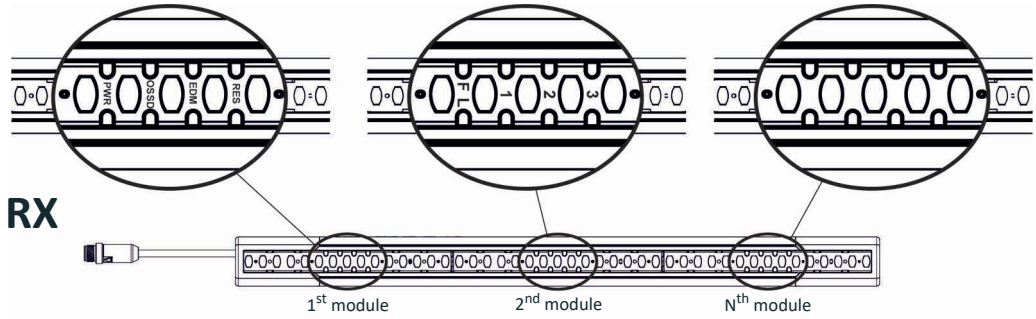


Figure 80: Receiver LED interface

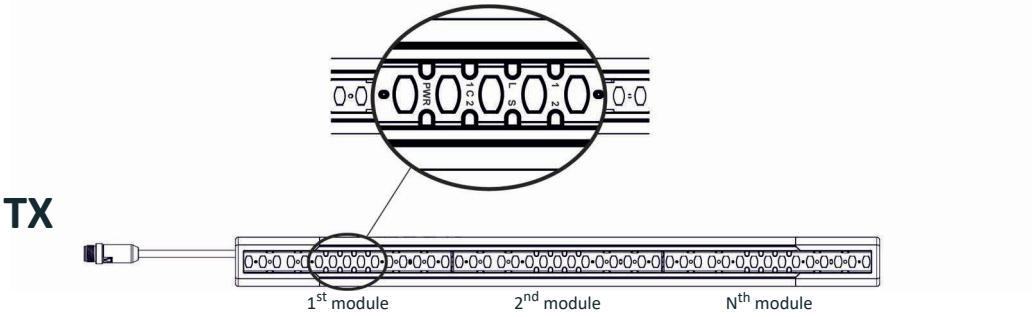


Figure 81: Emitter LED interface

LED meanings

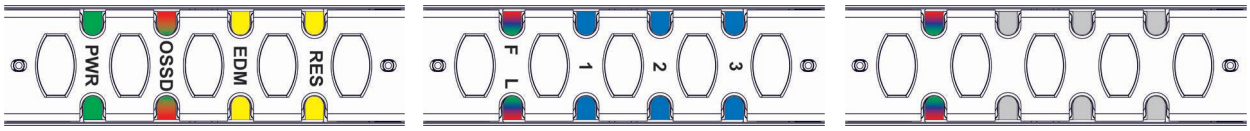
= ON

= OFF

= INDIFFERENT

= BLINK

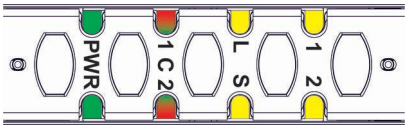
RX Side dialogue

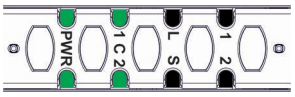
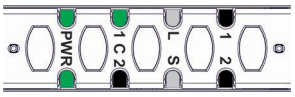
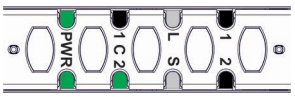
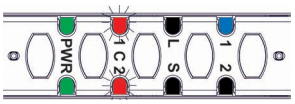
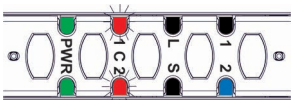
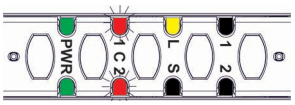


1st module | 2nd module | Nth module

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 Slave units only show their error code	F22 Microprocessor Failure	
	F33 Optics Failure	
	F1122 Cascade Failure	

TX Side dialogue



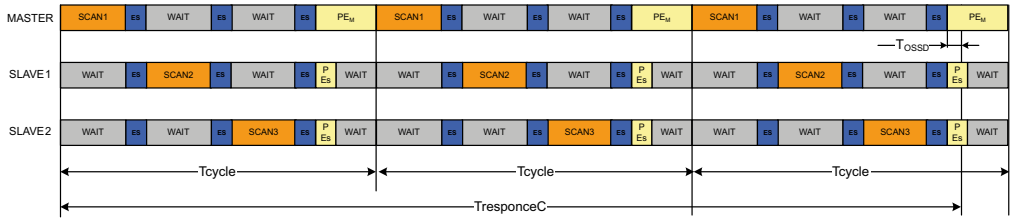
ESPE WORKING MODE	INDICATION	LED CONFIGURATION
Normal Operation Emission Active	NO CODE	
	CODE1	
	CODE2	
Failure	F1 Failure on microprocessor	
	F2 Failure on optics	
	FL Cascade Failure	

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).

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



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 master unit synchronize with emitter master unit by means of two sync optics and respective unique patterns, while T_{SCAN} and $T_{SELF\text{-}TEST}$ depend on all units operation (see fig. 47). For what said in 4.4 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 emitters detecting the optical beams interruptions inside the device caused by an opaque object present inside the specified detecting area.

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

Block condition (=BREAK)

Status of the light curtain taking place when a suitably-sized opaque object 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.

Emitter (TX)

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

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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