SIEMENS

SIGUARD Light Curtain and Light Grid 3RG7842

Instruction Manual

CE

Order No.: 3ZX1012-0RG78-3BS1

WARNING

SIGUARD photo-electric safety systems are intended to protect operators working at or near dangerous machinery. They can only perform this function if they are correctly fitted to a suitable machine. It is essential that the full contents of this manual and all the authoritative documents referred to herein are fully understood before any attempt at installation is made. If in doubt contact your authorised SIEMENS distributor.

IMPORTANT

This manual must accompany the product throughout its working life. Those persons responsible for the product must ensure that all persons involved in the installation, commissioning, operation, maintenance and servicing of the product have access to all the information supplied by the manufacturers of the machine and its safety system.

Notes on connecting and operating instructions
These instructions contain information on the efficiency in the use of SIGUARD light curtains and light grids in accordance with their intended applications. These instructions constitute a part of the scope of delivery.

Warning and safety notes are indicated by the symbol  .

The Siemens AG is not liable for damage resulting from improper use. Acquaintance with these instructions constitutes part of the knowledge required for proper use.

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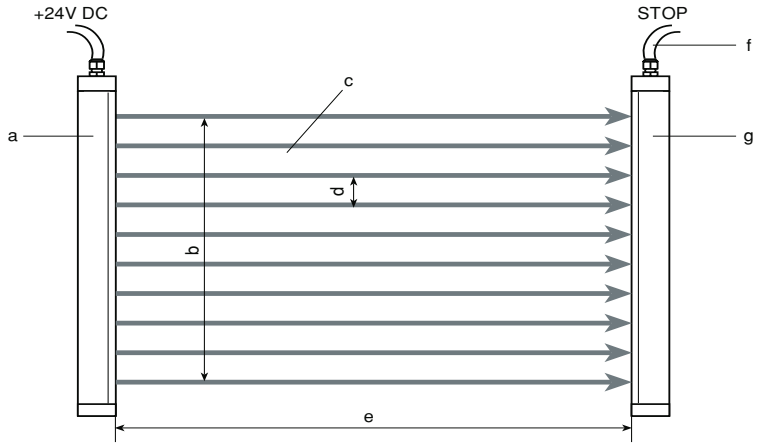
1 System Overview and Scope of Applications

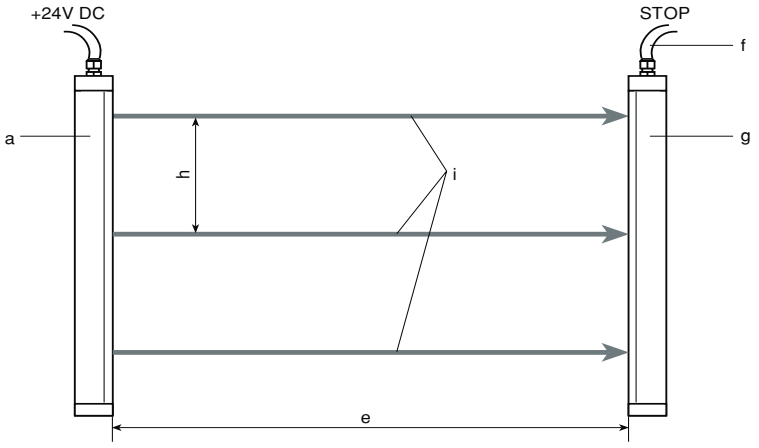
1.1 General

The SIGUARD light curtains and light grids are active optoelectronic protection devices (AOPD) of the type 4 according to IEC 61496-1, -2 and EN 61496-1, -2. A two-dimensional protective field of infrared radiation is generated between transmitter and receiver. Penetrating this protective field will trigger the safeguarded machine to go into a safe mode before the person can enter a potentially hazardous area.

Parameters of SIGUARD light curtains



Parameters of SIGUARD light grids



a = transmitter
b = protected height
c = sensing field
d = object sensitivity (smallest detected object)
e = protected width, range
f = to machine control
g = receiver
h = distance between beams
i = number of beams

Fig. 1 The major parameters of an AOPD

1.2 Approvals

EU Prototype Testing (Europe)

TÜV PRODUCT SERVICE GMBH
Ridlerstraße 31
80339 Munich

IEC 61496-2 testing conducted by:
BIA
Berufsgenossenschaftliches Institut für Arbeitssicherheit
Alte Heerstraße 111
53757 St. Augustin

North America

UL and C(UL)

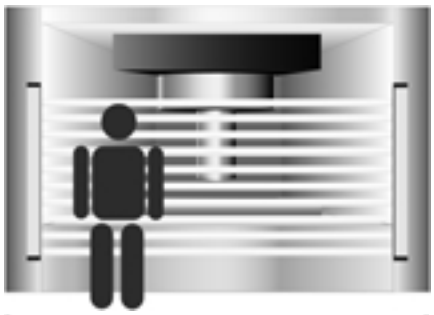
For additional information please see http://www.siemens.de/safety.

1.3 Overview of Product Characteristics

- High immunity to ambient lighting, welding arcs and stroboscopic light by the application of patented evaluation procedures and special ASIC's for signal processing
- Interference-free operation of neighbouring equipment by the selection of differing transmission channels
- Multiple evaluation procedures for environments with sources of extreme infrared impulsive disturbance
- Non-wear function through fail-safe semiconductor outputs
- Cascading of several units possible, e.g. hand protection and step-over protection
- Use of modern micro-controller engineering techniques
- Robust aluminium housing of small cross-section (52 x 55 mm, or 2 x 2.16 inch)
- Flexibility in add-on functions by connection to SIGUARD evaluation unit 3RG7847
- Straight forward connections through plug-in terminal compartment
- Integrated self-diagnostics systems for quick on-site fault localisation and PC-supported diagnostic routines in the workshop

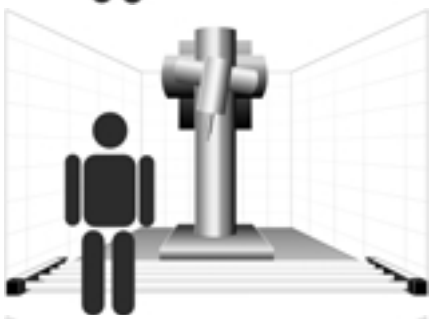
1.4 Equipment Variants and Scope of applications

The SIGUARD light curtains and light grids are available in different resolutions in order to provide an optimum price/performance ratio for differing applications.



SIGUARD light curtains for hand and finger protection at danger points

Resolution:	14 mm (finger) and 30 mm (hand)
Protected range:	resolution 14 mm: 0.3 - 6 m, resolution 30 mm: 0.8 - 18 m
Protected heights:	150, 225, 300, 450, 750, 900, 1050, 1200, 1350, 1500, 1650, 1800 mm (1950, 2100, 2250 mm on request)



SIGUARD light curtains for safeguarding danger areas close to the ground (height: from 0 mm on)

Resolution:	50 mm (lower leg)
Protected range:	0.8 - 18 m
Protected heights:	450, 600, 750, 900, 1050, 1200, 1350,1500,1650, 1800, 2100, 2400, 2700, 3000 mm

SIGUARD light curtains for safeguarding danger areas at a height of 600 - 1000 mm

Resolution:	90 mm (upper leg)
Protected range:	0.8 - 18 m
Protected heights:	750, 900, 1050, 1200, 1350, 1500, 1650, 1800, 2100, 2400, 2700, 3000 mm

SIGUARD light grids for safeguarding access

Dist. betw. beams:	500, 400, and 300 mm according to EN 999
Protected range:	0,8 - 18 m
Number of beams:	2, 3, and 4 beams according to EN 999

SIGUARD light grids for safeguarding access to large areas

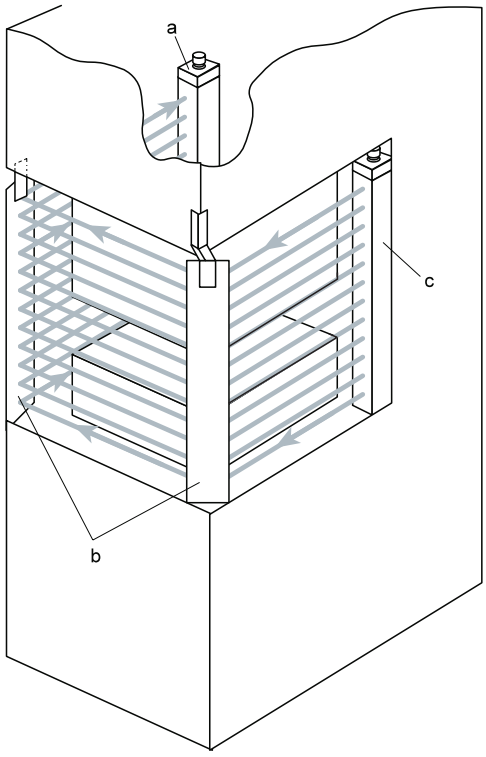
Dist. betw. beams:	500, 400, and 300 mm according to EN 999
Protected range:	6 - 60 m
Number of beams:	2, 3, and 4 beams according to EN 999

Fig. 2 SIGUARD light curtains and light grids - equipment variants and their scope of applications

1.5 Deflection Mirrors

A hazard location or a danger area can be guarded on more than one front by employing deflection mirrors. The maximum possible width of the protection zone is reduced for each mirror accordingly as shown in the following table. The use of more than two mirrors is not to be recommended because of the difficulties associated in the alignment.

SIGUARD light curtains and light grids	**Reduction in the Range per Mirror**
Resolution 14 mm (light curtain)	1 m
Resolution 30 mm, 50 mm, and 90 mm (light curtain)	2.3 m
2, 3, 4 beams and 18 m range (light grid)	2.3 m
2, 3, 4 beams and 60 m range (light grid)	10 m



a = receiver
b = deflecting mirror
c = transmitter

Fig. 3 Guarding several fronts of a hazard location by means of deflecting mirrors

2 Notes on Safety

2.1 General Hazards for Non-observance of Notes on Safety

Care is exercised in accordance with recognised codes of engineering practice in the development and production of SIGUARD light curtains and light grids. The protection function of the equipment can however be impaired if the units are not used in accordance with their intended application or are not used properly. Such instances can cause hazards for the health and life of the personnel operating the machinery. Safety light curtains and light grids do not provide protection against injuries resulting from flying objects.

2.2 Use according to Intended Applications

SIGUARD light curtains and light grids equipment type	**Use according to intended application**
Resolution 14 mm (light curtain)	Finger protection
Resolution 30 mm (light curtain)	Hand protection
Resolution 50 mm and 90 mm (light curtain)	Horizontal guard over areas of danger, detection of a person
2, 3, 4 beams (light grid)	Vertical guard against access to areas of danger, detection of a person

SIGUARD light curtains and light grids are not suitable for applications in explosion-endangered areas.

2.3 Operating Conditions

Applicable regulations (e. g. machinery-specific C-Standards in the EU or the OSHA and ANSI standards in the USA) apply for the use and installation of SIGUARD light curtains and light grids. The appropriate authorities for the country in question are available for answering questions regarding safety engineering. In general, compliance with the following operating is required:

- The SIGUARD light curtains and light grids shall be installed such that access from above, beneath or behind the protected field is ruled out. If this is not assured, then additional protection measures must be installed.

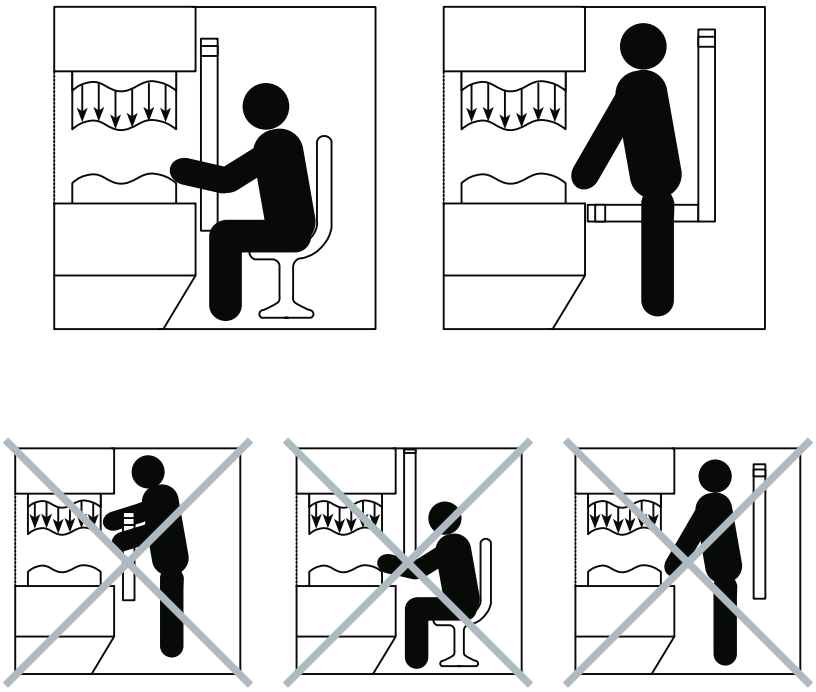


Fig. 4 Access from above, beneath or behind must be ruled out

- Intervention in the controls of the machine by electrical means must be possible so as to enable immediate termination of potentially hazardous states in each working phase.
- The safety clearance between hazard location and protection zone must be sufficiently large enough such that the potentially hazardous state is terminated before the person has reached the hazard location (refer to 4.1).
- The mechanical and electrical installation shall be carried out by trained and qualified personnel. The switching outputs of the SIGUARD light curtains and light grids (OSSD's) shall be connected as two-channel outputs to the shutoff path for the potentially hazardous condition (refer to 5.1 and 5.2).

3 Design and Function

3.1 System Overview

The SIGUARD light curtains and light grids consist of transmitter and receiver. The transmitter consists of the control electronics and a modular arrangement of IR-radiation sources which are sequentially triggered in quick succession and send out coded infrared pulses. The receiver consists of a control and evaluation assembly with the switching outputs and modular IR reception elements which are evaluated in synchronisation with the transmitter. The synchronisation is realised by optical means. Interconnection of both components by a cable is not necessary. The control assemblies are identical for all SIGUARD light curtains and light grids, the IR transmitter and reception modules differ however in their radiation range and optical characteristics. Each component is housed in a robust aluminium profile casing of standard design and is powered by 24 V DC.

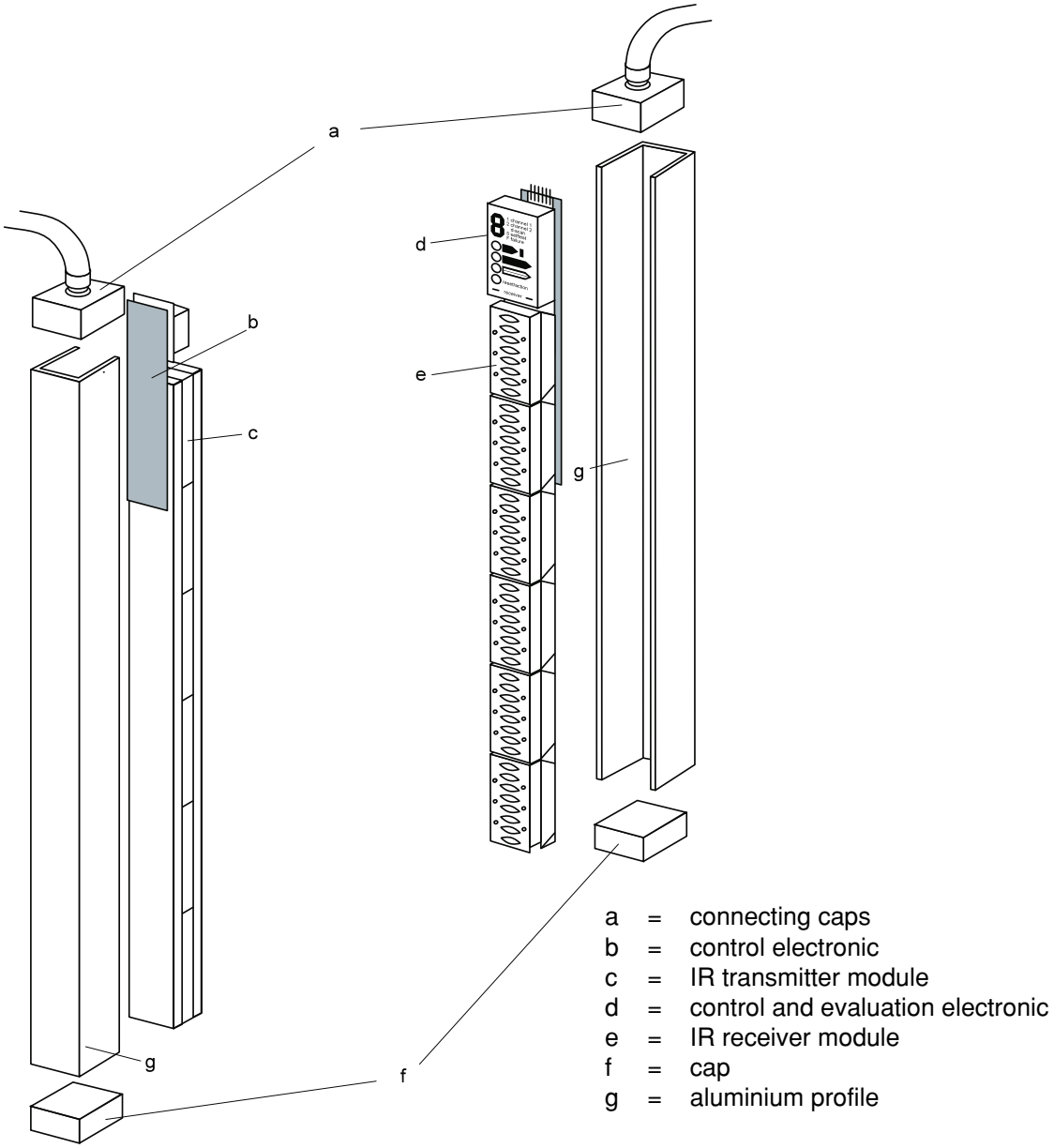


Fig. 5 SIGUARD light curtains and light grids system design

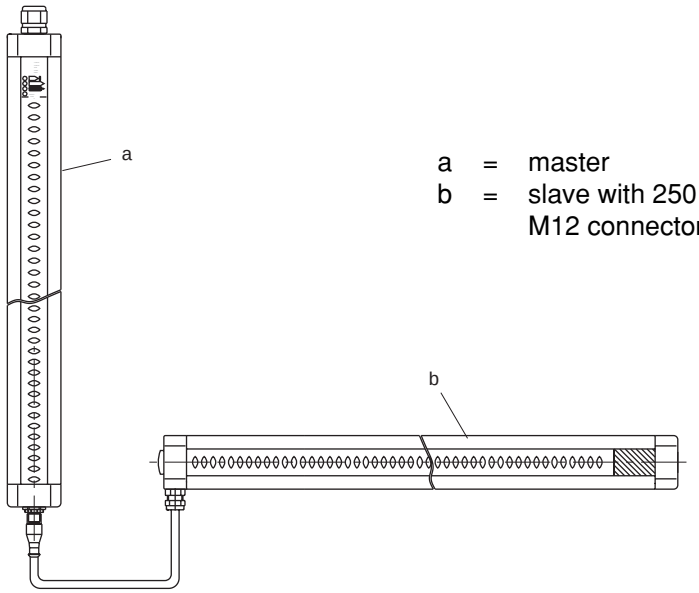
3.2 Operating Mode

The SIGUARD light curtains and light grids work in the operating mode „Protection operating mode without restart disable“. Reception of all light planes switches the output voltage at the OSSD’s to +24 V. Interruption of one or more light planes shuts off the output voltage at the OSSD’s within the response time for the system. The OSSD’s automatically revert to +24 V as soon as the planes of light are free again.

Additional functions such as restart disable and protection control can be realised by the SIGUARD evaluation unit 3RG7847-4BB or directly from a fail-safe PLC like SIMATIC S5-95F (refer to Chapter 5.2). The SIGUARD evaluation units 3RG7847-.. are suitable for additional intelligent functions such as clocked operating and muting.

3.3 Cascading

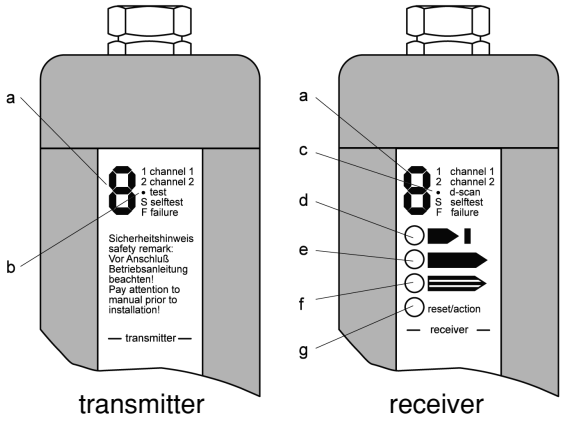
SIGUARD light curtain basic and follower equipment can be connected in succession in order to realise linked protection zones. Units of different resolution can thereby be combined with up to 240 planes of light (e.g. a basic unit 1650 mm with 14 mm resolution as finger protection and a follower unit with 450 mm and 50 mm resolution as step-over protection), see Table 2, Page 66. The follower units are available starting at a protection height of 150 mm and in graduations of 150 mm.



a = master
b = slave with 250 mm cable and M12 connector, 8pol + shield

Fig. 6 Cascading of basic and follower units over plug-in cable connection

3.4 Display Elements

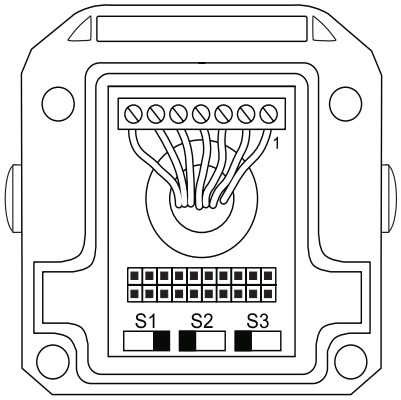


a = system status
b = test active
c = multiple analysis d-scan active
d = outputs OSSD off
e = outputs OSSD on
f = weak receiving signals
g = not occupied

Fig. 7 Display elements in transmitter and in receiver

3.5 Selectable System Functions

The SIGUARD light curtains and light grids are equipped with functions for the prevention of mutual interference and for an increased suppression of interference for operation in environments where there are sources of extreme infrared pulses, such as welding arcs.
These functions are optional and can be activated by means of DIP switches. The switches are mounted on the circuit boards in the plug-in terminal caps. In the event that the unit has to be replaced, then the set equipment parametrisation is retained in the terminal cap for that position and does not need to be set again.



S1 = pnp status output or RS-485 interface
contamination status pnp
RS-485 pour diagnostic PC
NOTE: The possibility of options is only for the receiver. For the transmitter S1 always has to be in the position shown above.

S2 = transmission channel
channel 1
channel 2
NOTE: The same channel has to be set always for the transmitter and receiver.
Switching over to d-scan increases the device‘s response time and thus also the safety distance required!
(see identification plate: response time and/or chart 1, page 65).

S3 = task
standard
d-scan
NOTE: d-scan can only be selected at the receiver.
S3 is not connected at the transmitter.

Switch 3 at the transmitter board has no function.
Switches are preset according to the figure.

Fig. 8 Selection of function by means of DIP switches on the terminal circuit boards for the transmitter and receiver.

3.5.1 Different Transmission Channels to Prevent Mutual Interference

Two differing transmission channels can be set by means of the DIP switch S2 in order to prevent functional disturbance from mutual interference by two neighbouring units. The selected transmission channel 1 or 2 is indicated in the transmitter and receiver displays.

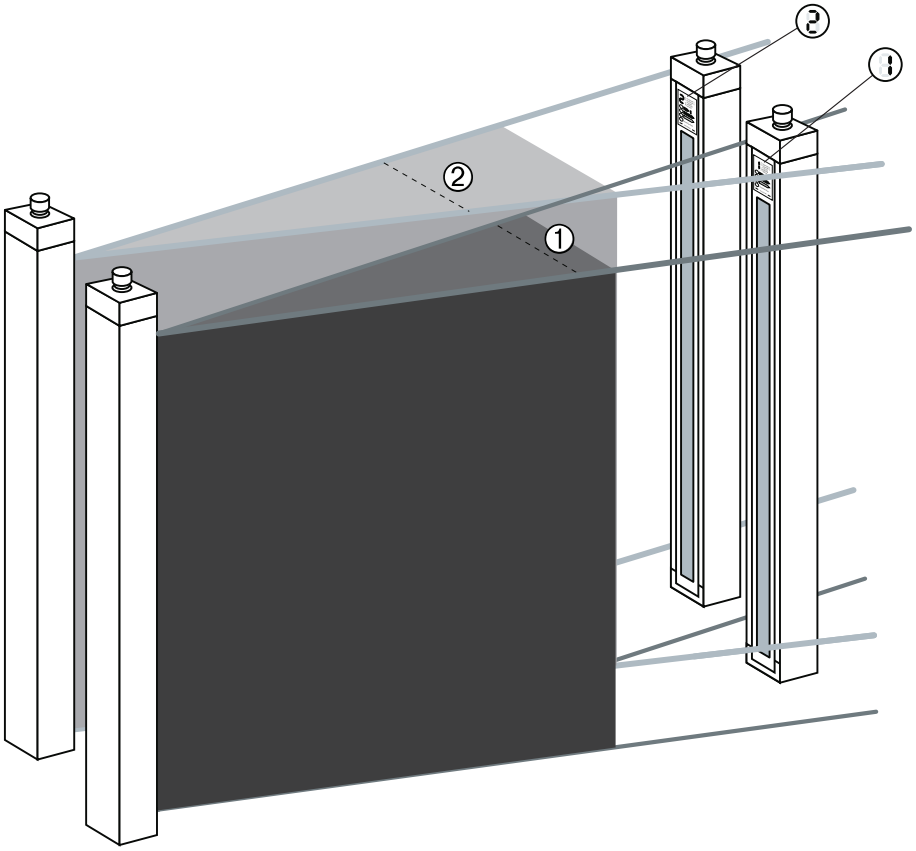


Fig. 9 Differing transmission channels prevent mutual interference

3.5.2 Multiple Evaluation Procedure for Environments with Sources of Extreme Infrared Pulses

High immunity to interference is already realised by the component technology used in the SIGUARD light curtains and light grids in combination with a special software algorithm for the suppression of interference. For applications in environments of extreme disturbance from interfering light, e.g. from many welding robots, the multiple scanning mode **d-scan** can be set by means of the DIP switch S3. The response time of the unit is thereby increased to the value which is indicated on the type plate and in Table 1 (Chapter 8, Technical data and dimensions).

3.5.3 Contamination and Fault Signal Output

A short-circuit-proof signal output for „weak signals or fault“ can be connected by means of the DIP switch S1 to the connecting terminal 6 in place of the RS-485 interface. The pnp output carries +24 V, and is switched to high resistance in the case of contamination or a fault.

3.5.4 Test Input

SIGUARD light curtains and light grids are equipped as AOPD Type 4 with a permanent self-monitoring function, which automatically detects faults in the system as well as cross-circuits and short-circuits to the output cables. An external signal is not required for this. In order to test connected circuits for follower protection devices, an external control (e.g. combination of protection devices) can switch off the OSSD outputs by means of a test signal and thereby test the drop in the switching devices. If this test function is not required, then the connecting terminal 3-4 of the transmitted shall be bridged by a jumper (already set by factory).

3.6 Fail-safe Semiconductor Outputs

Both switching outputs OSSD1 and OSSD2 of the receiver are active-monitored pnp semiconductor outputs for switching earthed loads up to 0.3 A. The outputs are HIGH-active and carry the voltage $U_{OSSD} = U_{supply}$ - 2,7 V for an uninterrupted protection zone. U_{OSSD} amounts to max. 2 V for an interrupted protection zone.

In order to monitor the safe function of the outputs, they are switched OFF cyclically every 140 µs (Channel 1) and every 80 µs (Channel 2). A cross-circuit between the output cables 3 and 4 of the receiver is detected immediately after signal changing of the outputs from OFF to ON by the self monitoring system. Then both outputs are switching to OFF as long as the cross-circuit exists. In case of a short-circuit of an output to + 24 V the other OSSD output will be switched to OFF as long as the short-circuit exists. Short-circuits to +24 V and 0 V are well as cross-circuits between OSSD1 and OSSD2 are indicated and do not lead to a destruction of the outputs (refer to Chapter 5.2 for circuits).

The semiconductor outputs are equipped with a fast de-energising function. Radio interference suppression circuits are not necessary. The fast de-energising function reduces the release time to a fraction in comparison with the conventional actuation of relays with recovery diodes. In total, this leads to a shorter reaction time of the protective fixture.

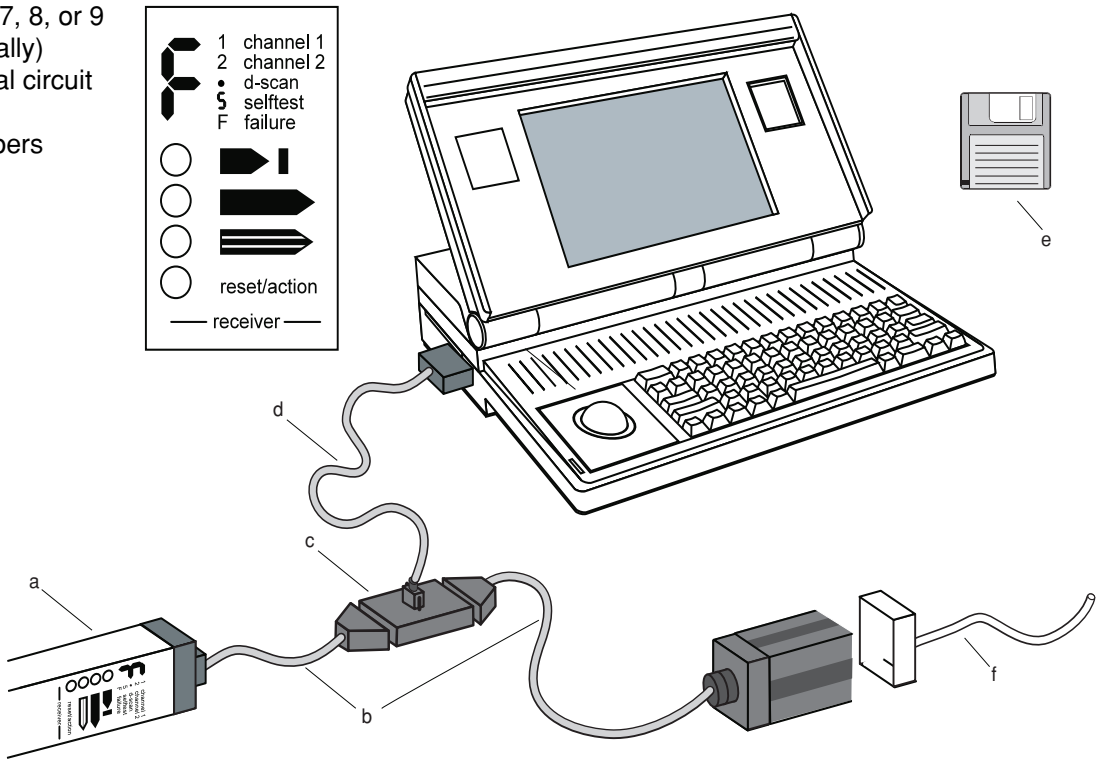
3.7 Diagnostic Function

Transmitter and receiver are equipped with extensive self-diagnostic functions. An „F“ is indicated in the 7-segment display for a discrepant unit in the event of a component failure. This enables the quick on-site identification of defective components (refer to Chapter 6.2). A PC can be connected to the serial RS-485 interface for visualizing the light axes during alignment or for locating problems in the workshop. An adapter for converting from RS-485 to RS-232 is available as an optional accessory. The adapter is connected to the receiver power cable by means of a cable set suited to the connector type. The serial interface of the PC must permit a transmission rate up to 57.6 kBaud.

The diagnostics software required for visualization can be run on Windows 3.1 and higher. Software, RS-485/RS-232 interface converter and diagnostics cable set are available as accessories.

F + fault number 6, 7, 8, or 9
(blinking symmetrically)
= fault in the external circuit

F + other fault numbers
= fault in the device



a = light curtain/light grid receiver
b = diagnostics cable set suited to the connector type
c = RS-485/232 converter
d = RS-232 serial cable
e = diagnostics software
f = Receiver connector cable for machine control

Fig. 10 Straightforward light axis visualization and on-site fault diagnostics, PC-supported diagnostics in the workshop

4 Installation

4.1 General Installation Procedures

Attention shall be paid to the general notes on safety given in Chapter 2.

Principally, all units shall be installed such that the hazard location can be reached only by the interruption of at least one plane of light and sufficient clearance is maintained between hazard location and the protection zone.

4.1.1 Clearance

The clearance S is calculated in accordance with EN 999 according to the following formula:

S = (K x T) + C

where:

S Minimum clearance between the protection zone and the hazard location in mm

K Rate of approach by the body or the person in mm/ms

T Overtravel time of the machine + the response time of the optoelectronic protection device (AOPD) in ms

C Allowance in mm, which depends on the detection capacity d of the AOPD

Depending on the differing applications (e.g. hand and finger protection, access protection), there are differing approach rates K and allowances C applicable in accordance with EN 999. The following installation procedures take the formula into account to be used in each application case.

4.1.2 Distance from Reflective Surfaces

Reflective surfaces within the 4° transmission and reception cone can lead to reflections and hence to a non-detection of bodies. It is for this reason that a minimum distance **(a)** must be maintained between the optical plane of the SIGUARD light curtains/light grids and such reflective surfaces as polished parts of machines and receptacles for material. The greater the distance between transmitter and receiver, the greater is the distance **(a)** which has to be maintained. The following diagrams illustrate the correct installation and this distance **(a)** as a dependency of the width of the protection zone.

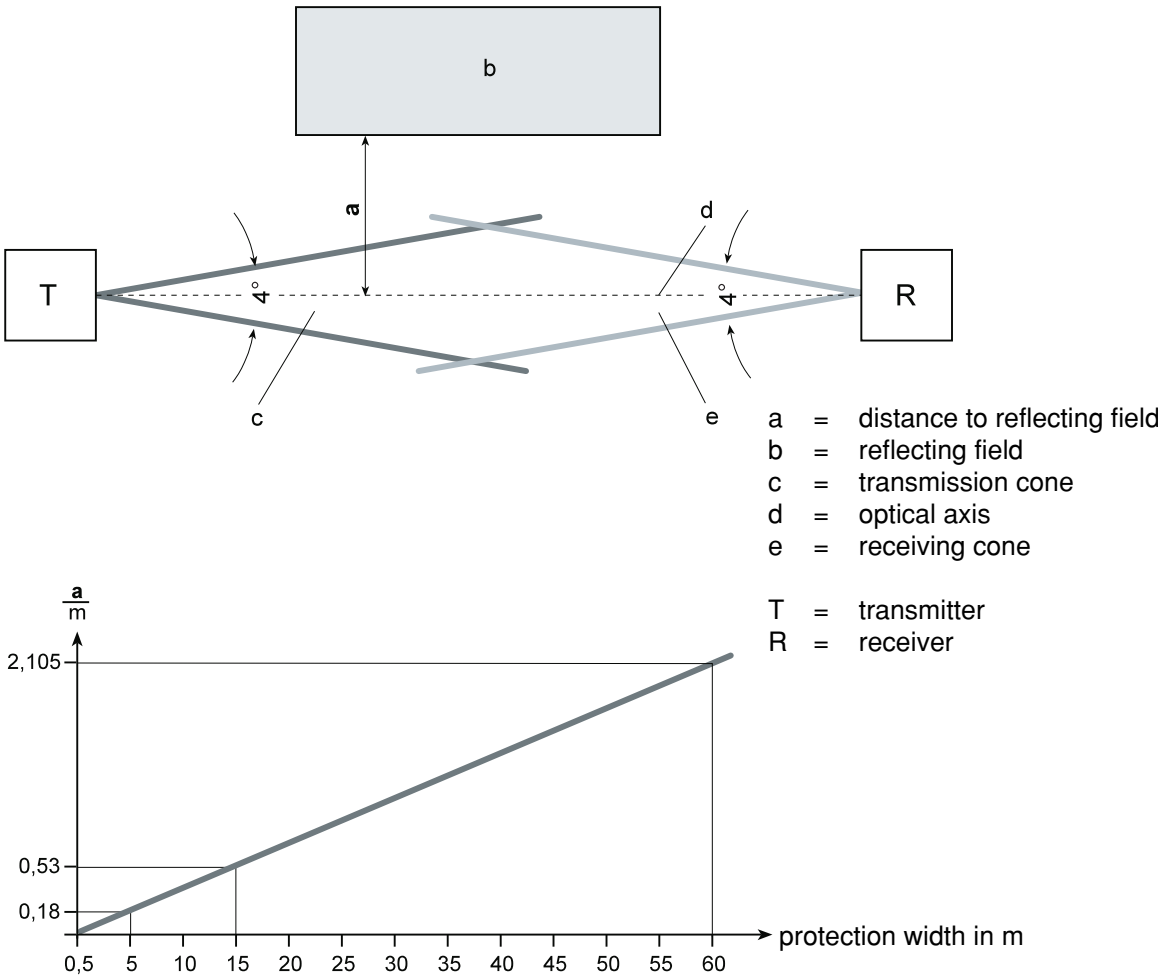


Fig. 11 Sufficiently large distance (**a**) from reflective surfaces must be assured.
a [m] = 0.035 x protection zone width [m] + 0.005 m

4.1.3 Prevention of Mutual Interference

Radiation from the transmitter and receiver is in the form of divergent cones with an angle of 4˚. The diameter of the radiated light beam thus increases with increasing distance and irradiates the receiver accordingly. Mutual interference and hence functional disturbance can result if a second receiver is positioned within this range.

Two differing transmission channels can be set by means of the DIP switch S2 in order to prevent this. The units can be mounted in opposite directions or be separated by appropriate shielding.

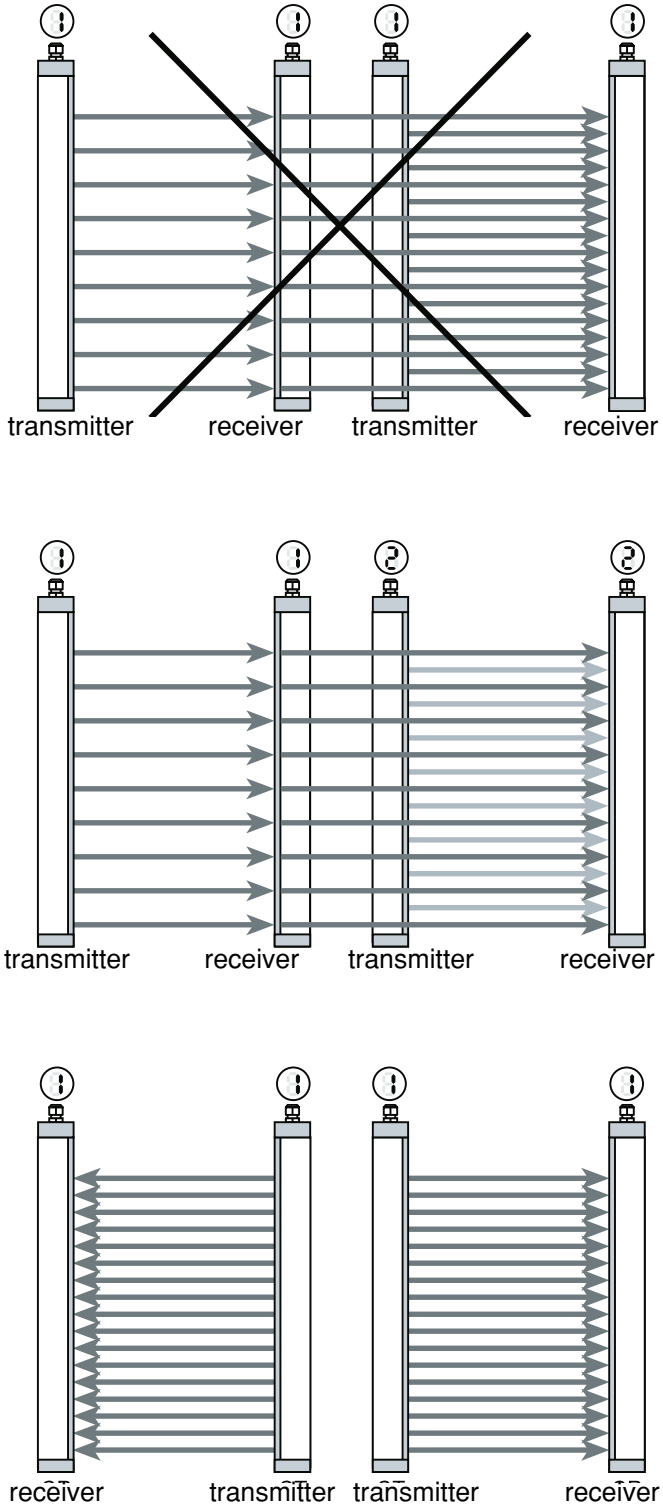


Fig. 12 Prevention of mutual interference by the selection of different transmission channels or by mounting in opposite directions

4.2 Mounting Procedures for SIGUARD Light Curtains (Resolution 14 mm and 30 mm)

With the SIGUARD light curtains for finger and hand protection, it shall be observed that access to the protection zone is not possible from above, below or around, as well as from stepping over the curtain, by the incorporation of additional mechanical safeguards or by cascading the SIGUARD light curtains.
The minimum clearance for protection is calculated as follows:

S = (K x T) + C

where:

S Minimum clearance between protection zone and hazard location, in mm ($S_{min} \geq 100$ mm)
K Accessing rate 2 mm/ms
T Overtravel time of the machine + the response time of the optoelectronic protection device (AOPD), in ms
C 8 (d - 14 mm), not less than 0 however
d Detection capacity (resolution) of the AOPD, in mm

If this calculation gives a value for S which is greater than 500 mm, then the calculation shall be repeated for K = 1.6 mm/ms. In this case the value of S_{min} may not be less than 500 mm.

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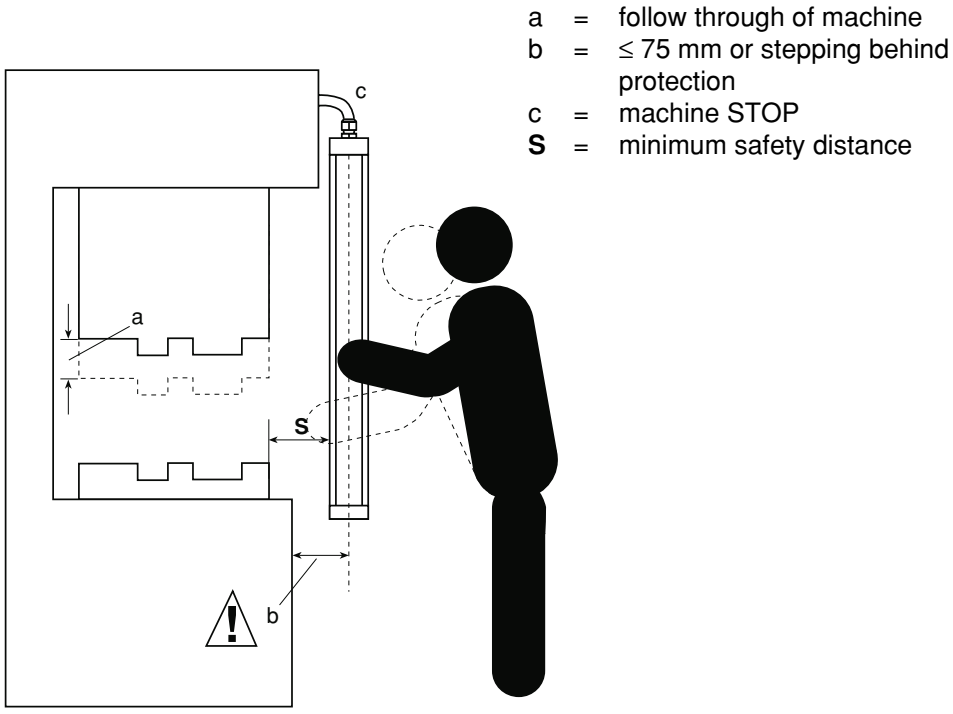


Fig. 13 Light curtain for hand or finger protection at hazard location

4.3 Installation Specifications for SIGUARD Light Curtains for Danger Area Safeguard, Horizontal Arrangement (Resolution 50 mm and 90 mm)

When light curtains, horizontal arrangement are being mounted to safeguard danger areas, make sure that the height of the sensing field does not exceed 1000 mm above the ground. If H exceeds 300 mm (200 mm if children are present), an undetected approach underneath the sensing field is possible. This must be taken into account when the risk is assessed. The lowest admissible height for grid assembly depends on the AOPDs resolution, to ensure that the human leg or foot can be recognized without failure. The minimum safety distance is calculated as follows:

S = (1.6 mm/ms x T) + C
C = 1200 mm - 0.4 x H
(with H = height of the sensing field above reference plane C_{min} = 850 mm)

Assembly height:
H_{max} = 1000 mm
H_{min} = 15 (d - 50 mm) with d = resolution of the AOPD

The admissible height for grid assemblies of the SIGUARD light grids by using this calculation is:

Resolution	**Height of the Sensing Field above Reference Plane from ... to**
50 mm	0 mm ... 1000 mm
90 mm	600 mm ... 1000 mm

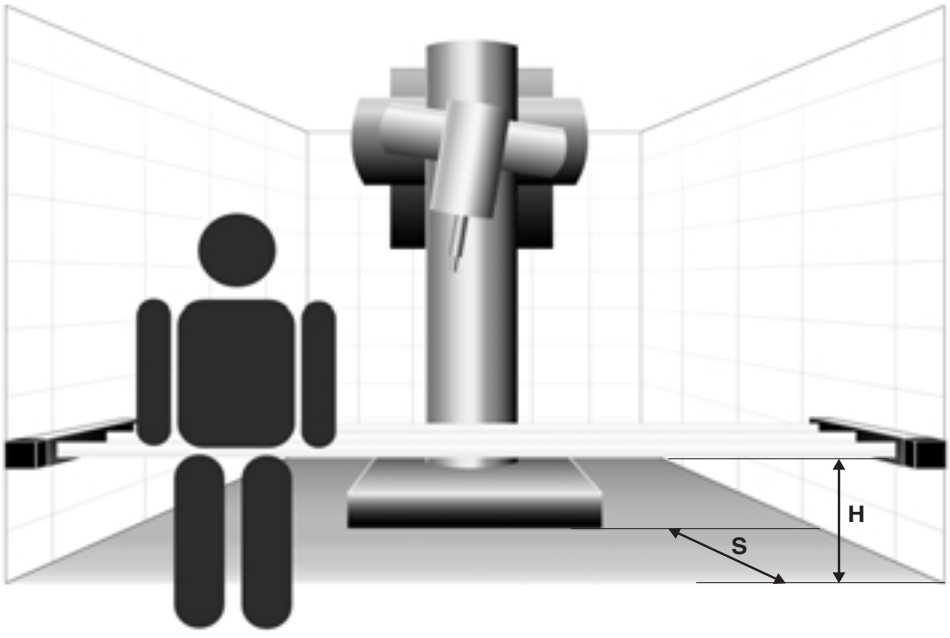


Fig. 14 Clearance and installation height for horizontal protection against dangerous areas

4.4 Mounting Procedures for SIGUARD Light Grids for Vertical Access Protection (2, 3, and 4 beams)

The installation of SIGUARD light grids shall ensure that hazard locations cannot be accessory by crawling under, between, reaching over the planes of light, or by reaching through the planes of light. The number of planes of light and the spacing between these depend on the risk assessment as well as machinery-specific regulations such as e.g. EN 775. The EN 999 proposes the following variants:

Number of beams	Height above the reference plane, e.g. ground in mm	SIGUARD light grids
4	300, 600, 900, 1200	3RG7842-6MH..
3	300, 700, 1100	3RG7842-6PG..
2	400, 900	3RG7842-6SE..

The minimum clearance is calculated as follows:
S = (1.6 mm/ms x T) + 850 mm

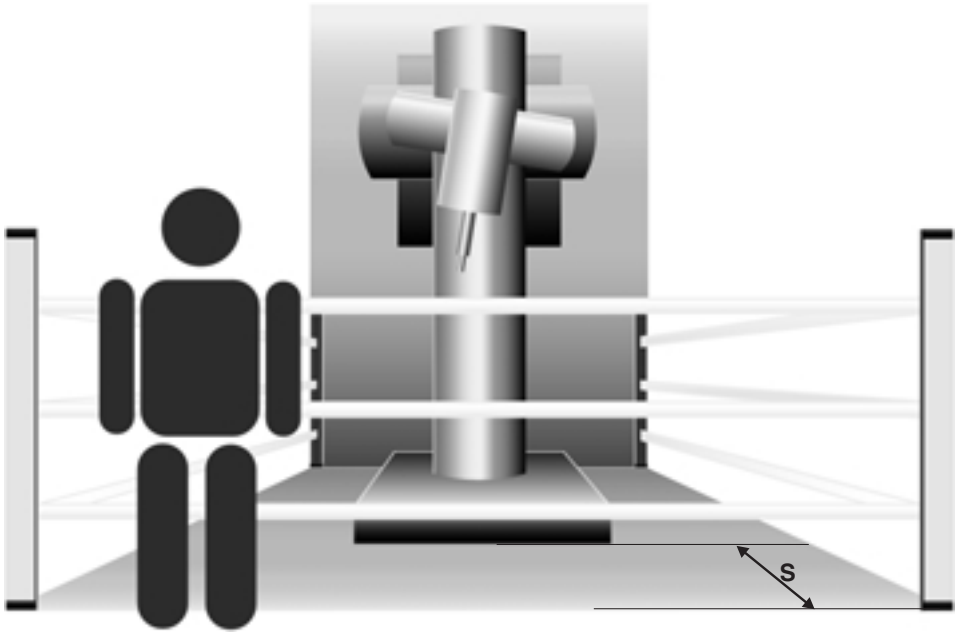
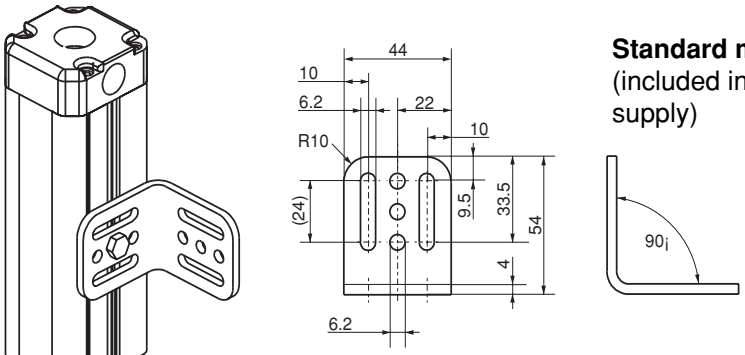


Fig. 15 Safety distance safeguarding access, vertical arrangement

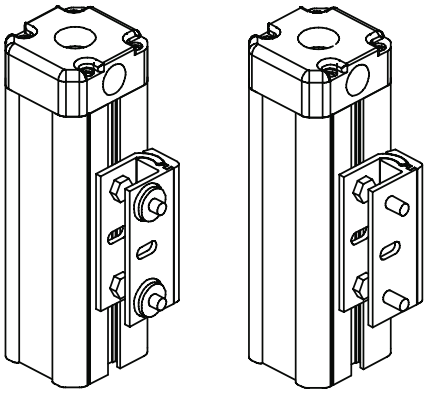
4.5 Mechanical Installation

The units are mounted using M6 T-slot nuts with an M6 thread, which is inserted from the side into the longitudinal grooves. The M6 T-slot nuts can be freely adjusted and allow the unit to be aligned along the longitudinal axis. These nuts are fitted with a retainer spring to prevent the elements from accidentally slipping when the screws are being tightened and in order to make the mounting easier.

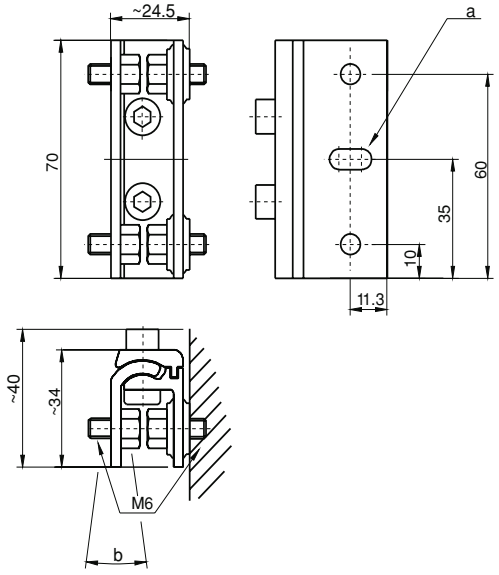
Two different types of mounting brackets are available for installation



Standard mounting bracket
(included in the scope of supply)



Swivelling mount with absorption of vibration
(Also permits rotation of the unit about the lengthwise axis and reduces the effects of vibrations and shocks.)



a = oblong punch 13 x 6
b = rotation area

Fig. 16 Mechanical mounting for SIGUARD light curtains and light grids

5 Electrical Installation

5.1 Installation Regulations

Attention shall be paid to the general notes of safety given in Chapter 2. The electrical installation shall be performed by experienced and qualified personnel. The OSSD outputs of the SIGUARD light curtains and light grids are principally to be connected as two-channel outputs to the safety engineering section of the machinery controls. When connecting relays, attention must be paid to ensure that relays or contactors with reliable network separation are used.

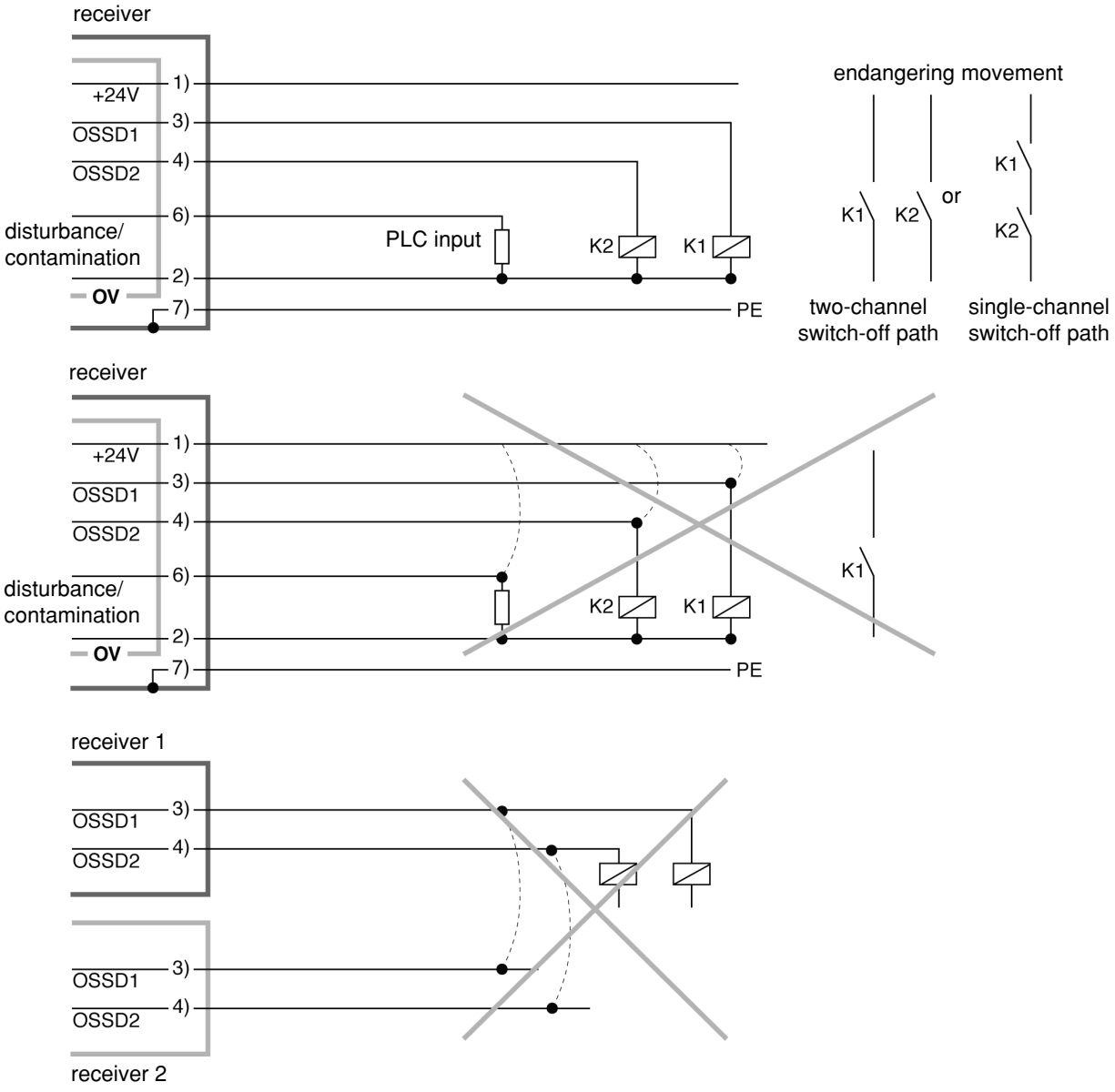


Fig. 17 Caution! Do not make any connections in parallel and do not apply any external voltages to OSSD outputs

5.2 Power Supply

The power supply to transmitter and receiver shall be 24 V DC ± 20 %. The maximum power consumption of SIGUARD light curtains and light grids equipment including 2 x 0.3 A on-load current, amounts to 0.9 A. The power supply shall meet the requirements of EN 60204 and exhibit a safe mains separation as well as bridging short-term mains failures of up 20 ms.

5.3 Connecting Cables

Transmitter and receiver shall be connected to the machinery controls by means of 7-pole connecting cables with a maximum conductor cross-section of 1.0 mm^2. The routing of the cables shall be separate from supply lines. If power circuits and/or interface sources are close by, it might be necessary to use shielded lines. The screen shall be connected at both ends. For differences in the potential between switching cabinet and installation location of the SIGUARD light curtains and light grids, the screen can be connected to the switching cabinet ground over a plastic-foil capacitor in accordance with the dielectric strength (e. g. x2-capacitors with 47 nF, 250 V AC).

5.4 Examples of Connections

The SIGUARD light curtains and light grids can integrated in a number of ways to the user controls. The SIGUARD light curtains and light grids can be connected directly to these controls if the safety engineering control system of the machine is equipped with such disable and surveillance functions as „Start/restart disable“ and „Protection control“ necessary for interconnection.

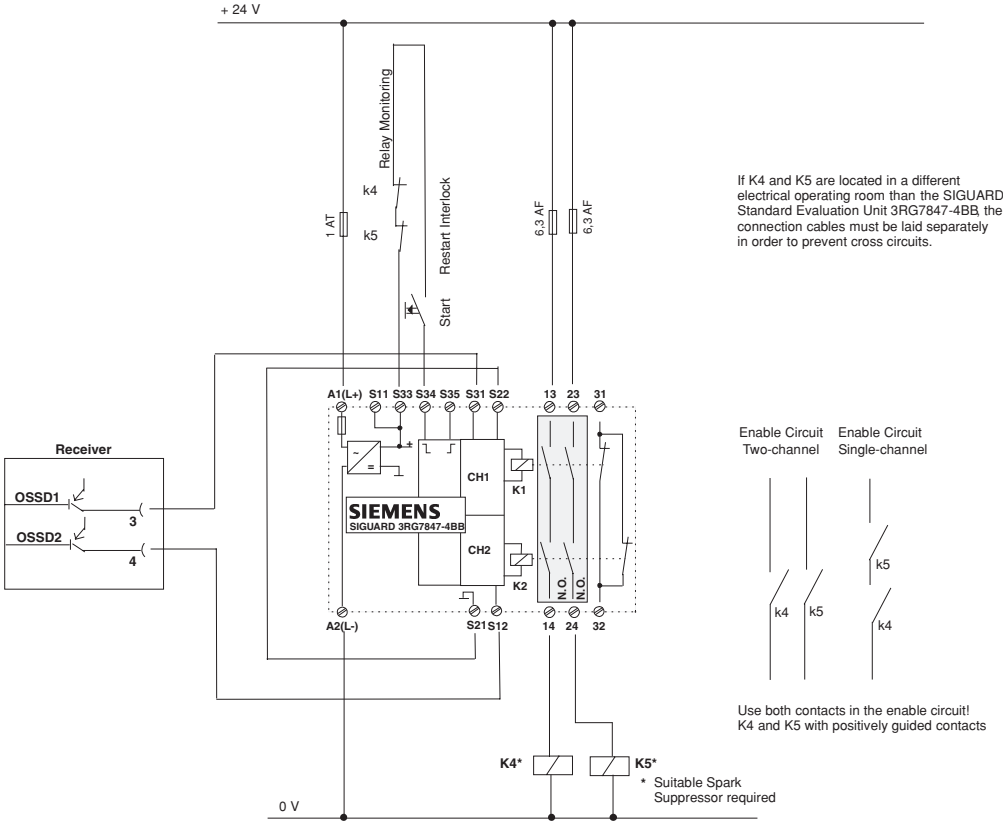
If the machine control does not contain this function, SIGUARD light curtains and light grids can be attached using the standard SIGUARD evaluation unit 3RG7847-4BB with selectable functions „start/restart inhibition“, and „relay monitoring“. For the implementation of a muting function the SIGUARD evaluation unit with muting 3RG7847-4BF must be used. When connecting SIGUARD evaluation units the technical instruction manuals must be followed.

More evaluation units are available for additional functions.

The following examples of connections demonstrate the principle of the connection of the SIGUARD light curtains and light grids into the user controller in compliance with Category 4 according to EN 954-1.

If a Safety PLC (e.g. SIMATIC S5-95F) is available, then the outputs of the light curtain can be attached directly to the safety inputs of the PLC. Functions like the „start/restart inhibition“ and „muting“ can be implemented then by software.

Connection by means of the SIGUARD evaluation unit 3RG7847-4BB



Connection by means of the SIGUARD evaluation unit 3RG7847-4BF

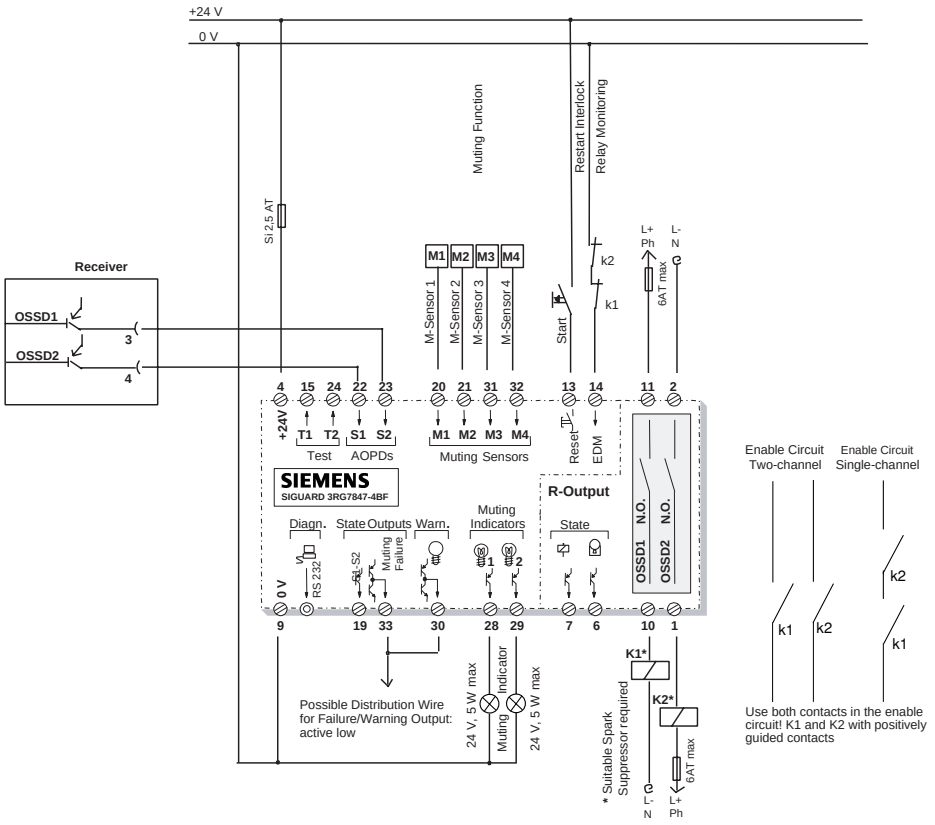


Fig. 18 Integration of the SIGUARD light curtains and light grids into the safety engineering section of the user controls in accordance with EN 954-1, Category 4

5.5 Connecting Techniques

The basic SIGUARD light curtains and light grids are fitted with a plug-in terminal connector compartment with PG cable feedthroughs. The terminal caps can be removed after loosening the screws. The connecting cables are routed through the glands and connected to the threaded terminals in accordance with the wiring diagram. The maximum conductor cross-section is 1.0 mm^2.

a = connecting pins
b = switches for adjusting parameters
c = pin receptables
d = indicator screw plug PG 9
e = PG 13,5

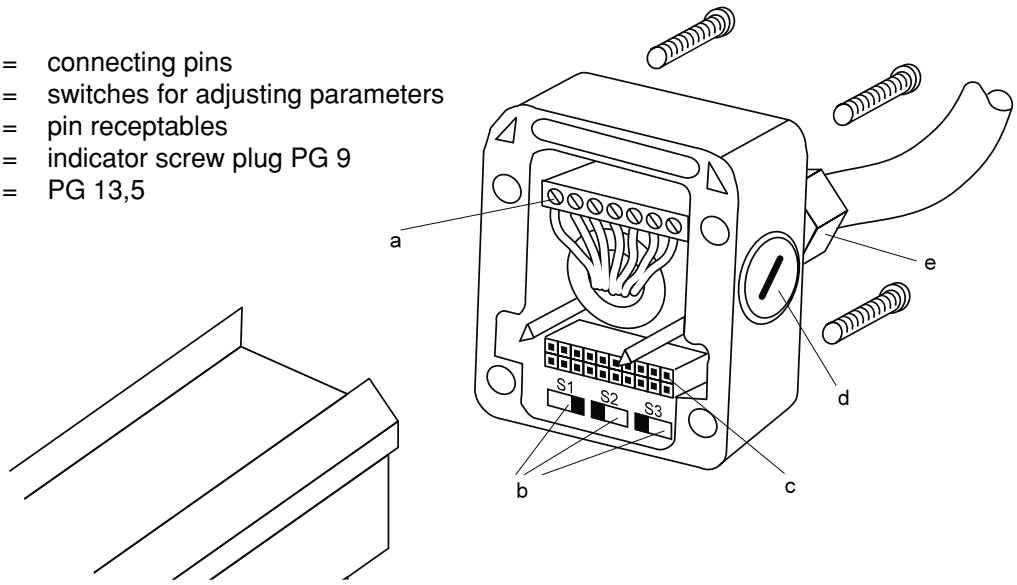
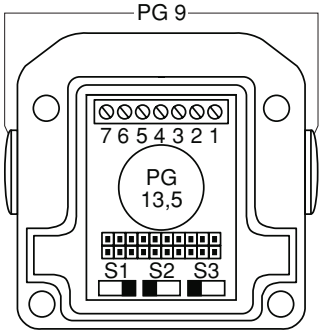


Fig. 19 The terminal caps can be removed once the screws have been loosened.



Terminal assignment		
Clamp, Connector	**Transmitter**	**Receiver**
1	+ 24 V	+ 24 V
2	0 V	0 V
3	Test out ⎫ Jumper has been	OSSD1
4	Test in ⎭ factory-set already *)	OSSD2
5	- RS-485	- RS-485
6	+ RS-485 (S1 ▭■)	select: + RS-485 (S1 ▭■) or pnp contamination and disturbance output (S1 ■▭)
7	PE, shield	PE, shield

Fig. 20 Plugable connecting cap with screw terminals (included in the scope of supply)

6 Commissioning

6.1 Functional Check

The correctness of the connections and the supply voltage (+24 V DC ± 20 %) shall be checked before switching the equipment on for the first time.

The LED's and the 7-segment displays indicate the system status of transmitter and receiver when the supply voltage is turned on:

7-segment display	**System status transmitter**	**System status receiver**
8.(only in the instant of being turned on)	Hardware reset	Hardware reset
S (for approx. 1 s)	Self-test running	Self-test running
1 or 2	Normal operation, channel 1 or channel 2 set	Normal operation, channel 1 or channel 2 set
.(decimal point turned on)	Test input open, testing activated	Multiple scanning d-scan set
F	Discrepancy in unit or circuitry	Discrepancy in unit or circuitry

Receiver LED's	**System status**
Green illuminated	OSSD's on, adequate reception of light at all light planes
Green + orange illuminated	OSSD's on, weak reception of light at one or more light planes => Perform fine adjustment of transmitter and receiver
Red illuminated	OSSD's off, at least one plane of light interrupted or transmitter tester input open (decimal point in transmitter display illuminated)
Yellow illuminated	Not used

6.2 Notes on Rectification of Faults

Operating faults are often attributable to simple causes which can easily be rectified. The following table provides remedies for these.

Symptom	Measures for fault rectification
7-segment displays and LED's are not illuminated	Check the 24 V DC power supply
7-segment display not illuminated at one component	Check the supply voltage, Check the connecting cable, Replace the unit if necessary.
F and 6 blinking (receiver)	External short circuit at OSSD1 to 0 V, or cross circuit, or connecting cable respectively device interchanged
F and 7 blinking (receiver)	External short circuit at OSSD1 to +24 V, or cross circuit
F and 8 blinking (receiver)	External short circuit at OSSD2 to 0 V, or cross circuit
F and 9 blinking (receiver)	External short circuit at OSSD2 to +24 V, or cross circuit
8. permanently illuminated	Hardware fault, replace unit
F glows continuously, interrupted by the fault number	Fault determined in the unit, replace unit (detailed fault code is outputted via the serial interface)
The decimal point of the transmitter´s 7-segment display glows (testinput active)	Jumper 3-4 in the transmitter end cap is missing or endcap of transmitter and receiver have been exchanged.

7 Cleaning

The cover disks in the transmitter and receiver must be cleaned regularly, depending on the amount of dirt. Illumination of the „weak reception signal“ message in the display of the receiver indicates when cleaning is necessary at the latest.

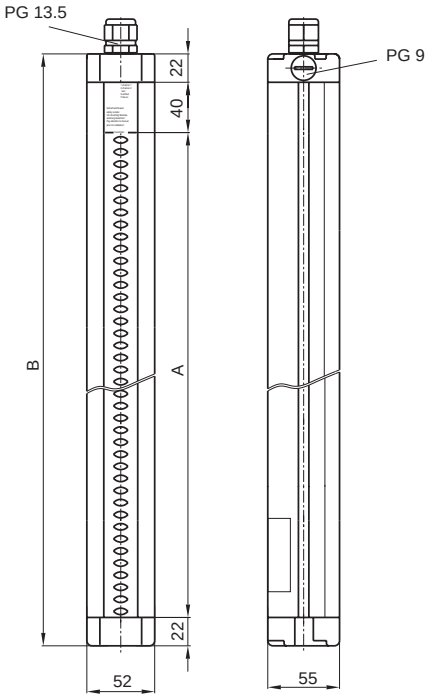
For the cleaning of the Plexiglass cover disks, we recommend a mild detergent. The plexiglass cover disks are highly resistant to dilute acids and alkalis, and against organic solvents to a limited extent.

8 Technical Data and Dimensions

Classification	Type 4 according to EN 61496-1, -2 and/or IEC 61496 -1,-2 (self-monitoring)
Protected height	150...1800 mm for resolution 14 mm and 30 mm 450...3000 mm for resolution 50 mm 750...3000 mm for resolution 90 mm
Protected width, Range	0.3...6 m for resolution 14 mm 0.8...18 m for resolution 30, 50, 90 mm and light grids (18 m version) 6.0...60 m for light grids (60 m version)
Resolution (object sensitivity)	14 mm, 30 mm, 50 mm, 90 mm, and/or whole person with 2, 3, or 4 beams
Response time (from interrupting the sensing field to switching off the OSSDs)	Response time increases in proportion to number of beams Resolution 14 mm: 7...39 ms (d-scan 10...78 ms) Resolution 30 mm: 7...20 ms (d-scan 10...39 ms) Resolution 50 mm: < 17 ms (d-scan 33 ms) Resolution 90 mm: < 13 ms (d-scan 20 ms) 2,3, and 4 beams: 5 ms (d-scan 8 ms) exact response time see Table 1, page 65
Switch on-delay time (after the release of the sensing field)	0.5 ms after the release of the sensing field. As an reaction of an interruption of the sensing field, the OSSDS remain switched off in minimum 100 ms, even if the interruption is shorter.
Enclosure rating	IP 65
Ambient temperature	0 ... +55 ˚C
Supply voltage	24 V DC +/- 20 % External supply unit with safe disconnecting function from the supply and 20 ms mains failure bridging
Current consumption	Transmitter: 75 mA Receiver: 180 mA (without load)
Safety outputs (OSSD)	2 fail-safe pnp-outputs with cross circuit monitoring, $U_{amin} = U_{vers}$ - 2.7 V surge current (100 ms) = 0.4 A permanent current at 35 °C = 0.3 A permanent current at 55 °C = 0.22 A max. capacity load per output = 0.3 µF (0.1 µF for channel 2)
Contamination and disturbance output	pnp output short circuit-proof, 70 mA max
Interface for safety and diagnosis	RS-485, 57,6 KBaud max
Test input transmitter	closed circuit operation, minimum length of opening equal to 50 ms

Electrical connection	via PG 13.5 and/or PG 9, screw terminals and plug-in connection device
Connection cable	Transmitter: 7 pole, max 1.0 mm^2 Receiver: 7 pole, max 1.0 mm^2 (if necessary shielded)
Length of circuit	max 100 m at 1,0 mm^2
Type of operation	protective operation without restart interlock
Synchronization Transmitter/receiver	optical synchronization, 2 transmission channels can be selected
Suppression of infra-red interfering light	2 methods can be selected Standard: high suppression **d-scan:** very high suppression response time increases according to measurement table (exact response time see Table 1, page 65).
Measurements	cross section 55 x 52 mm length depending on protected height 234 … 3084 mm
Air humidity	15 ... 95 %
Storage temperature	-25 ... +70 ˚C

Light curtains
(resolution 14, 30, 50, 90 mm)



Light grids
(2, 3, 4 beams)

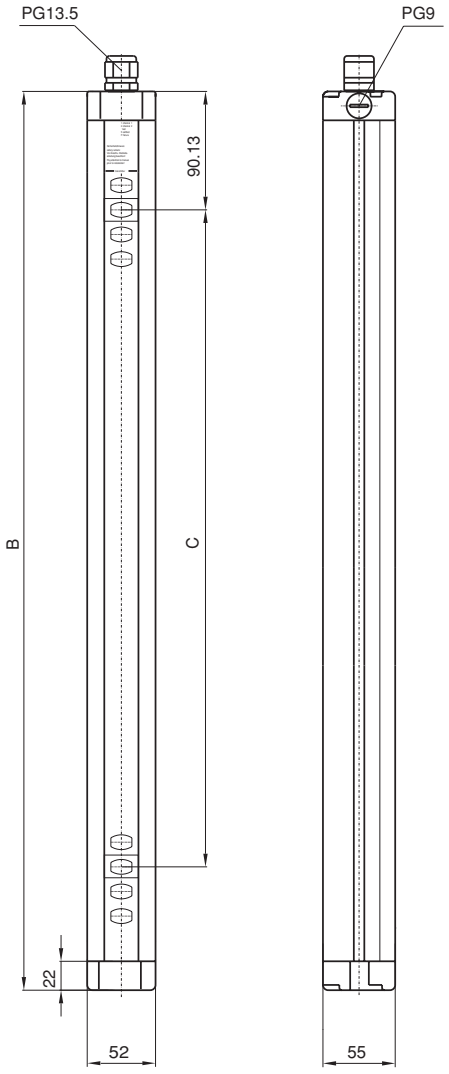
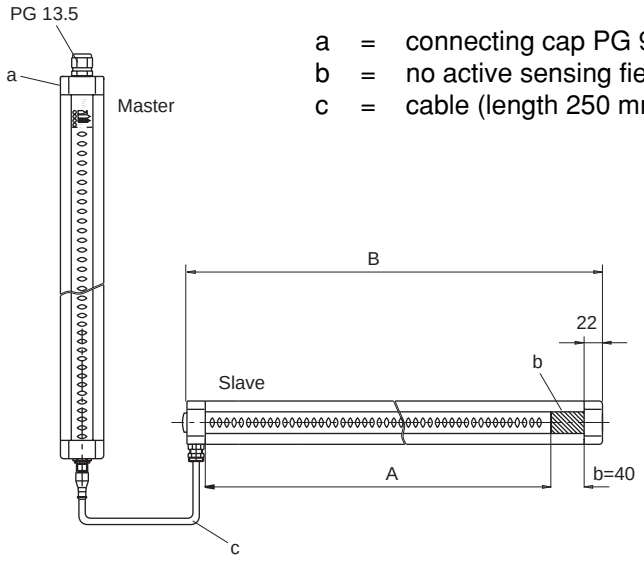


Fig. 21 Dimensions for standard version



a = connecting cap PG 9, on both sides
b = no active sensing field
c = cable (length 250 mm) with M12 connector

Fig. 22 Dimensions for cascaded basic unit - follower unit

Table 1: Dimensions, weight and response times for SIGUARD light curtains and light grids:

Light curtains (resolution 14, 30, 50, 90 mm)

Protect. height Meas. A [mm]	**Meas. B [mm]**	**Weight transmit-ter+ re-ceiver [kg]**	**Response time [ms] n = standard; d = d-scan**							
			resolu-tion 14 mm		**resolu-tion 30 mm**		**resolu-tion 50 mm**		**resolu-tion 90 mm**	
			n	d	n	d	n	d	n	d
150	234	1,2	7	10	7	10				
225	309	1,7	10	15	10	15				
300	384	2,1	13	20	7	10				
450	534	3,0	10	20	10	15	10	15		
600	684	3,7	13	26	13	20	7	10		
750	834	4,6	17	33	9	17	9	13	9	13
900	984	5,5	20	39	10	20	10	15	10	15
1050	1134	6,4	23	46	12	23	12	18	6	9
1200	1284	7,3	26	52	13	26	13	20	7	10
1350	1434	8,2	30	59	15	30	8	5	8	11
1500	1584	8,6	33	65	17	33	9	17	9	13
1650	1734	10,0	36	72	18	36	9	18	9	14
1800	1884	10,9	39	78	20	39	10	20	10	15
2100	2184	12,7					12	23	12	18
2400	2484	14,5					13	26	13	20
2700	2784	16,3					15	30	8	15
3000	3084	18,1					17	33	9	17

Light grids (2, 3, 4 beams)

Type	**Meas. B [mm]**	**Meas. C [mm]**	**Number of beams**	**Weight trans-mitter+ receiver [kg]**	**Response time [ms] n = standard; d = d-scan**	
					n	**d**
4 beams	1134	300	4	2,3	5	8
3 beams	984	400	3	2,0	5	8
2 beams	684	500	2	1,3	5	8

The response time of master and slave devices consists of the sum of the partial response times.

Table 2: Number of light axes of the resolution 14 mm, 30 mm, 50 mm, and 90 mm

Length of the SIGUARD light curtains and light grids				**Number of Light Axes**
resolution 14 mm	**resolution 30 mm**	**resolution 50 mm**	**resolution 90 mm**	
			150	2
		150		4
	150			8
			750	10
	225	450	900	12
			1050	14
150	300	600	1200	16
			1350	18
		750	1500	20
			1650	22
225	450	900	1800	24
			2100	28
300	600	1200	2400	32
		1350	2700	36
	750	1500	3000	40
		1650		44
450	900	1800		48
	1050	2100		56
600	1200	2400		64
	1350	2700		72
750	1500	3000		80
	1650			88
900	1800			96
1050				112
1200				128
1350				144
1500				160
1650				176
1800				192

The table shows how many light axes are included in the particular SIGUARD alternatives of the light curtains and light grids. A combination of master and slave may not exceed 240 light axes.

9 Selection and Notes on Ordering

9.1 Selection of a SIGUARD Light Curtain or Light Grid

1. Consult the applicable regulations for the application in question (e.g. machine-specific C-Standards of the EU, or OSHA and ANSI standards in the USA), observe the notes on safety given in Chapter 2.
2. Define the protection target and select the appropriate SIGUARD light curtains and light grids accordingly (e.g. finger protection at a hazard location => resolution 14 mm, refer to Chapters 1.4 and 2.2 for this)

   Calculate the clearance according the Chapter 4.
3. Determine the width for the protection zone; curtains on more than one front can be realised by using deflection mirrors (refer to 1.5).
4. Determine the protection height = height of the area to be protected or the depth for horizontal applications (take reaching over, reaching under, crawling under etc. into consideration).
5. Select the equipment type and the ordering number from the catalogue.

9.2 Scope of Delivery and Accessories

- 1 transmitter respectively 1 receiver
- 2 mounting brackets with fittings
- 1 instructions for connecting and operating (with receiver only)

Accessories

Order No.	Description
3RG7848-1AB	Laser alignment aid
3RG7848-1AG	Laser alignment aid for adjustment of mounting column
3RG7848-0AB	Standard mounting brackets (2 pieces with screws)
3RG7848-0BB	Swivelling mounted with vibration damping
3RG7848-0AC	M6 T-slot nuts (2 pieces)
3RG7848-1DA	End cap transmitter
3RG7848-1DB	End cap receiver
3RG7848-0CL	Mounting column 1000 mm
3RG7848-0CP	Mounting column 1300 mm
3RG7848-0CR	Mounting column 1600 mm
3RG7848-0CU	Mounting column 1900 mm

3RG7848-0DL	Mirror column 1000 mm
3RG7848-0DP	Mirror column 1300 mm
3RG7848-0DR	Mirror column 1600 mm
3RG7848-0DU	Mirror column 1900 mm
3RG7848-0FL	Deflection mirror columns, 2 beams
3RG7848-0FP	Deflection mirror columns, 3 beams
3RG7848-0FR	Deflection mirror columns, 4 beams
3RG7848-0ED	Deflection mirror 410 mm
3RG7848-0EE	Deflection mirror 510 mm
3RG7848-0EF	Deflection mirror 625 mm
3RG7848-0EG	Deflection mirror 740 mm
3RG7848-0EH	Deflection mirror 830 mm
3RG7848-0EJ	Deflection mirror 930 mm
3RG7848-0EK	Deflection mirror 1030 mm
3RG7848-0EL	Deflection mirror 1125 mm
3RG7848-0EM	Deflection mirror 1220 mm
3RG7848-0EN	Deflection mirror 1365 mm
3RG7848-0EP	Deflection mirror 1510 mm
3RG7848-0EQ	Deflection mirror 1650 mm
3RG7848-0ER	Deflection mirror 1830 mm
3RG7848-1AC	Diagnostics software for light curtains
3RG7848-1AD	RS-485/RS-232 converter for diagnosis interface
3RG7848-1AE	RS-232 serial cable
3RG7848-1AF	Set of cables for diagnosis, category 4, PG
3RG7848-4BB	SIGUARD evaluation unit standard
3RG7848-4BF	SIGUARD evaluation unit with muting function
3RG7848-4BH	SIGUARD evaluation unit with cyclical control
3RG7848-4BK	SIGUARD evaluation unit with muting function and cyclical control

Automation and Drives
Low Voltage Controls and Distribution
D-92220 Amberg

02/2000 Order No.: 3ZX1012-0RG78-3BS1