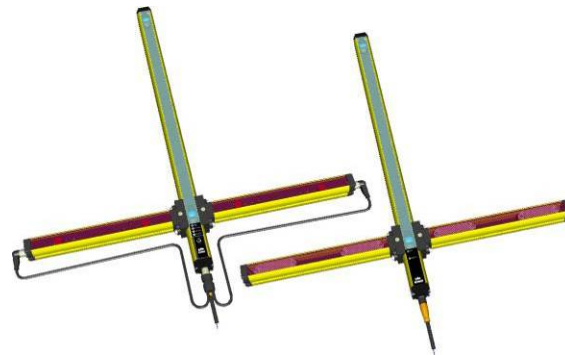




PSEN op4B-T, PSEN op4B-L, PSEN op4B-S

Safety light curtains with infrared beams



OPERATING MANUAL

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1 GENERAL INFORMATION



1.1 General description of the safety light curtain

Safety light curtains from the PSENopt series are multibeam optoelectronic protection devices. They secure work areas in which operating personnel can come into contact with moving parts of machinery, robots and automated systems in general, which present a risk of physical injury.

The safety light curtains are designed as safe Type 4 systems for accident prevention in accordance with applicable international standards, in particular:

EN 61496-1: 2004 Safety of machinery: Electrosensitive protective equipment. Part 1: General requirements and tests.

prEN 61496-2: 1997 Safety of machinery - Electrosensitive protective equipment. Part 2: Particular requirements for equipment using active optoelectronic protective devices.

The device consists of an emitter (TX) and a receiver (RX) housed in robust aluminium profiles. It secures the protected area by generating an infrared protected field, which will detect an opaque object as soon as it enters the protected field.

Both the control and evaluation logic are located inside the two units; the electrical connection is made via M12 connectors, which are positioned underneath the profiles. The emitter (TX) and receiver (RX) are synchronised optically. This means the two units do not have to be connected directly to each other.

The infrared beams are controlled and monitored via a microprocessor, which provides the user with information about the operating status of the safety light curtain via LED indicators (see Ch. 7, "*Diagnostics*").

Two yellow LEDs simplify the alignment of the two units during installation (see Ch. 5 "*Alignment*").

As soon as an object, a limb or the operator's body interrupts the beams sent by the emitter (TX), both outputs (OSSD) are immediately opened and the machine connected to the OSSD is stopped.

NB: *This manual uses the following abbreviations as defined in the applicable standards:*

AOPD *Active opto-electronic protective device*

ESPE *Electrosensitive protective equipment*

MPCE *Machine primary control element*

OSSD *Output signal switching device (switching output)*

TX *Transmitting device*

RX *Receiving device*

Some sections or paragraphs in this manual contain information of particular importance to those using or setting up the device. These sections are highlighted using the following symbols:



Detailed notes and descriptions of specific features of the safety light curtains, designed to explain their operation more clearly.

Specific installation guidelines.



This warning must be heeded! It warns of a hazardous situation that could lead to serious injury and death and indicates preventive measures that can be taken.

This manual contains all the information required for the selection and operation of the safety light curtains.

Specialised knowledge of safety issues is required to integrate a safety light curtain correctly on power-driven machinery.

As this manual is unable to provide such information in full, please contact the technical service department at Pilz for any information about the operation of the safety light curtains and the safety regulations relating to correct installation (see Ch. 8, "*Regular checks and maintenance*").

1.2 How to select a safety light curtain

- Muting function
The safety light curtains are suitable for applications that require a muting function. Safety light curtains PSEN op4B-T and PSEN op4B-L are equipped with pre-assembled, pre-wired and pre-aligned muting sensors. The muting sensors are designed for one or two-way muting applications in an "L" or "T" shaped configuration. Safety light curtains PSEN op4B-S are linear models without integrated muting sensors.
 - "L" shape configuration: is suitable for applications in which an object leaves the danger zone in one direction.
 - "T" shape configuration: is suitable for applications in which an object moves in two directions.
 - Linear models: Are suitable for applications on which the sensors are intended to be positioned individually. A plug connector enables the muting sensors to be connected simply.
- Resolution, depending on the part of the body requiring protection.

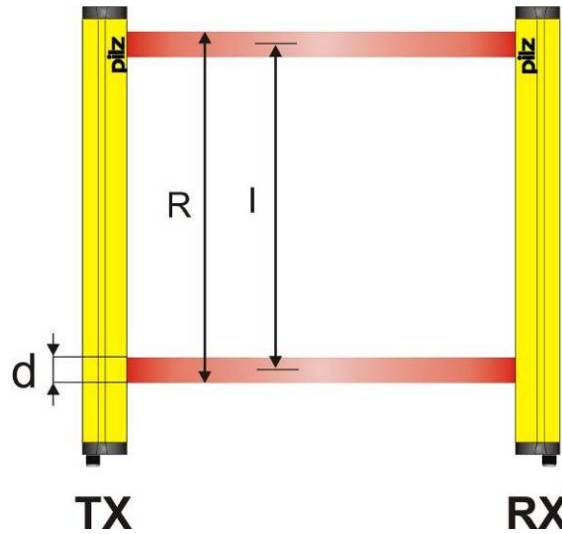
R = 40 mm

Body protection



The resolution (R) of a device is understood to be the minimum size an opaque object must be in order to interrupt at least one of the beams that form the sensing area.

As shown in Fig. 1, the resolution depends exclusively on the geometrical properties of the lenses, the diameter and the centre distance; it is independent of the ambient and operating conditions of the safety light curtain.



English

Fig. 1

The resolution can be calculated using the following formula:

$$R = I + d$$

The table below specifies the values for the light curtains with regard to the optical axis (**I**), the resolution (**R**) and the diameter of the optics (**d**).

Model	Optical axis mm (I)	No. of optics (n)	Resolution mm (R)	Ø of optics mm (d)	Range m
PSEN op4B-T-2-050	500	2	515	16	3
PSEN op4B-T-3-080	400	3	415	16	3
PSEN op4B-L-2-050	500	2	515	16	3
PSEN op4B-L-3-080	400	3	415	16	3
PSEN op4B-S-2-050	500	2	515	16	25
PSEN op4B-S-3-080	400	3	415	16	25

- Height of protected field: Here it is important to distinguish between the “Height of the sensing area” and the “Height of the protected area” (Fig. 2).
 - The height of the sensing area is the distance between the upper limit of the first lens and the lower limit of the last lens.
 - The height of the protected area is the effective protected area, in which an opaque object whose size is greater than or equal to the resolution of the safety light curtain will safely interrupt the beam.

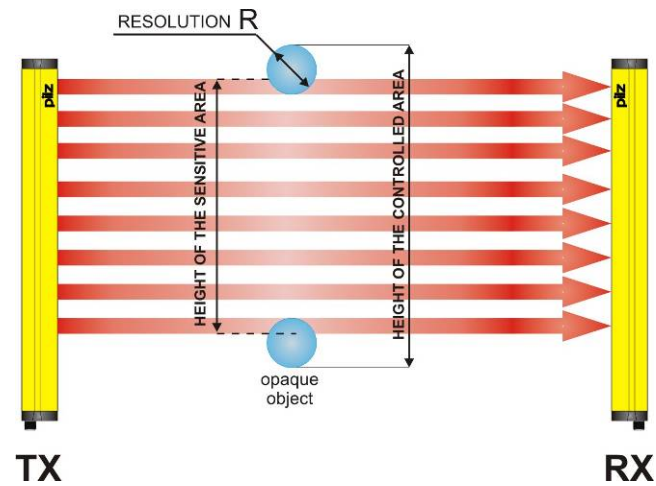


Fig. 2

- Safety distance: Great care must be taken when calculating the distance at which the safety light curtain should be positioned in relation to the hazardous machinery. (Please see Chapter 2, “Installation”, for details of how to calculate the safety distance.)

1.3 Typical application areas

Safety light curtains can be used in all areas of automation where it is necessary to control and guard access to danger zones.

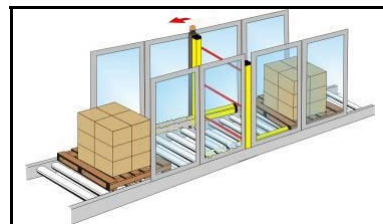
In particular they are used to stop the hazardous movement of mechanical parts on:

- Palletisers/depalletisers
- Packaging, handling and storage machinery
- Automatic or semi-automatic assembly lines
- Automated high-bay racking

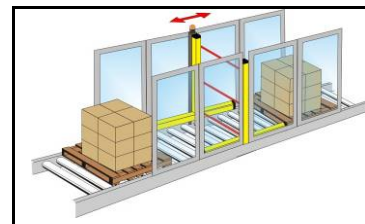


With food industry applications, please contact customer services at Pilz to check whether the safety light curtain's housing material can withstand the chemical substances that may be used in the production process.

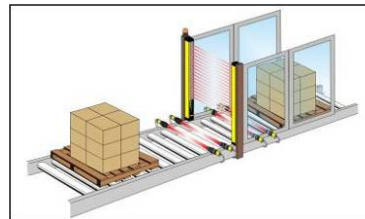
The following illustrations provide an overview of some of the main application areas:



L-shape version with integral muting sensors for muting in one direction (leaving the danger zone)



T-shape version with integral muting sensors for muting in two directions



Linear version with external muting sensors

1.4 Safety information



For the proper, safe use of the safety light curtains, the following guidelines must be followed:

- It must be possible to control the machine stop electrically.
- The control system must be able to stop the hazardous machine movement immediately at any stage of the operating cycle.
- The safety light curtain and its respective electrical connections must be installed by qualified personnel, in line with the guidelines stated in the relevant chapters.
- The safety light curtain must be positioned in such a way that the danger zone cannot be accessed without interrupting the beams (see Chapter 2 "*Installation*").
- Personnel working in the danger zone must be appropriately trained with regard to the operation of the safety light curtain.
- The test/reset button must be positioned outside the danger zone in such a way that operating personnel have a complete view of the danger zone during all reset, test or override operations.
- The feedback loop monitoring function used to monitor the external contactors will only be active if the corresponding wire is connected to the device.
- The muting lamp that displays the activated muting function must be visible from all sides of the work area.
- To ensure the correct operation of the muting switching devices, follow the instructions provided in the installation manual.
- Before switching on the safety light curtain, make sure you comply with the instructions regarding correct operation.

2 INSTALLATION

2.1 Precautionary measures when selecting and installing the device



- Make sure that the category guaranteed by the safety light curtain (Type 4) matches the risk assessment for the machinery that is to be monitored, as defined in the standard EN 954-1.
- The OSSD outputs on the safety light curtain must be used as machine stop devices and not as command devices (the machine must have its own START command).
- The dimensions of the smallest object to be detected must not be less than the resolution level of the device.
- The environment in which the safety light curtain is installed must comply with the technical details stated for the safety light curtain in Chapter 10, “*Technical details*”.
- Avoid installing the device, particularly the receiver (RX), close to intense and/or flashing light sources.
- Avoid strong electromagnetic interference as this can adversely affect the proper operation of the device.
- Smoke, mist or dust within the operating environment can reduce the range of the safety light curtain by up to 50%.
- Sudden temperature fluctuations beyond freezing point can cause condensation to form on the surface of the lenses, adversely affecting the proper operation of the safety light curtain.
- The activated muting function is displayed via an integral muting lamp. Make sure that the intensity of the LED is appropriate and that it is clearly visible, positioned close to the danger zone.
- Install and replace emitter and receiver only in pairs. Emitter and receiver have the same serial number.

- Make sure that the muting sensors are used appropriately and in accordance with the following specifications. Avoid connections that are inappropriate and unmonitorable, so that any accidental, potentially hazardous activation can be prevented.

2.2 General information on positioning the device

For effective protection it is necessary to proceed very carefully when positioning the device; in particular, the device must be installed in such a way that the danger zone cannot be accessed without interrupting the protected field.

To exclude the possibility of the machine being accessed from above or below (Fig. 3a), it is necessary to install a safety light curtain that is long enough to completely cover access to the danger zone (Fig. 3b).

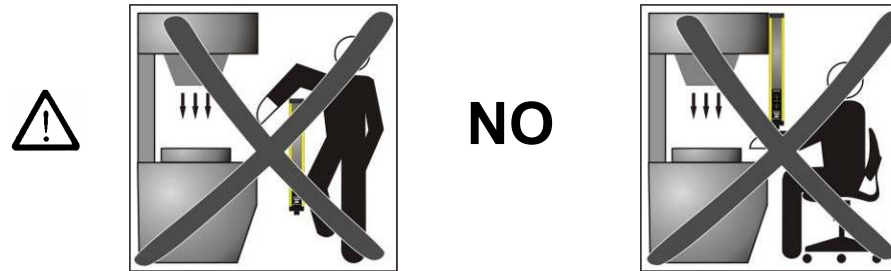


Fig. 3a

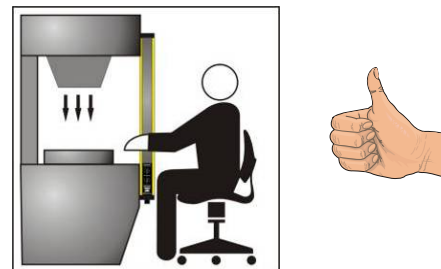


Fig. 3b

Also, under normal operating conditions, it must not be possible to start the machine until the operator is outside the danger zone.
If it is impossible to install the safety light curtain in immediate proximity to the danger zone, a second safety light curtain must be installed and aligned horizontally, to exclude access from the side, as shown in Fig. 4b.

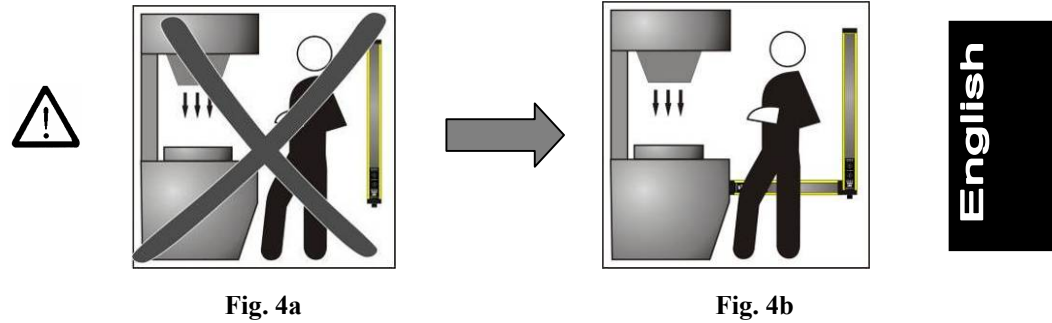



Fig. 4a

Fig. 4b

 If the installation position of the safety light curtain still enables an operator to access the danger zone without detection, an additional mechanical barrier must be installed to prevent this.

2.2.1 Minimum safety distance

The safety distance of the safety light curtain should be such that the operator cannot reach the danger zone until the movement of the hazardous machine part has come to a standstill (see Fig. 5).

According to the standards EN 999, 775 and 294, this distance depends on four factors:

- 1 Reaction time of the safety light curtain (time it takes for the signal at the OSSD output to switch from High to Low once the beams have effectively been interrupted).
- 2 Machine's overrun time (time it takes for the machine to come to a standstill once the reaction time of the safety light curtain has elapsed).
- 3 Resolution of the safety light curtain.
- 4 Approach speed of the object requiring detection.

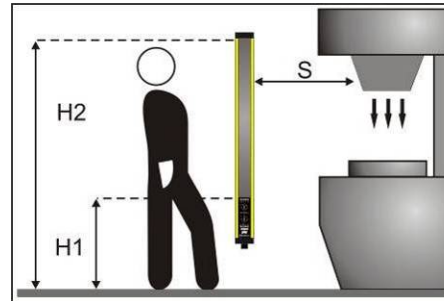


Fig. 5

The formula for calculating the safety distance is as follows:

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

where:

S = Minimum safety distance in mm between the protected field and the danger zone

K = The speed at which the object requiring detection (body or parts of the body) approaches the danger zone, in mm/s

t₁ = Reaction time of the safety light curtain in seconds (Ch. 10 "Technical details").

t₂ = Machine's overrun time in seconds

d = Resolution of the safety light curtain.

C = **850 mm** for a safety light curtain with a resolution > 40mm

Please note: The value of K is:

2000 mm/s, if the value calculated for S is ≤ 500 mm,

1600 mm/s, if the value calculated for S is > 500 mm.

If it is possible to access the danger zone from above and below (Fig. 5) and the devices used have a resolution of >40 mm, the upper beam must be positioned at a height of 900 mm (H2), starting from the reference plane (e.g. base of the machine), and the lower beam must be positioned at a height of 300 mm (H1).

If the safety light curtain is to be installed horizontally (Fig. 6), the distance between the danger zone and the furthest optical beam must equal the value calculated using the following formula:

$$S = 1600 \text{ mm/s} (t_1 + t_2) + 1200 - 0.4 H$$

where:

- S** = Minimum safety distance in mm between the protected field and the danger zone
- t₁** = Reaction time of the safety light curtain in seconds (Ch. 10 "Technical details").
- t₂** = Machine's overrun time in seconds
- H** = Height of the beams above the floor. This height must always be less than 1000 mm.

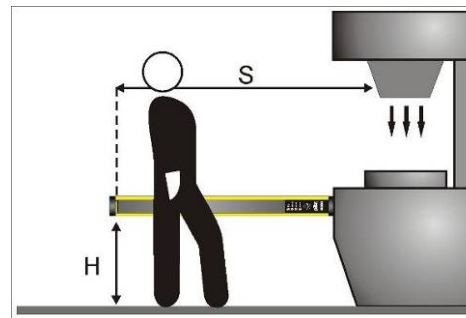


Fig. 6

2.2.2 Minimum distance from reflective surfaces

Reflective surfaces close to the light beams emitted from the safety device (whether above, below or to the side), may cause passive reflections and adversely affect detection of the object within the protected field (Fig. 7).

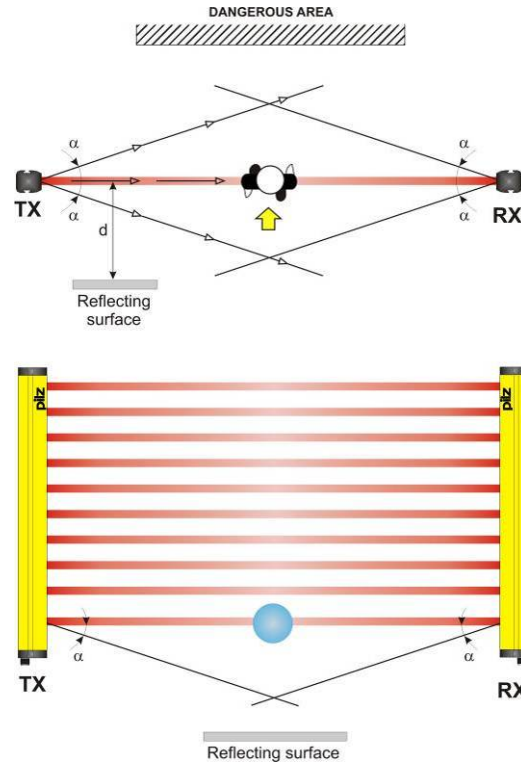


Fig. 7



Improper installation could mean that a protected field is interrupted without detection, resulting in serious injury.

So, when installing the device close to reflective surfaces (metal walls, floors, ceilings or workpieces), it is vital that the minimum distance in relation to reflective surfaces is maintained, as shown in the diagram in Fig. 8. This minimum distance depends on:

- The range between the emitter (TX) and receiver (RX)
- The maximum open angle of the light beams transmitted by the emitter (TX):
5° for Type 4 ESPE ($\pm 2.5^\circ$ to light axis)

The values for the minimum distance in relation to the operating range can be taken from the illustration in Fig. 8.

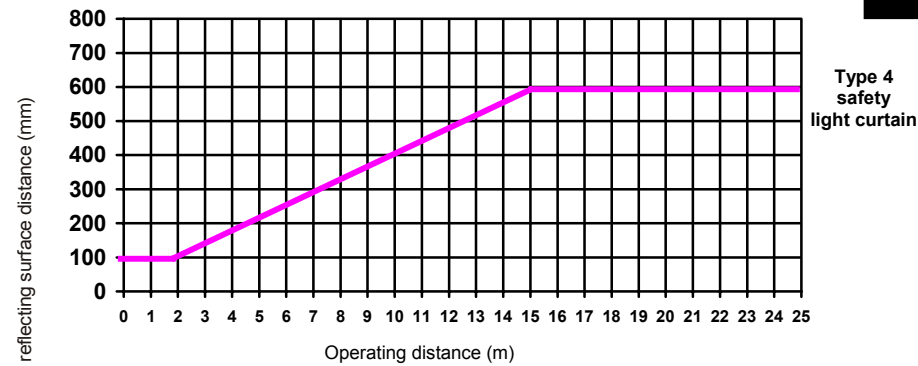


Fig. 8

2.2.3 Installing several adjacent safety light curtains

If it is necessary to install several safety light curtains in adjacent areas, you will need to ensure that the emitter (TX) on one device cannot interfere with the receiver (RX) on another. To prevent this, the devices will need to be installed conversely or must be separated via screening (opaque surface).

Fig. 9 gives an example of an installation that could lead to interference, plus two correct installations.

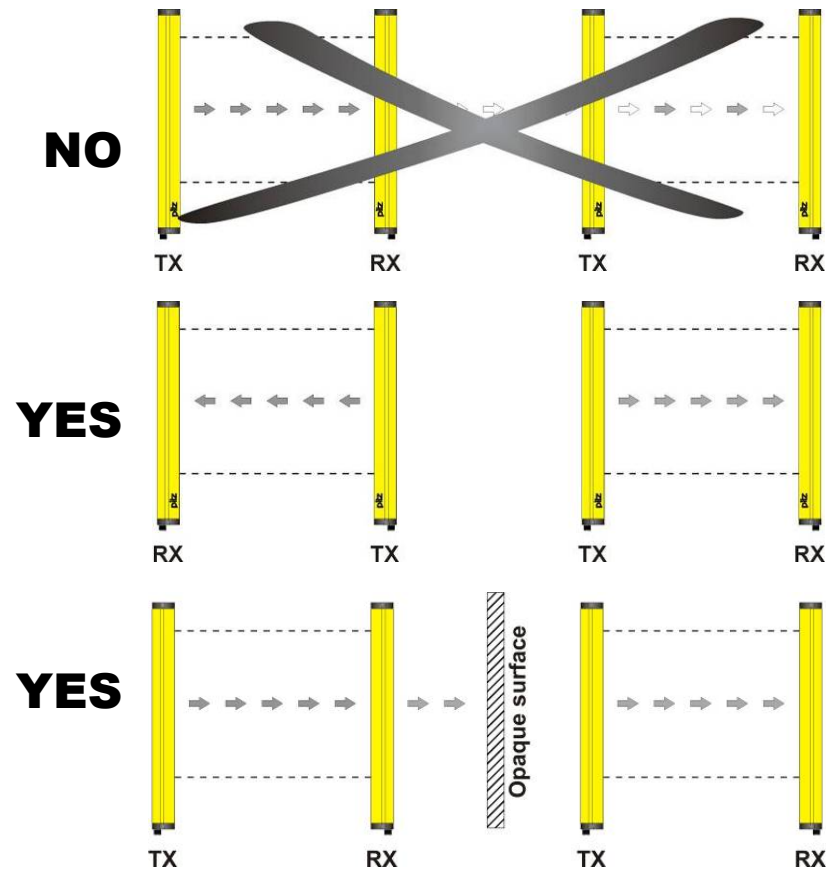


Fig. 9

2.2.4 Use of deviating mirrors

Deviating mirrors can be used to monitor danger zones where access is possible from various sides.

Fig. 10 illustrates a potential solution for monitoring three different access sides using two deviating mirrors positioned at an angle of 45° to the safety light curtain.

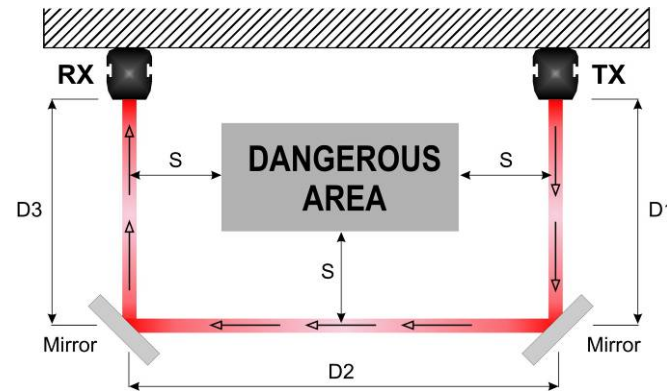


Fig. 10

Please note the following precautions to take when using deviating mirrors:

- The alignment of the emitter (TX) and receiver (RX) is particularly critical when you use deviating mirrors; just a slight angular displacement of the mirror is enough to lose the alignment. This problem can be resolved by using a laser pointer, which is available as an accessory.
- The minimum safety distance (S) must be maintained for each section of the safety light curtain.
- Use of a deviating mirror reduces the effective operating range by about 15%. If two or more deviating mirrors are used, the range will be reduced still further (for more details please refer to the technical specifications for the specific mirror).
- Never use more than three mirrors per device.
- Any dust or dirt on the mirror's reflective surface will drastically reduce the operating range.

English

3 MECHANICAL ASSEMBLY

The emitter (TX) and receiver (RX) must be assembled so that the respective optical surfaces are aligned in parallel and the connectors are positioned on the same side. The distance between the emitter (TX) and receiver (RX) must be within the operating range of the model you are using (see type label or Chapter 9, “*Technical details*”).

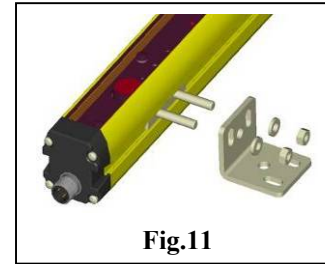


Fig.11

Align the devices precisely, following the guidelines given in Chapter 5, “*Alignment*”.

Depending on the application, both units may either be screwed on using the fixing bolts supplied or by using a rigid mounting bracket.

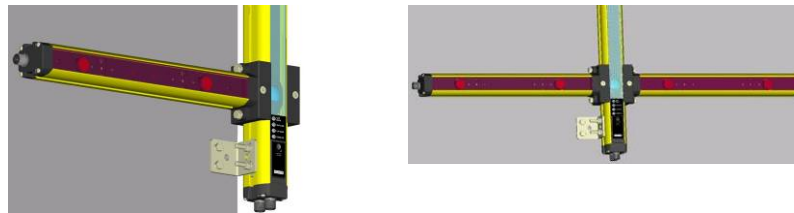


Fig. 12

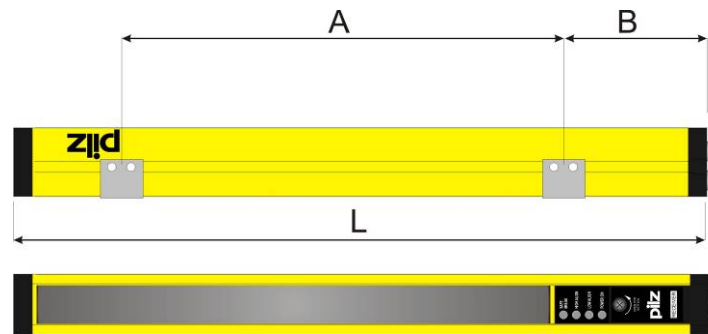
Where there is particularly strong vibration, the muting sensor profiles will also need to be screwed on using rigid mounting brackets (Fig. 13).



Fig. 13

Rigid mounting brackets are suitable for installations that require no large mechanical adjustments during alignment. Adjustable brackets enable the units to be inclined by $\pm 5^\circ$ and are available on request. Where applications are subject to particularly strong vibration we recommend the use of angle brackets with vibration dampers.

The drawing and table below indicate the recommended fixing points in relation to the length of the safety light curtain.



English

MODEL	L (mm)	A (mm)	B (mm)
PSEN op4B-T-2-050	642	342	150
PSEN op4B-T-3-080	942	542	200
PSEN op4B-L-2-050	642	342	150
PSEN op4B-L-3-080	942	542	200
PSEN op4B-S-2-050	642	342	150
PSEN op4B-S-3-080	942	542	200

3.1 Installing the integral muting sensor profiles with "L" and "T" shaped configuration

- Install the unit with the active muting sensors on the receiver (RX) and the unit with the reflectors on the emitter (TX) of the safety light curtain.
- Use the fastening clip to attach the muting sensor profile to the emitter (TX) and receiver (RX) of the safety light curtain. This ensures that the muting sensor profiles are aligned precisely and are perpendicular to the light curtain units (Fig. 14a, Fig. 14b).
- With an "L" shape configuration: Install the profile so that the object can be detected before it reaches the safety light curtain's sensing area.
- Both muting sensor profiles must be aligned in parallel. The muting sensors are already aligned. Slight adjustments may be made by moving the fastening clip.
- For areas of heavy vibration
- You can choose where to position the muting sensor profiles on the light curtain units. (Typically 14 cm from the bottom end of the light curtain unit).

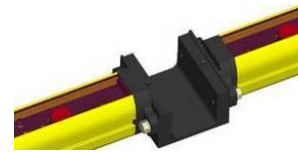


Fig. 14a



Fig. 14b



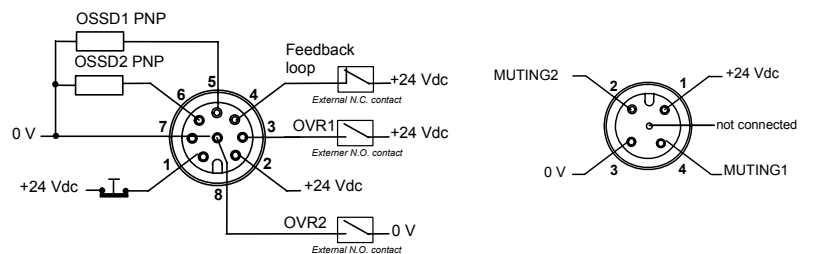
Fig. 14c

4 WIRING

4.1 Electrical connections

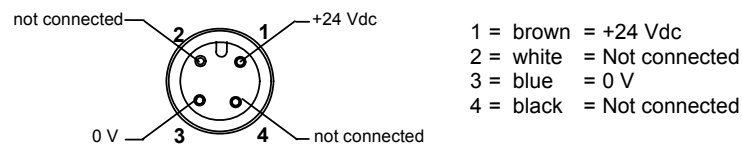
The electrical connections of the emitter (TX) and receiver (RX) are made via M12 connectors, which are located on the bottom of both units.

RECEIVER (RX): 8-pin M12 connector



- | | | | |
|------------|-----------------|-----------|-----------------|
| 1 = white | = TEST/START | 1 = brown | = +24 Vdc |
| 2 = brown | = +24 Vdc | 2 = white | = MUTING 2 |
| 3 = green | = OVERRIDE 1 | 3 = blue | = 0V |
| 4 = yellow | = Feedback loop | 4 = black | = MUTING 1 |
| 5 = grey | = OSSD1 | 5 = grey | = Not connected |
| 6 = pink | = OSSD2 | | |
| 7 = blue | = 0V | | |
| 8 = red | = OVERRIDE 2 | | |

EMITTER (TX): 4-pin M12 connector



- | | |
|-----------|-----------------|
| 1 = brown | = +24 Vdc |
| 2 = white | = Not connected |
| 3 = blue | = 0 V |
| 4 = black | = Not connected |

English

4.2 Notes on wiring

To ensure the correct operation of the safety light curtain, please note the following:

- Safe electrical isolation must be ensured for the external 24 V supply. Failure to do so could result in electric shock. The supply voltage must conform to EN 60950, 03/97, section 2.3, EN 60742, 9/95 or EN 50178, 10/97.
- Emitter and receiver must be connected using shielded cables (accessories).

Fig. 14 shows how to connect the emitter and receiver properly.

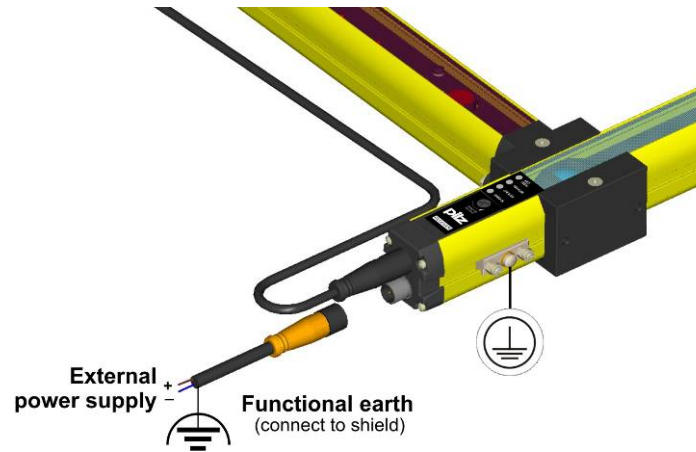
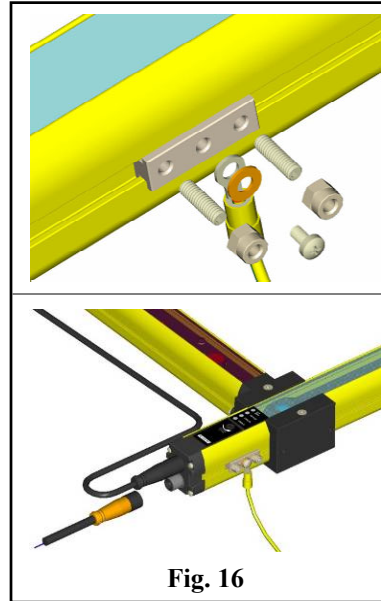


Fig. 15

- At the point where the cable enters the cabinet, connect the screen to the earth bar, without making a break in the cable. Use metal cable clamps which cover the screen over a wide surface area.
- Under no circumstances should the connection cables come into contact with or be laid in proximity to cables that generate strong electromagnetic interference (e.g.: motor feeds, inverters etc.); these could compromise the device's ability to function.
- Multicore cables may not be used to connect the outputs of more than one safety light curtain.

- The TEST/RESET input must be connected to the supply voltage on the ESPE via a button with a N/C contact. The test should be performed manually (by pressing the button) at least once a day in order to check the proper operation of the safety device.
- If the safety light curtain is started and there is no TEST/RESET input connected to 24Vcc, it will switch to a monitoring condition, in which the OSSD is not activated. In this case, set up the correct connections and restart the system to restore operation under normal safety conditions.
- The TEST/START button must be positioned in such a way that the operator has a clear view of the protected area when reset, test or override procedures are in progress (see *Ch. 6 "Operating mode"*).
- The input for monitoring external contactors (feedback loop) must be connected to 24 Vcc via a N/C contact before the safety light curtain is switched on.
The monitoring function will not be activated if the input is not connected properly when the safety light curtain is switched on. In this case the safety light curtain will change to a fault condition.
- The device is already fitted with internal voltage and current limitation. We would advise against the use of other external components, even where this is permitted.

- Earthing: If evaluation devices are connected without safe separation, the safety light curtain must be operated in protection class 1. In this case, the emitter and receiver must be labelled with the protective earth symbol and must be earthed via the fastening kit. Both are supplied with the unit.

**Fig. 16**

Assembling the fastening kit:

- Insert the slot nut (M4 x 0.7 mm tapped holes) into a groove on the safety light curtain.
- Screw the two threaded pins (M4 x 14) into the external tapped holes.
- Fix the screws firmly in place so that the cupped point on the threaded pin pierces the coating. This way contact will be made with the metal housing.
- To prevent the threaded pin from working loose under heavy vibration, attach two self-locking M4 nuts to the threaded pins. Use a hexagonal wrench CH.7.
- Attach the earth lead to the middle tapped hole using the lock washer (M4) and screw (M4).

- Under no circumstances should safety contacts OSSD1 and OSSD2 be wired in series or parallel; however, both may be used separately.
If one of these two configurations should be used by mistake, the safety light curtain will indicate an output malfunction (see Ch. 7 "Diagnostic functions").
- Connect both OSSD outputs to the control element. If an OSSD output is not connected to the control element, this will have a negative effect on the safety level of the system in which the safety light curtain is used.

English

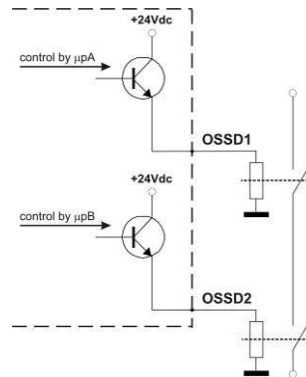


Fig. 17

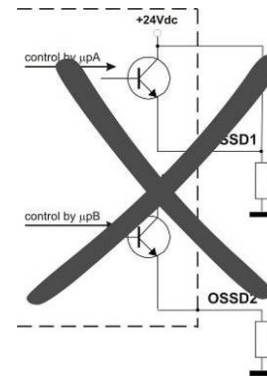


Fig. 18

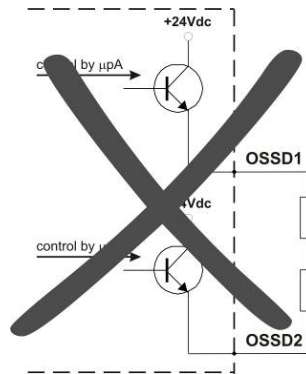


Fig. 19

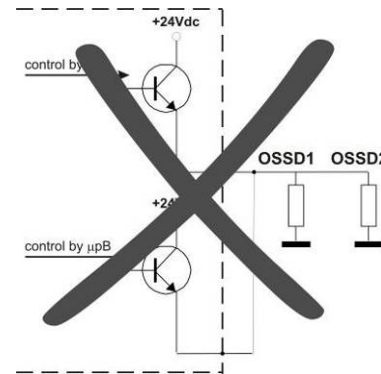


Fig. 20

5 ALIGNMENT

The emitter (TX) and receiver (RX) must be aligned to ensure the proper function of the device.

Perfect alignment is achieved when the optical axes of the first and last beam from the emitter (TX) meet the optical axes of the corresponding elements on the receiver (RX).

Two yellow LEDs on the receiver (RX), "HIGH ALIGN" and "LOW ALIGN", simplify the alignment process.

5.1 Alignment instructions

Once the mechanical assembly and the electrical connections have been completed, the safety light curtain can be aligned as described below:

- Disconnect the power supply to the safety light curtain.
- Press the TEST/START button and keep it held down (opens the contact).
- Reconnect the power supply.
- You can now release the TEST/RESET button.
- On the emitter (TX), ensure that the green LED "POWER ON" and the yellow LED "SAFE" are lit. This confirms that the transmitter is operating correctly.
- Make sure that the status of the receiver is one of the following:
 - **BREAK Status:** Green LED "POWER ON" is lit and LED "SAFE/BREAK" lights up red (BREAK).
-> The safety light curtain is not aligned correctly.
 - **SAFE Status:** Green LED "POWER ON" is lit and LED "SAFE/BREAK" lights up green. The yellow LEDs "HIGH ALIGN" and "LOW ALIGN" are lit.
-> The safety light curtain is aligned correctly.

Follow the steps below to align the units:

- Hold the receiver (RX) steady and align the emitter (TX) so that the yellow “LOW ALIGN” LED lights up, confirming that the first lower beam has been aligned correctly.
- Rotate the emitter (TX) until the yellow “HIGH ALIGN” LED is also lit. The “SAFE/BREAK” LED switches from red (BREAK) to green (SAFE).

NOTE: Make sure that the “SAFE/BREAK” LED is constantly green.

- With a few small movements, define the area in which the “SAFE/BREAK” LED is constantly green; do this first with one unit and then with the other. Place both units in the centre of this area.
- Use the pins and/or mounting brackets to firmly secure both the units.
- Disconnect the power supply to the safety light curtain.
- Reconnect the power supply.
- Make sure that the green “POWER ON” LED on the receiver (RX) is lit (light beams are clear, “SAFE” operating status) and that this switches to red if just a single beam is interrupted (detected object, “BREAK” operating status).
- Perform this test using a cylindrical “test rod”, the diameter of which should correspond to the resolution of the device (14 mm, 20 mm, 30 mm or 35 mm). The test rod is available as an accessory.

NOTE: If you pass the test rod from top to bottom along the length of the whole sensing area, at any distance from either unit, the “SAFE/BREAK” LED must be constantly red. We recommend that you perform this test daily.

5.2 Aligning the muting sensors

- Once the safety light curtain has been aligned and the muting sensor profiles have been installed and wired, you will need to check that the sensors on the profiles are aligned correctly. Slight adjustments may be made by moving the fastening clip.

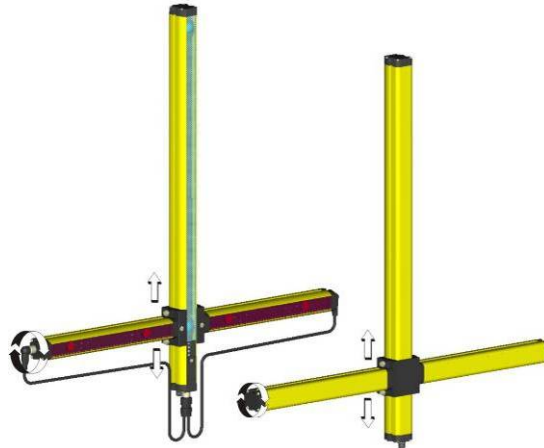


Fig. 21

6 FUNCTIONS

6.1 Selecting the operating mode via DIP switches

On the front of the receiver (RX) there is a cover flap (Fig. 22), which is easy to open using a screwdriver and enables access to a row of DIP switches for the following configurations:

- Muting function/muting timeout
- Feedback loop monitoring function
- Manual/automatic reset



The device will not accept configuration changes during normal operation. A configuration change will only take effect once the device is reset.

Particular care should therefore be taken when setting the DIP switches.

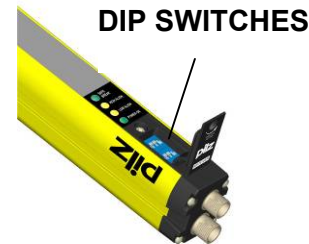


Abb. 22

DIP-sw	FUNCTION	ON	OFF
1	Muting timeout	10 min	Infinite
2	Muting	T-shape configuration, linear configuration	L-shape configuration
3	Feedback loop monitoring	Deactivated	Activated
4	Restart	Automatic	Manual

6.2 Standard configuration

The device is supplied with the following standard configuration:

- Muting timeout: 10 min
- Muting: In T shape configuration
- Feedback loop monitoring function: Deactivated
- Restart: Automatic

NOTE: The muting function can only be activated if muting inputs 1 and 2 and the muting lamps are connected correctly. Detailed information on this function can be found in chapters 6.3 and 6.4.

6.3 Restart

If the beams between the emitter (TX) and receiver (RX) are interrupted by an opaque object, the OSSD outputs will switch and the safety contacts will open ("BREAK" operating status).

There are two different ways to restart normal mode ("SAFE" operating status):

- Automatic reset: After the protected field has been interrupted, the safety light curtain returns to its normal mode as soon as the detected object has been removed from the protected field.
- Manual reset: After the protected field has been interrupted, the safety light curtain does not return to its normal mode until the object has been removed from the protected field and the restart button (TEST/RESET button) has been operated for at least 0.5 s.

Timing diagram for manual reset (local or external activation of restart function)

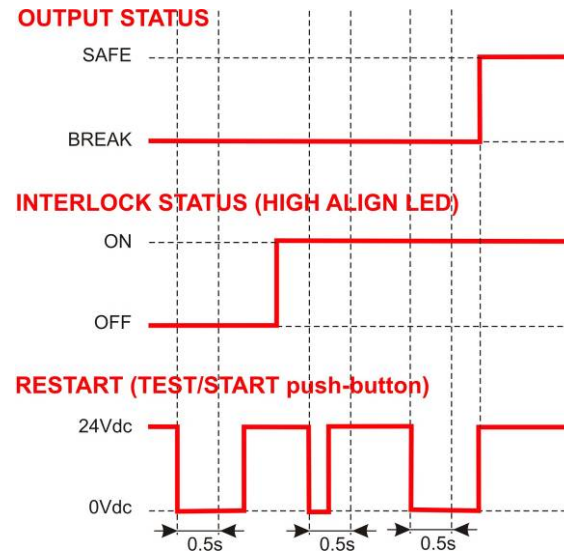
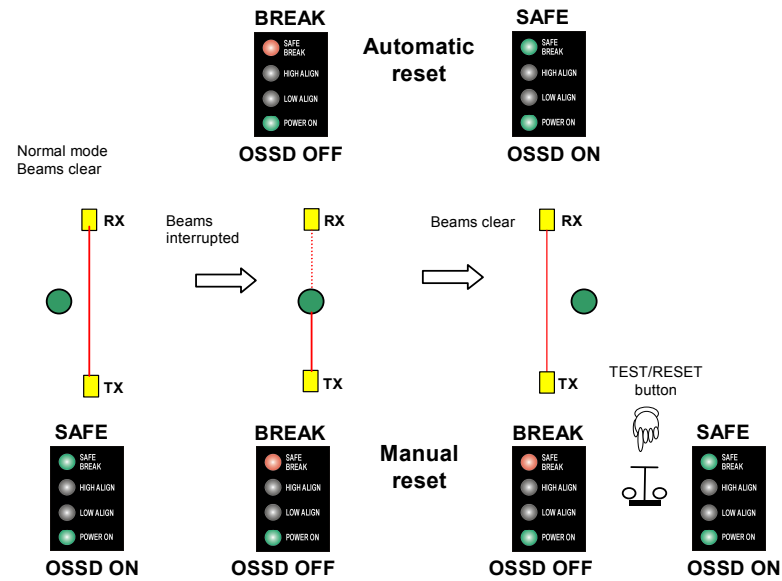


Fig. 23 shows the two operating modes:

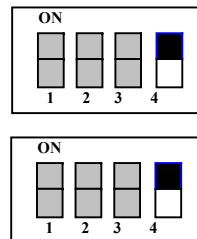


English

Fig. 23

Automatic or manual reset can be selected via the DIP switches on the receiver (RX).

- Automatic reset: Set position 4 on both DIP switches to ON
- Manual reset: Set position 4 on both DIP switches to OFF

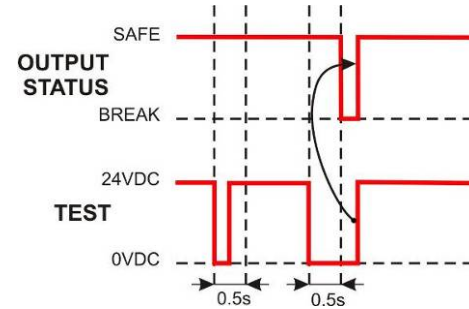


NOTE: DIP switches that are not used for this function are shown in grey in the diagram.

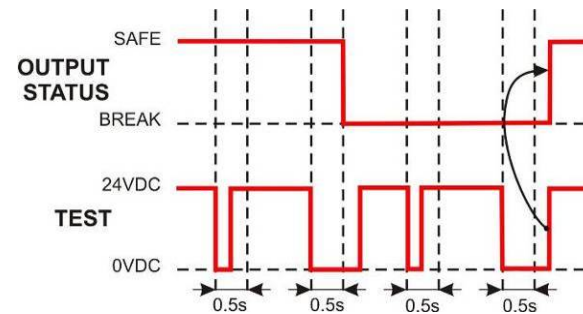
6.4 Test function

The test function can be used to carry out a function test on the safety light curtain. The test function is activated via the input (TEST/RESET) on the receiver (RX). The function is activated when the TEST/RESET button has been operated for at least 0.5 s.

AUTOMATIC RESET



MANUAL RESET



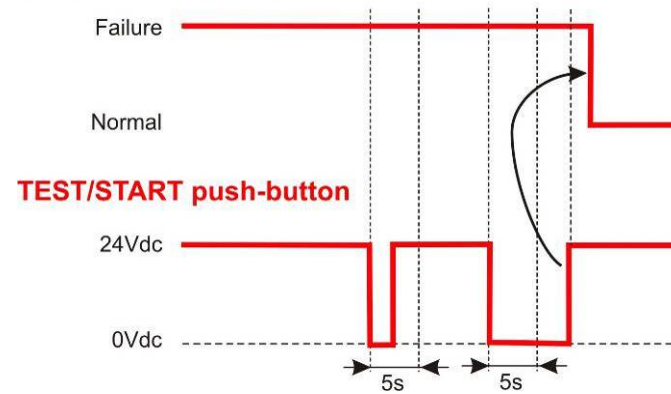
6.5 Reset function

The safety light curtain has a reset function which is used in the case of internal errors. To cancel the reset lock and restore the normal operating status, press the TEST/RESET button for at least 5 s. Carry out the reset function in the following cases:

- Irregular output function
- Irregular optical function
- Irregular operation of the feedback loop monitoring function
- Irregular muting display function

Timing diagram for the reset function

Safety light curtain status

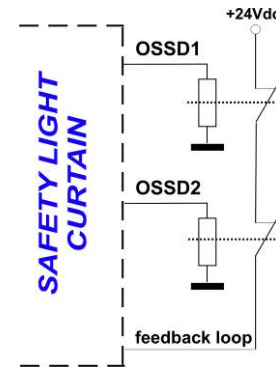


6.6 Feedback loop monitoring function

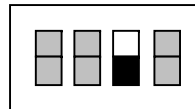
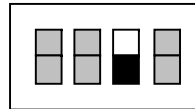
The safety light curtain has a feedback loop for monitoring the externally connected contactors. The opening/closing of the electrical contacts is monitored by a N/C contact.

Activate the feedback loop monitoring function:

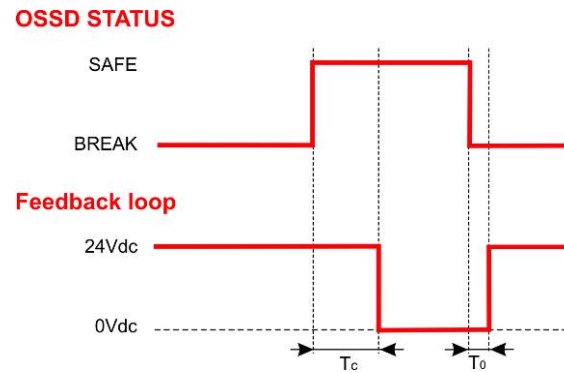
- Select the relevant DIP switch
- Connect the feedback loop input to a 24 Vcc N/C contact on the device to be monitored.



The diagram on the right shows the correct layout of the DIP switches (DIP switch 3 OFF) to activate the feedback loop.



This function monitors the switching of the N/C contacts when the OSSD output status changes.



$T_c \leq 350$ ms Time after which the feedback loop contacts open once the OSSD outputs switch from OFF-ON

$T_0 \leq 100$ ms Time after which the feedback loop contacts close once the OSSD outputs switch from ON-OFF

Use control elements whose dynamics are compatible with the time constraints stated above.

If inappropriate devices are used, the safety light curtain may switch to a fault condition.

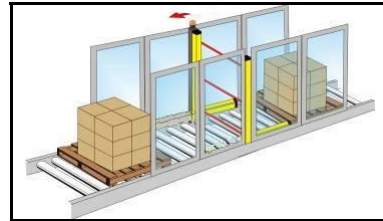
We recommend that this function is checked regularly.

English

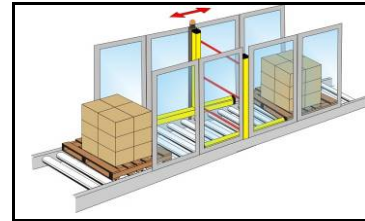
6.7 Muting function

The muting function enables the safety light curtain to be suspended temporarily while material is transported through the protected field (Fig. 24).

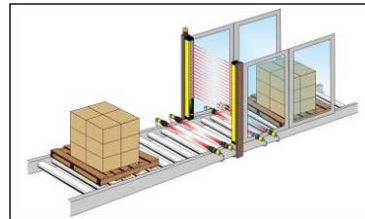
- "L" shape configuration: is suitable for applications in which an object leaves the danger zone in one direction.
- "T" shape configuration: is suitable for applications in which an object moves in two directions.
- Linear models: Are suitable for applications on which the sensors are intended to be positioned individually. A plug connector enables the muting sensors to be connected simply.



L-shape version with integral muting sensors for muting in one direction (leaving the danger zone)



T-shape version with integral muting sensors for muting in two directions



Linear version with external muting sensors

Fig. 24

To comply with current regulations the safety device has two inputs (muting 1 and muting 2) for activating the muting function. For example, the muting function can be used when objects need to pass through the protected field, but operating personnel still require protection.

Muting duration:

- Muting timeout 10 min.: Set position 1 on both DIP switches to ON
- Muting timeout infinite: Set position 1 on both DIP switches to OFF

Muting configuration:

- T-shape configuration or linear configuration: Set position 2 on both DIP switches to ON
- L-shape configuration: Set position 2 on both DIP switches to OFF

When using the muting function, please note the following:

- The muting function represents a forced situation for the whole system and as such should be applied with due care.
- The muting sensors must be connected and positioned properly, so that personnel are not exposed to unwanted muting activations or hazardous situations.
- Muting cannot be activated if the protected field is interrupted ("SAFE" LED lights up red).
- When you have different conveyor speeds in muting mode, you will need to consider the effect this will have on the overall duration of the muting process.
- The receiver has a muting lamp which displays the status of the muting function (Fig. X). If the muting lamp is defective, activating muting or override will cause the safety contacts to open and the plant will be disabled due to a muting lamp malfunction (see Chapter 8.2 "Error messages and diagnostics"). The muting lamp must be clearly visible from all sides of the work area.



Fig. 25







- The vehicle should be designed to make it impossible for people to ride on it.

- Limit the size of the entry area by applying appropriate safety measures. People must not be permitted to enter the danger area during the muting phase.

- Make sure that you select the correct muting configuration (DIP switch position 2). The "OFF" position is provided exclusively for safety light curtains with an L-shape configuration. Any discrepancy in the configuration may cause the muting function to operate incorrectly and reduce the level of safety.

- In each case, the muting sensors must be positioned so that muting cannot be activated by somebody passing through the protected field.

 - Muting can be activated in 2 ways:
 - Activation of both muting inputs simultaneously (not in the case of L-shaped muting)
 - Activation of muting input 1 and then muting input 2, or vice-versa.
 - Muting cannot be activated if the protected field is interrupted ("SAFE" LED lights up red).
 - An "infinite" muting timeout does not conform to the specifications of EN 61496-1. If the muting timeout has been set to "infinity", the muting sensors must be tested at intervals that are compatible with the process. This can be done by shutting down the plant or by idling the muting channel, for example.

 - If the muting timeout is set to "infinity", the level of safety that can be achieved may be reduced.


Fig. 26 shows an example of a muting function application.

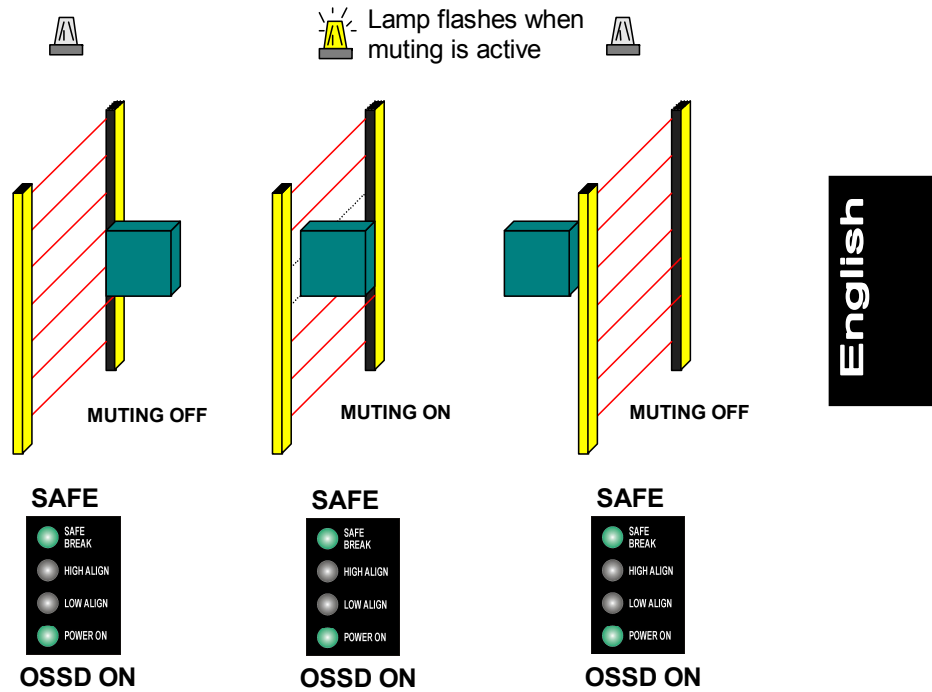
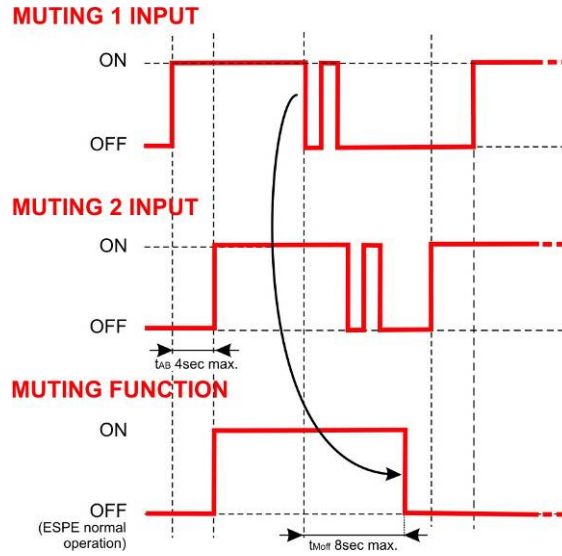
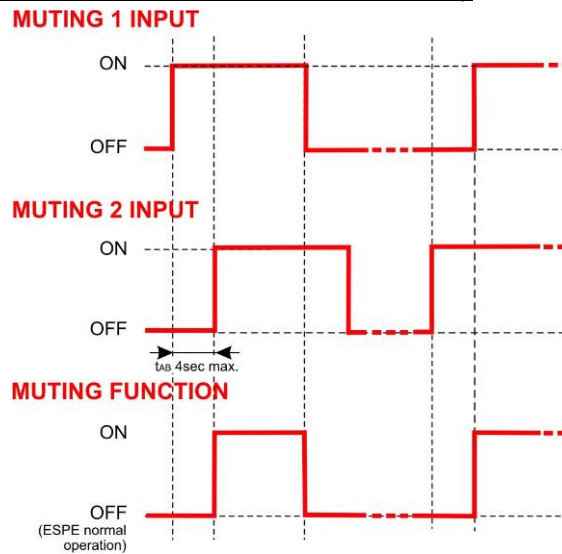


Fig. 26

Timing diagram of the muting function for configurations with 2 sensors (L-shaped version or linear version with 2 intersecting beams)



Timing diagram of the muting function for configurations with 4 sensors (T-shaped version or linear version with 4 sensors)



6.7.1 Installing the muting sensors on PSEN op4B-S models

As the package passes through, the safety function is temporarily suspended via the muting sensors. The outputs on these sensors are connected to the muting inputs MUTING 1 and MUTING 2 on the safety light curtain receiver (RX).

The contacts for these sensors are monitored via the receiver (RX).

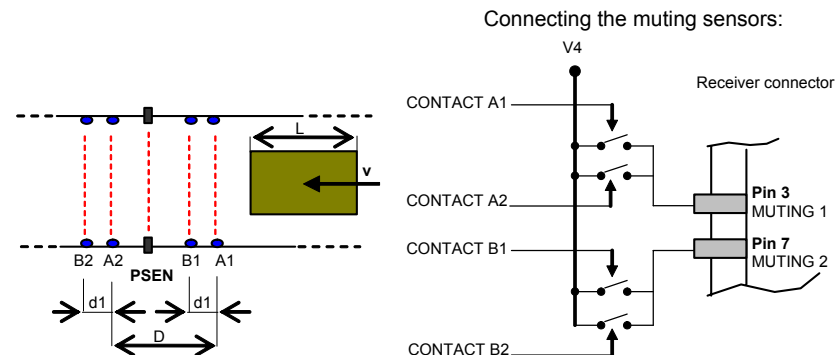
Optoelectronic, mechanical, proximity sensors etc. can be used as muting sensors, using a closed contact when the object requiring detection is present.

The following examples illustrate the application of the muting function:

- Application with four optoelectronic sensors: Configured with parallel light axes

This solution is suitable for applications in which the object can be moved in two directions.

For correct operation set position 2 on the DIP switch to ON.



- The distance between B2 and A2 or B1 and A1 should be as long as possible, but distance D between A2 and A1 must be less than the object size L .
- A2 and B1 must be positioned as close as possible in front of/behind the safety light curtain.

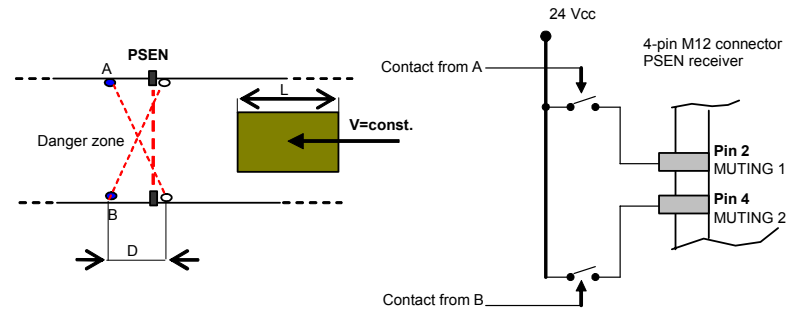
- The maximum possible distance of d_1 between B2 and A2 or B1 and A1, depends on the object's approach speed:
 $d_{1\max.} [\text{cm}] = v [\text{m/s}] * t_{G1} [\text{s}] * 100$
 $d_{1\min.} [\text{cm}] \geq 0.1 \text{ cm}$
- Muting sensors A1 and B1 or A2 and B2 must be operated within 4 s.

- Application with two optoelectronic sensors: configured with parallel intersecting beams

This solution is suitable for applications in which the object can only be moved in one direction.

For correct operation set position 2 on the DIP switch to ON.

Connecting the muting sensors:



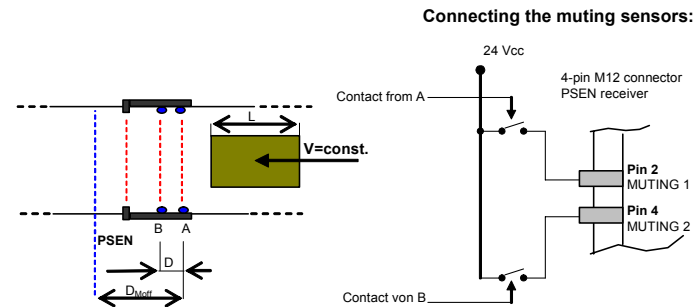
English

- The beams must always intersect within the danger area.
- Muting sensors A and B must be operated within 4 s.

6.7.2 Installing the muting sensors on PSEN opB-L models

The integrated muting function in an L-shaped configuration enables the muting sensors to be easily installed and is suitable for applications in which the object is **to travel out of the danger zone**.

For correct operation set position 2 on the DIP switch to OFF.

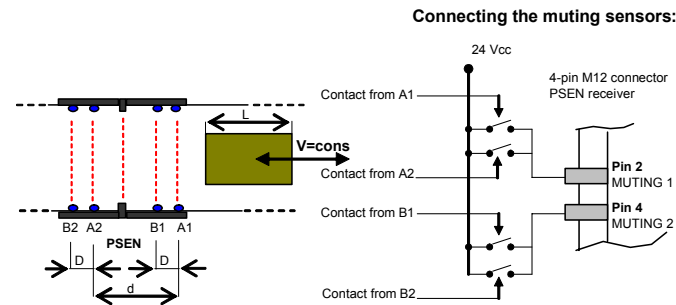


- The distance d_1 between A and B is 16.5 cm
- Muting sensors A and B must be operated consecutively within 4 s.
- Once muting sensor A has been cleared, the muting function is held for another 4 s. After this time the muting function switches off and the safety light curtain returns to normal mode.
- You should also secure the light curtain area outside the danger zone, e.g. using a safety fence, so that it is impossible for anyone to access the danger zone during the 4 s in which the muting function is held.

6.7.3 Installing the muting sensors on PSEN opB-T models

The integrated muting function in a T-shaped configuration enables the muting sensors to be easily installed and is suitable for applications in which the object is moved in two directions.

For correct operation set position 2 on the DIP switch to ON.



- The distance d between A1 and B1 or A2 and B2 is 16.5 cm.
- The distance D between A1 and A2 or B1 and B2 is 34.5 cm.
- Muting sensors A and B must be operated consecutively within 4 s.

English

6.8 Override function

This function can be used to activate the muting function when the plant needs to be started even though there is an object within the protected field. The aim is to clear the danger zone of any material that may have accumulated due to a fault in the operating cycle.

Example:

There is a pallet within the protected field and the conveyor cannot be switched on because the safety light curtain will not enable its outputs (one or more of the beams are interrupted), so the accumulated material cannot be transported away. Activating the override function enables this type of intervention.

Activate the override function:

- With manual reset: When the protected field has been interrupted, the override function cannot be activated until the TEST/RESET button has been pressed.
- The override function is activated via the local input (OVR1 and OVR2) on the receiver (RX). To do this, connect a pushbutton with N/O contacts to OVR1 and 24 Vcc and PVR2 and 0 Vcc.
- The override function is active when both N/O contacts close simultaneously (simultaneity between the contacts max. 400 ms).
- Press the OVERRIDE button and keep it held down until all the accumulated material has been cleared away.

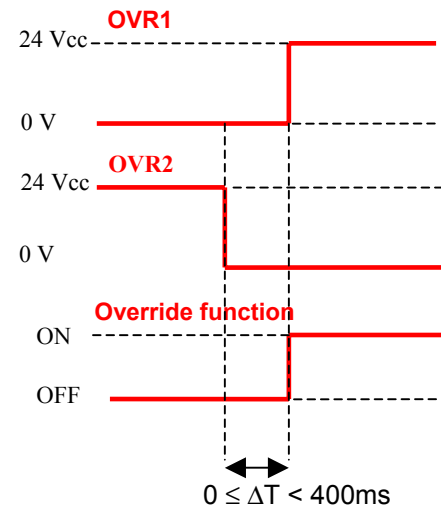
While the override function is active the muting lamp will flash to signal the suspension of the safety light curtain.

The maximum duration of the override function is 120 s. After this time the override function switches off, even if the "OVERRIDE" button is operated. If the button is released before this time has elapsed, the override function switches off immediately.

The override function is ended automatically when:

- There are no muting sensors active
- Muting timeout is exceeded
- At least one override input is deactivated

Timing diagram: Override function



English

7 DIAGNOSTICS

7.1 Function indicators

4 LEDs on the receiver (RX) and 2 LEDs on the emitter (TX) provide the user with information about the operating status of the safety light curtain.
















Fig. 27

The key to the LEDs on the receiver (RX) depends on the operating mode.

7.2 Error messages and diagnostics

The LEDs that display the function can also be used by operators to evaluate the main causes of an error.

RECEIVER:

Defect	Cause	Checks and remedy
 <i>Flashing red</i>  <i>Flashing yellow</i>  <i>Flashing yellow</i>  <i>Constant green</i>	Malfunction of the outputs	<ul style="list-style-type: none"> - Check the output connections. - Check that the load is compatible with the specifications given in the TECHNICAL DETAILS table (Ch. 9).
 <i>Flashing red</i>  <i>Off</i>  <i>Flashing yellow</i>  <i>Constant green</i>	Malfunction of the external control unit (function of the feedback loop monitoring test)	<ul style="list-style-type: none"> - Check the feedback loop monitoring connections - Check the compatibility of the external unit and the test times for feedback loop monitoring - Switch the unit off and then on again; if the problem persists, change the external unit.
 <i>Off</i>  <i>Flashing yellow</i>  <i>Flashing yellow</i>  <i>Constant green</i>	Malfunction of the microprocessor	<ul style="list-style-type: none"> - Check the correct position of the DIP switches. - Switch the device off and then on again; if the problem persists, contact PILZ.
 <i>Constant red</i>  <i>Flashing yellow</i>  <i>Off</i>  <i>Constant green</i>	Override function can be called up	<ul style="list-style-type: none"> - The display is indicating that there is no defect - Activate the override function in order to remove the material from the area of the protected field.
 <i>Constant red</i>  <i>Flashing yellow</i>  <i>Flashing yellow</i>  <i>Constant green</i>	Irregular override function	<ul style="list-style-type: none"> - Check the contacts for the override function. If the fault persists, contact Pilz.
 <i>Off</i>  <i>Off</i>  <i>Flashing yellow</i>  <i>Constant green</i>	Optical fault	<ul style="list-style-type: none"> - Check the alignment of emitter and receiver - Switch the device off and then on again; if the fault persists, contact PILZ.

English

Defect	Cause	Checks and remedy
	Irregular function of the integral muting display	- Switch the device off and then on again; if the fault persists, contact PILZ.
	Supply voltage error	- Check the supply voltage - If the fault persists, contact Pilz.
	The supply voltage is outside the permitted range Malfunction of the main microprocessor	- Check the supply voltage - If the fault persists, contact Pilz.

EMITTER:

Defect	Cause	Checks and remedy
	General irregularity on the emitter	- Check the supply voltage; if the display does not go out, contact Pilz.
	Supply voltage error	- Check the supply voltage - If the fault persists, contact Pilz.
	The supply voltage is outside the permitted range Malfunction of the main microprocessor	- Check the supply voltage - If the fault persists, contact Pilz.

8 REGULAR CHECKS AND MAINTENANCE

Qualified personnel must carry out the following checks regularly.
Ensure that:

- The “SAFE/BREAK” LED is constantly red when you pass the test rod from top to bottom along the length of the whole sensing area, at any distance from either unit.
- The safety light curtain switches to an OFF state when the test/reset button is operated (“SAFE/BREAK” LED lights up red - OSSD outputs open - monitored machine switches to a safe condition).
- The reaction time at a machine stop, incl. the reaction time of the safety light curtain and the machine overrun time, is within the limits defined through the calculation of the safety distance (see Chapter 2 “*Installation*”).
- The minimum safety distance between the danger zone and the protected field is in accordance with the details stated in Chapter 2 “*Installation*”.
- Nobody can access and remain in the danger zone between the safety light curtains and the hazardous machine parts.
- The danger zone cannot be accessed from any unprotected area.
- There is no visible damage to the safety light curtain and/or the external electrical connections.

We recommend a yearly inspection.

8.1 Maintenance

Safety light curtains require no particular maintenance, except for cleaning the optical covers. Moist cotton cloths should be used for cleaning.



We recommend that you do not use:

- Alcohol or solvents,
- Cloths made of wool or synthetic material

8.2 General information and useful data



Safety devices are only beneficial if they are installed correctly, in accordance with the regulations.

If you find that you do not have the necessary expertise to install the safety devices correctly, please contact our technical support.

Electronic fuses protect the devices against short circuit. Once these have reacted you will need to disconnect the power supply for at least 20 seconds and rectify the short circuit. When you reconnect the power supply the fuses will have reset and the safety light curtain can automatically resume normal operation.

Faults that result in a power supply failure may cause the outputs to open temporarily, but do not adversely affect the safe operation of the safety light curtain.

Install and replace emitter and receiver only in pairs.

Emitter and receiver have the same serial number.

Guideline for repair: Always send both emitter **and** receiver for repair.

(During repair, both units are programmed with the current software version).

9 TECHNICAL DETAILS

Supply voltage	24 VDC \pm 20% (SELV/PELV)
Internal capacity	23 nF (Tx) / 120 nF (Rx)
Current consumption, emitter (TX)	Max. 30 mA / 0.9 W
Current consumption, receiver (RX)	Max. 75 mA (without load) / 2.2 W
Current consumption, muting sensor profiles	Max. 35 mA / 1 W (when sensors switched to 'OFF')
Outputs:	2 PNP Max. short circuit stability: 1.4 A at 55°C min: 1.1A at -10°C
Output current:	Max. 0.5 A / each output
Output voltage ON - min.:	Vdd -1 V
Output voltage OFF - max.	0.2 V
Capacitive load (pure)	Max. 65 nF at 25°C
Resistance load (pure)	Min. 56Ω at 24 Vcc
Leakage current	< 1 mA
Reaction time	14 ms
Emitter, wavelength	Infra-red (880 nm)
Resolution	415 mm (2 optics) 515 mm (3 optics)
Operating range	0.5...3 m (PSEN op4B-T/L), 0.5...25 m (PSEN op4B-S)
Category	Type 4
Timeout points	Muting: 10 min / infinity Override: 2 min
Operating temperature	-10 ... +55 °C
Storage temperature	-25 ... +70 °C
Humidity	15 ... 95 % (non-condensing)
Protection class	Class 1 (see section 4.2 "Wiring guidelines", "Earthing" section)
Protection type	IP65 (EN 60529)
Ambient brightness	IEC-61496-2
Vibration	Amplitude 0.35 mm, frequency 10 ... 55 Hz, 20 sweeps for all axes; 1 octave/min., (EN 60068-2-6)
Shock resistance	16 ms (10 G) 1,000 shocks for all axes (EN 60068-2-29)
Reference standards	IEC 61496-1; IEC 61496-2
Housing material	Varnished aluminium (yellow RAL 1003)
Material of upper and lower cover	PC MAKROLON
Material for optics	PMMA
Connections	4-pin M12 connector on TX 8-pin M12 connector on RX
Cable runs	
Supply	Max. 50 m*
Weight	Max. 1.2 Kg / m per unit

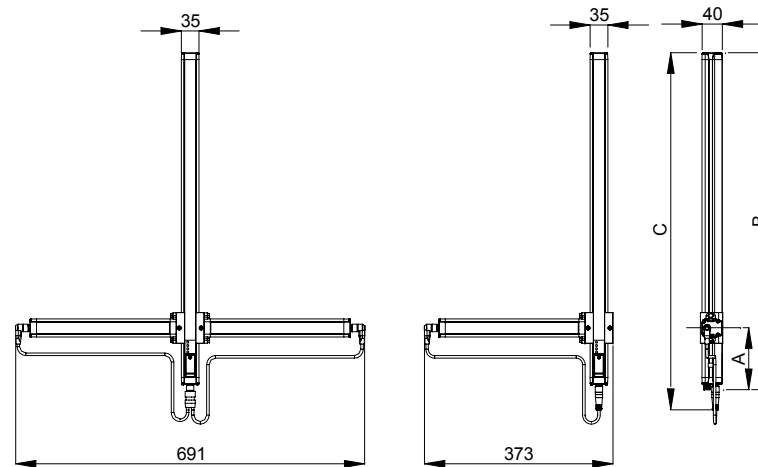
* If a longer cable is used, you will need to make sure that the relevant specifications are met.

10 LIST OF AVAILABLE MODELS

MODEL	Length of sensing area	Distance	No. of beams	Resolution mm	Reaction time (ms)	Operating range (m)
PSEN op4B-T-2-050	515	500	2	515	14	0.5...3 m
PSEN op4B-T-3-080	415	400	3	415	14	0.5...3 m
PSEN op4B-L-2-050	515	500	2	515	14	0.5...3 m
PSEN op4B-L-3-080	415	400	3	415	14	0.5...3 m
PSEN op4B-S-2-050	515	500	2	515	14	0.5...25 m
PSEN op4B-S-3-080	415	400	3	415	14	0.5...25 m

11 OVERALL DIMENSIONS

All dimensions are stated in mm.



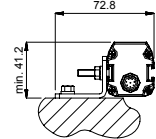
MODEL	A (mm)	B (mm)	C (mm)
PSEN op4B-T-2-050	120...260	653	690
PSEN op4B-T-3-080	120...260	953	990
PSEN op4B-L-2-050	120...260	653	690
PSEN op4B-L-3-080	120...260	953	990
PSEN op4B-S-2-050	120...260	653	690
PSEN op4B-S-3-080	120...260	953	990

12 ACCESSORIES

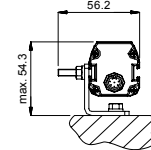
12.1 Mounting bracket

MODEL	DESCRIPTION
Bracket kit PSEN 4	(1) Bracket (4-part kit)
Bracket kit PSEN 4 anti vibr.	(2) Anti-vibration brackets (4-part kit)
Bracket kit PSEN 4 adjust.	(3) Adjustable brackets (4-part kit)

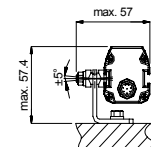
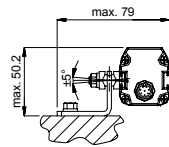
Mounting type A



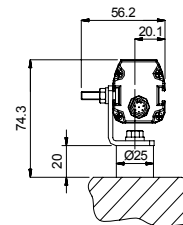
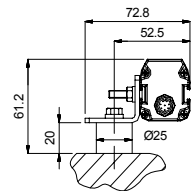
Mounting type B



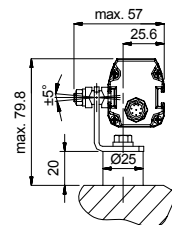
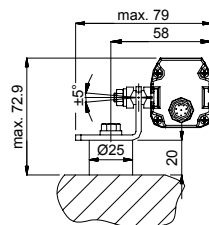
Standard mounting bracket (1)



Standard mounting bracket + adjustable bracket (1 + 3)



Standard mounting bracket + anti-vibration bracket (1 + 2)

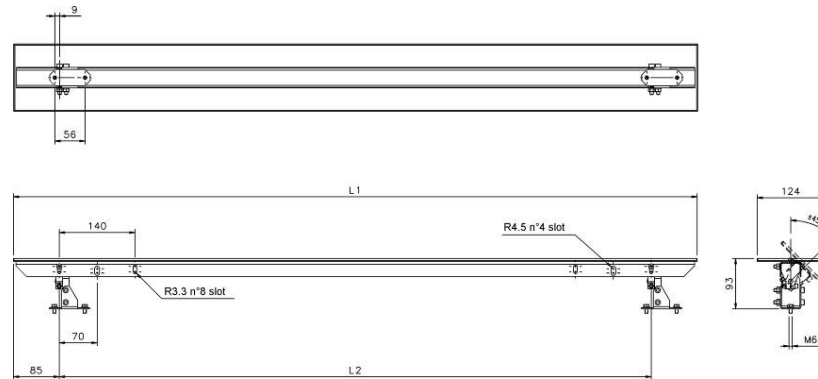


Standard bracket+adjustable bracket+anti-vibration bracket (1 + 2 + 3)

English

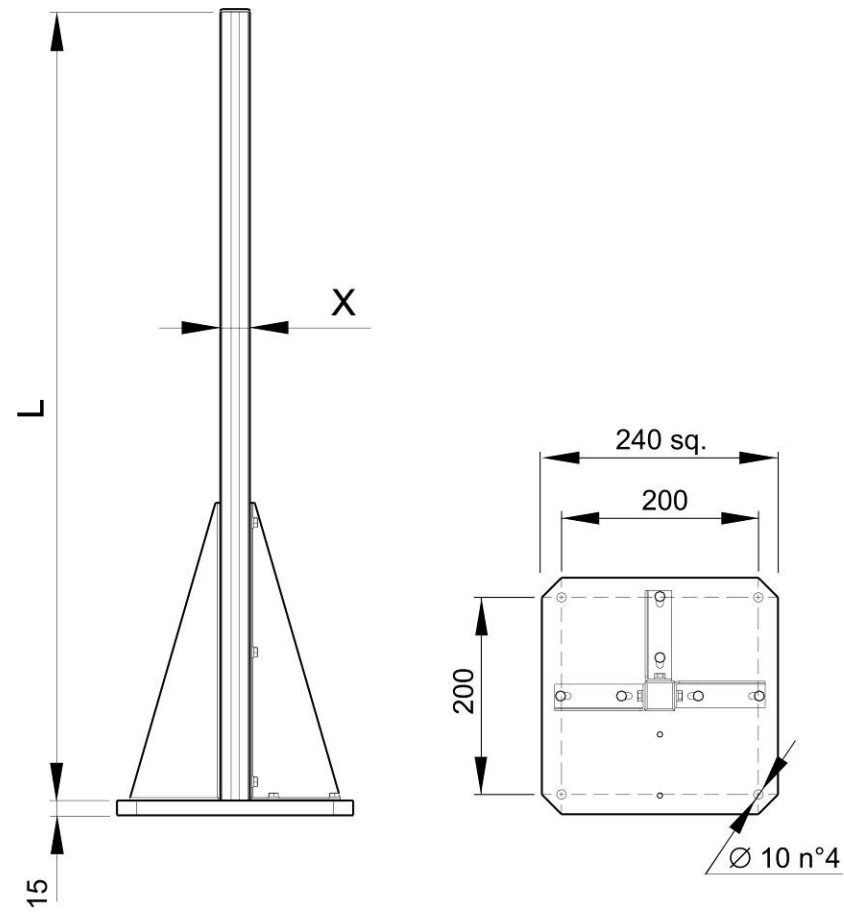
12.2 Deviating mirror

MODEL	DESCRIPTION	L ₁ (mm)	L ₂ (mm)
Mirror 550mm	Deviating mirror H= 550 mm	554	384
Mirror 700mm	Deviating mirror H= 700 mm	704	534
Mirror 900mm	Deviating mirror H= 900 mm	904	734
Mirror 1000mm	Deviating mirror H= 1000 mm	1004	834
Mirror 1270mm	Deviating mirror H= 1270 mm	1264	1094
Mirror 1600mm	Deviating mirror H= 1600 mm	1604	1434
Mirror 1800mm	Deviating mirror H= 1800 mm	1804	1634



12.3 Floor brackets

MODEL	DESCRIPTION	L (mm)	X (mm)
Stand 1000mm	Floor brackets H= 1000 mm	1000	30x30
Stand 1200mm	Floor brackets H= 1200 mm	1200	30x30
Stand 1500mm	Floor brackets H= 1500 mm	1500	45x45
Stand 1800mm	Floor brackets H= 1800 mm	1800	45x45



English

12.4 Laser pointer

The laser pointer in the PSEN op2/4 series is a valuable guide when aligning and installing the safety light curtains. The pointer can be moved along the light curtain profile to check the overall alignment of the safety light curtain.

MODEL	DESCRIPTION
LaserPointer for PSEN 4/2	Laser pointer for alignment

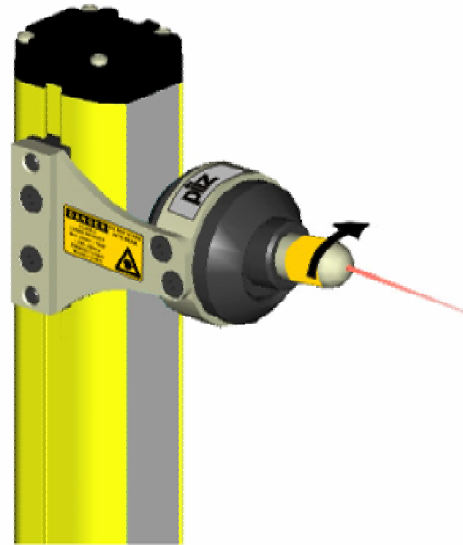


Fig. 28

12.5 Connection box

The connection box PSEN iop1 makes it easier to connect and operate the safety light curtains.

Features:

- Key switch for the override function
- TEST/RESET button for activating the test, restart and reset function
- Connections for:
 - Receiver (RX)
 - Emitter (TX)
 - Supply voltage
 - Relay outputs
 - External control unit

English

MODEL	DESCRIPTION
PSEN iop1	Connection box

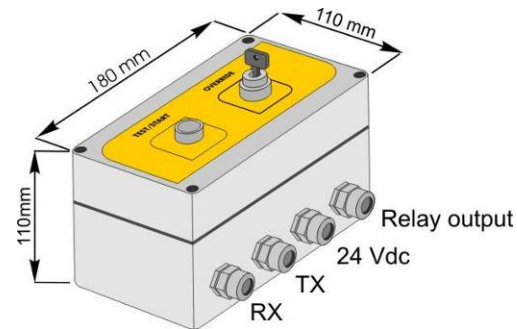


Fig. 29