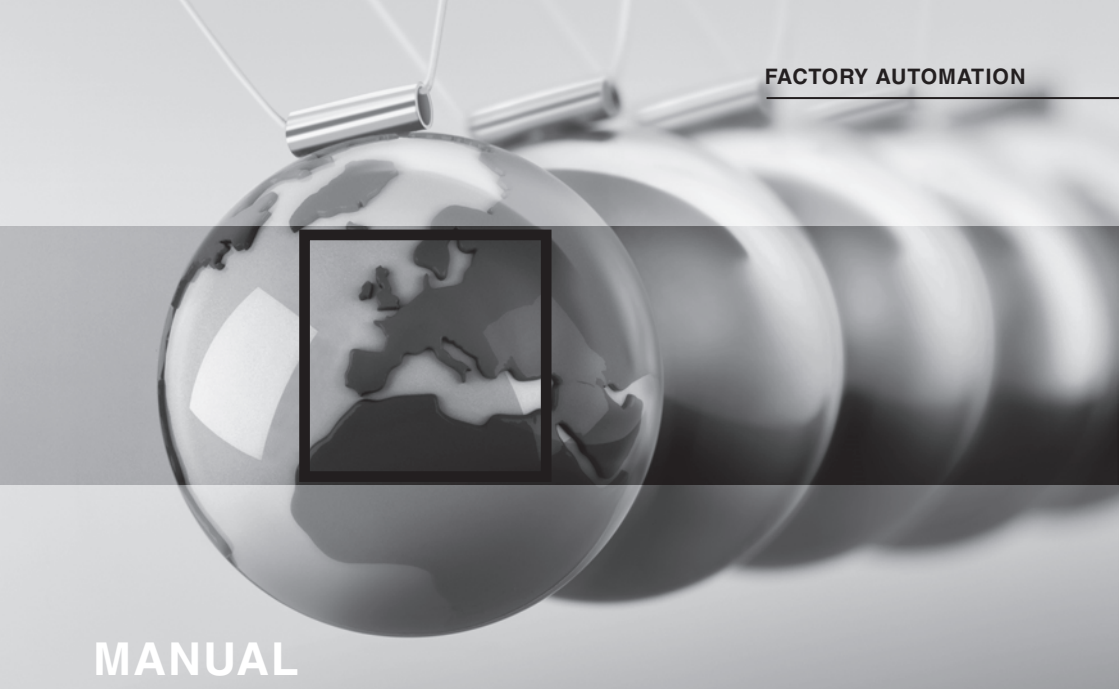

# MANUAL

## SLVA-4Kplus

### CONTROL UNIT

CE

PEPPERL+FUCHS
SENSING YOUR NEEDS

Part No. 109008
Date of issue 2012-03

PEPPERL+FUCHS

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## Introduction!

These operating instructions provide information on the intended use of the product and are intended to prevent the occurrence of dangerous situations. They must be read and applied by all persons involved in the application, installation, operation, servicing, repair and inspection of the product. This product can only fulfil the purpose for which it is intended if it is installed, operated, serviced, repaired and inspected in accordance with the information provided by Pepperl+Fuchs.

The guarantee provided by Pepperl+Fuchs for this product is rendered null and void if the product is not installed, operated, serviced, repaired and inspected in accordance with the information provided by Pepperl+Fuchs.

Before the selection and use of the product, an evaluation must be undertaken to determine that it is suitable for the envisaged application. Pepperl+Fuchs has no control over the selection and use of the product. Our liability is therefore restricted to the intrinsic quality of the product.

The product must be regularly inspected and serviced by specialist personnel. The results of such inspections and servicing operations are to be recorded. Only original Pepperl+Fuchs parts are to be used when effecting repairs.

Modifications to the equipment or components and the use of defective or incomplete equipment or components are not permitted. Repair work on equipment or components carried out other than by Pepperl+Fuchs must only be undertaken in proper workshop facilities. Such workshop facilities are responsible for acquiring the latest technical information on the equipment and components from Pepperl+Fuchs.

Repair work on the product, which has not been carried out by Pepperl+Fuchs, is outside the control of Pepperl+Fuchs. Our liability is therefore restricted to those repairs that have been carried out by Pepperl+Fuchs.

The statements above do not replace the clauses relating to guarantees and liability in the Pepperl+Fuchs general terms and conditions of sale and supply.

This equipment contains assemblies that are electrostatically sensitive. Opening of the equipment for the purpose of servicing and repair work must be undertaken by specialist personnel. Electrostatic discharges due to unprotected contact with the assemblies must

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be avoided. The destruction of components caused by an electrostatic discharge will render the guarantee null and void!

The right is reserved to make technical changes.

## Symbols

In this manual important notes for operation and safety when using the control unit SLVA-4Kplus are distinguished by symbols. The meaning of the symbols are:

*Recommendation for the user*
*Attending these notes the insallation procedure and the use of the control unit* SLVA-4Kplus will be lightened.


*Indication of dangerous circumstances or a direct danger. Non observance may lead to damage to property, or to severe or fatal injury.*

We reserve the right to alter specifications at any time and without notice.

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# 1 Intended use

The SLVA-4K system, comprising the SLA light barriers or the SLP light grids and the control unit SLVA-4Kplus, must only be used for the intended purpose, i.e., as a non-contact **e**lectro-**s**ensitive **p**rotection **d**evice (**ESPD**) for the prevention of access to danger points and areas.


*If the system is used for a purpose other than that intended, its function may not be guaranteed.*

When operating the equipment the relevant safety regulations, standards and specifications are to be observed and the specific requirements of the specific application must be considered.

The SLVA-4Kplus is a control unit for a safety light barrier system with 1 to 4 single-pass light barriers of type BWS (Non-contact electro-sensitive protection device) category 4 (ISO 13849-1) and type 4 (EN 61496-1), which can be used for the prevention of access to danger points and areas. A complete light barrier safety system consists of:

- 1-4 single-pass light barriers (transmitters and receivers),
- the SLVA-4Kplus control unit and optionally
- a 2-channel monitoring system (for example for Emergency-Stop switches)

Each transmitter generates a light beam, which is detected by an associated receiver. Any interruption of the light beam is detected by the control unit, which opens the contacts of the output relay, thus in turn enabling secondary switching devices to initiate methods of preventing the danger of movement into the protected area.

In constructing a BWS of type 4, only the permitted light barriers of type SLA and light grids of type SLP may be connected to SLVA-4Kplus control unit. The light barriers and light grids cannot be operated without the control unit.

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# 2 Product description

## 2.1 Product features

- Self-monitoring
- Modular construction
- Monitored relay outputs (EDM, external device monitor)
- Can be operated with and without start-up/restart interlock
- Selectable relay monitor
- Diagnostic indication for ease of fault location
- Control unit to protection class IP20/NEMA 1 for installation in a control cabinet or in a housing with a protection class of at least IP54/NEMA 3
- Up to four protective beams
- Red transmitted light for simple alignment
- Stability control indication on the light barrier receivers and on the control unit
- Monitored connection of 2-channel safety circuit (EMERGENCY-STOP circuit)

## 2.2 Components of the light barrier safety system

The system is represented schematically in figure 2.1 and figure 2.2. The control unit generates the required supply voltages for the light barriers. The control electronics drives the light barrier transmitters and evaluates the signals coming from the receivers. A safety-aligned microprocessor control permanently monitors the light barrier functions. Two positive-action relays provide the switch-off signal when a light beam is broken. The switching time of the relays is monitored to ensure that the maximum switching time is not exceeded. The SLVA-4Kplus can be used in various operating modes, i.e. the functions:

- Start-up/Restart interlock
- Relay monitor
- Monitoring of 2-channel safety circuits.

These can also be activated by the user, either singly, or in combination.

Signal outputs for the conditions:

- Ready for start/fault condition
- Safety outputs switched-off
- Safety outputs switched-on

enable a system message to be provided to a location appropriate to the respective safety device.

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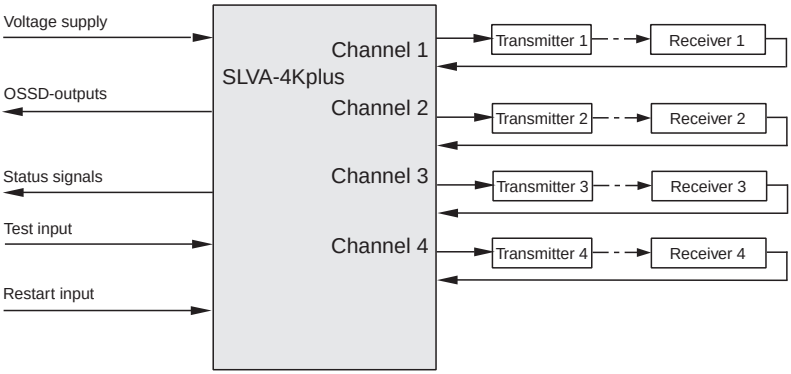


Fig. 2.1: Light barrier safety system with SLVA-4Kplus

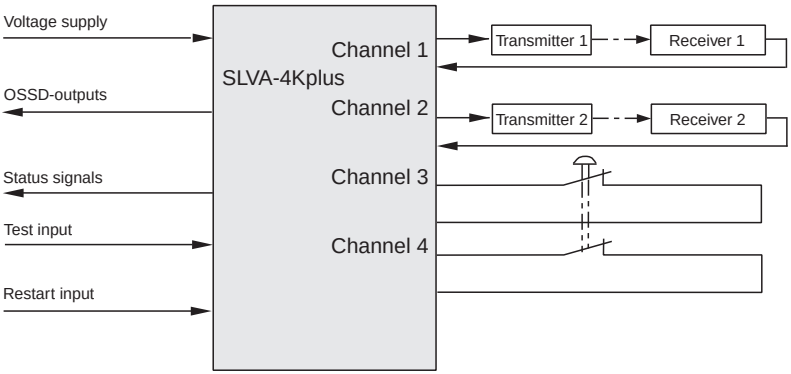


Fig. 2.2: Light barrier safety system with EMERGENCY-STOP switch

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## 2.3 Connections on the SLVA-4Kplus

The connection of the light barriers and light grids to the control unit is by means of terminals. The control unit connections are shown in figure 2.3.

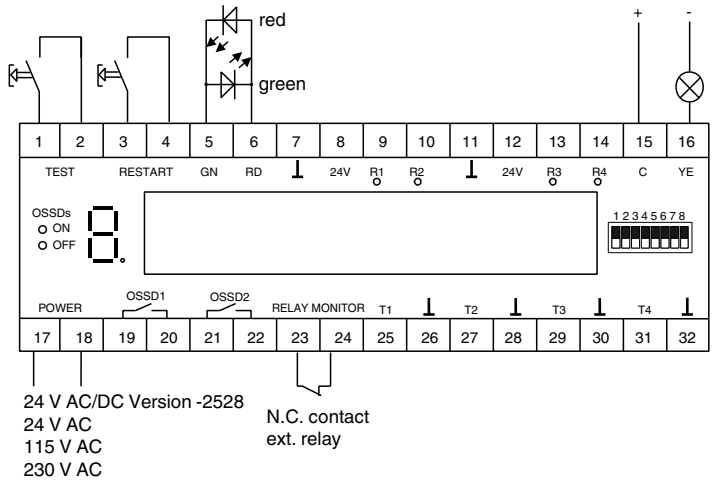


Fig. 2.3: Control unit connections

| Terminal | Function |
|---|---|
| 1-2 | Normally-open contact for test and fault elimination; has to be closed, unless the test or fault elimination is started by switching the power supply off and then on again - see section 9. |
| 3-4 | Normally-open contact for start-up/restart enable; has to be closed. The contact remains open when the control unit is operating in the mode without a start-up/restart inhibit. |
| 5-6 | Direct connection of LED for indication of output relay status (Optionally available with relay contacts) - see section 2.6.2. |
| 7-14 | Connections for light barrier receiver, or the Emergency-Stop circuits - see section 5. |
| 15-16 | Connection for start-up readiness/fault status indicator light - see section 2.6.2. |
| 17-18 | Power supply connection: Arbitrary polarity for direct voltage supply. |
| 19-22 | Safety relay switch outputs (OSSD), zero potential contacts for machine control. |
| 23-24 | Relay monitor: Only connected when the function relay monitor is used - see section 2.5.3. |
| 25-32 | Connections for light barrier transmitter - see section 5. |

Table 2.1: Terminal assignment

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## 2.4 Fuses

The OSSD control unit outputs are fused.


*Before replacing a fuse, the control unit must be isolated from the power supply.*

All fuses are located inside the control unit and are not accessible from outside. In order to replace a fuse, the lower terminal strip must be removed.

| Output | Value | Plan view |
|---|---|---|
| Switch output, N.O. 1 (19-20) | T 2,0 A | Left |
| Switch output, N.O. 2 (21-22) | T 2,0 A | Right, adjacent |

Table 2.2: Fuse assignment and values.

## 2.5 Operating modes

### 2.5.1 Setting the operating mode

The operating mode is factory-set to match the order code. However, the user can change the operating mode. Following a change in the operating mode, the selected setting must always be checked for correct operation before the system is enabled.

*On the SLVA-4Kplus the operating mode is set by means of DIP switches. The DIP switches are accessed by removing the transparent cover from the top of the control unit. For each setting, two DIP switches are set at the stated positions.*

The table shows the operating modes that can be selected.

| Switch | Position | Operating mode |
|---|---|---|
| 1 +5 | OFF | without start-up/restart interlock |
| | ON | with start-up/restart interlock |
| 2 + 6 | OFF | without relay monitor (EDM) |
| | ON | with relay monitor (EDM) |
| 3 + 7 | OFF | Light barriers on channels 3 and 4 |
| | ON | Emergency-Stop on channels 3 and 4 |
| 4 + 8 | OFF | Emergency-Stop static |
| | ON | Emergency-Stop pulsed |

Table 2.3: DIP switches

In order to set the DIP switches, a suitable screwdriver is used to remove the transparent cover. The cover is replaced after setting the switches. If the DIP switches are actuated during operation, the control unit switches to the safe condition (Outputs switched-off) and the 7-segment indicator displays a P. In addition, output 15/16 flashes (Ready for start-up).

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*The safety device must be checked after every change of the DIP switch settings (see Section 6).*

Changes to the settings in accordance with table 2.3 must be marked in the appropriate boxes on the type label.

### 2.5.2 Start-up/restart interlock

The start-up/restart interlock prevents the dangerous motion from switching on again of its own accord after the protected area has been entered. The switch for the start-up/restart inhibit should be located such that it can be seen from the area of danger and yet it is not possible for it to be actuated from within this area.

In order to switch the plant/machinery on again, the start-up/restart enable (Terminals 3-4) must be actuated for 0.05 s ... 1 s. The dynamic enable serves to provide protection against static faults in the start-up enable circuit.

The devices are supplied with on or off-switched start-up/restart inhibit. The product type plate is marked to identify this feature.

Any change made to this setting using the DIP switches must be marked in the appropriate fields on the product type plate.

### 2.5.3 Relay monitor

The relay monitor provides a monitoring function via the SLVA-4Kplus for externally connected relays (or protection devices / contactors). The wiring of the relay monitor is illustrated in figure 2.4. Any number of normally-closed contacts of any number of relays can be connected in series.

In the figure, K1 and K2 are positive-action relays. The normally-closed contacts K1K and K2K (control contacts) must ensure a secure contact at 24 V / 5 mA. Attachable auxiliary contacts or the contacts of auxiliary relays normally satisfy this requirement.


*A surge withstand capability of 6 kV between the control contacts and other contacts, which carry critical voltages, must be guaranteed by the relay manufacturer. The relay operating circuit must be protected with a fuse having a maximum nominal value of 60 % of the load rating of the relay contacts, in order to prevent welding of the contacts.*

The relays are monitored with a delay of 200 ms after the switching operation. If the new switching state has not been achieved after 200 ms, the SLVA-4Kplus assumes an inhibit state and fault **F** is indicated on the diagnostic display.

The devices are supplied with either a connect or disconnect relay monitor. This function is indicated on the type label. Any modification to this setting using the DIP switches must be marked in the appropriate box on the type label.

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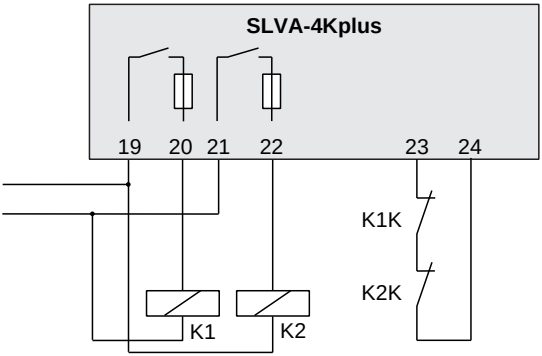


Fig. 2.4: Relay monitor

### 2.5.4 Emergency-Stop

In the Emergency-Stop operating mode, the two channels of an Emergency-Stop circuit are connected in place of the light barriers 3 and 4. There are two versions of this arrangement:

1. Static operation: Both channels switch the 24 V static voltage to the receiver inputs of light barriers 3 and 4. Due to the resulting loss of the cross-circuit monitoring, the two channels of the Emergency-Stop circuit must either be laid in separate cables or in a common mechanically-protected cable. The current loading of the Emergency-Stop circuit is approx. 10 mA.
2. Pulse operation: The two channels switch a connection between the transmitter outputs of light barriers 3 and 4, on the one hand, and on the other hand between the receiver inputs of light barriers 3 and 4. Due to the existing short-circuit and cross-circuit monitoring, the protected laying of the Emergency-Stop circuit is not necessary. The mean current loading of the Emergency-Stop circuit is very low, so that the Emergency-Stop switches that are used for zero-current switching are suitable.


*If Emergency-Stop switches are attached, the start up/restart interlock mode must be activated to prevent a start up/restart, when unlocking the Emergency-Stop switches (EN 418).*


*The Emergency-Stop would also function in the DIP switch settings XX00 XX00 and XX01 XX01, however, in this case there is no simultaneity monitoring (not permissible)! Therefore, if a pulsed Emergency-Stop is used, care must be taken to ensure that the DIP switches remain in the settings **XX11 XX11**!*

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## 2.6 Indicator lights

### 2.6.1 Internal control unit indicator lights

The functions of the control unit indicator lights are shown in table 2.4. The digital display indicates the operating and fault conditions of the BWS (see Section 9). A fault condition is indicated when the decimal point on the 7 segment display flashes. The LEDs R1-R4 (yellow) indicate the reception status of the connected light barriers or of the connected Emergency-Stop circuit. The OSSD LED (ON = green, OFF = red) indicates the status of the safety outputs (OSSDs).

| | | |
|---|---|---|
| LED | red | OSSD outputs OFF |
| | green | OSSD outputs ON |
| | yellow | Indicator for channels (1-4)<br>On = Light beam free or Emerg.-Stop On<br>Flashing = Light beam free, stability control inadequate<br>Off = Light beam broken or Emerg.-Stop circuit switched off |
| 7-Segment indicator |  | Protected area clear, OSSD ON (Run light) (symbol elements light in turn, clockwise) |
| |  | Protected area obstructed |
| |  | Protected area clear, OSSD OFF,<br>Ready for start-up |
| |  | System fault |
| |  | DIP switch setting incorrect |
| |  | Short-circuit, transmitter connection |
| |  | Fault, simultaneity condition<br>Emergency-Stop channel |
| |  | Fault in an external relay |
| |  | DIP switches being set |

Table 2.4: Control unit indicator lights

### 2.6.2 External indicator lights

The external indicator lights have to be connected to the control unit by the operator. These are not included in the delivery package. The external start-up readiness indicator light must be clearly visible.

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**Start-up readiness indicator light:**
- Installation - see Section 5
- ON status (yellow): System waiting to be enabled
- OFF status: protected area clear, OSSD On or protected area obstructed, OSSD Off
- Status indicator flashing: Control unit in the fault condition or operating mode is set.
- see Section 7.1 for connection values, indicator outputs.

**Indicator light for the output relay:**
2 indications, red and green, for the output relay status (OSSD). Standard version with direct LED control, optional relay output with changeover contact (Centre contact on terminal 15).

- For installation, see Section 5.
- ON status (green): Output relay On
- ON status (red): Output relay Off
- See Section 7.1 for connection values, indicator outputs.

### 2.6.3 Light barrier and light grid indicators

Each receiver has an LED that signals the receiver status. Indications are given of light beam broken (Indicator dark) and light beam unbroken. Incorrect alignment of the light barrier is also indicated.

| Type | red | yellow | green | Meaning |
|---|---|---|---|---|
| SLA5<br>SLA5S<br>SLA20<br>SLA25<br>SLA40 | not available | dark | dark | Light beam broken |
| | | lit | dark | Light beam unbroken, stability control inadequate |
| | | dark | lit | Light beam unbroken |
| SLP | dark | not available | | Light beam broken |
| | flashing | | | Light beam unbroken, stability control inadequate |
| | lit | | | Light beam unbroken |
| | | | | The SLP has an additional red LED, near the connector cap, as a power supply indicator. |
| SLA28 | lit | dark | dark | Light beam broken |
| | flashing | lit | dark | Light beam unbroken, stability control inadequate |
| | dark | dark | lit | Light beam unbroken |

Table 2.5: Light barrier indicator lights

## 2.7 Test

The input test causes the system to execute a system reset, followed by a restart. The complete switching system is tested, including the safety outputs. The same effect is achieved if the power supply is switched off for at least 1s. The wiring of the connection is not absolutely necessary.

The system reset is used to accept failure conditions on the unit and to check the switching capability of the safety outputs.

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## 3 Arrangement and combination of light barriers and light grids

Light barriers of the SLA type and light grids of the type SLP are through beam photoelectric sensors, generally consisting of a transmitter and a receiver. Together with the SLVA4-Kplus control unit they form a BWS of Type 4 (EN 61496-1) or Category 4 (ISO 13849-1). Up to 4 light barriers or light beams can be connected to one control unit.

SLA light barriers and SLP light grids connected to the same control unit do not subject one another to mutual interference. Light barriers and grids that are connected to different control units should be arranged such that the transmitters of one group of light barriers do not irradiate the receivers of the other group of light barriers, so that mutual interference is avoided.

Light barriers type SLA and SLP light grids that are approved for connection to SLVA system control units can be mixed arbitrarily, provided that the transmitters and receivers are of the same type. Further data can be obtained from the respective technical information on the light barriers and light grids.

The SLA light barriers and SLP light grids must only be connected to control units in the SLVA family.

In addition to the differences in range and housing construction, the light barriers and light grids also differ in respect of their electrical connections. The light barriers have either a fixed cable connection, a plug connection or are provided with a terminal compartment, into which the user inserts and attaches the cable connections. The connections that have to be made are shown in figure 3.1 and figure 3.2. The SLP light grids are fitted with a terminal compartment.

The SLP light grids are suitable for access security functions with 2-4 protective beams. The distances between the protective beams are as prescribed in ISO 13855. The wiring between the control unit and the transmitter/receiver is shown in Figure 6.

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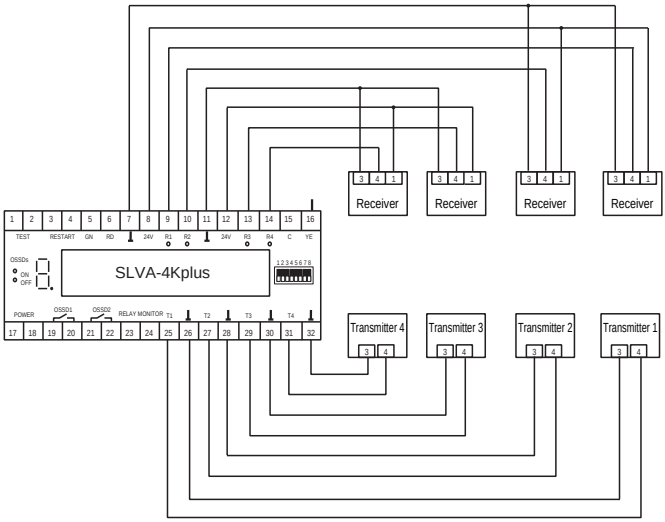


Fig. 3.1: Connection of light barriers with terminal compartment connections (e.g. SLA28) and with plug connection (e.g. SLA5(s)/92, SLA40/92 SLA28/104). Caution: On transmitter type SLA20, connect terminal 2 in place of terminal 4.

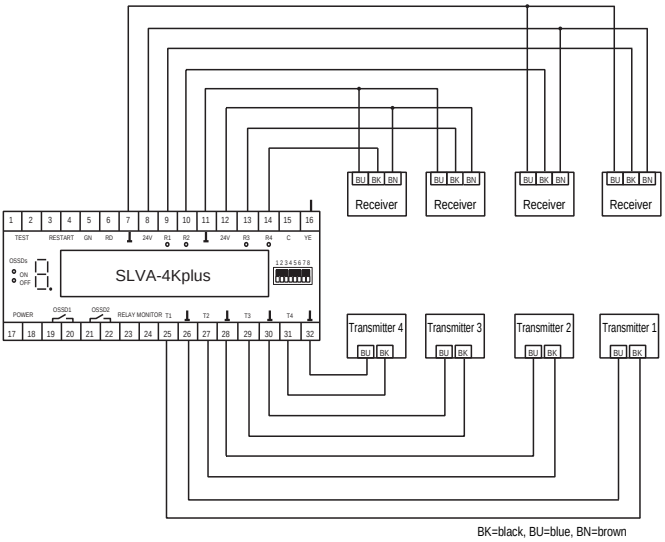


Fig. 3.2: Connection of light barriers with fixed cable (e.g. SLA5(S), SLA40)

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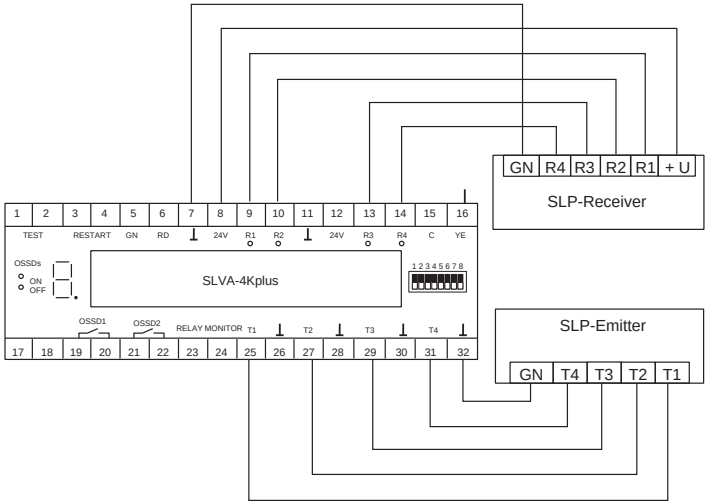


Fig. 3.3: Connection of SLP light grid

*The light barriers must be installed in such a way, that it is not possible to gain access to the danger area by by-passing the light barrier.*

*In other words, it must not be possible to:*

- *Crawl under the lowest beam.*
- *Reach over the highest beam.*
- *Step through between two beams.*

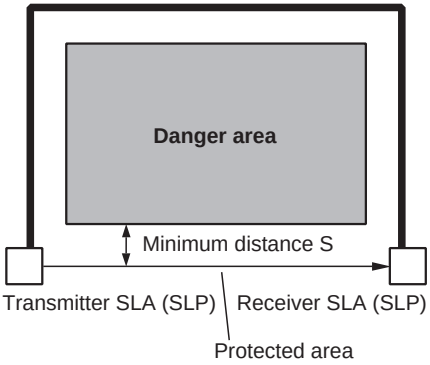


Fig. 3.4: Minimum distance, protective beam(s)

The light barriers should be installed in such a way that they can be adjusted.

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Calculation of the minimum distance from the danger area is in accordance with the relevant specifications and standards. In accordance with ISO 13855, the minimum distance is calculated from the formula:

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

where:

S = Minimum safety distance in mm (Separation between the boundary of the danger area and the boundary of the protected area)

K = Approach speed constant in mm/s

T = Total response time in s,

$$T = t1 + t2$$

t1 = Response time of the protective device (40 ms)

t2 = Response time of the machine

C = Additional distance in mm. This distance depends on how far a person can enter into the danger area before the safety device is actuated.

For access security:

$$S = K \cdot T + 850 \text{ mm}$$

In accordance with ISO 13855, the following heights are recommended for the individual beams:

| No. of beams | Height above the reference plane (mm) |
|---|---|
| 2 | 400, 900 |
| 3 | 300, 700, 1100 |
| 4 | 300, 600, 900, 1200 |

Table 3.1: Installation heights

Care should be taken that there are no reflecting objects within the transmitter or receiver lobes, which could cause reflections around an obstacle (see EN 61496-1).

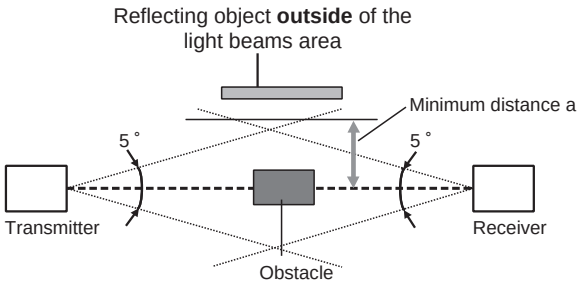


Fig. 3.5: Reflection around obstacle

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# 4 Installation/removal of the control unit

In order to install the control unit, a standard 35 mm rail to DIN EN 50022-35 is fixed to the base on which the installation is to be made. A plastic profile and spring-loaded latching device are provided on the underside of the control unit. The control unit is positioned with its underside on one edge of the standard rail and then pushed on to the latching device.

To remove the control unit, the latching device is pulled back with a screwdriver to allow the unit to be extracted. Sufficient space must be allowed above the screw terminals to enable a screwdriver to be inserted.

# 5 Installation

## 5.1 SLA light barriers and SLP light grids

The transmitters are connected to terminal pairs 25-26 (S1), 27-28 (S2), 29-30 (S3) and 31-32 (S4) in accordance with the colour coding.

Likewise, the receivers are connected to terminals 7-8-9 (E1), 7-8-10 (E2), 11-12-13 (E3) and 11-12-14 (E4) in accordance with the colour coding.

The length of the connection cable between the light barriers and the control unit must not exceed 50 m. The cable for connecting the light barriers is specified in Section 7.2.

If less than 4 light barrier channels are to be operated, the channel that is not used must be replaced by a jumper, for which a length of up to 3 m is permissible.

| Light barrier channel to be replaced | Jumper between |
|---|---|
| 1 | 25-9 |
| 2 | 27-10 |
| 3 | 29-13 |
| 4 | 31-14 |

Table 5.1: Jumpering of unused light barrier channels

## 5.2 Emergency-Stop circuit

For Emergency-Stop operation, the Emergency-Stop circuit is to be connected to the control unit in accordance with figure 10.1 or figure 10.3.


*In the case of a static Emergency-Stop, the cabling of the Emergency-Stop circuit is to be provided with protection.*

## 5.3 Indicator lights

A green/red indicator light is to be connected to the output 5/6. The output is to be laid out so that an anti-parallel circuit for a green and a red LED can be connected without series resistors, in which a current of approx. 9 mA flows. Appropriate circuitry must be provided if heavier current indicator lights are required. The output data is provided in section 7.1.

For operation with a start-up interlock (Restart), an easily visible yellow indicator light must

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be connected to output 15/16. This indicator light signals to the operator that the start-up enable has to be activated to switch the system on. It is a zero-potential output, therefore the indicator light must be supplied from an external power source.

In the SLVA-4KPlus-2528 option, the output 5/6 is controlled by a relay, whose common contact is connected to terminal 15, so that heavier current indicator lights can be connected. The circuit is illustrated in figure 10.4. The indicator light circuits are protected internally by a 2.5 A automatic fuse that can be reset.

## 5.4 Safety outputs

The safety outputs (OSSDs) 19-22 are zero-potential, normally-open contacts, without cross-circuit monitoring. Connection to the system is achieved with a protected cable or to protect from short circuit by an apropriate wiring. The withstand voltage must be adequate to provide safe isolation.

*In the case of an inductive load, the output contacts must be protected against the increased loading by RC combinations or free-wheeling diodes. The circuitry must be provided by the user. Note that when using free-wheeling diodes, the contact release time of the connected relays or contactors should be increased.*

If DC loads are switched with the outputs, the permissible switching capacity stated in section 7 should be noted.

When interconnecting the control unit in the machine safety control system, the factors considered should take account of the instructions in EN 61496-1 (Interface connection of the BWS series-connected control elements).

## 5.5 User check lists

### 5.5.1 Before installation

- Have the related standards been taken into account? (See Section 14)
- Are the SLVA4-Kplus control unit and the light barriers/light grids of the prescribed type available in the appropriate quantities?
- Are jumper cables available for the unused channels?
- Is the SLVA4-Kplus suitable for the required operating voltage (Note type label)?
- Has the overvoltage category required in accordance with EN 50178 been achieved in respect of voltages from the output connections and power supply connections to other connections?
- Has the control unit been supplied with the correct setting for start-up/restart interlock and relay monitor (see type label)?
- Is there sufficient space above the screw terminals of the SLVA4-Kplus for installation and removal?
- Will the SLVA4-Kplus be installed into a control cabinet or built into a housing with a protection class of at least IP54/NEMA 3?
- In the case of a relay monitor: Is the necessary safe isolation between the normally closed control contact and other contacts, in accordance with overvoltage category 4 (EN 50178), guaranteed by the relay or contactor manufacturer?

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### 5.5.2 After installation

- Are all the light barriers/light grids correctly connected?
- Have the unused channels been bridged?
- Is there a red/green LED in a visible position to indicate the status of the outputs, or has the prescribed red/green indicator light been provided by an alternative means?
- For start-up/restart interlock:
  - Is the restart input connected?
  - Is the test input connected?
  - Is there a clearly visible yellow indicator light to signal start-up readiness?
- For relay monitor:
  - Is the relay monitor input connected to at least 2 positive-action N.C. relays in series?
  - Are the operating contacts of the external relays protected against contact welding by a suitable fuse?
- Are the light barriers arranged in such a way that it is not possible to access the danger area by avoiding them?
- Have the light barriers been adjusted?
- Emergency-Stop circuit, static operation: Has attention been paid to the fact that the cable between the Emergency-Stop switch and the switching device must be protected, or that the two Emergency-Stop channels must be laid in separate cables?
- Emergency-Stop circuits, pulse operation: Has attention been paid to the fact that the Emergency-Stop switch must be suitable for switching smaller loads (see Section 7.1)?

### 5.5.3 Commissioning

- Has each beam of the safety device been checked after installation for effective detection, using a test piece of the prescribed diameter?
- Has the start-up/restart interlock (if activated) been checked for correct function?
- In case of attached Emergency-Stop-switches, is the start-up/restart interlock mode activated?
- Has the relay monitor (if activated) been checked for correct function?
- Have the Emergency-Stop circuits (if activated) been checked for correct function?
- Has the set operating mode been entered on the supplementary label?

### 5.5.4 Periodic check

- Is the protected area penetrated at least once each day of operation, the system switched on and the contact test/fault enable activated?
- Is the effectiveness of the Emergency-Stop circuits checked at the prescribed distances?

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# 6 Commissioning

After the installation of the system, commissioning is initiated by switching on the power supply.

## 6.1 Adjustment

Adjustment is simplified by the visible red light of the light barrier transmitter. The adjustment commences at the transmitter: The transmitter light spot is adjusted to the position occupied by the receiver. In executing this, the visible red light is either observed directly at the receiver by looking into the transmitter (not dangerous!) or after positioning a retro-reflector at the position of the receiver, observed from the transmitter side. It should be noted that the eye must be positioned close to the light beam axis. If this is not possible, a deflecting mirror can be used as an aid in making the adjustment. After adjusting the transmitter, the receiver is adjusted such that its indicator lights signal unbroken light beams with adequate stability control (see section 2.6.3).

## 6.2 Checking the detection capability

- Remove all objects from the paths of the beams.
- Using the test rod prescribed for the light barriers, break the light beams one after the other.
- Ascertain whether the output relays switch off as required and the output relay indicator changes from green to red. Also check that the broken beam is indicated at the control unit by the extinguishing of the associated reception indicator on the control unit.

## 6.3 Checking the start-up/restart interlock and start-up enable

- Break one beam and then leave all the beams unobstructed.
- The output relays must remain inhibited, due to the existing start-up interlock and the yellow start-up readiness indicator light must come on.
- Operate the restart button.
- The output relays must switch-on and the start-up readiness indicator must go out.

## 6.4 Checking the test input

- Remove all objects from the light beam paths.
- If a start-up interlock is in effect, operate the start-up enable.
- The output relays must switch-on.
- Actuate Test.
- The output relays must switch-off during the actuation.

## 6.5 Checking the relay monitor

- Disconnect the leads from connections 23 or 24.
- Switch on the SLVA4-Kplus.
- Note the SLVA4-Kplus digital indicator. If .**F** is displayed, the relay monitor is active.
- Reconnect the leads.

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### 6.6 Checking the static Emergency-Stop

Switch on all Emergency-Stop switches, make sure all the light beams are unobstructed and enable the start-up. The safety outputs must then be in the switched-on state.

Operate an Emergency-Stop switch. The safety outputs must then be in the switched-off state and the control unit digital indicator must not display a fault.

This check must be repeated for all Emergency-Stop switches on the Emergency-Stop circuit.

### 6.7 Checking the pulsed Emergency-Stop

The check is carried out in the same way as for the static Emergency-Stop.


*For the pulsed Emergency-Stop an additional check must be made to ensure that the DIP switches occupy the positions XX11 XX11!*

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# 7 Technical data

## 7.1 General specifications

| | |
|---|---|
| **Approvals** | TÜV, cNRTLus |
| **Tests** | EN IEC 61496; EN ISO 13849; EN 55022<br>The specified standards refer on the respective current version of the normative documents |
| **Safety type** | 4 (EN IEC 61496) |
| **Performance Level** | PL e (EN ISO 13849) |
| **Safety Integrity Level (SIL)** | SIL 3 (EN IEC 61508) |
| **Category** | Cat. 4 (EN ISO 13849) |
| **Marking** | CE |

## 7.2 Electrical data

| | |
|---|---|
| **Supply voltage:** | |
| 230 VAC version: | 230 V AC (-15%, +10%), 48 Hz ... 62 Hz |
| 115 VAC version: | 115 V AC (-15%, +10%), 48 Hz ... 62 Hz |
| 24 VDC version: | 24 V DC (-15%, +15%) |
| 24 V AC/DC version, option 2528 | 24 V AC/DC (-10%, +10%) |
| **Current consumption:** | |
| 230 VAC version: | ≤ 50 mA |
| 115 VAC version: | ≤ 100 mA |
| 24 VDC version: | ≤ 220 mA |
| 24 V AC/DC version, option 2528 | ≤ 220 mA |
| **Power consumption:** | |
| 230 VAC version: | 13 W |
| 115 VAC version: | 13 W |
| 24 VDC version: | 7 W |
| 24 V AC/DC version, option 2528 | 7 W |
| **Rating:** | |
| 230 VAC version: | II (IEC 61140) |
| 115 VAC version: | II (IEC 61140) |
| 24 VDC version: | III (IEC 61140) |
| 24 V AC/DC version, option 2528 | III (IEC 61140) |
| **Response time:** | 40 ms |
| **Activation current and voltage for potential-free control contacts** | 8 mA / 24 V |
| **Activation time for start-up enable(restart) and error enable (reset)** | 0.05 s .... 1 s |
| **Relay monitor:** | |
| Switching voltage: | 24 V DC |
| Switching current: | 10 mA |
| Detection of maloperation: | 200 ms after switch over |
| **Emergency-Stop circuits:** | |
| Switching voltage: | 24 V DC continuous or 12 V DC pulsed operation |
| Actuation current: | 10 mA |
| Indication of maloperation: | 2 s after switch over |

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| | |
|---|---|
| **OSSD-outputs, isolated relays outputs at clamps 19 to 21:** | |
| Switching voltage AC/DC: | 20 V AC/DC ... 230 V AC/DC |
| Switching current AC: | 0.01 A ... 2 A |
| Switching current DC: | see load limit curve |
| Switching frequency: | Maximum 1/s |
| fusing: | fuse T2A |
| **Outputs for indicators:** | |
| Output for indicator "OSSD", isolated relays outputs between clamps 5 and 6, option 2528 only | |
| Switching voltage AC/DC: | 24 V AC/DC |
| Switching current AC: | 0.01 A ... 1.5 A |
| fusing: | Polyfuse (re-settable) |
| notice: | Supply via clamp 15 |
| Outputs for LED-indicators between clamps 5 and 6 | |
| Voltage: | max. 5 V |
| Current: | max. 10 mA |

## 7.3 Other data

| | |
|---|---|
| **Ambient conditions:** | |
| Operating temperature: | 0 ºC ... 50 ºC |
| Storage temperature: | -20 ºC ... 75 ºC |
| rel humidity, uncondensed: | max. 95 % (at temperatures between 20 °C and 50 °C) |
| **Wiring:** | |
| connection: | terminal clamps with terminal screws |
| conductor cross section: | litz wire with sleeve, max. 1.5 $mm^2$ |
| **Weight:** | 900 g |
| **Housing material:** | Polycarbonate / UL-94 V-0 |
| **Protection class:** | IP 20 / NEMA 1 |
| notice | mounting in a switch cabinet or enclosure with rating IP54/NEMA 3 or better is demanded |
| **Length of the connection cable:** | |
| between control unit and light barriers: | max. 50 m |
| between control unit and system: | max. 100 m |

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## 7.4 Dimensions

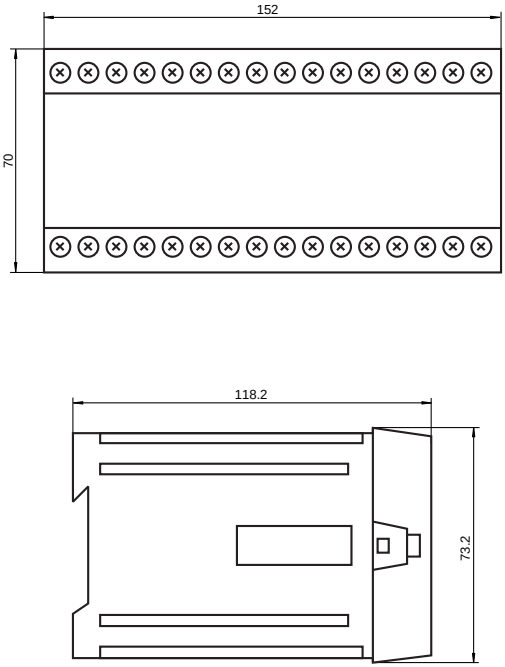
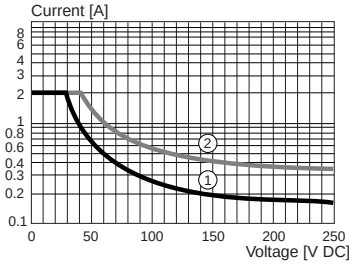



Fig. 7.1: Dimensions

## 7.5 Curves and diagrams




1) inductive load, L/R = 40 ms
2) ohmic load

Fig. 7.2: Load limit curves with direct current across the outputs

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## 8 Periodic checks


*The periodic check is a check of the output relay. This must be carried out if there is uncertainty that*
*- Penetration of the protected area takes place at least once daily*
*- Or that the device is not switched-on once per operating day.*

The check is carried out as follows:

1. Clear the protected area and enable start-up.
2. Penetrate the protected area by breaking any one beam and observe the indicator on the control unit or the external indicator light. These must change from green to red.
3. If the BWS does not enter a fault condition, the check is complete. If a fault condition is indicated, the fault must be eliminated and the check repeated.

## 9 Fault elimination

In all cases, faults in the system cause the system to switch to the safe condition. Most faults cause the system to enter a fault condition, which is identified by a fault code to assist in isolating the fault. Output 15/16 generates a clock signal of approx. 1 Hz when the system enters a fault condition. This signal can be used to provide a fault indication remote from the control unit. Several faults, which have their origin outside the control unit, do not generate a fault indication. If a fault occurs, the operator activates the fault enable and then checks whether the system runs again. If the system does not restart, an attempt should be made to return to normal operation by switching the power supply off and then on again.

Under high-frequency fields which exceed a field strength of 10 V/m, the outputs of the SLVA-4Kplus may switch to the safe state.

The following table lists a number of fault situations in which self-help is possible.

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| Fault | Operator action |
|---|---|
| No indicator lights come on any of the components in the system. | Check power supply. |
| External protected area indicator (5-6) does not light. | Check installation and indicator lights. |
| Start-up readiness indicator (15-16) does not operate. | Check installation. |
| Start-up enable does not function. | Check whether the indicator lights E1-E4 light. If they do not, then a beam has been interrupted. If the start-up readiness indicator is indicating, the restart input connection should be checked. |
| Fault **2** is indicated. | Check the transmitter installation. |
| Fault **F** is indicated. | Check relay; check connection between relay and relay monitor. |
| The protected area is not clear: **0** is indicated. | Check on the control unit (E1-E4) to see if a beam is broken. Readjust if necessary. Emergency-Stop operating mode activated: Emergency-Stop circuit is open, or pulse operation is wired-in and static Emergency-Stop selected via operating mode. |
| The beam is still not clear after adjustment. | Check receiver installation. |
| One output cannot be switched. | Check the fuses on terminals 20-21 and 22-23 with start-up enabled and replace if necessary. Check installation. |
| Fault **E** is indicated. | Either short-circuit of a receiver to $+U_B$ or interference from another light barrier. |
| Fault **E** is indicated/Emergency-Stop operating mode set | The Emergency-Stop operating mode is wired-in, but pulse operation is selected via the operating mode setting. |
| Fault **E** is indicated | Internal fault. Switch-off and then on again or activate test. If there is no short-circuit on the receiver leads, send the unit for repair. |

Table 9.1: Fault elimination

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## 10 Circuit examples

The figure 10.1 shows a circuit with 4 light barriers, start-up/restart interlock and relay monitor. In this example, the SLA5 is used as a light barrier. The DIP switches are set to 1100 1100.

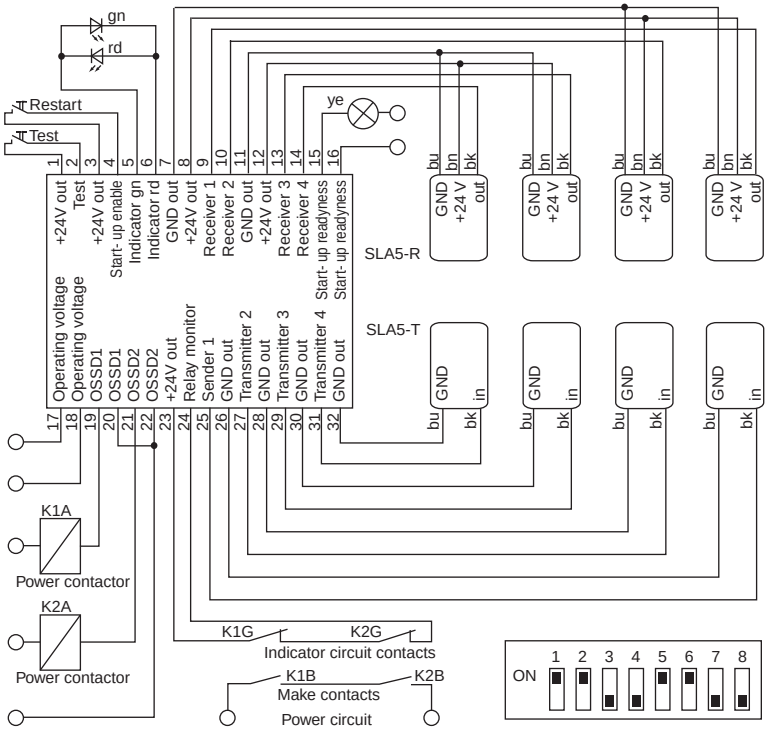


Fig. 10.1: Connection schematic for operation with 4 light barriers, start-up /restart inhibit and relay monitor.

The figure 10.1 shows a connection schematic for a static Emergency-Stop. In this scheme, the Emergency-Stop cable must be protected. The DIP switches are set to XX10 XX10.

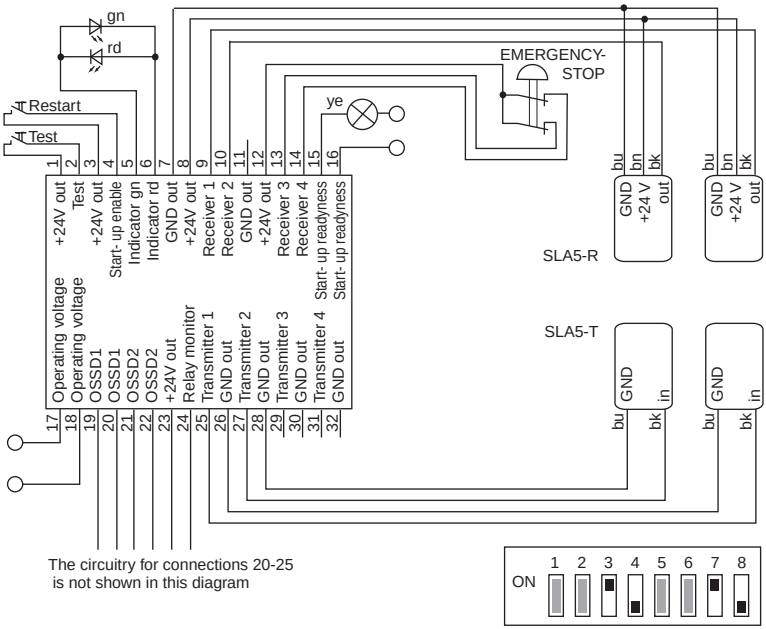


Fig. 10.2: Connection schematic for operation with 2 light barriers and static Emergency-Stop.

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The figure 10.3 shows a connection schematic for a pulsed Emergency-Stop. In this scheme, mechanical protection of the Emergency-Stop cable is not necessary. The Emergency-Stop switch must be suitable for the switching of low currents. The DIP switches are set to XX11 XX11.


*The pulsed Emergency-Stop likewise functions in the DIP switch settings XX00 XX00 and XX01 XX01. However, simultaneity of the channels is not monitored. Therefore a short-circuit in one channel is then not covered, e.g. from SLVA4-Kplus connection15 to SLVA4-Kplus connection 31!*

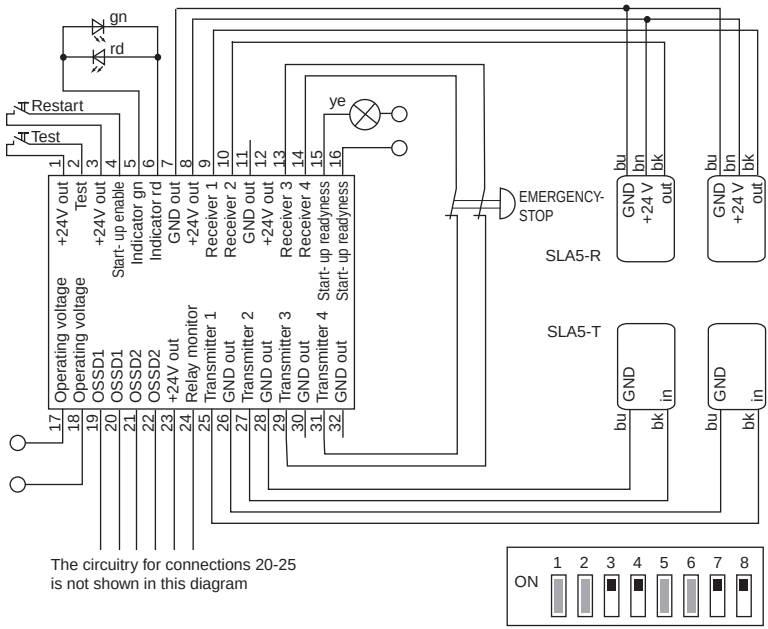


Fig. 10.3: Connection schematic for operation with 2 light barriers and pulsed Emergency-Stop.

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The figure 10.4 shows a connection schematic for the SLVA4-Kplus 2528, that has a relay output in place of the LED control circuit. Other details have been omitted.

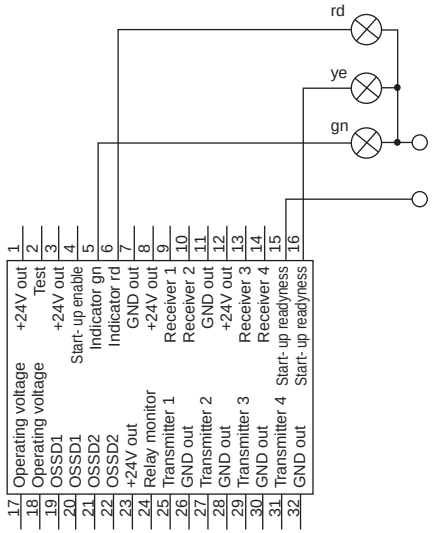


Fig. 10.4: Connection schematic for the SLVA4-Kplus 2528

## 11 Ordering information

### SLVA4-Kplus

| Power supply | Order numbers | | | |
|---|---|---|---|---|
| | Without AWS & RM | AWS | RM | AWS & RM |
| 24 V DC | SLVA-4Kplus 24VDC | SLVA-4Kplus 24VDC-RI | SLVA-4Kplus 24VDC-RM | SLVA-4Kplus 24VDC-RI,RM |
| 115 V AC | SLVA-4Kplus 115VAC | SLVA-4Kplus 115VAC-RI | SLVA-4Kplus 115VAC-RM | SLVA-4Kplus 115VAC-RI,RM |
| 230 V AC | SLVA-4Kplus 230VAC | SLVA-4Kplus 230VAC-RI | SLVA-4Kplus 230VAC-RM | SLVA-4Kplus 230VAC-RI,RM |

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**SLVA-4KPlus-2528**

Version with relay contacts for OSSD indication in place of LED initiation (Terminals 5, 6 and 15))

| Power supply | Order numbers |
|---|---|
| 24 V AC/DC | SLVA-4Kplus-2528 24VAC/DC |
| 115 V AC | SLVA-4Kplus-2528 115VAC |
| 230 V AC | SLVA-4Kplus-2528 230VAC |

*The operating modes AWS, RM and Emergency-Stop channels have to be set by the user. The factory setting on delivery is AWS switched-on.*

## 12 Guarantee conditions

The guarantee period for the SLVA4-Kplus control unit is 12 months, in accordance with the general conditions of supply of the ZVEI.

Repairs must only be carried out by the manufacturer. Interference or modification of the unit is not permitted. Such action will lead to invalidation of the guarantee.

## 13 Glossary

| | |
|---|---|
| OSSD | Output signal switching device |
| BWS | Non tactile protection device |
| AWS | Start-up/restart interlock |
| RM | Relay monitor |

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# 14 Standards

The relevant laws and standards apply to the use of photoelectric protective devices. There are differences depending on the area of use. The following regulations are relevant within the EU and Germany.

## 14.1 Construction and equipping of protective equipment

| | |
|---|---|
| IEC 61496-1 | Safety of machinery. Electro-sensitive protective equipment |
| IEC 61508, | Functional safety of EEPE safety-related systems |
| DIN V VDE0801 | Principles for computers in systems with safety tasks |
| DIN EN 62061 | Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems |

## 14.2 Use and installation of protective equipment

| | |
|---|---|
| IEC 50178 | Electronic equipment for use in power installations |
| DIN IEC 68 | Electrical engineering; basic environmental testing procedures |
| DIN EN 60204-1 | Safety of machinery - electrical equipment of machines |
| DIN EN 61140 | Protection against electric shock - common aspects for installations and equipment (IEC 61140:2001 and A1:2004, modified) |
| DIN EN 60664-1 | Coordination of the insulation of electronic equipment in low-voltage systems - Part 1: Principles, requirements and tests (IEC 60664-1:2007) |
| DIN EN 60068-1:1995-03 | Environmental testing - Part 1: General matters and guidance |
| Directive 98/37/EC, from 29.12.2009 Directive 2006/42/EC | Machinery Directive |
| EN ISO 12100 | Safety of machinery - electrical equipment of industrial machines |
| EN ISO 13849-1 | Safety of machinery - safety relevant parts of controls- part 1: General design principles |
| DIN CLC/TS 62046, preliminary standard, 2005-09 | Safety of machinery - Use of protective equipment to recognize the presence of people (IEC/TS 62046:2004)<br>Safety of machinery - The positioning of protective equipment with respect to approach speeds of parts of the human body |
| EN999/EN ISO 13855 | Safety of machinery - The positioning of protective equipment with respect to approach speeds of parts of the human body |
| ZH1/597 | Safety rules for non-contact protective equipment on powered equipment |
| EN ISO 13857 | Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs |

In addition to the stipulations listed there may be other applicable standards for special machinery and applications that should be considered.

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