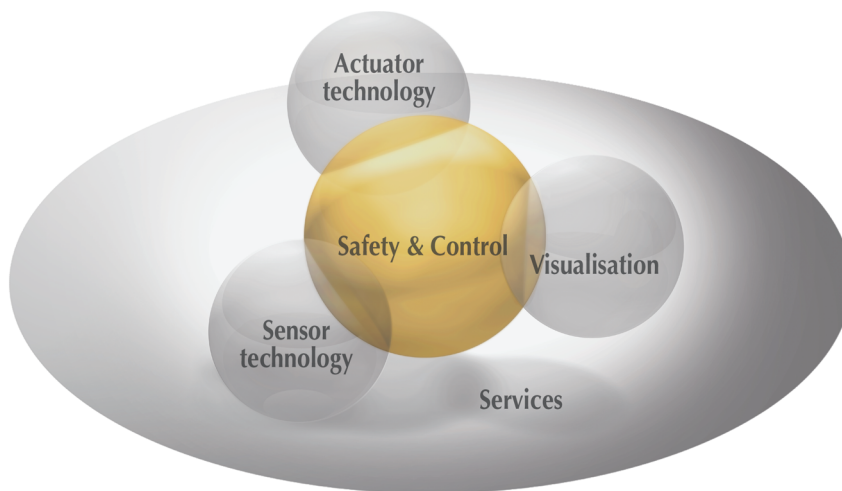




## PSENopt light curtains and light barriers

**pilz**  
more than automation  
safe automation

Configuration guide



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April 2005

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## Basics

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## Basics

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## Basics Description

This technical catalogue describes the units in the PSENopt product range:

- PSEN op2H
  - PSEN op2B
  - PSEN op4F
  - PSEN op4H
  - PSEN op4B
- Safety light curtains with integral SafetyBUS p interface:
- PSEN opSB-4F
  - PSEN opSB-4H
  - PSEN opSB-4B

### Operation

Safety light curtains in the PSENopt product range are optoelectronic protection devices. They are used to safeguard access areas, danger points or danger zones.

They are designed as safe type 2 or type 4 systems, for accident prevention in accordance with applicable international standards, in particular EN 61496-1, 1997 and IEC 61496-2, 1997.

The safety light curtains consist of a transmitter and a receiver, which are optically synchronised.

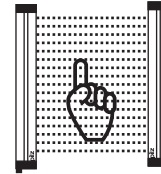
The infrared beams are controlled and monitored via a microprocessor. As soon as at least one of the beams emitted by the transmitter is interrupted, the OSSD outputs switch to LOW and the hazardous movement is stopped.

### Evaluation devices

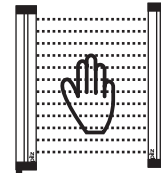
- **PSEN opSB-4** safety light curtains have an integral SafetyBUS p interface and are designed for use on SafetyBUS p. They can be connected directly via M12 connectors
- **PSEN op** safety light curtains can be used in conjunction with the following evaluation devices:
  - PNOZelog electronic safety relays
  - PNOZmulti modular safety relays
  - PNOZ safety relays
  - PSS programmable safety systems
  - Safe, open bus system SafetyBUS p

### Selection criteria for safety light curtains

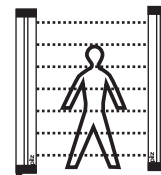
- Area of use
- Resolution, depending on the part of the body requiring protection:
  - Finger protection ( $R = 14 \text{ mm}$ )



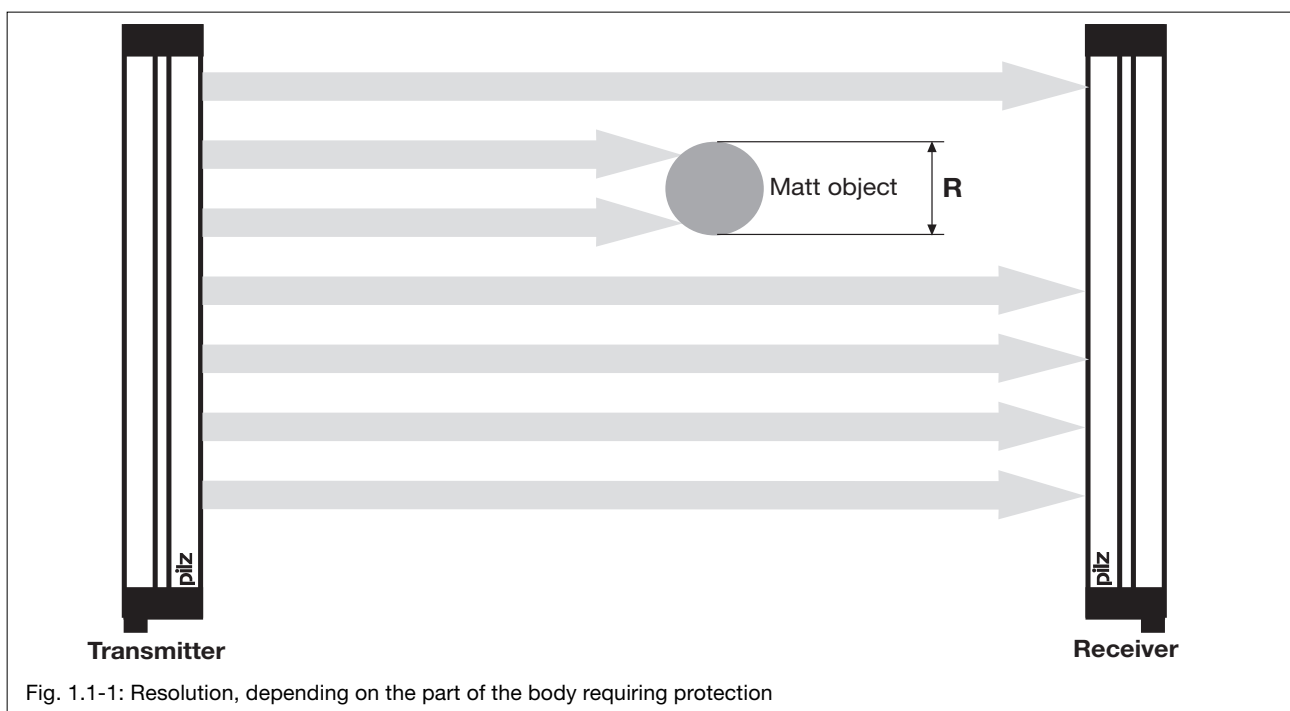
- Hand protection ( $R = 30 \text{ mm}$ )



- Body protection ( $R > 40 \text{ mm}$ )

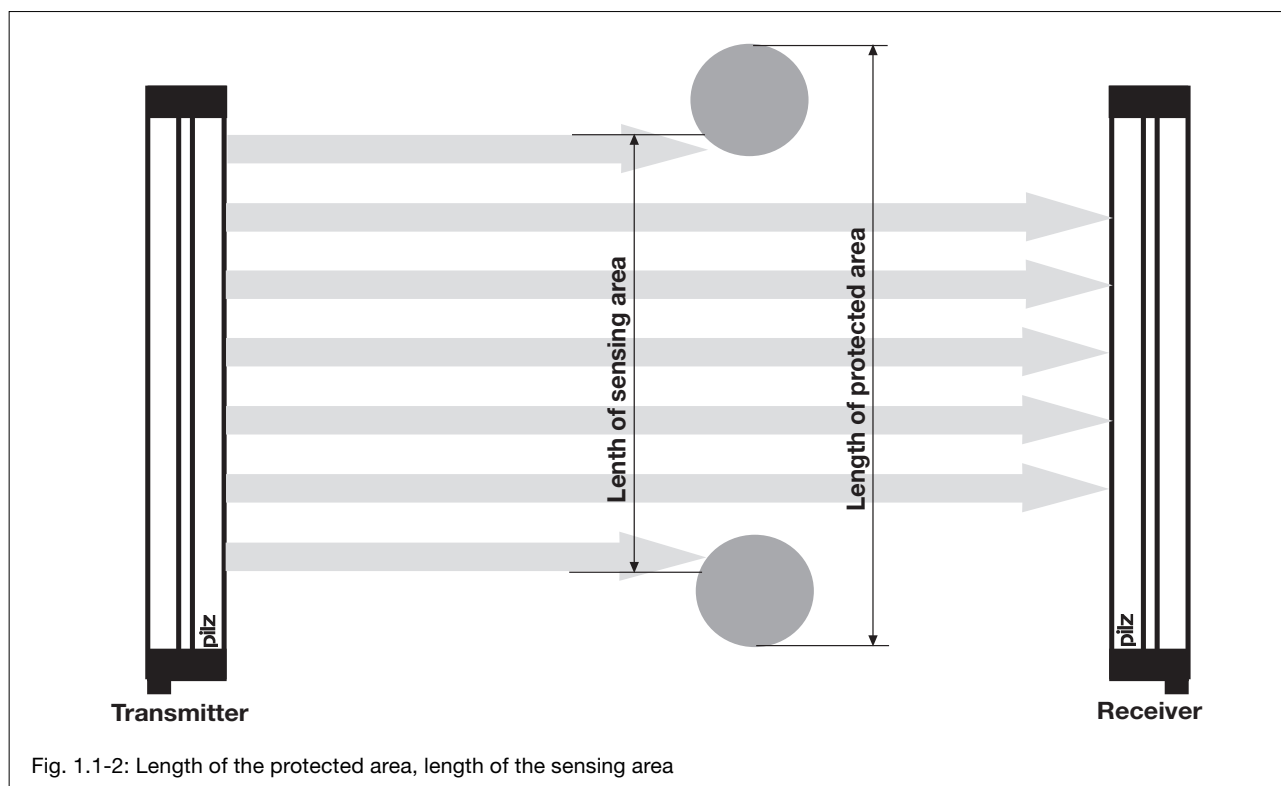


- Length of the protected area/length of the sensing area



## Basics

### Description



1.1

### Application areas

Safety light curtains in the PSENopt product range are used in particular to stop hazardous movements of mechanical parts, i.e. on:

- Automatic machinery
- Packaging, handling and storage machinery
- Textile processing, woodworking and ceramic processing machinery
- Automatic or semi-automatic assembly lines
- Automated high-bay racking

## Basics

### Functions PSEN op2-4

The integrated functions depend on the individual unit:

**PSEN op2B, PSEN op4F, PSEN op4H, PSEN op4B:**

- Function selection via the integrated DIP switches
- Automatic/manual reset
- Integrated muting/override function
- Diagnostic function
- Test function

**PSEN op2H:**

- Automatic reset
- Diagnostics function
- Test function

#### Operating modes

- **Automatic reset:** Following interruption of the beam between the transmitter and the receiver, the safety light curtain resumes normal operation as soon as the detected object has been removed from the protected area.
- **Manual reset:** Following interruption of the beam between the transmitter and the receiver, the safety light curtain does not resume normal operation until the detected object has been removed from the protected area and the restart button (TEST/START button) has been pressed.

#### Muting function

The **muting function** enables the safety function to be temporarily suspended by blanking the protected area. The muting function is used to allow a conveyed item to pass through the protected field unhindered. Muting sensors (muting signals) are used to reliably detect the conveyed item. Muting lamps are used to signal the activity of the muting function. Both need to be connected for activation of a muting function and are available as accessories (refer to the "Accessories" chapter).

PSENopt can undertake the full muting operation thanks to its **integral muting function:**

- **Total muting function:**  
The entire protected area is blanked.
- **Partial muting function:**  
Only certain zones in the protected area are blanked.

If several safety functions are required or if more extensive muting options are needed, then the **muting function can also be implemented externally using the following evaluation devices:**

- **PMUT X1P**

Muting controller

- The full muting functionality is provided by PMUT, PSENopt only supplies the information: "Protected field broken"
- Partial muting is not available

- **PNOZmulti**

Modular safety system

For use with multiple safety functions

- PSENopt receives the information that the muting function is active via the inputs MS1 and MS2.
- Muting times are variable and adjustable
- Partial muting is available

- **PSS/SafetyBUS p**

Programmable safety system

For use with multiple safety functions

- The muting function is performed via the standard function blocks in the safety system
- PSENopt receives the information that the muting function is active via the inputs MS1 and MS2.
- Muting times are variable and adjustable
- Partial muting is available

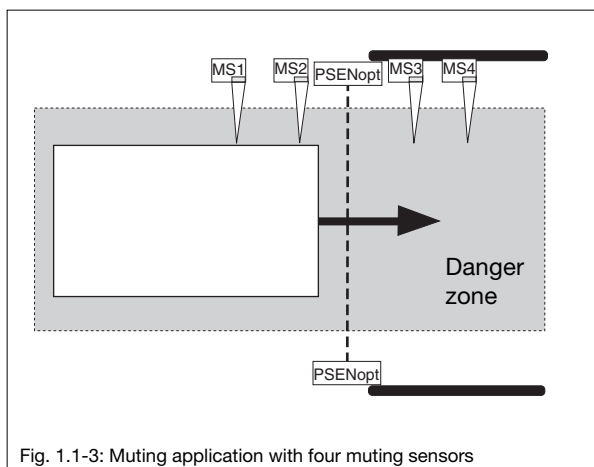


Fig. 1.1-3: Muting application with four muting sensors

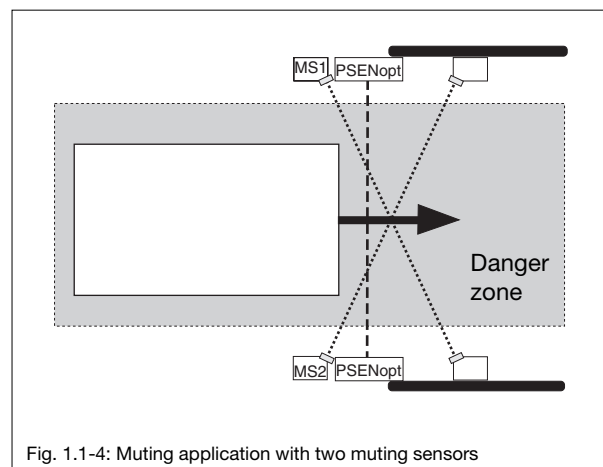


Fig. 1.1-4: Muting application with two muting sensors



## Basics

### Functions PSEN op2-4

---

#### Override function

The muting function can be reactivated with the override function if the machine needs to be restarted despite at least one of the beams being interrupted. The aim is to clear the danger zone of any material that may have accumulated due to a fault in the operating cycle.

#### Diagnostic functions

The following states can be diagnosed via the LEDs located on the transmitter and receiver:

- Operating status
- Alignment (yes/no)
- Error messages, fault diagnostics

#### Test function

The function of the light curtain's safety outputs is checked every 0.5 s during the normal operating cycle. The test function can also be manually activated.

## Basics

### Functions PSEN opSB-4

1.1

The functions of the PSEN opSB safety light curtains can be performed locally via the I/O connector on the safety light curtain or externally via the PSS. When functions are selected externally, they are configured in the "Editor for light curtains from the PSEN opSB-4 series" in the SafetyBUS p Configurator.

#### Functions:

- Automatic/manual reset
- Integrated muting override function
- Diagnostic function
- Test function
- E-STOP function

#### Operating modes

##### Automatic reset

Following interruption of the beam between the transmitter and the receiver, the safety light curtain resumes normal operation as soon as the detected object has been removed from the protected area.

##### Manual reset

Following interruption of the beam between the transmitter and the receiver, the restart is blocked. The safety light curtain does not resume normal operation until the object has been removed from the protected field and either

- the restart button (test/reset button) has been operated for at least 0.5 s (local activation)

or

- the restart has been activated via the external command "LG\_RESTART\_EXT" (external activation)

#### Muting function

The **muting function** enables the safety function to be temporarily suspended by blanking the protected area. The muting function is used to allow a conveyed item to pass through the protected field unhindered. Muting sensors (muting signals) are used to reliably detect the conveyed item. Muting lamps are used to signal the activity of the muting function. Both need to be connected for activation of a muting function and are available as accessories (refer to the "Accessories" chapter).

#### Connection of muting sensors

##### Local connection of muting sensors

The 2 or 4 muting sensors are connected to the local muting inputs on the safety light curtain.

##### External connection of muting sensors

The muting sensors are connected to the inputs on a PSS or an I/O-Device on SafetyBUS p. The signals from the sensors are transmitted to the safety light curtain via the external

commands

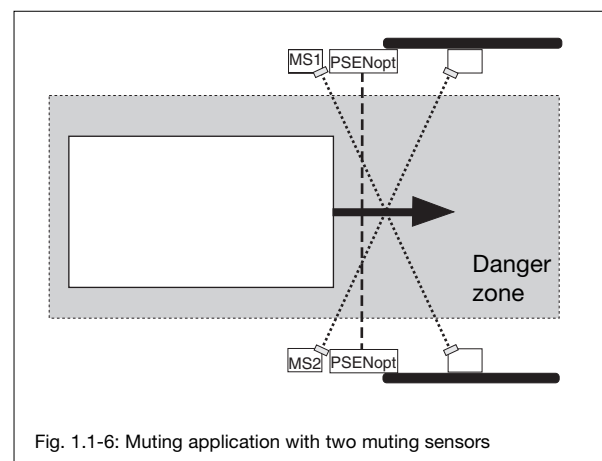
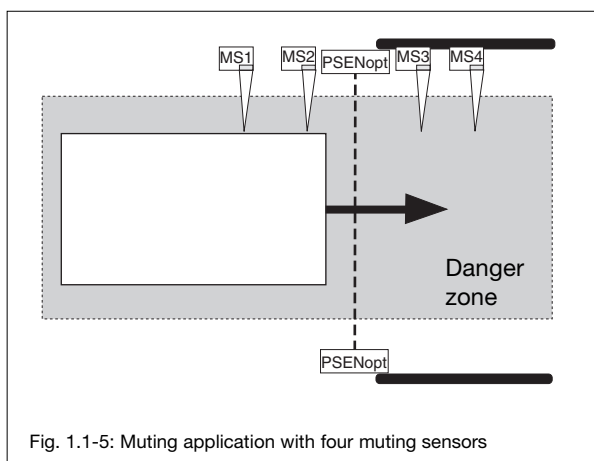
"LG\_Muting\_SensorOvrd (1)" and "LG\_Muting\_SensorOvrd (2)". The muting function in the safety light curtain processes the sensor signals in the same way as described under "Local connection of muting sensors".

#### Simultaneity of the muting sensors

The "Simultaneity of the muting sensors" setting in the editor can be used to set the maximum time that is permitted to elapse between activation of both muting sensors. The following times can be set: 0.5 s, 1 s, 3 s and 4 s. If the second muting sensor is not activated within the preset time, the muting function will not start and the safety light curtain will remain in normal mode.

#### Muting duration

This setting can be used to adjust the maximum muting duration. The following times can be set: 10 min, 1 h, 8 h and "infinity" (ca. 90 h). Once the set muting duration has elapsed the muting function is ended and the safety light curtain returns to normal mode, even if the muting sensors are still activated.



## Basics

### Functions PSEN opSB-4

#### Partial/total muting

- **Total muting function:**

The entire protected area is blanked

- **Partial muting function:**

Only certain zones in the protected area are blanked.

The following states can be diagnosed:

- Operating status
- Alignment (yes/no)
- Error

#### Override function

The muting function can be activated with the override function if the machine needs to be restarted despite at least one of the beams being interrupted. The aim is to clear the danger zone of any material that may have accumulated due to a fault in the operating cycle.

#### E-STOP function

The E-STOP function enables the connection of an E-STOP push-button (Category 4) with two separate N/C contacts.

#### Test function

The test function can be used to carry out a function test on the safety light curtain.

The test function can be activated in two ways:

- **Local activation**

The test function is activated via the local input (test/reset) on the receiver.

- **External activation**

The test function is activated via an external command (LG\_TEST).

#### Diagnostic functions

Status or fault diagnostics can be carried out in a number of ways:

- Via the LEDs on the receiver and transmitter
- By evaluating the safety light curtain's error stack in the SafetyBUS p Configurator in the PSS WIN-PRO system software
- By evaluating the process status diagnostics LG\_PD in the user program

## Basics

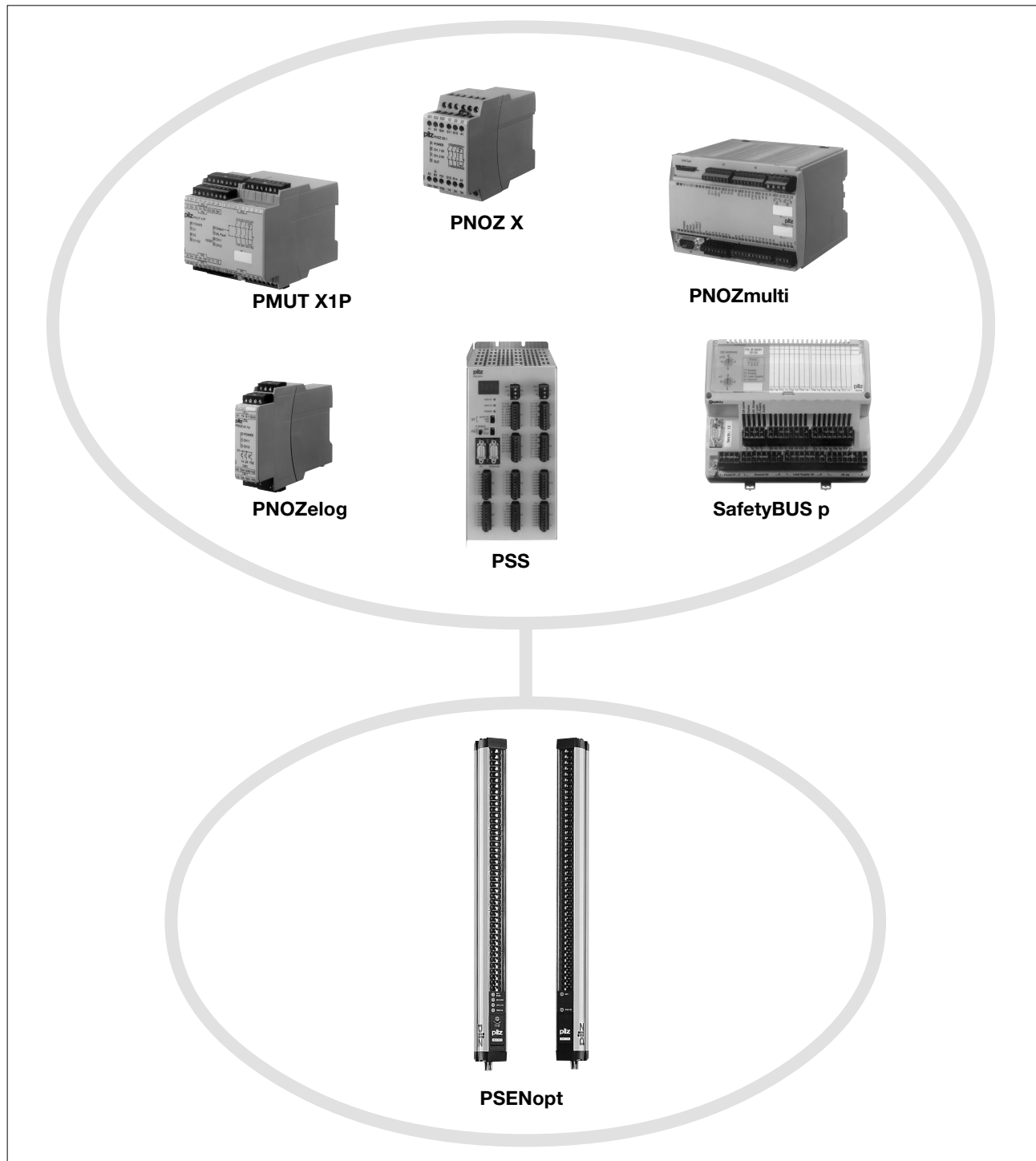
### Wiring - Evaluation devices for PSENopt2-4

Permitted evaluation devices

- PNOZ X2.9P
- PNOZelog
- PNOZmulti
- PMUT X1P
- PSS
- SafetyBUS p

The connection is dual-channel without detection of shorts across contacts

1.1



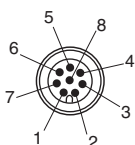
## Basics

### Wiring - Evaluation devices for PSENo2-4

#### Pin assignment for PSEN op2B, PSEN op4F, PSEN op4H, PSEN op4B

##### Receiver

Assignment of the  
8-pin M12 male connector



| PIN | Function              | Cable colour |
|-----|-----------------------|--------------|
| 1:  | TEST/START            | white        |
| 2:  | + 24 V U <sub>B</sub> | brown        |
| 3:  | MUTING1               | green        |
| 4:  | MUTING2               | yellow       |
| 5:  | OSSD1                 | grey         |
| 6:  | OSSD2                 | pink         |
| 7:  | 0 V U <sub>B</sub>    | blue         |
| 8:  | LAMP                  | red          |

##### Transmitter

Assignment of the  
4-pin M12 male connector

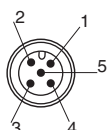


| PIN | Function              | Cable colour |
|-----|-----------------------|--------------|
| 1:  | + 24 V U <sub>B</sub> | brown        |
| 2:  | Not assigned          | -            |
| 3:  | 0 V U <sub>B</sub>    | blue         |
| 4:  | Not assigned          | -            |

#### Pin assignment for PSEN op2H

##### Receiver

Assignment of the  
5-pin M12 male connector



| PIN | Function              | Cable colour |
|-----|-----------------------|--------------|
| 1:  | + 24 V U <sub>B</sub> | brown        |
| 2:  | OSSD1                 | white        |
| 3:  | 0 V U <sub>B</sub>    | blue         |
| 4:  | OSSD2                 | black        |
| 5:  | TEST                  | grey         |

##### Transmitter

Assignment of the  
4-pin M12 male connector



| PIN | Function              | Cable colour |
|-----|-----------------------|--------------|
| 1:  | + 24 V U <sub>B</sub> | brown        |
| 2:  | Not assigned          | -            |
| 3:  | 0 V U <sub>B</sub>    | blue         |
| 4:  | Not assigned          | -            |



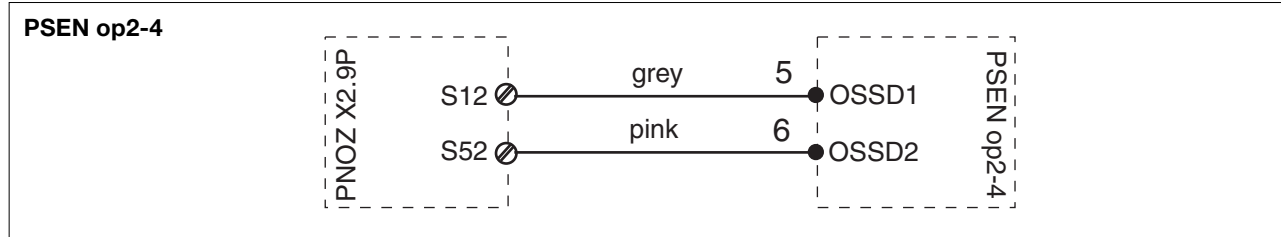
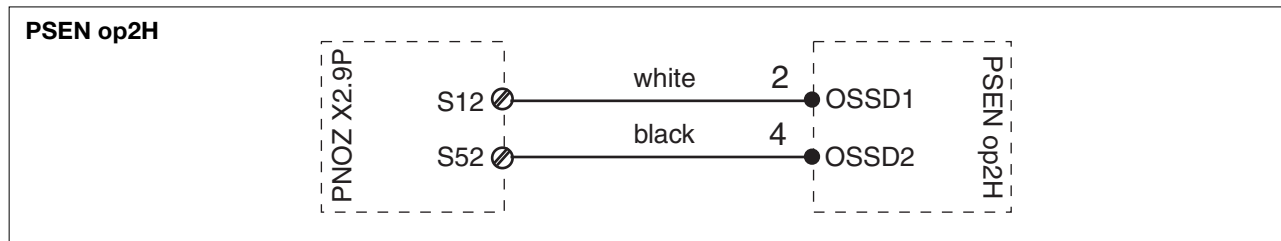
#### INFORMATION

Please refer to the "Accessories" chapter for details of the connection cables that need to be used.

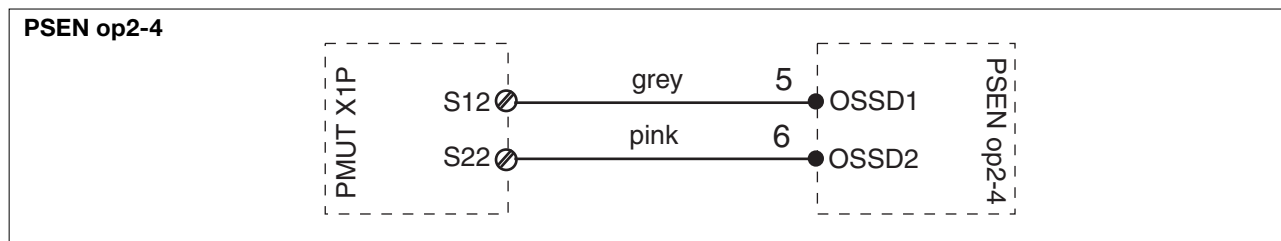
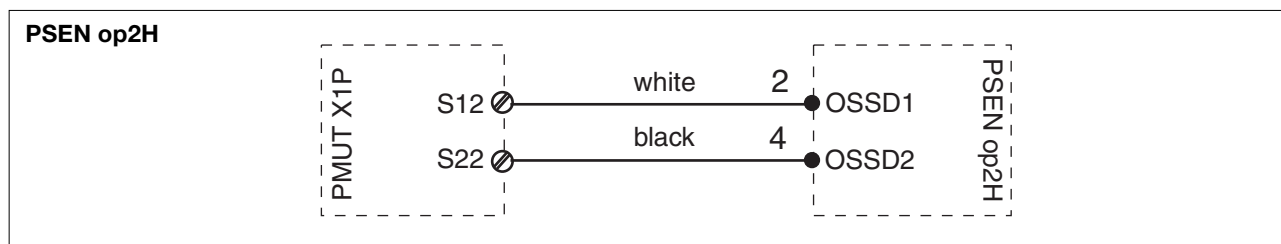
## Basics

### Wiring - Evaluation devices for PSENOpt2-4

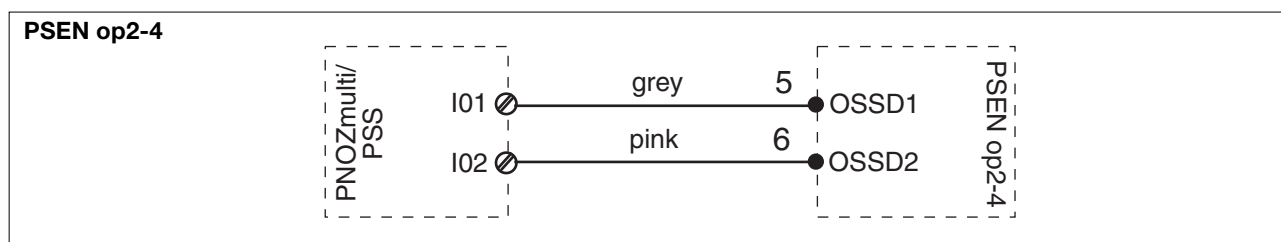
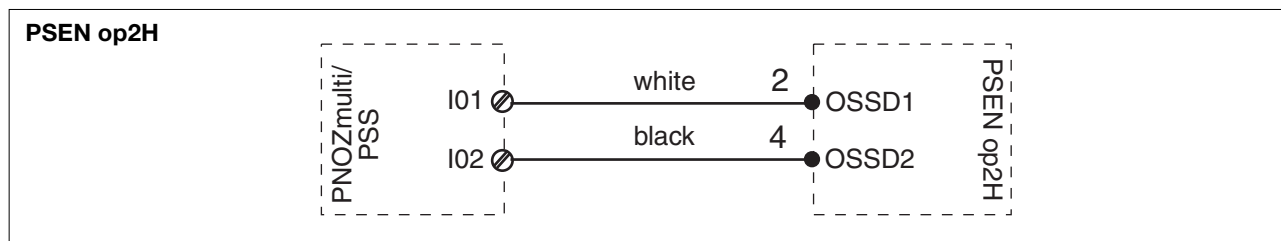
#### Connection to PNOZ X2.9P



#### Connection to PMUT X1P



#### Connection to PNOZmulti/PSS



## Basics

### Wiring - Evaluation devices for PSENopt2-4

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## Basics

### Wiring PSENoSB-4

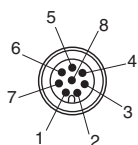
**Pin assignment for PSEN opSB-4F,  
PSEN opSB-4H PSEN opSB-4B,**

1.1

#### Receiver

Local I/O connector

Assignment of the  
8-pin M12 male connector



| PIN | Function                   | Cable colour |
|-----|----------------------------|--------------|
| 1:  | V4: insulated power supply | white        |
| 2:  | E-stop out 1               | brown        |
| 3:  | MUTING1 - in               | green        |
| 4:  | E-stop in 2                | yellow       |
| 5:  | LAMP                       | grau         |
| 6:  | E-stop in 1                | pink         |
| 7:  | MUTING2 - in               | blue         |
| 8:  | TEST/START                 | red          |

Bus connector

Assignment of the  
5-pin M12 male connector



| PIN | Function | Cable colour |
|-----|----------|--------------|
| 1:  | Screen   | -            |
| 2:  | V CC     | red          |
| 3:  | GND      | white        |
| 4:  | Can_H    | green        |
| 5:  | Can_L    | brown        |

#### Transmitter

Assignment of the  
4-pin M12 male connector



| PIN | Function     | Cable colour |
|-----|--------------|--------------|
| 1:  | Not assigned | -            |
| 2:  | V CC         | red          |
| 3:  | GND          | white        |
| 4:  | Not assigned | green        |
| 5:  | Not assigned | brown        |



#### CAUTION!

To supply the inputs and outputs,  
only connect the supply voltage  
“V4”!



## Basics

### Wiring PSENoSB-4

#### PSEN opSB-4 connection to SafetyBUS p

To make the connection to SafetyBUS p, the safety light curtain must be linked to the SafetyBUS p main branch. To do this use the active SafetyBUS p junction "PSS SB ACTIVE JUNCTION BASIS".

1.1

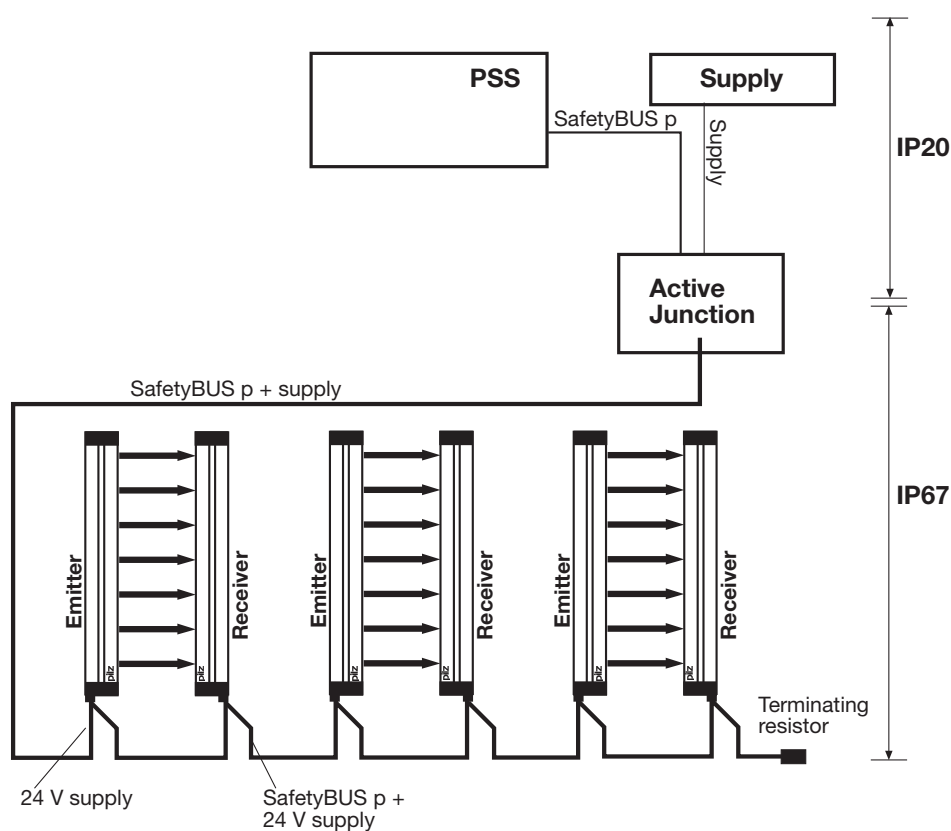


Fig. 1.1-8: Connecting the PSEN opSB-4 safety light curtain to SafetyBUS p

## Basics

### Wiring PSENoSB-4

#### Light curtain calculation tool

The maximum number of subscribers and the maximum possible cable runs for the cable segments from the ACTIVE JUNCTION BASIS to the last connected subscriber depend on the type of subscriber and the supply voltage on the ACTIVE JUNCTION BASIS.

The Pilz light curtain calculation tool enables you to check how many subscribers can be used and how long the cable runs can be, taking into account the subscriber type and the supply voltage.

The light curtain calculation tool is available on the Internet from the Pilz homepage at [www.pilz.com](http://www.pilz.com).

#### Entry in the light curtain calculation tool

- Select all subscribers under "Type":
  - Emitter (transmitter (TX))
  - Receiver (RX)
  - Receiver + X W (3 W or 5 W) A selection must be made if a muting lamp (3 W or 5 W) is connected to the receiver's (RX) I/O connector
- Under "distance in meters", enter the required cable runs L1 ... LX (see diagram in the light curtain calculation tool).

- Under "Supply Voltage ACTIVE JUNCTION (V)", enter the supply voltage at the ACTIVE JUNCTION BASIS.

#### Result

- If a green "OK" field appears under "Result", the supply voltage at the last subscriber is sufficient.
- If a red "Not OK!" field appears under "Result", the supply voltage at the last subscriber is too low and you will need to make some adjustments.

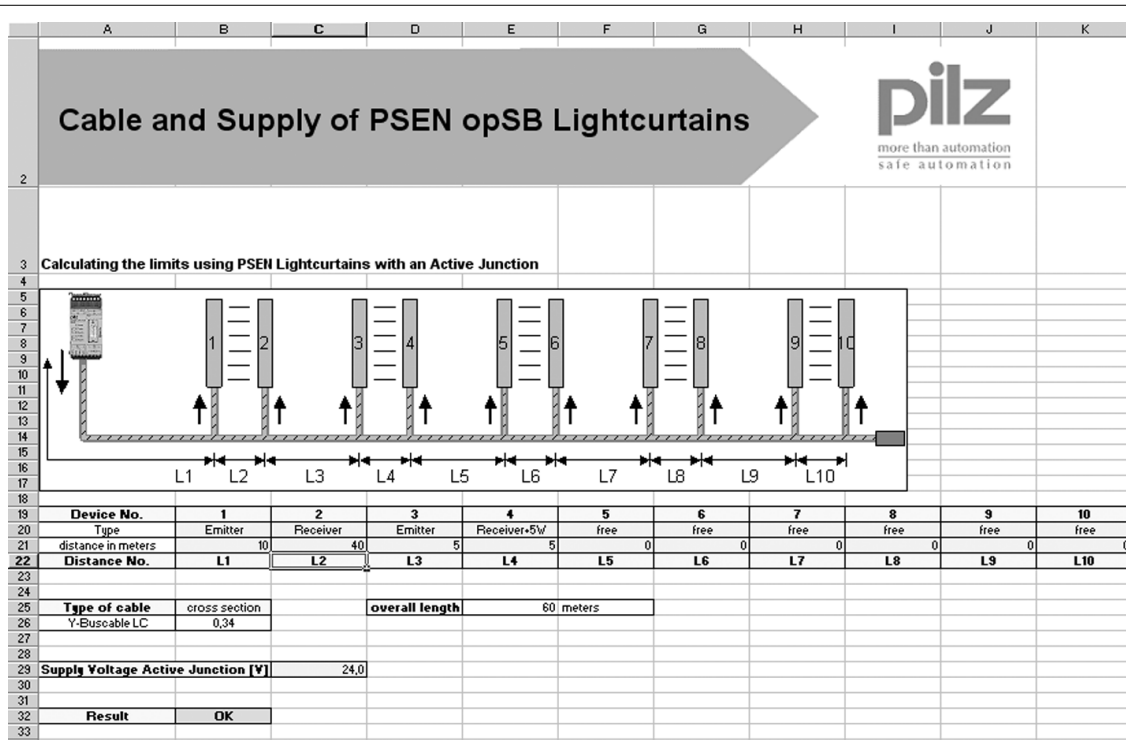


Fig. 1.1-9: Light curtain calculation tool

## Basics

### Wiring PSENoptSB-4

---

## Basics

### Safety

1.1

#### Safety assessments

Before using a unit it is necessary to perform a safety assessment in accordance with the Machinery Directive. The safety system guarantees functional safety, but not the safety of the entire application. You should therefore define the safety requirements for the plant as a whole, and also define how these will be implemented from a technical and organisational standpoint.

Before using optoelectronic protection devices, please refer to the standards EN 999 and IEC 62046 in particular.

#### General safety requirements

Always ensure the following safety requirements are met:

- Only install and commission the unit if you are familiar with the information in the operating instructions or this technical catalogue, as well as the relevant regulations concerning health and safety at work and accident prevention.
- Only use the unit for the purpose for which it is intended and comply with both the general and specific technical details.
- Transport, storage and operating conditions should all conform to EN 60068-2-6 (see general technical details on the individual units, in the chapter entitled "Unit-specific descriptions").

You must observe the warning notes given in other parts of this technical catalogue. These are highlighted visually through the use of symbols.



#### NOTICE

Failure to comply with the safety requirements will render the guarantee invalid, as will use of the unit contrary to its intended purpose.

#### Intended use

The units' intended use depends on the individual unit and is therefore explained in the chapter entitled "Unit-specific descriptions".

#### Expert inspection

Proper operation of the optoelectronic protection devices needs to be verified:

- Before initial commissioning
- In Europe: at regular intervals in accordance with Work Equipment Directive 89/655/EEC

Key points to be inspected:

- Is the operation of the safety device appropriate for the current machine application?
- Is the type of safety device appropriate for the hazards that may arise?
- Does the safety device conform to the type required in accordance with IEC 61496?
- Does the incorporation of the safety device meet the required category in accordance with EN 954, right through to the transfer of the signal to the controller?
- Is the safety device difficult to defeat?

In general, this type of testing and inspection takes a lot of time. Short-term changes and modifications to the ESPE may increase the risk of accidents.

For this reason we recommend that you take advantage of our "ESPE inspection" service and make the most of the experience of our experts.

## Basics

### Safety

---

## Basics

### Installation and assembly

1.1

The unit should be installed in such a way that it is not possible to access the danger zone without interrupting the protected area.

To exclude the possibility of the machine being accessed from above or below, it is necessary to install a light curtain of sufficient length to completely cover access to the danger zone.

If it is impossible to install the light curtain in immediate proximity to the danger zone, a second light curtain must be installed, aligned horizontally, to exclude access from the side.

#### Minimum safety distance

The following must be taken into account when positioning the light curtain:

When the safety device is triggered, there is a delay before the machine comes to a standstill.

The distance between the light curtain and the nearest danger zone must be large enough for the hazardous movement to come to a standstill before the operator can reach the danger zone. All access directions must be taken into account. According to **EN 999, "The positioning of protective equipment in respect of approach speeds of parts of the human body"**, this minimum distance is calculated using the following formula:

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

**Approach direction perpendicular to the protected field**

**S** = Minimum distance from the danger zone to the detection point, detection line, detection plane or protected field

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

**K = 2000 mm/s**, if the calculated value for  $S \leq 500$  mm

**K = 1600 mm/s**, if the calculated value for  $S > 500$  mm

**T** = Overrun of the entire system

$t_1$  = Reaction time of the safety device in seconds

$t_2$  = Overrun time of the machine in seconds

**C** = Additional distance in millimetres, based on intrusion into the danger zone prior to actuation of the safety device:

**8 (d-14)** for a safety device with a

**resolution  $d < 40$  mm**

**850 mm** for a safety device with a resolution

$d > 40$  mm

**1200 mm** for single-beam safety devices

Bottom beam:  $\leq 300$  mm  
Top beam:  $\geq 900$  mm

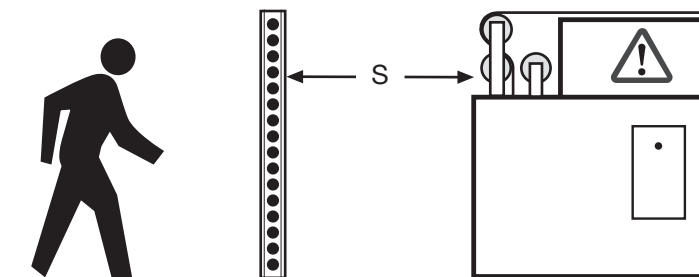


Fig. 1.1-10: Minimum safe distance S from the safety device to the danger zone for a perpendicular approach

## Basics

### Installation and assembly

#### Approach direction parallel to the protected field

**S** = Minimum distance from the danger zone to the detection point, detection line, detection plane or protected field

**K** = The speed at which the object requiring detection (body or parts of the body) approaches

the danger zone, in mm/s  
 $K = 1600 \text{ mm/s}$

**T** = Overrun of the entire system  
 $t_1$  = Reaction time of the safety device in seconds  
 $t_2$  = Overrun time of the machine in seconds

**C** = Additional distance in millimetres, based on intrusion

into the danger zone prior to actuation of the safety device:

**C** =  $(1200 \text{ mm} - 0.4 H) \geq 850 \text{ mm}$

**H** = (Height of the protected field above the reference plane)

1.1

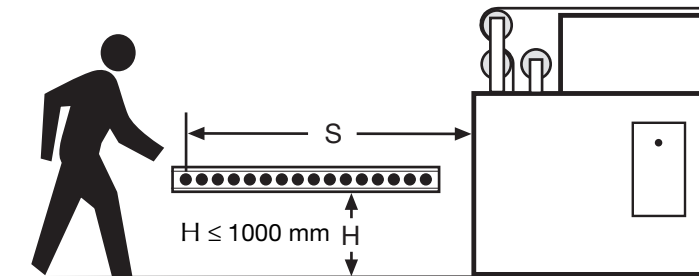


Fig. 1.1-11: Minimum safe distance S from the safety device to the danger zone for a parallel approach

#### Approach direction at any angle to the protected field

$\beta > 30^\circ$  see perpendicular approach

$\beta < 30^\circ$  see parallel approach

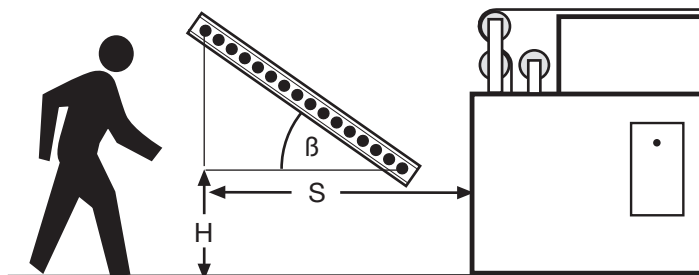


Fig. 1.1-12: Minimum safe distance S from the safety device to the danger zone for an angled approach

## Basics

### Installation and assembly

1.1

#### Use of deviating mirrors

Deviating mirrors can be used to monitor danger zones where access is possible from various sides (see "Deviating mirrors" in the "Accessories" chapter).

#### Installing several adjacent safety light curtains

When installing several safety devices side by side, please note that the transmitter of one device must not interfere with the receiver of another device. To prevent this, the devices will need to be installed facing in opposite directions, or they should be separated via screening.

#### Installation

The transmitter and receiver should be installed with the optical surfaces aligned parallel and opposite each other, and with the plugs arranged on the same side.

The distance between the transmitter and the receiver must be within the range of the model used (refer to the type label or the operating manual, "Technical details" chapter).

Before carrying out assembly and installation work, always read the "Devices" chapter of the operating manual for the relevant units.



## Basics

### Installation and assembly

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## Unit-specific description

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## Unit-specific description

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## Unit-specific description

### Approvals

#### Approvals

| Model            |  |  | Model               |  |  |
|------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| PSEN op2B-2-050  | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4F-14-030 | ◆                                                                                   | ◆                                                                                   |
| PSEN op2B-3-080  | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4F-14-045 | ◆                                                                                   | ◆                                                                                   |
| PSEN op2B-4-090  | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4F-14-060 | ◆                                                                                   | ◆                                                                                   |
| PSEN op2B-4-120  | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4F-14-075 | ◆                                                                                   | ◆                                                                                   |
| PSEN op2H-30-015 | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4F-14-090 | ◆                                                                                   | ◆                                                                                   |
| PSEN op2H-30-030 | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4H-30-030 | ◆                                                                                   | ◆                                                                                   |
| PSEN op2H-30-045 | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4H-30-045 | ◆                                                                                   | ◆                                                                                   |
| PSEN op2H-30-060 | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4H-30-060 | ◆                                                                                   | ◆                                                                                   |
| PSEN op2H-30-075 | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4H-30-075 | ◆                                                                                   | ◆                                                                                   |
| PSEN op2H-30-090 | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4H-30-090 | ◆                                                                                   | ◆                                                                                   |
| PSEN op2H-30-105 | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4H-30-105 | ◆                                                                                   | ◆                                                                                   |
| PSEN op2H-30-120 | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4H-30-120 | ◆                                                                                   | ◆                                                                                   |
| PSEN op2H-30-135 | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4H-30-135 | ◆                                                                                   | ◆                                                                                   |
| PSEN op2H-30-150 | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4H-30-150 | ◆                                                                                   | ◆                                                                                   |
| PSEN op4B-2-050  | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4H-30-165 | ◆                                                                                   | ◆                                                                                   |
| PSEN op4B-3-080  | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4B-2-050  | ◆                                                                                   | ◆                                                                                   |
| PSEN op4B-4-090  | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4B-3-080  | ◆                                                                                   | ◆                                                                                   |
| PSEN op4B-4-120  | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4B-4-090  | ◆                                                                                   | ◆                                                                                   |
| PSEN op4F-14-015 | ◆                                                                                 | ◆                                                                                 | PSEN opSB-4B-4-120  | ◆                                                                                   | ◆                                                                                   |
| PSEN op4F-14-030 | ◆                                                                                 | ◆                                                                                 |                     |                                                                                     |                                                                                     |
| PSEN op4F-14-045 | ◆                                                                                 | ◆                                                                                 |                     |                                                                                     |                                                                                     |
| PSEN op4F-14-060 | ◆                                                                                 | ◆                                                                                 |                     |                                                                                     |                                                                                     |
| PSEN op4F-14-075 | ◆                                                                                 | ◆                                                                                 |                     |                                                                                     |                                                                                     |
| PSEN op4F-14-090 | ◆                                                                                 | ◆                                                                                 |                     |                                                                                     |                                                                                     |
| PSEN op4H-30-015 | ◆                                                                                 | ◆                                                                                 |                     |                                                                                     |                                                                                     |
| PSEN op4H-30-030 | ◆                                                                                 | ◆                                                                                 |                     |                                                                                     |                                                                                     |
| PSEN op4H-30-045 | ◆                                                                                 | ◆                                                                                 |                     |                                                                                     |                                                                                     |
| PSEN op4H-30-060 | ◆                                                                                 | ◆                                                                                 |                     |                                                                                     |                                                                                     |
| PSEN op4H-30-075 | ◆                                                                                 | ◆                                                                                 |                     |                                                                                     |                                                                                     |
| PSEN op4H-30-090 | ◆                                                                                 | ◆                                                                                 |                     |                                                                                     |                                                                                     |
| PSEN op4H-30-105 | ◆                                                                                 | ◆                                                                                 |                     |                                                                                     |                                                                                     |
| PSEN op4H-30-120 | ◆                                                                                 | ◆                                                                                 |                     |                                                                                     |                                                                                     |
| PSEN op4H-30-135 | ◆                                                                                 | ◆                                                                                 |                     |                                                                                     |                                                                                     |
| PSEN op4H-30-150 | ◆                                                                                 | ◆                                                                                 |                     |                                                                                     |                                                                                     |
| PSEN op4H-30-165 | ◆                                                                                 | ◆                                                                                 |                     |                                                                                     |                                                                                     |

## Unit-specific description

### PSEN op2-4

#### PSEN op2H

Light curtains for hand protection, in accordance with EN/IEC 61496-1/-2: Type 2

##### Unit features:

- ▶ Type 2
- ▶ Resolution: 30 mm
- ▶ Range 0.2 ... 15 m
- ▶ Automatic reset
- ▶ Test function

| Model            | Length of the sensing area (mm) | Length of the protected area (mm) | Number of beams | Dimensions (H x W x D) (mm) | For further data refer to the PSEN op2H operating manual |
|------------------|---------------------------------|-----------------------------------|-----------------|-----------------------------|----------------------------------------------------------|
| PSEN op2H-30-015 | 147                             | 187                               | 8               | 31 x 32 x 227               |                                                          |
| PSEN op2H-30-030 | 294                             | 334                               | 16              | 31 x 32 x 375               |                                                          |
| PSEN op2H-30-045 | 441                             | 481                               | 24              | 31 x 32 x 521               |                                                          |
| PSEN op2H-30-060 | 588                             | 628                               | 32              | 31 x 32 x 668               |                                                          |
| PSEN op2H-30-075 | 735                             | 775                               | 40              | 31 x 32 x 815               |                                                          |
| PSEN op2H-30-090 | 882                             | 922                               | 48              | 31 x 32 x 962               |                                                          |
| PSEN op2H-30-105 | 1029                            | 1069                              | 56              | 31 x 32 x 1109              |                                                          |
| PSEN op2H-30-120 | 1176                            | 1216                              | 64              | 31 x 32 x 1256              |                                                          |
| PSEN op2H-30-135 | 1323                            | 1363                              | 72              | 31 x 32 x 1403              |                                                          |
| PSEN op2H-30-150 | 1470                            | 1510                              | 80              | 31 x 32 x 1550              |                                                          |

#### PSEN op2B

Light curtains for body protection, in accordance with EN/IEC 61496-1/-2: Type 2

##### Unit features:

- ▶ Type 2
- ▶ Range 0.5 ... 50 m
- ▶ Automatic/manual reset
- ▶ Integrated muting/override function
- ▶ Test function

| Model           | Length of the sensing area (mm) | Resolution (mm) | Number of beams | Dimensions (H x W x D) (mm) | For further data refer to the PSEN op2H operating manual |
|-----------------|---------------------------------|-----------------|-----------------|-----------------------------|----------------------------------------------------------|
| PSEN op2B-2-050 | 515                             | 515             | 2               | 35 x 40 x 652               |                                                          |
| PSEN op2B-3-080 | 815                             | 415             | 3               | 35 x 40 x 952               |                                                          |
| PSEN op2B-4-090 | 915                             | 315             | 4               | 35 x 40 x 1052              |                                                          |
| PSEN op2B-4-120 | 1215                            | 415             | 4               | 35 x 40 x 1352              |                                                          |

## Unit-specific description

### PSEN op2-4

#### PSEN op4F

Light curtains for finger protection, in accordance with EN/IEC 61496-1/-2: Type 4

##### Unit features:

- ▶ Type 4
- ▶ Resolution: 14 mm
- ▶ Range 0.2 ... 6 m
- ▶ Automatic/manual reset
- ▶ Integrated muting/override function
- ▶ Test function

| Model            | Length of the sensing area (mm) | Length of the protected area (mm) | Number of beams | Dimensions (H x W x D) (mm) | For further data refer to the PSEN op2/4 operating manual |
|------------------|---------------------------------|-----------------------------------|-----------------|-----------------------------|-----------------------------------------------------------|
| PSEN op4F-14-015 | 147                             | 161                               | 21              | 35 x 40 x 256               |                                                           |
| PSEN op4F-14-030 | 294                             | 308                               | 42              | 35 x 40 x 403               |                                                           |
| PSEN op4F-14-045 | 441                             | 455                               | 63              | 35 x 40 x 550               |                                                           |
| PSEN op4F-14-060 | 588                             | 602                               | 84              | 35 x 40 x 697               |                                                           |
| PSEN op4F-14-075 | 735                             | 749                               | 105             | 35 x 40 x 844               |                                                           |
| PSEN op4F-14-090 | 882                             | 896                               | 126             | 31 x 32 x 991               |                                                           |

#### PSEN op4H

Light curtains for hand protection, in accordance with EN/IEC 61496-1/-2: Type 4

##### Unit features:

- ▶ Type 4
- ▶ Resolution: 14 mm
- ▶ Range 0.2 ... 6 m
- ▶ Automatic/manual reset
- ▶ Integrated muting/override function
- ▶ Test function

| Model            | Length of the sensing area (mm) | Length of the protected area (mm) | Number of beams | Dimensions (H x W x D) (mm) | For further data refer to the PSEN op2/4 operating manual |
|------------------|---------------------------------|-----------------------------------|-----------------|-----------------------------|-----------------------------------------------------------|
| PSEN op4H-30-015 | 147                             | 180                               | 8               | 35 x 40 x 256               |                                                           |
| PSEN op4H-30-030 | 294                             | 327                               | 16              | 35 x 40 x 403               |                                                           |
| PSEN op4H-30-045 | 441                             | 474                               | 24              | 35 x 40 x 550               |                                                           |
| PSEN op4H-30-060 | 588                             | 621                               | 32              | 35 x 40 x 697               |                                                           |
| PSEN op4H-30-075 | 735                             | 768                               | 40              | 35 x 40 x 844               |                                                           |
| PSEN op4H-30-090 | 822                             | 915                               | 48              | 35 x 40 x 991               |                                                           |
| PSEN op4H-30-105 | 1029                            | 1062                              | 56              | 35 x 40 x 1138              |                                                           |
| PSEN op4H-30-120 | 1176                            | 1209                              | 64              | 35 x 40 x 1285              |                                                           |
| PSEN op4H-30-135 | 1323                            | 1356                              | 72              | 35 x 40 x 1432              |                                                           |
| PSEN op4H-30-150 | 1470                            | 1503                              | 80              | 35 x 40 x 1579              |                                                           |
| PSEN op4H-30-165 | 1617                            | 1650                              | 88              | 35 x 40 x 1726              |                                                           |

## Unit-specific description

### PSEN op2-4

#### PSEN op4B

Light curtains for body protection, in accordance with EN/IEC 61496-1/-2:  
Type 4

##### Unit features:

- ▶ Type 4
- ▶ Range 0.5 ... 25 m
- ▶ Automatic/manual reset
- ▶ Integrated muting/override function
- ▶ Test function

| Model           | Length of the sensing area (mm) | Resolution (mm) | Number of beams | Dimensions (H x W x D) (mm) | For further data refer to the PSEN op2/4 operating manual |
|-----------------|---------------------------------|-----------------|-----------------|-----------------------------|-----------------------------------------------------------|
| PSEN op4B-2-050 | 515                             | 515             | 2               | 35 x 40 x 652               |                                                           |
| PSEN op4B-3-080 | 815                             | 415             | 3               | 35 x 40 x 952               |                                                           |
| PSEN op4B-4-090 | 915                             | 315             | 4               | 35 x 40 x 1052              |                                                           |
| PSEN op4B-4-120 | 1215                            | 415             | 4               | 35 x 40 x 1352              |                                                           |

## Unit-specific description

### PSEN opSB-4

#### PSEN opSB-4F

Light curtains for finger protection, in accordance with EN/IEC 61496-1/-2: Type 4

##### Unit features:

- ▶ Integral SafetyBUS p interface
- ▶ Type 4
- ▶ Resolution: 14 mm
- ▶ Range 0.2 ... 6 m
- ▶ Automatic/manual reset
- ▶ Integrated muting/override function
- ▶ Test function
- ▶ E-STOP function

| Model               | Length of the sensing area (mm) | Length of the protected area (mm) | Number of beams | Dimensions (H x W x D) (mm) | For further data refer to the PSEN opSB-4 operating manual |
|---------------------|---------------------------------|-----------------------------------|-----------------|-----------------------------|------------------------------------------------------------|
| PSEN opSB-4H-14-030 | 294                             | 308                               | 42              | 35 x 40 x 403               |                                                            |
| PSEN opSB-4F-14-045 | 441                             | 455                               | 63              | 35 x 40 x 550               |                                                            |
| PSEN opSB-4F-14-060 | 588                             | 602                               | 84              | 35 x 40 x 697               |                                                            |
| PSEN opSB-4F-14-075 | 735                             | 749                               | 105             | 35 x 40 x 844               |                                                            |
| PSEN opSB-4F-14-090 | 882                             | 896                               | 126             | 31 x 32 x 991               |                                                            |

#### PSEN opSB-4H

Light curtains for hand protection, in accordance with EN/IEC 61496-1/-2: Type 4

##### Unit features:

- ▶ Integral SafetyBUS p interface
- ▶ Type 4
- ▶ Resolution: 30 mm
- ▶ Range 0.2 ... 6 m
- ▶ Automatic/manual reset
- ▶ Integrated muting/override function
- ▶ Test function
- ▶ E-STOP function

| Model               | Length of the sensing area (mm) | Length of the protected area (mm) | Number of beams | Dimensions (H x W x D) (mm) | For further data refer to the PSEN opSB-4 operating manual |
|---------------------|---------------------------------|-----------------------------------|-----------------|-----------------------------|------------------------------------------------------------|
| PSEN opSB-4H-30-015 | 147                             | 180                               | 8               | 35 x 40 x 256               |                                                            |
| PSEN opSB-4H-30-030 | 294                             | 327                               | 16              | 35 x 40 x 403               |                                                            |
| PSEN opSB-4H-30-045 | 441                             | 474                               | 24              | 35 x 40 x 550               |                                                            |
| PSEN opSB-4H-30-060 | 588                             | 621                               | 32              | 35 x 40 x 697               |                                                            |
| PSEN opSB-4H-30-075 | 735                             | 768                               | 40              | 35 x 40 x 844               |                                                            |
| PSEN opSB-4H-30-090 | 822                             | 915                               | 48              | 35 x 40 x 991               |                                                            |
| PSEN opSB-4H-30-105 | 1029                            | 1062                              | 56              | 35 x 40 x 1138              |                                                            |
| PSEN opSB-4H-30-120 | 1176                            | 1209                              | 64              | 35 x 40 x 1285              |                                                            |
| PSEN opSB-4H-30-135 | 1323                            | 1356                              | 72              | 35 x 40 x 1432              |                                                            |
| PSEN opSB-4H-30-150 | 1470                            | 1503                              | 80              | 35 x 40 x 1579              |                                                            |
| PSEN opSB-4H-30-165 | 1617                            | 1650                              | 88              | 35 x 40 x 1726              |                                                            |



## Unit-specific description

### PSEN opSB-4

#### PSEN opSB-4B

Light curtains for body protection,  
in accordance with EN/IEC 61496-1/-2: Type 4

#### Unit features:

- ▶ Integral SafetyBUS p interface
- ▶ Type 4
- ▶ Range 0.2 ... 6 m
- ▶ Automatic/manual reset
- ▶ Integrated muting/override function
- ▶ Test function
- ▶ E-STOP function

| Model              | Length of the sensing area (mm) | Resolution (mm) | Number of beams | Dimensions (H x W x D) (mm) | For further data refer to the PSEN opSB-4 operating manual |
|--------------------|---------------------------------|-----------------|-----------------|-----------------------------|------------------------------------------------------------|
| PSEN opSB-4B-2-050 | 515                             | 515             | 2               | 35 x 40 x 652               |                                                            |
| PSEN opSB-4B-3-080 | 815                             | 415             | 3               | 35 x 40 x 952               |                                                            |
| PSEN opSB-4B-4-090 | 915                             | 315             | 4               | 35 x 40 x 1052              |                                                            |
| PSEN opSB-4B-4-120 | 1215                            | 415             | 4               | 35 x 40 x 1352              |                                                            |

## Applications

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## Applications

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## Applications

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## Applications

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### Safety assessments

Before using a unit it is necessary to perform a safety assessment in accordance with the Machinery Directive. The units as individual components guarantee functional safety, but not the safety of the entire application. You should therefore define the safety requirements for the plant as a whole, and also define how these will be implemented from a technical and organisational standpoint (e.g. refer to BIA [BG Institute for Occupational Safety] Report 6/97).

## Applications

### PSENo2H with PNOZ X2.9p evaluation device, Category 2, EN 954-1

1.3

#### Features

- 1 safety light curtain
- 1 safety relay PNOZ X2.9P
- Dual-channel with detection of shorts across contacts

#### Description

The danger zone is protected with a PSENo2H safety light curtain, which is monitored by the evaluation device PNOZ X2.9P.

Safety outputs OSSD1 and OSSD2 are wired directly onto the terminals S12 and S52 of the PNOZ X2.9P. The safety light curtain operates in guard mode.

The motor of the machine (contactors K1 and K2) is switched on when the light curtain is not interrupted. If the light curtain is interrupted, the signal at the outputs changes from High to Low and the machine is switched off (contactors K1 and K2).

#### Feedback loop

N/C contacts K1 and K2 are connected in series to the reset circuit for feedback loop monitoring.

#### Reset

The reset behaviour of the PNOZ X2.9P can be selected via the wiring of the terminal pairs Y36/Y37 and S12/S34:

1. Automatic reset  
If the safety light curtain is not interrupted then the unit is active.
2. Manual reset  
If the light curtain is not interrupted then the units can be reset by pressing the reset button S2.
3. Monitored reset  
If the light curtain is not interrupted then the units can be reset by pressing the reset button S2.

#### Test

The test input can be supplied with 24 V either by a fixed connection or via a N/C contact S1. Press the S1 button to perform a test which checks that the light curtain is operating properly.

The signals at the outputs must change from High to Low and switch off the machine.



#### NOTICE

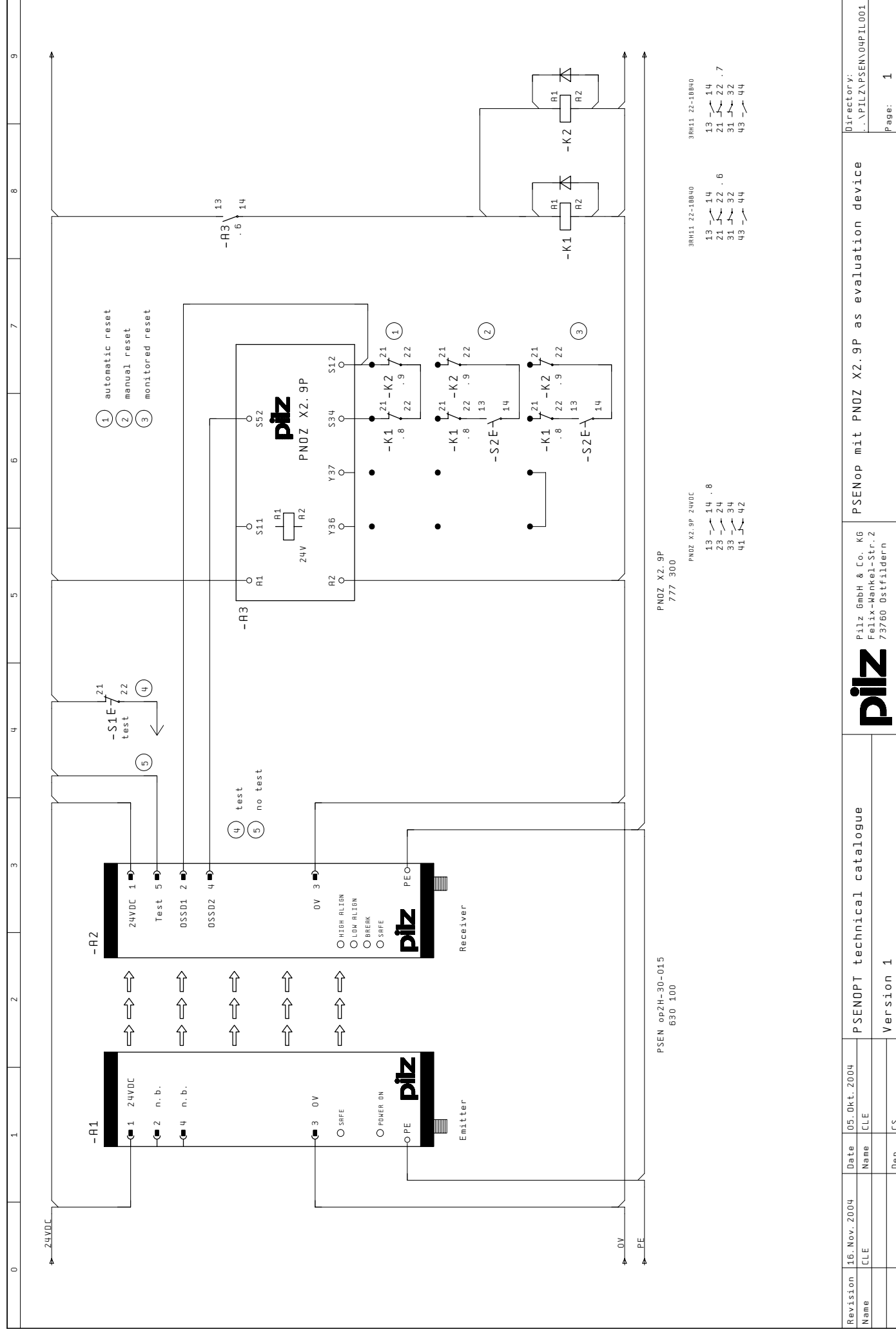
Buttons S1 and S2 must be positioned in such a way that the operator has a clear view of the protected area when reset or test procedures are in progress.

#### Safety assessment

- A short circuit between 24 VDC and the safety outputs OSSD1 and OSSD2 of the light curtain is detected as an error by the light curtain. The safety outputs will carry a low signal.
- A short between the safety outputs OSSD1 and OSSD2 of the light curtain is detected as an error by the light curtain. The safety outputs will carry a low signal.

#### Pilz units

| Number | Type           | Features | Order number |
|--------|----------------|----------|--------------|
| 1      | PSENo2H-30-015 | 24 VDC   | 630 100      |
| 1      | PNOZ X2.9P     | 24 VDC   | 777 300      |



|          |     |               |  |                             |     |                                                                                       |  |                                                               |  |                                       |  |
|----------|-----|---------------|--|-----------------------------|-----|---------------------------------------------------------------------------------------|--|---------------------------------------------------------------|--|---------------------------------------|--|
| Revision |     | Date          |  | PSENOPT technical catalogue |     |  |  | PSENop mit PNOZ X2.9P as evaluation device                    |  | Directory:<br>.. \FILZ\PSEN\OUP\PL001 |  |
| Name     | CLE | 16. Nov. 2004 |  | Name                        | CLE | 05. Okt. 2004                                                                         |  |                                                               |  |                                       |  |
|          |     |               |  |                             |     |                                                                                       |  |                                                               |  |                                       |  |
|          |     |               |  | Dep.                        | CS  |                                                                                       |  | Page: 1                                                       |  |                                       |  |
|          |     |               |  |                             |     |                                                                                       |  | Pilz GmbH & Co. KG<br>Felix-Wankel-Str. 2<br>73760 Ostfildern |  |                                       |  |

## Applications

### PSENopt with PSS or PNOZmulti, Category 4, EN 954-1

1.3

#### Features

- 1 safety light curtain
- PSS safety system
- Dual-channel with detection of shorts across contacts

#### Description

The danger zone is protected with a PSEN op4F safety light curtain, which is monitored by the PSS safety system.

The safety outputs OSSD1 and OSSD2 are wired directly onto the inputs of the safety system.

The motor of the machine (contactors K3 and K4) is switched on when the light curtain is not interrupted. If the light curtain is interrupted, the signal at the outputs changes from High to Low and the machine is switched off (contactors K3 and K4).

#### Test

The test input has a fixed 24 V supply.

#### Reset

If the light curtain is not interrupted, the units can be started by pressing the reset button S3 (monitored reset).



#### INFORMATION

In this example, a matching solution can be implemented with the modular safety system PNOZmulti.

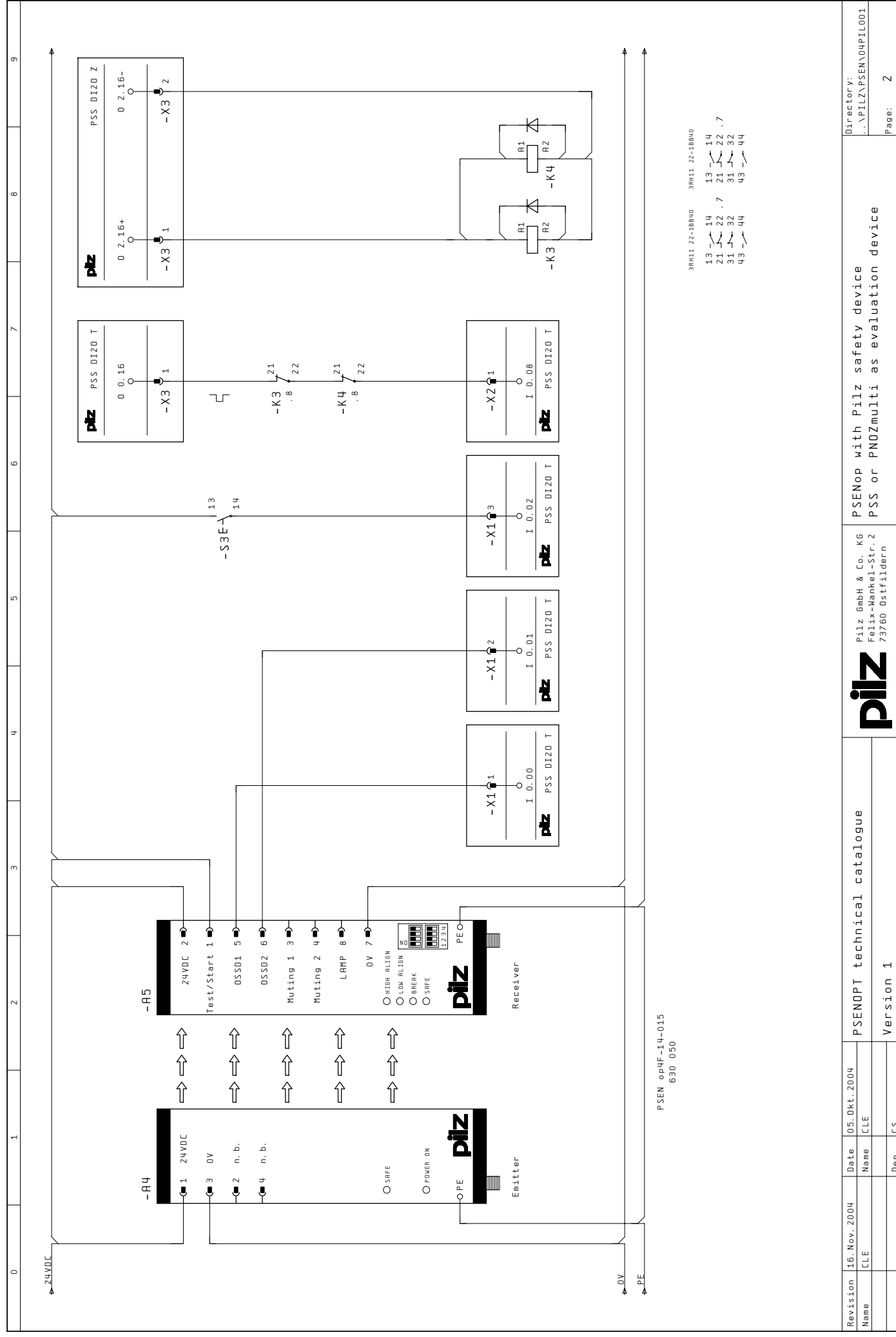
#### Safety assessment

- A short circuit between 24 VDC and the safety outputs OSSD1 and OSSD2 of the light curtain is detected as an error by the light curtain. The safety outputs will carry a low signal.
- A short between the safety outputs OSSD1 and OSSD2 of the light curtain is detected as an error by the light curtain. The safety outputs will carry a low signal.

#### Pilz units

| Number | Type             | Features | Order number |
|--------|------------------|----------|--------------|
| 1      | PSEN op4F-14-015 | 24 V DC  | 630 050      |
| 1      | PSS CPU3         | 24 V DC  | 301 064      |
| 1      | PSS BMP 4/2      | 24 V DC  | 301 006      |
| 1      | PSS PS 24        | 24 V DC  | 301 051      |
| 1      | PSS DI2OT        | 24 V DC  | 301 112      |
| 1      | PSS DI2OZ        | 24 V DC  | 301 109      |





## Applications

### Muting with PMUT X1P, Category 4, EN 954-1

1.3

#### Features

- 1 safety light curtain
- Muting controller PMUT X1P
- Dual-channel with detection of shorts across contacts
- 4 muting sensors
- 2 muting lamps
- 1 reset button
- 1 key switch

#### Description

Muting mode enables the safety function to be temporarily suspended in order, for example, to insert workpieces.

The full muting functionality is provided by the muting controller PMUT X1P. The light curtain only supplies the information: "Protected field broken".

In normal operation the drive is enabled and contactors K5 and K6 are switched on if the light curtain is not interrupted.

The muting sensors enable the light curtain function to be suspended. The muting sensors (N/O) supply a low signal when they are not operated. In muting mode, a high signal is present at the muting sensor outputs. As a result, the motor is enabled even if the light curtain is interrupted, and contactors K5 and K6 still remain switched on.

Muting mode finishes if just one muting sensor remains active.

#### Muting lamp

Muting mode is displayed via two monitored lamps.

#### Key switch

If the muting sensor simultaneity requirement of 3 s is exceeded, the unit will go to a fault condition. The simultaneity requirement can be reset by operating the key switch S5 at S43-S44. Then the reset button S4 needs to be operated at S33-S34. The muting controller is ready for operation.

#### Reset

If the light curtain is not interrupted, the units can be started by pressing the reset button S4 (monitored reset).

#### Safety assessment

- A short circuit between 24 VDC and the safety outputs OSSD1 and OSSD2 of the light curtain is detected as an error by the light curtain. The safety outputs will carry a low signal.
- A short between the safety outputs OSSD1 and OSSD2 of the light curtain is detected as an error by the light curtain. The safety outputs will carry a low signal.

#### Pilz units

| Number | Type                      | Features | Order number |
|--------|---------------------------|----------|--------------|
| 1      | PSEN op4F-14-015          | 24 VDC   | 630 050      |
| 1      | PMUT X1P                  | 24 VDC   | 778 010      |
| 4      | PSEN op1.3 muting sensors | 24 VDC   | 630 320      |
| 2      | PIT si1.1 muting lamps    | 24 VDC   | 620 010      |



## Applications

### Muting with PSEN op4 and PSS or PNOZmulti, Category 4, EN 954-1

#### Features

- 1 safety light curtain
- PSS safety system
- Dual-channel with detection of shorts across contacts
- 4 muting sensors
- 1 muting lamp
- 1 reset button
- 1 key switch
- Partial muting can be configured

#### Description

Muting mode enables the safety function to be temporarily suspended in order, for example, to insert workpieces.

The muting function is performed by a standard block in the PSS safety system.

The light curtain receives the "Muting active" information via the inputs MS1 and MS2.

In normal operation the drive is enabled and contactors K7 and K8 are switched on if the light curtain is not interrupted.

The muting sensors enable the light curtain function to be suspended. The muting sensors (N/O) supply a low signal when they are not operated. In muting mode, a high signal is present at the muting sensor outputs. As a result, the motor is enabled even if the light curtain is interrupted, and contactors K7 and K8 still remain switched on.

Muting mode finishes if just one muting sensor is active or if the muting time elapses (max. 10 minutes).

#### Partial muting

There is an option to blank only certain zones of the protected area (settings made via DIP switches 1 to 3 at the light curtain).

#### Muting lamp

Muting mode is displayed via a monitored lamp.

The lamp must be connected to the lamp output of the PSENopt.

#### Key switch

If the muting sensor simultaneity requirement is exceeded, the unit will go to a fault condition. Key switch S7 can be used to override the muting station until no muting sensor is activated any more.

#### Reset

If the light curtain is not interrupted, the units can be started by pressing the reset button S6 (monitored reset).



#### INFORMATION

In this example, a matching solution can be implemented with the modular safety system PNOZmulti.

#### Safety assessment

- A short circuit between 24 VDC and the safety outputs OSSD1 and OSSD2 of the light curtain is detected as an error by the light curtain. The safety outputs will carry a low signal.
- A short between the safety outputs OSSD1 and OSSD2 of the light curtain is detected as an error by the light curtain. The safety outputs will carry a low signal.
- A short between 24 VDC and the muting inputs of the light curtain will be detected as an error by the safety system.
- A short circuit between the muting inputs will be detected as an error by the light curtain.
- A broken wire in the lamp's filament will be detected as an error by the light curtain.

#### Pilz units

| Number | Type                      | Features | Order number |
|--------|---------------------------|----------|--------------|
| 1      | PSEN op4F-14-015          | 24 VDC   | 630 050      |
| 1      | PSS CPU3                  | 24 VDC   | 301 064      |
| 1      | PSS BMP 4/2               | 24 VDC   | 301 006      |
| 1      | PSS PS 24                 | 24 VDC   | 301 051      |
| 1      | PSS DI2OT                 | 24 VDC   | 301 112      |
| 1      | PSS DI2OZ                 | 24 VDC   | 301 109      |
| 1      | PSS DOS                   | 24 VDC   | 301 111      |
| 4      | PSEN op1.3 muting sensors | 24 VDC   | 630 320      |
| 1      | PIT si1.1 muting lamps    | 24 VDC   | 620 010      |



## Applications

### Direct muting with PSENopt4 safety light curtain , Category 4, EN 954-1

#### Features

- 1 safety light curtain
- Dual-channel with detection of shorts across contacts
- 4 muting sensors
- 1 muting lamp
- 1 reset button
- Partial muting can be configured

#### Description

Muting mode enables the safety function to be temporarily suspended in order, for example, to insert workpieces.

The full muting functionality is provided by the light curtain PSENopt.

In normal operation the drive is enabled and contactors K9 and K10 are switched on if the light curtain is not interrupted.

The muting sensors enable the light curtain function to be suspended. The muting sensors (N/O) supply a low signal when they are not operated.

Inputs MS1 and MS2 must be actuated simultaneously within 0.5 s.

In muting mode, a high signal is present at the muting sensor outputs. As a result, the motor is enabled even if the light curtain is interrupted, and contactors K9 and K10 still remain switched on.

Muting mode finishes if just one muting sensor is active or if the muting time elapses (max. 10 minutes).

Muting sensors 1 and 3 are connected in parallel to input MS1. Muting sensors 2 and 4 are connected in parallel to input MS2.

#### Partial muting

There is an option to blank only certain zones of the protected area (settings made via DIP switches 1 to 3).

#### Overriding

Once the muting time has been exceeded the system needs to be "overridden".

- Switch the receiver off and back on via the "OFF" button S8.
- Press the "RESET" button S9 within 10 s of the device being switched back on and keep it pressed for 5 s.

#### Muting lamp

Muting mode is displayed via a monitored lamp.

The lamp must be connected to the lamp output of the PSENopt.

#### Reset

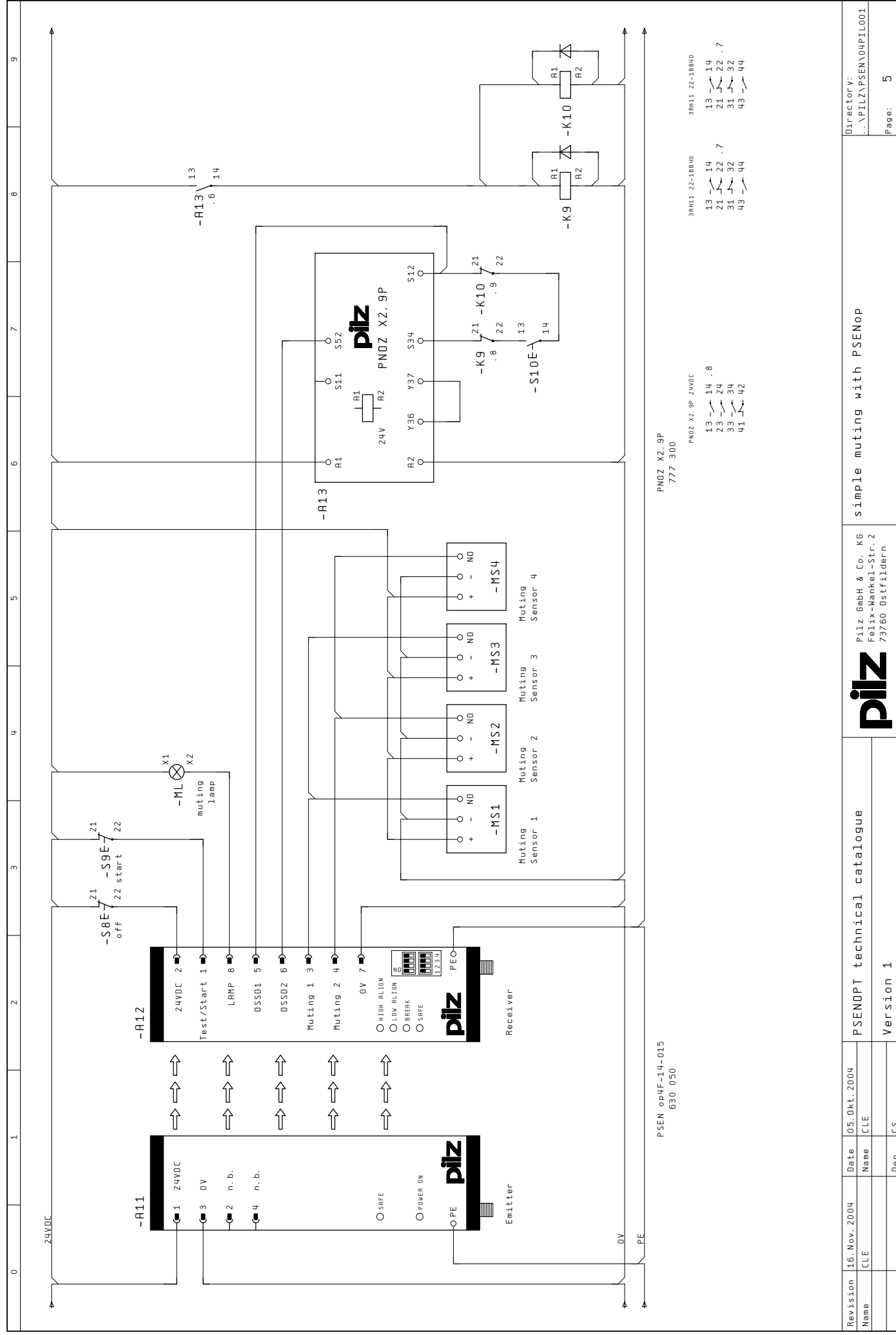
If the light curtain is not interrupted, the units can be started by pressing the reset button S10 (monitored reset).

#### Safety assessment

- A short circuit between 24 VDC and the safety outputs OSSD1 and OSSD2 of the light curtain is detected as an error by the light curtain. The safety outputs will carry a low signal.
- A short between the safety outputs OSSD1 and OSSD2 of the light curtain is detected as an error by the light curtain. The safety outputs will carry a low signal.
- A short between 24 VDC and the muting inputs of the light curtain will be detected as an error by the safety system.
- A broken wire in the lamp's filament will be detected as an error by the light curtain.

#### Pilz units

| Number | Type                      | Features | Order number |
|--------|---------------------------|----------|--------------|
| 1      | PSEN op4F-14-015          | 24 VDC   | 630 050      |
| 1      | PNOZ X2.9P                | 24 VDC   | 777 300      |
| 4      | PSEN op1.3 muting sensors | 24 VDC   | 630 320      |
| 1      | PIT si 1.1 muting lamps   | 24 VDC   | 620 010      |



## Applications

### PSEN opSB-4 with SafetyBUS p

1.3

#### Features

- ▶ Manual reset
- ▶ Reset lock
- ▶ IP67 wiring with pre-assembled hybrid cable (supply/ SafetyBUS p)
- ▶ Safety light curtain is configured in the PSS WIN-PRO system software (from Version 1.3.0)

#### Description

In this example the safety system with the safe bus system SafetyBUS p is monitoring the safety light curtain PSEN opSB-4 (B1/B2).

The SafetyBUS p address (device address 33) for the safety light curtain is set on the receiver via rotary switches (safety light curtain is given one bus address only).

The PSS SB Active Junction Basis (A1) supplies voltage to the safety light curtain and SafetyBUS p.

Pre-assembled cable sets (Pilz) with Y-junctions are used for the IP67 wiring. A terminating resistor (PSS SB M12 TERMINATOR) must be connected at the end of the SafetyBUS p branch.

#### Light curtain monitoring function

If the protected field is interrupted or an error occurs, the safety function in the safety light curtain is reset.

The status of the outputs on the safety light curtain is signalled to the PSS via SafetyBUS p.

When the PSS is cold started (PSS switched from off to on) and warm started (PSS transferring from STOP to RUN), the enable signals M80.00 and M81.00 (enable signals from safety gates for example) and the enable signal from the safety light curtain E33.00 are required in order to achieve an overall enable signal (M89.00), which will start or stop a hazardous movement, for example. The enable signal on the safety light curtain (E33.00 LG\_OSSD) does not need to be dual-channel because the signal is generated safely within the safety light curtain and is transmitted to the PSS safely via SafetyBUS p. After the protected field has been interrupted, the safety light curtain does not resume normal operation until the object has been removed from the protected field and the Test/Start button (S1) has been operated (1/0 pulse edge at the Test/Start input on the safety light curtain).

#### Safety assessment

- ▶ The PSEN opSB-4 safety light curtain is approved up to Category 4 of EN 954-1 and Type 4 of EN/IEC 61496-1/-2.
- ▶ Status and fault diagnostics via displays, as well as externally via SafetyBUS p
- ▶ Data exchange via SafetyBUS p is safe.

#### Classification in accordance with EN 954-1

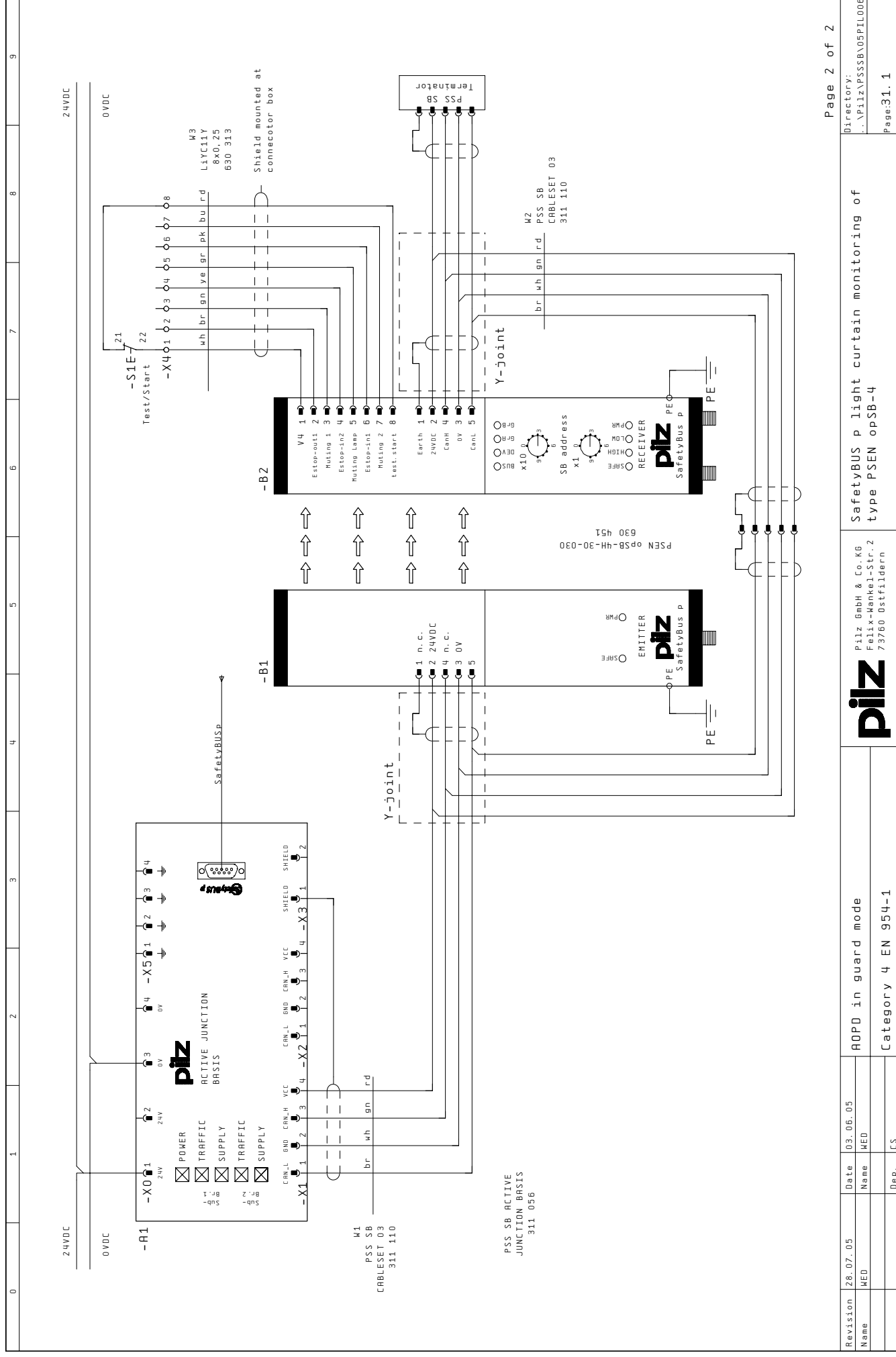
Depending on the application area and its respective regulations, this connection example is suitable for applications up to category 4, in accordance with EN 954-1.

#### Pilz units

| Number | Type                          | Order number |
|--------|-------------------------------|--------------|
| 1      | PSEN opSB-4H-30-030           | 301 600      |
| 1      | PSS SB ACTIVE JUNCTION BASIS  | 311 056      |
| 1      | PSS SB 3006-3 DP-S            | 630 451      |
| 2      | PSS SB CABLESET 03            | 311 110      |
| 1      | PSEN op cable axial M12 8-pin | 630 451      |
| 1      | PSS SB M12 TERMINATOR         | 311 032      |
| 2      | PSS SB SUB-D1                 | 311 051      |
| 1      | PSS SB cable                  | 311 070      |







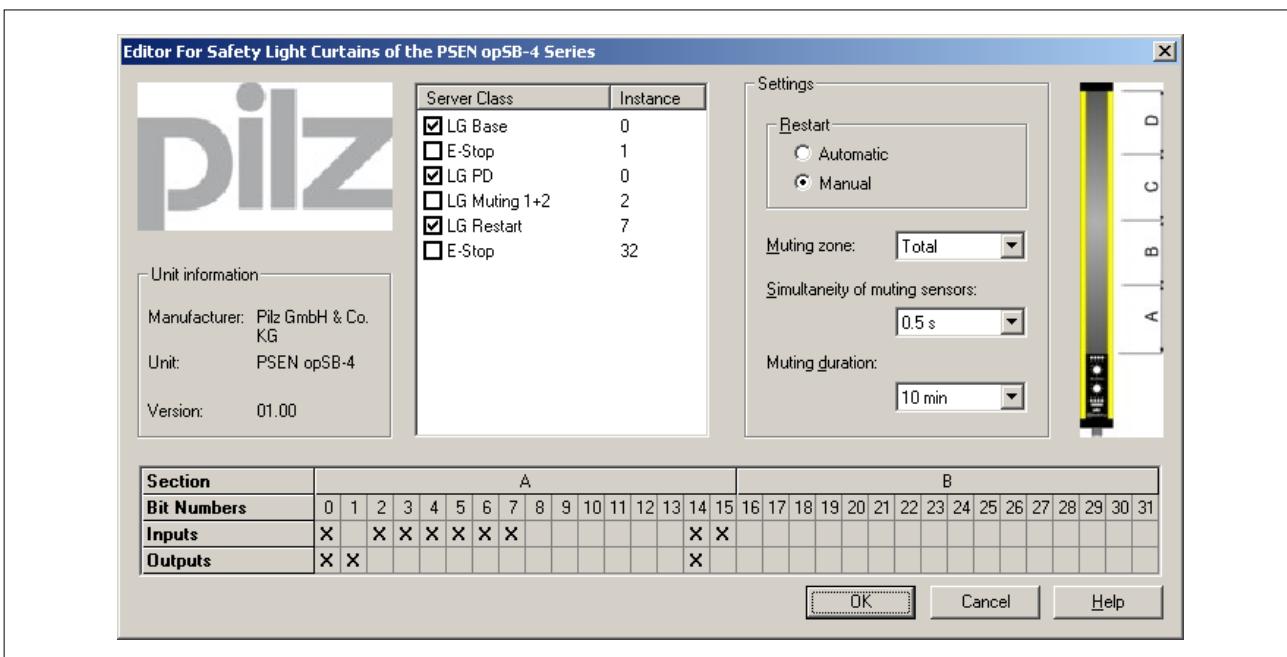
## Applications

### PSEN opSB-4 with SafetyBUS p

#### Configuration of the safety light curtains

- ▶ Server class:
  - LG Base activated      Light curtain basic function (OSSD and test)
  - LG PD activated        Process diagnostics, which can be evaluated by the user program.
  - LG Muting deactivated   Internal light curtain muting function
  - LG Restart activated    Restart safety light curtain
  - E-STOP deactivated     Local E-STOP pushbutton
- ▶ Settings:
  - Manual restart

1.3



#### Program

Programming was carried out in OB101. It may also be carried out elsewhere, e.g. in a PB or FB.

Listing for OB101

SEG 0

// Read in status of safety light curtain  
// and link to other enable signals

```

L   E 033.00   .LG_OSSD           // Status of OSSD;
                                     // 1 = Light curtain clear
U   M 080.00   .Enable_1          // Enable signal from
                                     // another device (e.g. gate)
U   M 081.00   .Enable_2          // Enable signal from
                                     // another device
                                     // (e.g. pressure mat)
=   M 089.00   .Enable_total       // Overall enable signal
                                     // for further use

```

BE

## Appendix

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## Appendix

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| <b>Appendix</b>     |       |
| Chemical resistance | 1.4-2 |

## Appendix

### Chemical resistance

#### Chemical resistance, housing material of the PSENopt safety light curtains

The resistance values listed here are only standard values and may be fundamentally changed by influencing

factors such as filling material, changing temperatures, high load, environmental influences, reaction period etc. For this reason we cannot guarantee this information. This data was determined at room temperature and with normal to strong concentrations.

#### PC plastic (flap cover, flap, end caps)

| Resistance to                                   | Resistance |
|-------------------------------------------------|------------|
| Acetone                                         | No         |
| Alcohol                                         | Yes        |
| Benzine                                         | Yes        |
| Benzol                                          | No         |
| Hot water, continuous                           | No         |
| Chlorinated hydrocarbons                        | No         |
| Hydrocarbons - halogenated, aliphatic, aromatic | No         |
| Concentrated ethanoic acid                      | No         |
| Methanol                                        | No         |
| Caustic soda                                    | No         |
| Fruit juices/citric acid                        | Yes        |
| Oil                                             | Yes        |
| Cooking/salad oil                               | Yes        |
| Toluene                                         | No         |
| Diluted alkaline solutions                      | Yes        |
| Diluted acids                                   | Yes        |
| Detergent                                       | Yes        |
| Water/saltwater < 60°                           | Yes        |
| Xylene                                          | No         |

#### PMMA plastic (optical covers)

| Resistance to                                   | Resistance |
|-------------------------------------------------|------------|
| Acetone                                         | No         |
| Alcohol                                         | No         |
| Ammonia                                         | Yes        |
| Benzine                                         | Yes        |
| Benzol                                          | No         |
| Chlorinated hydrocarbons                        | No         |
| Hydrocarbons - halogenated, aliphatic, aromatic | No         |
| Concentrated alkaline solutions                 | No         |
| Concentrated acids                              | No         |
| Methanol                                        | No         |

|                            |     |
|----------------------------|-----|
| Fruit juices/citric acid   | Yes |
| Oil                        | Yes |
| Polar solvents             | No  |
| Cooking/salad oil          | Yes |
| Toluene                    | No  |
| Diluted alkaline solutions | Yes |
| Diluted acids              | Yes |
| Detergent                  | Yes |
| Xylene                     | No  |

#### ABS plastic (muting sensor housings)

| Resistance to                                   | Resistance |
|-------------------------------------------------|------------|
| Acetone                                         | No         |
| Alcohol                                         | Yes        |
| Benzine                                         | No         |
| Benzol                                          | No         |
| Chlorinated hydrocarbons                        | No         |
| Hydrocarbons - halogenated, aliphatic, aromatic | No         |
| Concentrated alkaline solutions                 | No         |
| Concentrated acids                              | No         |
| Methanol                                        | Yes        |
| Fruit juices/citric acid                        | Yes        |
| Oil                                             | Yes        |
| Cooking/salad oil                               | Yes        |
| Polar solvents                                  | No         |
| Toluene                                         | No         |
| Diluted alkaline solutions                      | Yes        |
| Diluted acids                                   | Yes        |
| Detergent                                       | Yes        |
| Xylene                                          | No         |

#### Aluminium AlMgSi 0.5 anodised (light curtain profile)

| Resistance to                            | Resistance |
|------------------------------------------|------------|
| Inorganic solvents                       | Yes        |
| Atmospheric corrosion                    | Yes        |
| Lime                                     | No         |
| Alkaline solutions                       | No         |
| Organic solvents                         | Yes        |
| Acids                                    | No         |
| Contaminations in a pH range from 5 to 8 | Yes        |
| Water/saltwater                          | Yes        |
| Cement                                   | No         |

## **Appendix**

### **Chemical resistance**

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## Accessories

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## Accessories

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| <b>Accessories</b> |       |
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## Accessories

### Unshielded cables, axial

#### Cable M12, unshielded

##### Unit features:

- ▶ M12 coupling sockets
- ▶ Axial

| Model                               | Length<br>(m) | Core |
|-------------------------------------|---------------|------|
| Cable M12/4 3m straight unshielded  | 3             | 4    |
| Cable M12/4 5m straight unshielded  | 5             | 4    |
| Cable M12/4 10m straight unshielded | 10            | 4    |
| Cable M12/5 3m straight unshielded  | 3             | 5    |
| Cable M12/5 5m straight unshielded  | 5             | 5    |
| Cable M12/5 10m straight unshielded | 10            | 5    |

### Shielded cables, axial

#### Cable M12 shielded

##### Unit features:

- ▶ M12 coupling sockets
- ▶ Axial

| Model                             | Length<br>(m) | Core |
|-----------------------------------|---------------|------|
| Cable M12/4 3m straight shielded  | 3             | 4    |
| Cable M12/4 5m straight shielded  | 5             | 4    |
| Cable M12/4 10m straight shielded | 10            | 4    |
| Cable M12/8 3m straight shielded  | 3             | 8    |
| Cable M12/8 5m straight shielded  | 5             | 8    |
| Cable M12/8 10m straight shielded | 10            | 8    |



##### Caution!

Shielded cables must be used  
for the light curtains  
PSEN op4F/4H/4B/2B.

### Cable for connecting PSEN opSB-4 to SafetyBUS p

| Model                 | Description                                                | Length<br>(m) | Core |
|-----------------------|------------------------------------------------------------|---------------|------|
| PSS SB CABLESET 03    | Y cable, 1 x M12 male connector, 2 x M12 female connectors | 0.5 and 3     | 5    |
| PSS SB CABLESET 05    | Y cable, 1 x M12 male connector, 2 x M12 female connectors | 0.5 and 5     | 5    |
| PSS SB CABLESET 10    | Y cable, 1 x M12 male connector, 2 x M12 female connectors | 0.5 and 10    | 5    |
| PSS SB CABLESET 15    | Y cable, 1 x M12 male connector, 2 x M12 female connectors | 0.5 and 15    | 5    |
| PSS SB BUSCABLE LC    | SafetyBUS p bus cable, low current, shielded               | 0.5 and 5     | 4    |
| PSS SB M12 TERMINATOR | SafetyBUS p terminating resistor IP67, M12 male connector  | 0.5 and 10    | -    |

## Accessories

### Floor brackets Stand

#### Unit features:

- ▶ Can be used for all PSENopt light curtains and the deviating mirrors
- ▶ Dimensions of the floor mounting plate:  
240 x 240 mm

| Model         | Dimensions<br>(L x W x H) | For further data refer to the operating manual, Stand 1000 - 1800 mm |
|---------------|---------------------------|----------------------------------------------------------------------|
| Stand 1000 mm | 1000 x 30 x 30 mm         |                                                                      |
| Stand 1200 mm | 1200 x 30 x 30 mm         |                                                                      |
| Stand 1500 mm | 1500 x 45 x 45 mm         |                                                                      |
| Stand 1800 mm | 1800 x 45 x 45 mm         |                                                                      |

### Deviating mirror Mirror

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

#### Unit features:

- ▶ Can be used for all PSENopt light curtains
- ▶ Dimensions of the floor mounting plate:  
240 x 240 mm

| Model          | Length<br>(mm) | For further data refer to the Deviating mirrors operating manual |
|----------------|----------------|------------------------------------------------------------------|
| Mirror 550 mm  | 550            |                                                                  |
| Mirror 700 mm  | 700            |                                                                  |
| Mirror 900 mm  | 900            |                                                                  |
| Mirror 1000 mm | 1000           |                                                                  |
| Mirror 1270 mm | 1270           |                                                                  |

## Accessories

### Mounting bracket Bracket kit PSEN 4

Adjustable or vibration-proof mounting brackets are available for installations requiring mechanical adjustments or for applications which are subject to heavy vibrations.

#### Unit features:

- ▶ The standard mounting brackets are included in the delivery scope of the PSENopt 2/4 light curtains.
- ▶ The adjustable or vibration-proof mounting brackets can be used with all PSENopt light curtains.

| Model                             | Features                           | For further data refer to the<br>Bracket kit PSEN4<br>operating manual |
|-----------------------------------|------------------------------------|------------------------------------------------------------------------|
| Bracket kit PSEN 4                | Standard mounting bracket          |                                                                        |
| Bracket kit PSEN 4 adjustable     | Adjustable mounting bracket *      |                                                                        |
| Bracket kit PSEN 4 anti vibration | Vibration-proof mounting bracket * |                                                                        |

- \* Standard bracket kit PSEN 4 is additionally required for attachment of the PSEN op2H.

### Laser pointer LaserPointer for PSENopt 2/4

The LaserPointer helps to simplify the process of aligning the PSENopt light curtain transmitter and receiver.

#### Unit features:

- ▶ Can be used with the light curtains PSEN op4F/H/B, PSEN op2B, PSEN opSB-4

For further data refer to the operating manual for the LaserPointer for PSEN4/2

## Accessories

### Test rod

The correct operation of the PSENopt light curtain beams should be checked on a regular basis. This is done with a designated test rod.

#### Unit features:

- Can be used with the light curtains PSEN op4F/H/B, PSEN op2H.

| Model            | Can be used for                     |
|------------------|-------------------------------------|
| Test rod F 14 mm | Light curtain for finger protection |
| Test rod H 30 mm | Light curtain for hand protection   |

### Muting lamps

#### PITsi

The muting lamps are used to signal the activity of the muting function. A muting lamp must be connected before a muting function can be activated.

#### Unit features:

- Protection type IP65
- Can be used for muting applications with the light curtains PSEN op4F/H/B, PSEN op2B.

| Model     | Features                 | For further data refer to the PIT si1.1/PIT si1.2 operating manual |
|-----------|--------------------------|--------------------------------------------------------------------|
| PIT si1.1 | Muting lamp, unmonitored |                                                                    |
| PIT si1.2 | Muting lamp, monitored   |                                                                    |

## Accessories

### Muting sensors (muting signals) PSENOp1

The PSENOp1 muting sensors are optoelectronic protection devices. They are used to reliably detect the conveyed item(s) when muting functions are active.

Muting sensors must be connected before a muting function can be activated.

#### Unit features:

- ▶ Can be used for muting applications with the light curtains PSEN op4F/H/, PSEN op2B, PSEN opSB-4F/H/B
- ▶ Supply voltage: 10 ... 30 VDC
- ▶ Connection: M12 connector, 4-pin
- ▶ Output: PNP, n/o and n/c

| Model                             | Features                                        | Range       | For further data refer to the following operating manuals:<br>PSEN op1.1,<br>PSEN op1.2<br>PSEN op1.3 |
|-----------------------------------|-------------------------------------------------|-------------|-------------------------------------------------------------------------------------------------------|
| PSEN op1.1 Receiver pnp NO/NC M12 | Infrared one-way light barrier, receiver        | 0 ... 20 m  |                                                                                                       |
| PSEN op1.2 Emitter M12            | Infrared one-way light barrier, transmitter     | 0 ... 20 m  |                                                                                                       |
| PSEN op1.3 Reflex pnp NO/NC M12   | Reflex light barrier, polarised, with reflector | 0.1 ... 6 m |                                                                                                       |
| Reflector                         | Reflector                                       |             |                                                                                                       |
| Bracket                           | Mounting bracket for PSEN op1-3                 |             |                                                                                                       |

## Accessories

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# Order Reference

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2.0



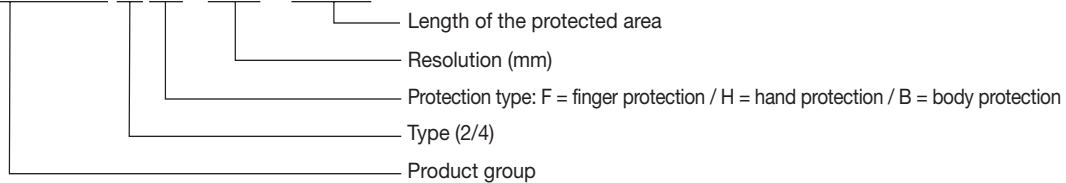
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| <b>Order number</b>         |       |
| Alphabetically by type      | 2.1-2 |
| Numerically by order number | 2.1-5 |

## Alphabetically by type

Please note the following key when ordering

**PSEN op4H-30-165**



| Model            | Features                  | Order number | Page  |
|------------------|---------------------------|--------------|-------|
| PSEN op2B-2-050  | Muting, auto/manual reset | 630 200      | 2.1-2 |
| PSEN op2B-3-080  | Muting, auto/manual reset | 630 201      | 2.1-2 |
| PSEN op2B-4-090  | Muting, auto/manual reset | 630 202      | 2.1-2 |
| PSEN op2B-4-120  | Muting, auto/manual reset | 630 203      | 2.1-2 |
| PSEN op2H-30-015 | Auto reset                | 630 100      | 2.1-2 |
| PSEN op2H-30-030 | Auto reset                | 630 101      | 2.1-2 |
| PSEN op2H-30-045 | Auto reset                | 630 102      | 2.1-2 |
| PSEN op2H-30-060 | Auto reset                | 630 103      | 2.1-2 |
| PSEN op2H-30-075 | Auto reset                | 630 104      | 2.1-2 |
| PSEN op2H-30-090 | Auto reset                | 630 105      | 2.1-2 |
| PSEN op2H-30-105 | Auto reset                | 630 106      | 2.1-2 |
| PSEN op2H-30-120 | Auto reset                | 630 107      | 2.1-2 |
| PSEN op2H-30-135 | Auto reset                | 630 108      | 2.1-2 |
| PSEN op2H-30-150 | Auto reset                | 630 109      | 2.1-2 |
| PSEN op4B-2-050  | Muting, auto/manual reset | 630 250      | 2.1-4 |
| PSEN op4B-3-080  | Muting, auto/manual reset | 630 251      | 2.1-4 |
| PSEN op4B-4-090  | Muting, auto/manual reset | 630 252      | 2.1-4 |
| PSEN op4B-4-120  | Muting, auto/manual reset | 630 253      | 2.1-4 |
| PSEN op4F-14-015 | Muting, auto/manual reset | 630 050      | 2.1-3 |
| PSEN op4F-14-030 | Muting, auto/manual reset | 630 051      | 2.1-3 |
| PSEN op4F-14-045 | Muting, auto/manual reset | 630 052      | 2.1-3 |
| PSEN op4F-14-060 | Muting, auto/manual reset | 630 053      | 2.1-3 |
| PSEN op4F-14-075 | Muting, auto/manual reset | 630 054      | 2.1-3 |
| PSEN op4F-14-090 | Muting, auto/manual reset | 630 055      | 2.1-3 |
| PSEN op4H-30-015 | Muting, auto/manual reset | 630 150      | 2.1-3 |
| PSEN op4H-30-030 | Muting, auto/manual reset | 630 151      | 2.1-3 |
| PSEN op4H-30-045 | Muting, auto/manual reset | 630 152      | 2.1-3 |
| PSEN op4H-30-060 | Muting, auto/manual reset | 630 153      | 2.1-3 |
| PSEN op4H-30-075 | Muting, auto/manual reset | 630 154      | 2.1-3 |
| PSEN op4H-30-090 | Muting, auto/manual reset | 630 155      | 2.1-3 |
| PSEN op4H-30-105 | Muting, auto/manual reset | 630 156      | 2.1-3 |
| PSEN op4H-30-120 | Muting, auto/manual reset | 630 157      | 2.1-3 |
| PSEN op4H-30-135 | Muting, auto/manual reset | 630 158      | 2.1-3 |
| PSEN op4H-30-150 | Muting, auto/manual reset | 630 159      | 2.1-3 |
| PSEN op4H-30-165 | Muting, auto/manual reset | 630 160      | 2.1-3 |

## Alphabetically by type

| Model               | Features                                         | Order number | Page  |
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| 600 010      | PIT si1.1                           | Muting lamp, unmonitored                     | 5.1-4 |
| 600 020      | PIT si1.2                           | Muting lamp, monitored                       | 5.1-4 |
| 630 300      | Cable M12/4 3m straight shielded    | Cable, shielded                              | 5.1-1 |
| 630 301      | Cable M12/4 3m straight unshielded  | Cable, unshielded                            | 5.1-1 |
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| 630 303      | Cable M12/4 5m straight unshielded  | Cable, unshielded                            | 5.1-1 |
| 630 304      | Cable M12/4 10m straight shielded   | Cable, shielded                              | 5.1-1 |
| 630 305      | Cable M12/4 10m straight unshielded | Cable, unshielded                            | 5.1-1 |
| 630 310      | Cable M12/5 3m straight unshielded  | Cable, unshielded                            | 5.1-1 |
| 630 311      | Cable M12/5 5m straight unshielded  | Cable, unshielded                            | 5.1-1 |
| 630 312      | Cable M12/5 10m straight unshielded | Cable, unshielded                            | 5.1-1 |
| 630 313      | Cable M12/8 3m straight shielded    | Cable, shielded                              | 5.1-1 |
| 630 314      | Cable M12/8 5m straight shielded    | Cable, shielded                              | 5.1-1 |
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| 630 320      | PSEN op1.3 Reflex pnp NO/NC M12     | Muting sensor                                | 5.1-5 |
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| 630 338      | Mirror 1000 mm                      | Deviating mirror                             | 5.1-2 |
| 630 339      | Mirror 1270 mm                      | Deviating mirror                             | 5.1-2 |
| 630 340      | LaserPointer for PSEN 4/2           | Laser pointer                                | 5.1-3 |
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## European directives and status of the standards in Europe

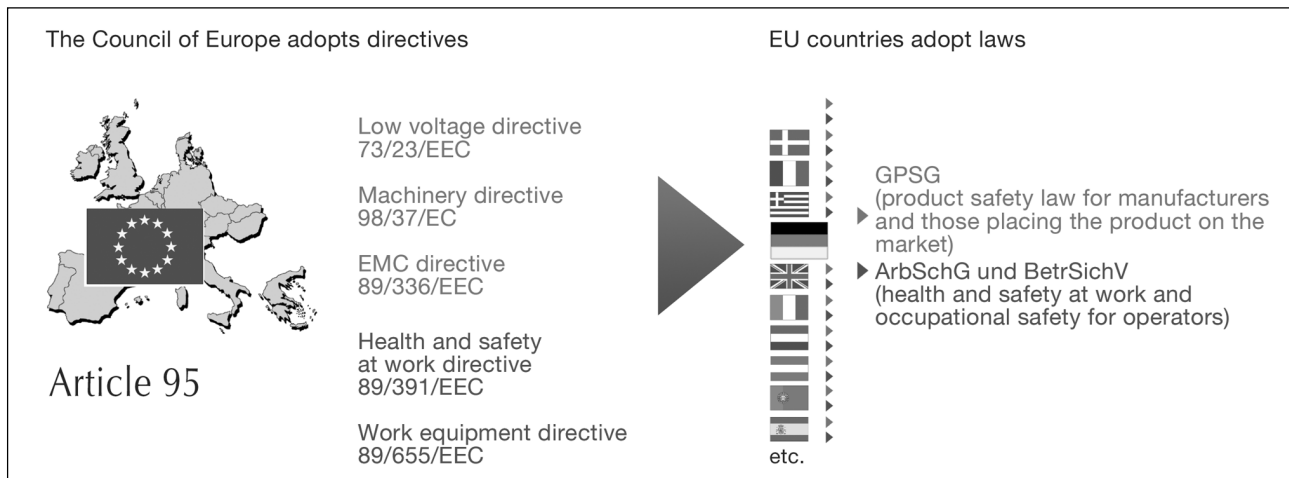


Fig. 1: Incorporation of the directives into domestic law (using Germany as an example)

### European directives

The concept of a single European internal market in terms of the "New Approach" can be traced right back to the start of the 70s: The low voltage directive was the first piece of European legislation to take into account the approach towards harmonisation of a common internal market.

Products that are covered by one or more of the following directives have to apply a CE-mark, i.e. the product must be accompanied by a declaration of conformity. With a declaration of conformity, the manufacturer confirms that his product meets all the requirements of the European directives applicable to his product. This means he can launch and sell his product within the scope of the EU without consideration of any national regulations.

- Lifts 95/16/EC
- Construction products 89/106/EEC
- Pressure equipment directive 97/23/EC
- EMC directive 89/336/EEC
- ATEX 94/9/EC

- Appliances burning gaseous fuels 90/396/EEC
- Machinery directive 98/37/EC
- Medical device directive 93/42/EEC
- Low voltage directive 73/23/EEC
- Personal protective equipment 89/686/EEC
- Safety of toys directive 88/378/EEC

The directives are addressed to member states, who are obliged to incorporate the European directives into domestic law. In Germany, this is normally achieved through the device safety law.

### Status of the standards in Europe

The legal status of standards is continuously discussed. Inside Europe, i.e. within the scope of the European directives that are subject to the CE-marking obligation, a manufacturer is not bound by standards or other specifications. He simply needs to comply with the health and safety requirements of the directive(s). The associated benefits of a division between standards and legislation are obvious: it is easier for legislators to agree on the essential requirements than on technical details. Also, the directives do not

regularly have to be adapted to the state of technology; member states can use their own legal system for incorporation and the manufacturer is free to select how he implements the requirements of the directive.

## European directives and status of the standards in Europe

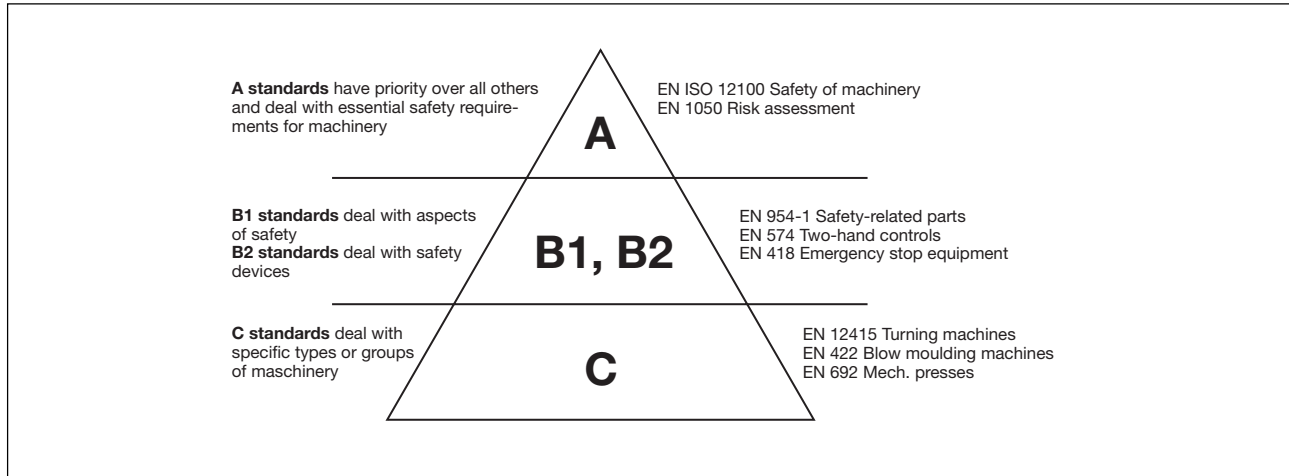


Fig. 2: Standards pyramid

So what are the benefits of applying the standards? With so-called harmonised standards with presumption of conformity, there is a shifting of the burden of proof, i.e. if a manufacturer applies these standards, he can assume that he will also comply with the specific requirements of the European directives. It would therefore be up to the regulatory authorities to

prove that a manufacturer did not meet the legal requirements.

However, should a manufacturer deviate from the harmonised standards, he himself must prove how he has met the essential safety requirements. This is generally done via a hazard analysis. In practice people endeavour to apply the

harmonised standards, unless the products concerned are highly innovative and no harmonised standards yet exist. The standards for which this “presumption effect” applies can be researched in the Official Journal of the EU (e.g. on the Internet). Standards in Europe are subdivided into A, B and C standards.

## Legal regulations outside Europe and Standards for functional safety

### Legal regulations outside Europe

The situation is somewhat different in the USA: primarily there are two types of standards: ANSI (American National Standards Institute) and OSHA (Occupational Safety and Health Administration). OSHA standards are published by the state and compliance is mandatory. ANSI standards, on the other hand, are developed by private organisations and generally their application is not strictly essential. However, ANSI standards are still quoted as part of a contract. And yet ANSI standards are being taken over by OSHA. You can still come across the NFPA (National Fire Protection Association), which developed NFPA 79 as a counterpart to EN 60204-1, for example. The OSHA standards can be compared with the European directives. Unlike the European directives, OSHA standards are more involved with formulating requirements for technical specifications than with abstract requirements.

The legal foundations in the USA can be seen as a mix of product standards, fire codes (NFPA), electrical codes (NEC) and national laws. Local government bodies have the authority to monitor that these codes are being enforced and implemented.

Russia and the CIS states implemented GOST-R certification some years ago. This means that technical devices falling within a specific product catalogue must undergo a certain certification process. Machinery and any corresponding technical accessories undergo a type approval test through a European notified body, for example. This test is generally recognised by a Russian-based approvals body. From the point of view of safety, the same requirements apply as in Europe.

China, on the other hand, has introduced CCC certification. Similar to the position in Russia, technical products are subject to mandatory certification through a national approvals body in China. In addition, production sites are inspected. If a technical device falls with the scope of the product catalogue, which is subdi-

vided into 19 categories, certification is mandatory, otherwise it will be necessary to supply a type of “declaration of no objection” from a national notified body.

Japan is currently in a transition period: the plan is for Japan to adopt the European “new approach” – in other words, to keep standards and legislation separate. At the moment the international ISO and IEC standards are being directly incorporated into national legislation, which is why people are currently confronted with frequent amendments to laws and lengthy implementation periods.

### Standards for functional safety

Different standards may be called upon to observe functional safety on control systems, depending on the application. In the area of machine safety, EN 954-1 is the main standard for safety-related control systems. This applies to the whole chain from the sensor to the actuator, irrespective of the technology. The risk graphs and corresponding risk parameters can be used to estimate the potential risk for danger zones on machinery. The category is initially established without the use of risk-reducing measures.

## Risk parameters and categories in accordance with EN 954-1

### Risk parameters

S = Severity of injury:

- 1 = Slight (normally reversible) injury
- 2 = Serious (normally irreversible) injury, including death

F = Frequency and/or exposure to the hazard

- 1 = Seldom to quite often and/or exposure time is short
- 2 = Frequent to continuous and/or exposure time is long

P = Possibility of avoiding the hazard

- 1 = Possible under specific conditions
- 2 = Scarcely possible

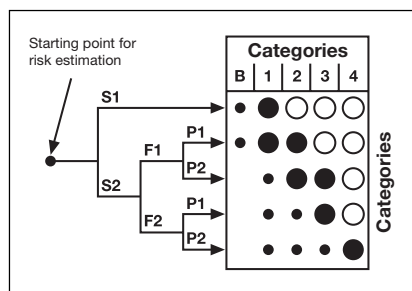


Fig. 3: Risk graph from EN 954

### Categories in accordance with EN 954-1

The control system requirements derived from the risk graph are specified as follows:

#### Category B

Basic category with no special requirements = "good industrial standard"

#### Category 1

Safety-related parts must be designed and constructed using well-tried components and well-tried safety principles.

Well-tried means: the components have been widely used in the past with successful results in similar applications, or they have been manu-

factured using principles that demonstrate their suitability and reliability for safety-related applications.

Example: safety switch with forced-opening contacts.

Well-tried safety principles are circuits constructed in such a way that certain faults can be avoided by the appropriate arrangement or layout of components.

Example: avoiding a short circuit through appropriate separation, avoiding component failures that result from over-dimensioning, using the failsafe principle (on switching off).

Note: When a fault occurs it can lead to the loss of the safety function.

#### Category 2

Safety-related parts of control systems must be designed so that their safety function(s) are checked at suitable intervals by the machine control system. The safety function(s) must be checked: at the machine start-up and prior to the initiation of any hazardous situation; periodically during operation, if the risk assessment and the kind of operation show that it is necessary.

This check may be initiated automatically or manually. Automatically, for example, the check may be initiated by a signal generated from a control system at suitable intervals. The automatic test should be provided by preference. The decision about the type of test depends on the risk assessment and the judgement of the end user or machine builder. If no fault is detected, operation may be approved as a result of the test. If a fault is detected, an output must be generated to initiate an appropriate control action. A second, independent shutdown route is required for this.

Notes: In some cases Category 2 is not applicable because the checking of the safety function cannot be

applied to all components and devices. Moreover, the cost involved in implementing Category 2 correctly may be considerable, so that it may make better economic sense to implement a different category. In general Category 2 can be realised with electronic techniques. The system behaviour allows the occurrence of a fault to lead to the loss of the safety function between checks; the loss of the safety function is detected by the check.

#### Category 3

Safety-related parts of control systems must be designed so that a single fault in any of these parts does not lead to the loss of the safety function.

Whenever reasonably practicable, the single fault shall be detected at or before the next demand upon the safety function. This does not mean that all faults will be detected. The accumulation of undetected faults can lead to an unintended output signal and a hazardous situation at the machine.

#### Category 4

Safety-related parts of control systems must be designed so that a single fault in any of these parts does not lead to a loss of the safety function; the single fault must be detected at or before the next demand upon the safety functions (e.g. immediately at switch on, at the end of a machine operating cycle). If this detection is not possible, then an accumulation of faults shall not lead to a loss of the safety function.

## Functional safety and legal status of EN/IEC 61508

### Functional safety with EN/IEC 61508?

EN/IEC 61508 is regarded as a generic safety standard, which deals with the functional safety of electrical, electronic and programmable electronic systems, irrespective of the application.

One of the main tasks of EN/IEC 61508 is to serve as a basis for the development of application-oriented standards. Standards' committees are currently busy in the areas of

machine safety with EN/IEC 62061, and process safety with EN/IEC 61511. Also under revision is EN 954, the standard harmonised under the scope of the machinery directive, which in future will be listed as EN/ISO 13849.

These sector-specific standards are intended to continue the principle approaches of EN/IEC 61508 and to implement the requirements for the relevant application area in a suitably practical manner.

### What is the legal status of EN/IEC 61508?

As EN/IEC 61508 is not listed in the Official Journal of the European Communities for implementation as a European directive, it lacks the so-called "presumption effect". If the standard is used on its own, a control system designer cannot assume that the relevant requirements of the specific European directive have been met.

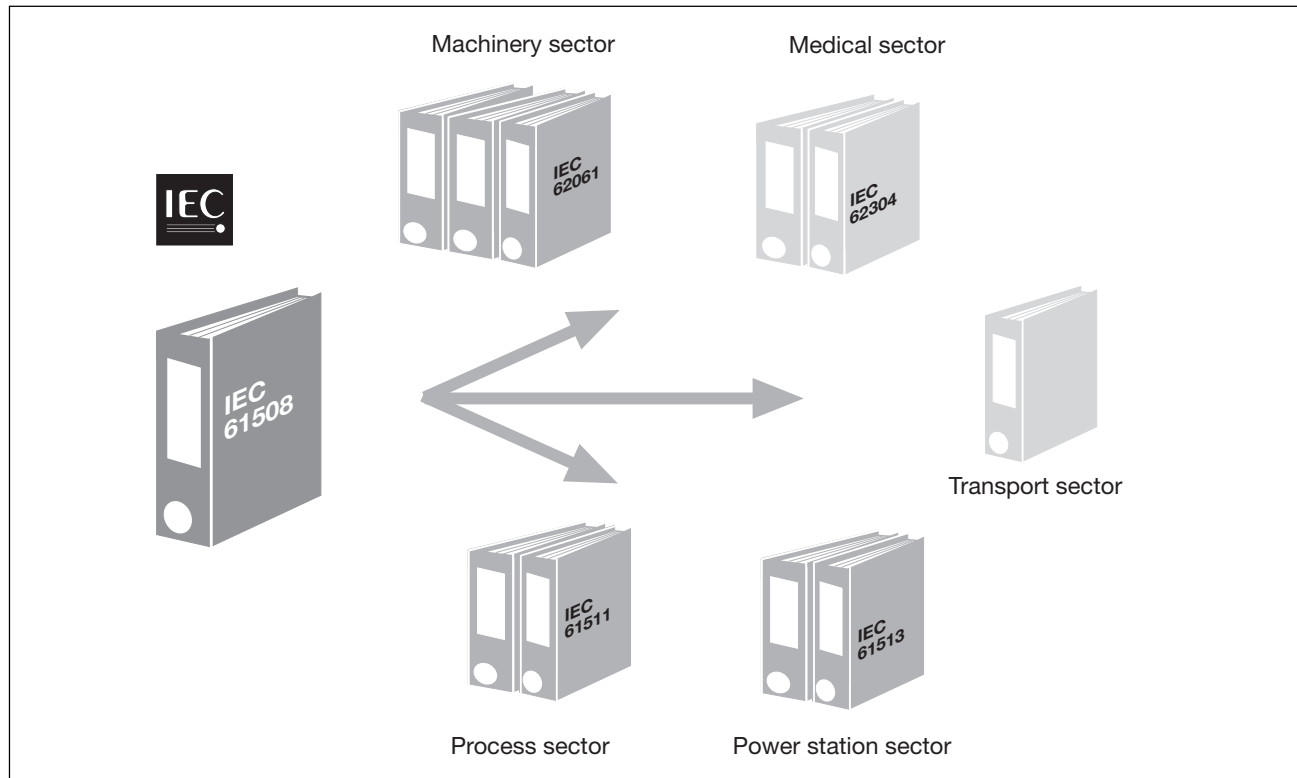


Fig. 4: Sector standards from IEC 61508

## Risk analysis

### Risk analysis

Under the terms of the machinery directive, a machine manufacturer must carry out a risk analysis in order to identify all the hazards that apply to his machine. This analysis must then be taken into account in the design and construction of the machine. This requirement also applies to operators who act as manufacturers under the terms of the machinery directive. For

example, this may occur with machines that are interlinked or for machinery that has been upgraded and substantially modified.

EN 1050 contains "Principles for risk assessment" on machinery. These approaches can be called upon as part of a comprehensive analysis. EN 954-1 expands on EN 1050 with regard to the assessment of safety-related parts of control systems.

The hazards emanating from a machine may be many and varied. For example, it is necessary to consider not just mechanical hazards through crushing and shearing, but also thermal and electrical hazards and hazards from radiation. Risk reduction is therefore an iterative process, i.e. it is carried out before and during the planning phase and after completion of the plant or machine.

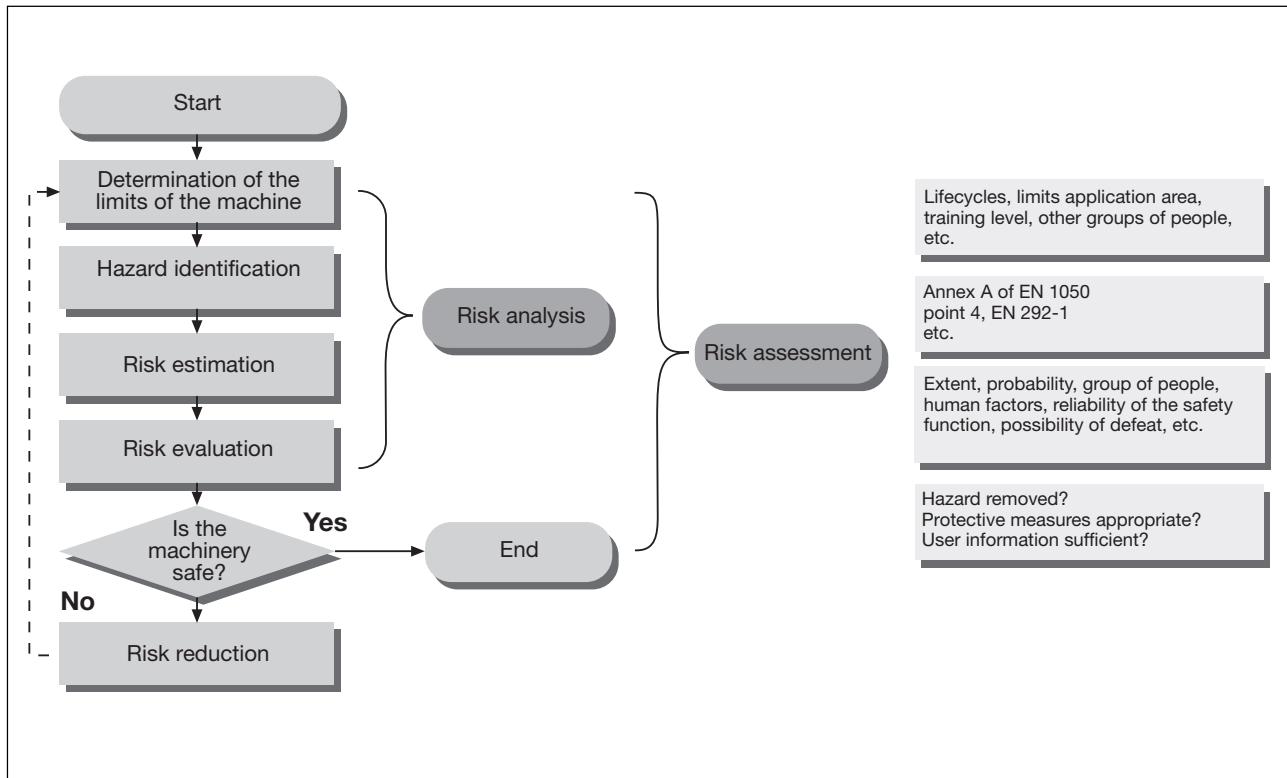


Fig. 5: Iterative process in accordance with EN 1050





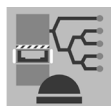
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## Pre-sales/after sales

### Services, concepts and solutions



We are happy to advise you, in the configuration phase or during commissioning.



#### Plant assessment

Analysis and assessment of the safety-related condition of your plant and machinery. Presentation of basic proposals for improvement.



#### Risk assessment

Assessment of the hazards and risks on plant and machinery, based on standards and norms.



#### Safety concept

Based on the risk assessment, appropriate protective measures can be selected and a safety concept drawn up.



#### Safety design

Pilz can undertake all the tasks required to implement a project: component selection, preparation of circuit diagrams, programming, control cabinet, installation, commissioning.



#### CE services

Co-ordination and implementation of all the activities necessary for the "CE conformity" of plant and machinery.



#### Safety sign-off

Check of all the relevant safety-related documents, creation of check lists and examination of plant and machinery.



#### Technical support

Our engineers can support you in the selection, use and application of our products. They are in constant contact with customers from the widest range of industries and industrial sectors and are happy to answer your queries at any time.



#### Supply and repair service

From a fast, economical repair through to a long supply guarantee to safeguard your investment – always expect more from Pilz.



#### Certificates and approvals

Pilz is certified to DIN ISO 9001. International approvals and certification from recognised test bodies confirm our products' suitability for worldwide use.



#### E-Mail:

[techsupport@pilz.de](mailto:techsupport@pilz.de)



#### 24-hour hotline:

+49 711 3409-444



#### Training and education

A wide range of seminars and courses help to pass on the basics to minimise risks and safeguard your success.



#### Worldwide representatives

Our worldwide network of subsidiaries and sales partners ensures comprehensive support and assistance with your questions and problems.



#### Internet

Our homepage at [www.pilz.com](http://www.pilz.com) provides the latest information, electronic shopping, direct dialogue and enquiry functions, as well as extensive download options.



#### E-Business

The focus of Pilz's E-Business activities is to strengthen customer orientation through the use of new media and to increase added value via a supplementary business model for Business-to-Business.

## Business terms and conditions

### Terms of delivery and payment

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The terms of delivery and of payment of the respective Pilz company with whom a sales contract is closed are applied. As a rule this is the Pilz company that places the order. Please select the legal contract partner from the order confirmation.