SCHMERSAL

Content

1. About this document

1.1 Function

This operating instructions manual provides all the information you need for the mounting, set-up and commissioning to ensure the safe operation and disassembly of the safety switchgear. The operating instructions must be available in a legible condition and a complete version in the vicinity of the device.

1.2 Target group: authorised qualified personnel

All operations described in this operating instructions manual must be carried out by trained specialist personnel, authorised by the plant operator only.

Please make sure that you have read and understood these operating instructions and that you know all applicable legislations regarding occupational safety and accident prevention prior to installation and putting the component into operation.

The machine builder must carefully select the harmonised standards to be complied with as well as other technical specifications for the selection, mounting and integration of the components.

1.3 Explanation of the symbols used

Information, hint, note:
This symbol is used for identifying useful additional information.

Caution: Failure to comply with this warning notice could lead to failures or malfunctions.
Warning: Failure to comply with this warning notice could lead to physical injury and/or damage to the machine.

x.000 / 09.2017 / v.A. - 103016077-EN / A / 2017-09-13 / AE-Nr. -

1.4 Appropriate use

The products described in these operating instructions are developed to execute safety-related functions as part of an entire plant or machine. It is the responsibility of the manufacturer of a machine or plant to ensure the correct functionality of the entire machine or plant.

The safety switchgear must be exclusively used in accordance with the versions listed below or for the applications authorised by the manufacturer. Detailed information regarding the range of applications can be found in the chapter "Product description".

1.5 General safety instructions

The user must observe the safety instructions in this operating instructions manual, the country specific installation standards as well as all prevailing safety regulations and accident prevention rules.

Further technical information can be found in the Schmersal catalogues or in the online catalogue on the Internet: www.schmersal.net.

The information contained in this operating instructions manual is provided without liability and is subject to technical modifications.

The entire concept of the control system, in which the safety component is integrated, must be validated to EN ISO 13849-2.

There are no residual risks, provided that the safety instructions as well as the instructions regarding mounting, commissioning, operation and maintenance are observed.

Additional measures could be required to ensure that the system does not present a dangerous breakdown, when other forms of light beams are available in a special application (e.g. use of wireless control devices on cranes, radiation of welding sparks or effects of stroboscopic lights).

1.6 Warning about misuse

In case of improper use or manipulation of the safety switchgear, personal hazards or damages to machinery or plant components cannot be excluded. The relevant requirements of the standards EN ISO 13855 & EN ISO 13857 must be observed.

Only if the information described in this operating instructions manual are realised correctly, the safety function and therefore the compliance with the Machinery Directive is maintained.

1.7 Exclusion of liability

We shall accept no liability for damages and malfunctions resulting from defective mounting or failure to comply with this operating instructions manual. The manufacturer shall accept no liability for damages resulting from the use of unauthorised spare parts or accessories.

For safety reasons, invasive work on the device as well as arbitrary repairs, conversions and modifications to the device are strictly forbidden; the manufacturer shall accept no liability for damages resulting from such invasive work, arbitrary repairs, conversions and/or modifications to the device.

2. Product description

2.1 Destination and use

The SLC/SLG240COM is a non-contact, self-testing safety guard (AOPD), which is used for the protection of hazardous points, hazardous areas and machine accesses. If one or more light beams are interrupted, the hazardous movement must be stopped.

The user must evaluate and design the safety chain in accordance with the relevant standards and the required safety level.

2.2 Ordering code

This operating instructions manual applies to the following types:

SLC240COM-ER-①-②

No.	Option	Description
①	xxxx	Protection field heights in mm available lengths: 0330, 0410, 0490, 0570, 0650, 0730, 0810, 0890, 0970, 1050, 1130, 1210, 1290, 1370, 1450, 1530, 1610, 1690, 1770, 1850, 1930
②	14	Resolution 14 mm
	30	Resolution 30 mm
	35	Resolution 35 mm

SLG240COM-ER-①

No.	Option	Description
①		Distance between outermost beams:
	0500-02	500 mm, 2 beams
	0800-03	800 mm, 3 beams
	0900-04	900 mm, 4 beams

2.3 Special versions

For special versions, which are not listed in the order code, these specifications apply accordingly, provided that they correspond to the standard version.

2.4 Included in delivery

- Emitter (E)
- Receiver (R) with integrated signal light
- Mounting kit MS-1100
- Operating instructions DE/EN
- Spacer MSD5, from protection field height of 1050 mm

2.5 Technical data

Standards:	EN 61496-1; EN 61496-2; EN ISO 13849; EN 62061
Material of the enclosure:	Aluminium
Protection field heights:	
- SLC240COM:	330 … 1930 mm
- SLG240COM:	500 mm, 800 mm, 900 mm
Detection ability for test bodies:	
- SLC240COM:	14 mm, 30 mm, 35 mm
- SLG240COM:	2 beams with resolution 500 mm [1)] 3 beams with resolution 400 mm [1)] 4 beams with resolution 300 mm [1)]
Range of the protection field:	
SLC240COM:	
- Resolution 14 mm:	Protection field height 330 to 1450 mm: 0.3 … 7.0 m Protection field height 1530 to 1930 mm: 0.3 … 6.0 m
- Resolution 35 mm:	Protection field height 330 to 1770 mm: 0.3 … 7.0 m Protection field height 1850 to 1930 mm: 0.3 … 6.0 m
- Resolution 30 mm:	0.3 … 12.0 m
SLG240COM:	0.3 … 12.0 m
Response time:	1 - 48 beams = 10 ms 49 - 144 beams = 20 ms 145 - 192 beams = 28 ms
Rated operating voltage:	24 VDC ±10% (PELV) supply unit $I_{max.}$ 1.0 A, to EN 60204 (power drop ≤ 20 ms)
Rated operating current:	200 mA max. + 2 x 0.25 A each OSSD
Wavelength of the infrared radiation:	880 nm
Emitter, infrared emitted radiation	
- to DIN EN 12198-1:	Category 0
- to DIN EN 62471:	free group

Safety outputs

OSSD 1, OSSD 2:	2 x short-circuit proof PNP semi-conductor outputs
Test impulse cycle OSSD:	750 ms
Test impulse length:	150 µs
Switching voltage HIGH [2]:	15 … 26.4 V
Switching voltage LOW [2]:	0 … 2 V
Switching current each OSSD:	0 … 250 mA
Leakage current [3]:	1 mA
Load capacity:	0 … 50 nF
Load inductance [4]:	0 … 2H
Test input:	
Test function not active:	+24 V
Test function active [5]:	0 V
Connection:	
- Emitter:	Cable M12, 4-pole,
- Receiver:	Cable M12, 4-pole, 5-pole
Ambient temperature:	−10° C … + 50° C
Storage temperature:	−25° C … + 70° C
Protection class:	IP67 (IEC 60529)
Resistance to vibration:	10 … 55 Hz to IEC 60068-2-6
Resistance to shock:	10 g, 16 ms, to IEC 60028-2-29
Year of construction:	as of 2017 version 1.0

[1] Resolution = beam distance + beam diameter 10 mm
[2] To IEC 61131-2
[3] In case of failure, the leakage current flows to the OSSD cable. The downstream control element must recognise this state as LOW. A safety PLC must detect this state.
[4] The load inductivity generates an induced voltage during the switch-off, which compromises the downstream components (spark quenching element).
[5] See section 2.8.8 Test input on emitter

2.6 Response time (reaction time)

The response time depends on the height of the protection field, the resolution and number of beams.

SLC240COM Resolution 14 mm

Protection field height [mm]	Beams [Number]	Response time [ms]	Weight [kg]
330	32	10	0.5
410	40	10	0.7
490	48	10	0.8
570	56	20	0.9
650	64	20	1.0
730	72	20	1.1
810	80	20	1.3
890	88	20	1.4
970	96	20	1.5
1050	104	20	1.6
1130	112	20	1.7
1210	120	20	1.9
1290	128	20	2.0
1370	136	20	2.1
1450	144	20	2.2
1530	152	28	2.3
1610	160	28	2.5
1690	168	28	2.6
1770	176	28	2.7
1850	184	28	2.8
1930	192	28	2.9

SLC240COM Resolution 30 mm

Protection field height [mm]	Beams [Number]	Response time [ms]	Weight [kg]
330	16	10	0.5
410	20	10	0.7
490	24	10	0.8
570	28	10	0.9
650	32	10	1.0
730	36	10	1.1
810	40	10	1.3
890	44	10	1.4
970	48	10	1.5
1050	52	20	1.6
1130	56	20	1.7
1210	60	20	1.9
1290	64	20	2.0
1370	68	20	2.1
1450	72	20	2.2
1530	76	20	2.3
1610	80	20	2.5
1690	84	20	2.6
1770	88	20	2.7
1850	92	20	2.8
1930	96	20	2.9

SLC240COM Resolution 35 mm

Protection field height [mm]	Beams [Number]	Response time [ms]	Weight [kg]
330	11	10	0.5
410	14	10	0.7
490	16	10	0.8
570	19	10	0.9
650	22	10	1.0
730	25	10	1.1
810	27	10	1.3
890	30	10	1.4
970	33	10	1.5
1050	36	10	1.6
1130	38	10	1.7
1210	41	10	1.9
1290	44	10	2.0
1370	47	10	2.1
1450	49	20	2.2
1530	52	20	2.3
1610	55	20	2.5
1690	58	20	2.6
1770	60	20	2.7
1850	63	20	2.8
1930	66	20	2.9

SLG240COM

Beams [Number]	Beam distance [mm]	Response time [ms]	Weight [kg]
2	500	10	0.8
3	400	10	1.3
4	300	10	1.4

2.7 Safety classification

Standards:	EN ISO 13849-1, EN 62061
PL:	up to
Control category:	up to 2
PFH value:	8.05 x 10^{-9} / h
SIL:	up to 1
Service life:	20 years

2.8 Functions

The system consists of a receiver and an emitter. No other safety monitoring module is needed to perform the described functions. The diagnosis and adaptation of operating parameters are carried out using a command device (push button), see chapter Parameter setting.

The AOPD offers the following modes of operation:
- Protective mode automatic
  (automatic start after release of the protection zone)
- Restart Interlock (manual reset)
- Parameter setting
- Alignment kit

The AOPD offers the following functions:
- Blanking non-changeable objects with movable edges
- Blanking of changeable objects with one or two beams
- Series wiring of two AOPDs
- Display of selected configuration and signal strength after system start
- Display of signal strength in operating mode

When delivered, automatic/protection mode is active.

The functions of the AOPD can be adapted in parameter setting mode.

2.8.1 Protective mode / Automatic

In this mode the safety switching outputs (OSSDs) are automatically switched to the ON state once the detection zone is cleared.

This operating mode may only be selected in conjunction with the restart interlock of the machine.
This operating mode must not be chosen, when persons can step behind the protection field.

Display

Indicator	Status
Red	OFF state (protection zone interrupted, OSSD signal low)
Green	ON state (protection zone uninterrupted, OSSD signal high)

2.8.2 Restart interlock (manual reset)

In the operating mode restart interlock, the safety switching outputs (OSSDs) remain in the OFF condition after the power supply is applied or after the protection zone has been interrupted.

The AOPD switches the OSSDs to the ON state only if at the reset input a signal impulse is applied with a duration of 100 ms < T < 1500 ms using a command device (pushbutton).The receiver indicates the restart interlock state by a yellow signal on the signal end cap.If the protection zone is interrupted, the signal lamp remains red.

The restart interlock operating mode is selected with parameter setting (P1). If the restart interlock is not selected, protection/automatic mode is active.
See section Parameter setting.

The AOPD changes to alignment aid mode if the command device (push button) is pressed for at least 2 seconds when the operating voltage is applied, see section Alignment aid.

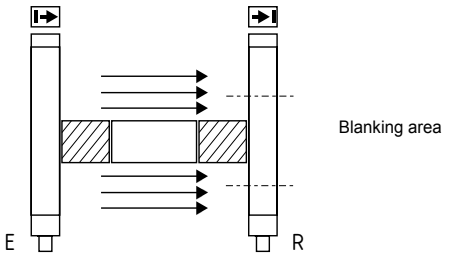
The command device (push button) must be installed outside of the hazardous area. The hazardous zone must be clearly visible to the user.

Display

Indicator	Status
Red	OFF state (protection zone interrupted, OSSD signal low)
Green	ON state (protection zone uninterrupted, OSSD signal high)
Yellow	Restart interlock active, AOPD expects an enabling signal

2.8.3 Blanking non-changeable objects with moveable edges (only SLC240COM)

This function can blank position changes of up to two stationary objects in the protection zone with a tolerance of one beam.



Key

Object in protection field
mechanical cover

The change in position equates to a displacement of approx.
- 10 mm (with 14 mm resolution)
- 20 mm (with 30 mm resolution)
- 30 mm (with 35 mm resolution)

upwards and downwards in the protection zone.

Example object movement in protection zone

Beam number	3	4	5	6	7	Status OSSDs
Blanking, beam 4, 5 and 6	○	●	●	●	○	Teach In
Shift 1 beam down	●	●	●	○	○	ok
Shift 1 beam up	○	○	●	●	●	ok
Object only covers 2 beams	○	○	●	●	○	ok
Object only covers 2 beams	○	●	●	○	○	ok
Object with downward edge displacement	●	●	●	●	○	ok
Object with upward edge displacement	○	●	●	●	●	ok
Object displacement exceeds 1 beam	○	○	○	●	●	Error
Object size changed (1 beam)	○	○	●	○	○	Error
Object size changed (5 beams)	●	●	●	●	●	Error

A maximum of two objects can be trained in the protection zone (teach-in). The distance between the objects must be at least three beams.

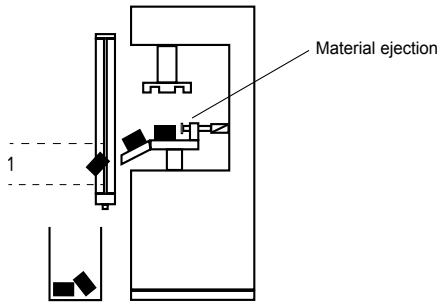
The blanking of stationary objects is trained with parameter P2. See section Parameter setting.

The effective resolution of the AOPD is different in the edge region of the blanked object.
For effective resolution in the edge area, see chapter Blanking changeable objects (1 beam).

Perform a new calculation of the safety distance with the effective resolution. Adjust the safety distance in accordance with your calculation.

Display
Blanking of objects with moveable edges is displayed when the system starts, by two pulses of the signal light.

2.8.4 Blanking changeable objects (only SLC240COM)
The AOPD can blank out changeable objects.
Up to 2 beams can be blanked in the protection zone.



Key
1: Area of changeable blanking

Changeable object blanking is not bound to one position in the protection zone. The first beam (with connector end cap) cannot be blanked.

This function allows a protection zone interruption without switching off the safety outputs (e.g. with material movements in the protection zone, material discharge or process controlled material movement). The changeable object blanking causes a reduction in the effective resolution, the effective resolution has to be taken into consideration for the determination of the safety distance.

If a system has a physical resolution of 14 mm, the effective resolution is reduced to 34 mm with changeable object blanking of 2 beams. The effective resolution is to be permanently and visibly marked on an information sign on the receiver.

Resolution 14 mm		
Beams blanked	**Physical Resolution**	**Effective resolution**
1	14 mm	24 mm
2	14 mm	34 mm

Resolution 30 mm		
Beams blanked	**Physical Resolution**	**Effective resolution**
1	30 mm	48 mm
2	30 mm	68 mm

Resolution 35 mm		
Beams blanked	**Physical Resolution**	**Effective resolution**
1	35 mm	64 mm
2	35 mm	94 mm

Blanking of one/two beams is selected with parameters P3/P4. See section Parameter setting.

Perform a new calculation of the safety distance with the effective resolution. Adjust the safety distance in accordance with your calculation.

The Standard IEC/TS 62046 describes the measures that may be necessary to protect persons from hazards due to protected areas that are blanked.

Display
Blanking of objects with one/two beams is displayed when the system starts, by three/four pulses of the signal light.

2.8.5 Blanking changeable objects (only SLG240COM)
The AOPD can blank changeable objects with one beam in the protection zone.

The changeable object blanking is not bound to a position in the protection zone. The first beam (with connector end cap) cannot be blanked.

This function allows a beam interruption without switching off the safety outputs (e.g. with material movements in the protection zone, material discharge or process-controlled material movement).

Blanking of one beam is selected with parameter P3.
See section Parameter setting.

- Changeable object blanking with the SLG240COM not possible with just 2 beams.
- Blanking of a maximum of one beam in SLG240COM with 3 or 4 beams is possible provided the protective function is taken into account.
- The protection zone should be checked after the configuration, the protection zone must be confirmed (recognition of a person).
- The Standard IEC/TS 62046 describes the measures that may be necessary to protect persons from hazards due to protected areas that are blanked.

Display
Blanking of objects with one beam is displayed when the system starts with three pulses of the signal light.

2.8.6 Series-wiring of two systems

With the 240COM range, series-wiring of two systems is possible.
See circuit diagram in chapter 4.2 (circuit diagram SLC/SLG240COM - series-wiring).

While the emitter is configured as master or slave by connection of pin 4 (SLAVE), the receiver should be configured as a master (P5) or slave (P6) by means of parameter selection.

The reaction time until deactivation of both safety switch outputs is the sum of the reaction time of master and slave:

Protection field	Adjustment	Response time
up to 47 beams	Master	10 ms
up to 47 beams	Slave	15 ms
48 to 144 beams	Master	20 ms
48 to 144 beams	Slave	27 ms
145 to 192 beams	Master	28 ms
145 to 192 beams	Slave	40 ms

Series-wiring is only possible in protection/automatic operating mode. Before selecting master/slave, it may be necessary to deactivate an active restart interlock using parameter P1.

For series-wiring, one emitter/receiver pair must be configured as a master and the other emitter/receiver pair must be configured as a slave. Non-observance may result in mutual optical interference. The safety function is no longer assured.

The control system must always consider both safety outputs, OSSD1 and OSSD2.
Evaluation of one OSSD alone is not permissible.

This operating mode may only be chosen in conjunction with the restart interlock (manual reset) of the machine. This operating mode must not be chosen, when persons can step behind the protection field.

Following configuration, the system must be checked thoroughly.
See section set-up and maintenance.

Display

Configuration as master/slave is displayed with five/six pulses of the signal light when the system starts.

2.8.7 Parameter setting

In parameter setting mode, individual adaptation of the operating parameters can be carried out on the receiver.

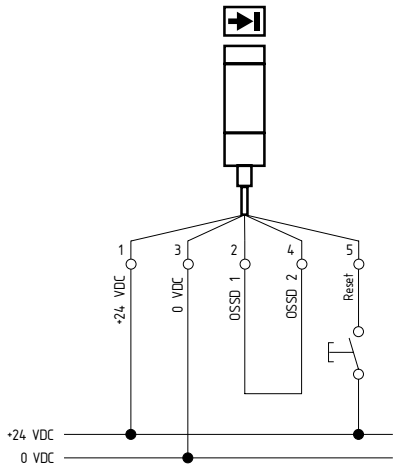
No.	Option	Description
P1	active / not active	active = restart interlock not active = protection / automatic mode
P2	active / not active	Blanking non-changeable objects with moveable edges, TEACH-IN
P3	active / not active	Blanking of changeable objects with one beam
P4	active / not active	Blanking of changeable objects with two beams
P5	active / not active	Master with series-wiring
P6	active / not active	Slave with series-wiring

Parameter setting with adapter cable KA-0896

- Switch the supply voltage off.
- Connect the adapter cable to the device.
- Press and hold the integrated button and switch the supply voltage on. The button can be released as soon as the indicator of the emitter changes from red to magenta or cyan.
- The status of parameter 1 is now indicated. The signal lamp pulses once in magenta (parameter is not active) or cyan (parameter is active).
- Press the button briefly to change to the next parameter. The number of light impulses indicates the parameter number. The colour indicates the parameter status (magenta = not active, cyan = active).
- Press and hold the button (2.5 seconds < T < 6 seconds) and the status of the current parameter changes from ACTIVE to NOT ACTIVE or from NOT ACTIVE to ACTIVE. While the button is pressed, the indicator changes after 1.5 seconds to the colour of the current status. Pressing and holding the button longer T > 2.5 seconds indicates the colour of the new status. The button can now be released to save. If the button is pressed and held for longer than 6 seconds, the indicator goes out and the change is not accepted.
- To exit the parameter setting function, switch off the supply voltage and restore the original wiring.

Parameter setting with 5-pin connection cable without adapter cable KA-0896

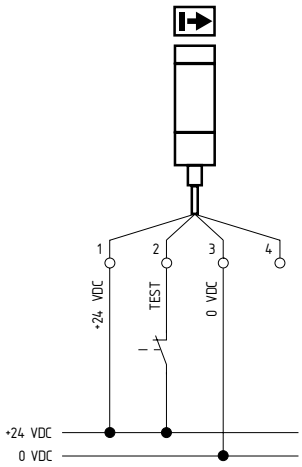
Alternatively the parameter setting can be performed with a command device (pushbutton) as follows:



- Switch the supply voltage off.
- Connect OSSD1 with OSSD2.
- Connect a pushbutton between input "Reset" and +24V.
- Press the pushbutton while switching on the supply voltage on. The button can be released as soon as the indicator of the emitter changes from red to magenta or cyan.
- For the parameter setting, follow the instructions as described in the section "Parameter setting with adapter cable KA-0896".

2.8.8 Test input on emitter

The emitter is equipped with a test input that enables a higher level safety monitoring module to perform a regular function check. If no external test is required, the test input (pin 2) must be connected to +24V.



A test should be performed as follows:

- Test input is HIGH, AOPD is in protection mode, OSSDs are in ON state.
- Test input is switched to LOW, test is triggered, OSSDs switch to OFF state.
- When the safety monitoring module detects the OFF state, the test input is set back to HIGH and restarting of the OSSDs is monitored.
- If the complete test takes longer than 150 ms, the safety monitoring module must activate a restart interlock.

Reaction times with standard configuration and master configuration:

Protection field	Deactivation delay	Activation delay
up to 47 beams	20 ms	50 ms
48 to 144 beams	35 ms	97 ms
145 to 192 beams	50 ms	129 ms

Reaction times with slave configuration:

Protection field	Deactivation delay	Activation delay
up to 47 beams	25 ms	70 ms
48 to 144 beams	45 ms	125 ms
145 to 192 beams	65 ms	178 ms

If the emitter is operated without external test, the test input (pin 2) must be connected to +24V. Emitter and receiver run cyclical tests autonomously.

The external test may only be carried out if the machine is not in a dangerous state. If the AOPD does not respond as expected (OSSDs on receiver do not follow test signal), the higher level control system must ensure deactivation.

Function tests that exceed a test duration of 150 ms must be safeguarded with a restart interlock by the higher level safety monitoring module.

2.8.9 Self-test

The AOPD carries out a self-test within 2 seconds after the power supply is applied. In the event of a fault, the AOPD locks out in a secure OFF state and indicates a fault (see section Fault diagnosis).

After a successful self-test, and with an unobstructed protection zone, the AOPD switches to the ON state (Automatic mode).

During operation, the system executes a cyclic self-test.
Safety relevant faults are detected within the response time, and result in an OFF state lock-out and fault indication.

3. Mounting

3.1 General conditions

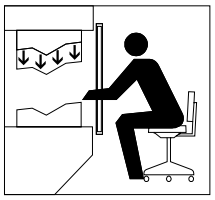
The following guidelines are provided as preventive warning notices to ensure a safe and appropriate handling. These guidelines are an essential part of the safety instructions and must therefore always be observed and respected.

- The AOPD must not be used on machines which cannot be stopped electrically in case of emergency.
- The safety distance between the AOPD and a hazardous machine movement must always be observed.
- Additional mechanical safety guards must be installed so that the operator has to pass by the protection field to reach the hazardous machine parts.
- The AOPD must be installed so that the personnel always must be within the detection zone when operating the machine. An incorrect installation can lead to serious injuries.
- Never connect the outputs to +24VDC. If the outputs are wired to +24VDC, they are in ON state, as a result of which they are unable to stop a hazardous situation occurring on the application/machine.
- The safety inspections must be conducted regularly.
- The AOPD must not be exposed to flammable or explosive gasses.
- The connecting cables must be connected in accordance with the installation instructions.
- The fixing screws of the mounting brackets must be firmly tightened.

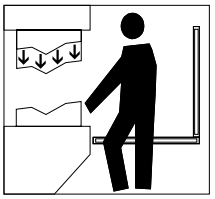
3.2 Protection field and approach

The protection field of the AOPD consists of the area between the protection field markings of emitter and receiver. Additional protection devices must ensure that the operator has to pass through the protection zone to reach hazardous machine parts.
The AOPD must be installed in such a way that personnel are always within the detection zone of the safety device during operation of hazardous machine parts.

Correct installation

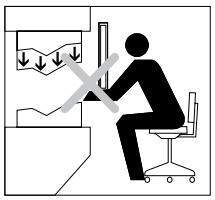


Hazardous machine parts can only be reached after passing through the protection field.

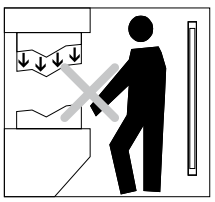


The presence of staff members between the protection field and hazardous machine parts must be prevented/avoided (protection against stepping over).

Unauthorised installation



Hazardous machine parts can be reached without passing through the protection field.



The presence of staff members between the protection field and hazardous machine parts is possible.

3.3 Aligning the sensors

Procedure:

- Emitter and receiver must be fitted parallel to each other and at the same height.
- First turn the emitter and then the receiver so that the front covers are opposite each other, and until the integrated signal lamp lights up green (automatic mode) or yellow (restart interlock mode).
- For the first five minutes after power-up, the display responds as described in the section Alignment aid and indicates the signal strength by means of pulses with various frequencies in the colours green (automatic mode) or yellow (restart interlock mode).
- Adjust the emitter and receiver so that they are in the middle of the angular range for a green or yellow indication. Fix the position with the two screws for each mounting bracket.

3.4 Alignment mode

In this operating mode, the signal strength is indicated by yellow light pulses on the indicator; the safety switch outputs OSSD always remain in the OFF state. The better the alignment, the higher the frequency of the light pulses. Alignment is optimal when the pulsed signal switches over to continuous light. If there is no optical synchronisation between the emitter and the receiver, a light pulse is emitted every three seconds.

Activating alignment mode with 5-pin cable connection

Apply a voltage of +24V on the "Reset" input for at least 2 seconds when the system starts (e.g. by pressing the reset pushbutton). The receiver unit starts in alignment mode. The pushbutton can be released as soon as the indicator changes from red to yellow.

If master/slave series-wiring is active, the alignment mode cannot be activated with +24V at the "Reset" input. Alternatively activate with +24V at OSSD 1.

Activating alignment mode with 4-pin cable connection

If +24V is applied for at least 2 seconds at the "OSSD 1" output during power-up, the receiver unit starts in alignment mode.

If alignment mode is to be activated with 24V at OSSD 1, the outputs OSSD 1 and OSSD 2 must not be connected to the machine or the machine controls.

To exit alignment mode, switch the supply voltage off and restore the original wiring.

Display

Yellow indicator	Signal status
static ON	best possible
pulses at 10 Hz	good
pulses at 2 Hz	adequate
1 Hz	signal strength too low (signal reserve, contamination)
1 pulse every three seconds	no signal

3.5 Display of signal strength

The signal strength is evaluated in operation. If it is too low, a signal pulse is indicated every 5 seconds (green in colour). If this status is indicated, check the front cover of the emitter and receiver for contamination and damage or check the alignment.
If a suitable signal strength is present, no status is displayed.

3.6 Safety distance

The safety distance is the minimum distance between the protection zone of the AOPD and the hazardous area. The safety distance must be observed to ensure that the hazardous area cannot be reached before the hazardous movement has come to standstill.

Calculation of the safety distance to EN ISO 13855 and EN ISO 13857

The safety distance depends on the following factors:

- Stopping time of the machine (calculation by run-on time measurement)
- Response time of the machine and the AOPD and the downstream safety-monitoring module (entire safety guard)
- Approach speed
- Resolution of the AOPD

Safety light curtain SLC240COM

The safety distance for resolutions 14 mm up to 40 mm is calculated by means of the following formula.

(1) S = 2 mm/ms * T + 8 (d - 14) [mm]

S = Safety distance in mm
T = Total response time in ms (machine run-on time, response time of the safety guard, relays, etc.)
d = Resolution of the AOPD in mm

The approach speed is covered with a value of 2 mm/ms. If after calculating the safety distance the value is S ≤ 500 mm, then use the calculated value S.

If value S >= 500 mm, recalculate the distance:

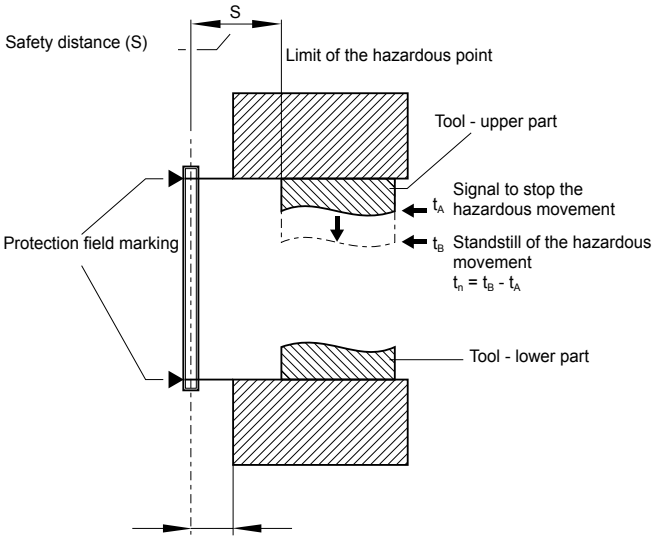
(2) S = 1.6 mm/ms * T + 8 (d - 14) [mm]

If the new value is S > 500 mm, then use the calculated value S as the safety distance.
If the new value S < 500 mm, use a minimum distance of 500 mm.

Example:
Response time of the safety light curtain = 10 ms
Resolution of the safety light curtain = 14 mm
Stopping time of the machine = 330 ms

S = 2 mm/ms * (330 ms + 10 ms) + 8(14 mm - 14 mm)
S = 680 mm
S = > 500 mm, therefore new calculation with V = 1.6 mm/ms
S = 544 mm

Safety distance to the hazardous area



≤ 75 mm = max. distance for protection against stepping over
To prevent persons from stepping over the protection field this dimension must be imperatively respected and observed.

Calculation of the safety distance for the multi-beam light grid SLG240COM

S = (1.6 mm/ms * T) + 850mm

S = Safety distance in mm
T = Total response time in ms (machine run-on time, response time of the safety guard, relays, etc.)
K = approach speed 1.6 m/s (= 1.6 mm/ms)
C = Safety supplement 850 mm

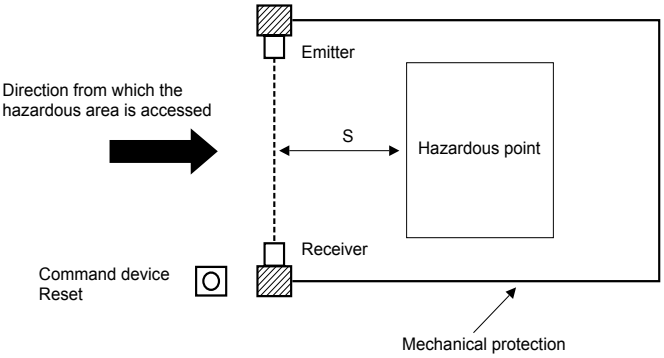
Example
Reaction time of the SLG240COM = 10 ms
Stopping time of the machine T = 170 ms

S = 1.6 mm/ms * (170 ms + 10 ms) + 850 mm
S = 1138 mm

The following mounting heights must be observed:

Number of beams	Mounting height above reference floor in mm
2	400, 900
3	300, 700, 1100
4	300, 600, 900, 1200

Safety distance to the hazardous area



The formulae and calculation examples are related to the vertical set-up (refer to drawing) of the AOPD with regard to the hazardous point. Please observe the applicable harmonised EN standards and possible applicable national regulations.

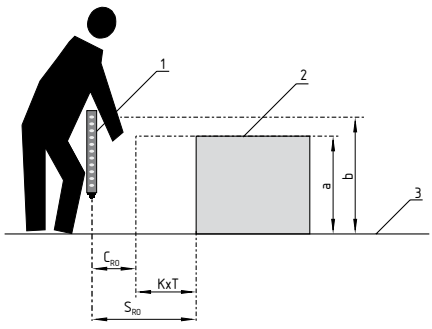
The safety distance between the AOPD and the hazardous point must always be respected and observed. If a person reaches the hazardous point before the hazardous movement has come to a standstill, he or she is exposed to serious injuries.

To calculate the minimum distances of the safety guards with regards to the hazardous point, the EN ISO 13855 must be observed.
If an **overlap of the protection field** is possible, take care with the calculation of the safety distance referring to additional CRO according to the table A1 as per norm EN ISO 13855.

The norm EN ISO 13855 defines two types of safety distances,
- Access **through** the protection area with an additional distance C, according to the resolving power
- Access **over** the protection area with an additional distance C_{RO} according to table 1

If it is possible to reach through the hazardous area (vertical alignment) then both values C and C_{RO} have to be determined. The larger of the two values is to be used for calculating the safety distance. Calculating the safety distance with CRO:

S_{CRO} = K x T + C_{RO}
K = Approach speed
T = Total response time (machine run-on time, response time of the safety guard, relays, etc.)
C_{RO} = Additional distance due to reaching through the hazardous area with parts of body, see table 1 for value



1 Safety sensor
2 Hazardous point
3 Floor
a Height of the hazardous point
b Height of the topmost beam of the safety sensor

Reaching through the protective area of a non-contact functioning guard system (extract EN ISO 13855)

Height of the hazardous point a [mm]	Height b of the upper edge of the protection area of the non-contact functioning guard system Additional distance C_{RO} to the hazardous area [mm]											
	900	**1000**	**1100**	**1200**	**1300**	**1400**	**1600**	**1800**	**2000**	**2200**	**2400**	**2600**
2600	0	0	0	0	0	0	0	0	0	0	0	0
2500	400	400	350	300	300	300	300	300	250	150	100	0
2400	550	550	550	500	450	450	400	400	300	250	100	0
2200	800	750	750	700	650	650	600	550	400	250	0	0
2000	950	950	850	850	800	750	700	550	400	0	0	0
1800	1100	1100	950	950	850	800	750	550	0	0	0	0
1600	1150	1150	1100	1000	900	850	750	450	0	0	0	0
1400	1200	1200	1100	1000	900	850	650	0	0	0	0	0
1200	1200	1200	1100	1000	850	800	0	0	0	0	0	0
1000	1200	1150	1050	950	750	700	0	0	0	0	0	0
800	1150	1050	950	800	500	450	0	0	0	0	0	0
600	1050	950	750	550	0	0	0	0	0	0	0	0
400	900	700	0	0	0	0	0	0	0	0	0	0
200	600	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0

Schedule 1

a = Height of the hazard spot [mm]
b = Height of the upper edge of the protection area of the AOPD
C_{RO} = Additional distance to the hazardous area [mm]

Determination of the additional distance C_{RO} from the table:

1) Locate the height of the upper edge of the hazardous area **a** (left table column)
2) Locate the height of the protection area **b** (upper table row)
3) C_{RO} is to be taken from the crossing point of both exes

If the known value for **a** and **b** is between the table values, the next higher value is to be used.

Example: Calculation of the safety distance, vertical installation
Total response time T = 220 ms, resolving capability d = 30 mm, height of the hazardous area 1400 mm, height of the protection area above the floor 1600 mm

S = K * T + C = 2 mm/ms * 220 ms + 8 (30 -14) = 568 mm
(S > 500 mm, following K = 1.6 mm/ms)

S = K * T + C = 1.6 mm/ms * 220 ms + 8 (30 -14) = **480 mm**
(S < 500 mm, following S = 500 mm) **S = 500 mm**

Safety distance C_{RO}

S_{CRO} = K x T + C_{RO} = 1.6 mm/ms x 220 ms + 650 mm = **1002 mm**

S_{CRO} > S i.e.

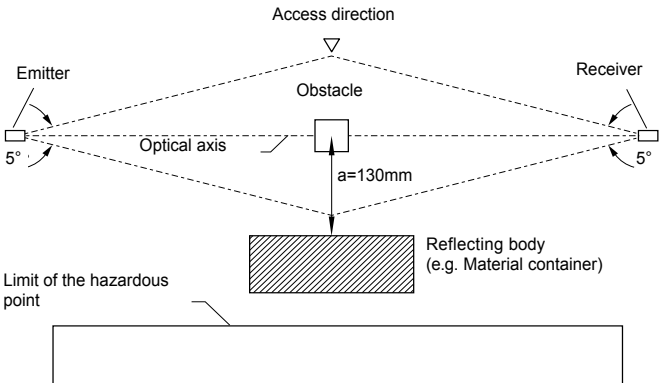
Safety distance **S = 1002 mm**

If the safety distance of 1002 mm is too large for the application, the protection field height can be increased from 1600 mm to 1800 mm, this makes the value C_{RO} = 0 mm (table 1).

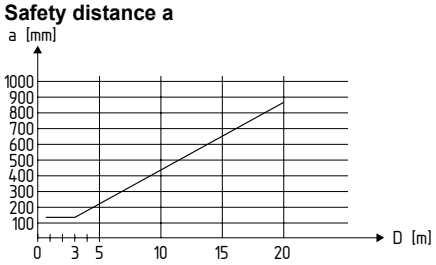
Result: By adjusting the protection field height to the value 1800 mm above the floor results in a safety distance: **S = 500 mm**

3.6.1 Minimum distance to reflecting surfaces

During the installation, the effects of reflecting surfaces must be taken into account. Faulty installation can lead to an interruption in the protective field not being detected, which could result in serious injuries. The hereafter-specified minimum distances with regard to reflecting surfaces (metal walls, floors, ceilings or parts) must be imperatively observed.



Safety distance a



Calculate the minimum distance to reflecting surfaces as a function of the distance with an aperture angles of ± 2.5° degrees or use the value from the table below:

Distance between emitter and receiver [m]	Minimum distance a [mm]
0.3 … 3.0	130
4	175
5	220
7	310
10	440
12	530

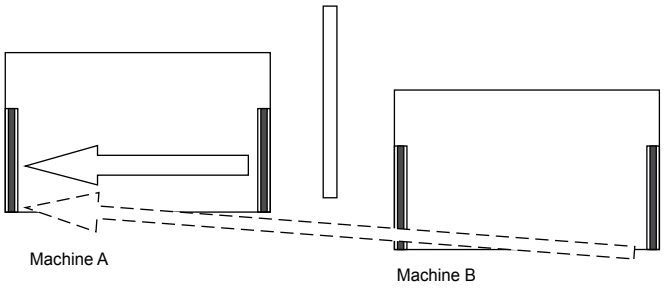
Formula: a = tan 2.5° x L [mm]

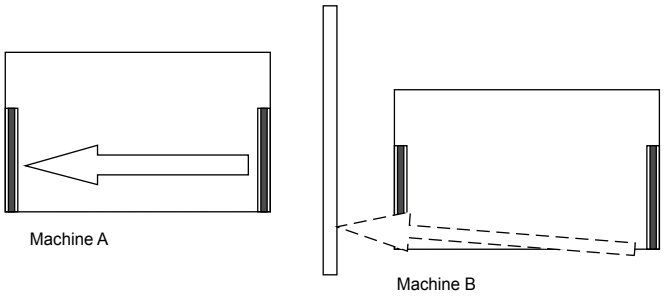
a = Minimum distance to reflecting surfaces
L = Distance between emitter and receiver

3.7 Mounting

The AOPD must be mounted in such a way that it is not possible for a AOPD to influence adjacent systems.

If two or more applications are arranged so that mutual interference is possible, this should be eliminated using a partition.



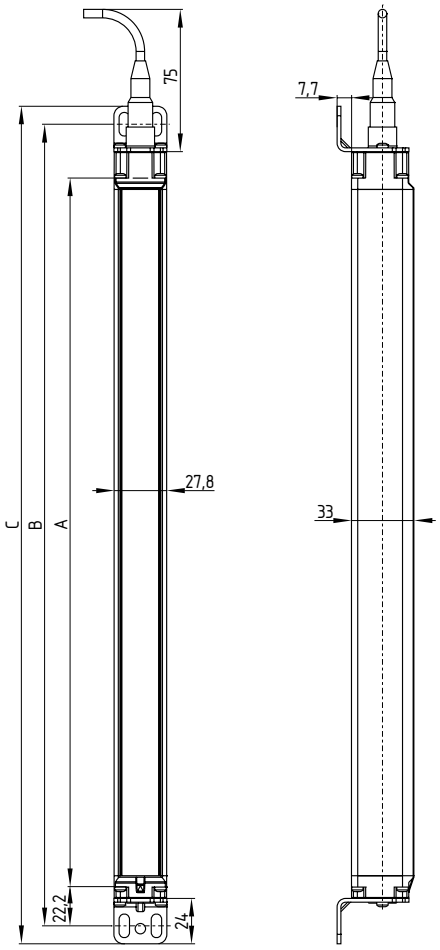


⚠ Mutual interference of the sensors is to be prevented through appropriate installation.

3.8 Dimensions

3.8.1 Dimensions emitter and receiver SLC240COM

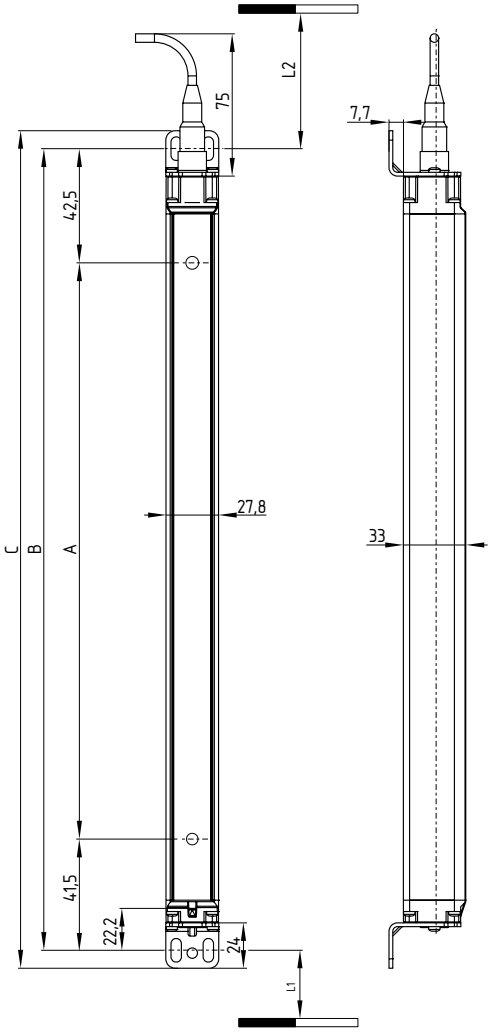
All measurements in mm.



Type	A Protected height ± 1	B Mounting dimension ± 1	C Total length ± 1
SLC240COM-ER-0330-XX	330	384	403
SLC240COM-ER-0410-XX	410	464	483
SLC240COM-ER-0490-XX	490	544	563
SLC240COM-ER-0570-XX	570	624	643
SLC240COM-ER-0650-XX	650	704	723
SLC240COM-ER-0730-XX	730	784	803
SLC240COM-ER-0810-XX	810	864	883
SLC240COM-ER-0890-XX	890	944	963
SLC240COM-ER-0970-XX	970	1024	1043
SLC240COM-ER-1050-XX	1050	1104	1123
SLC240COM-ER-1130-XX	1130	1184	1203
SLC240COM-ER-1210-XX	1210	1264	1283
SLC240COM-ER-1290-XX	1290	1344	1363
SLC240COM-ER-1370-XX	1370	1424	1443
SLC240COM-ER-1450-XX	1450	1504	1523
SLC240COM-ER-1530-XX	1530	1584	1603
SLC240COM-ER-1610-XX	1610	1664	1683
SLC240COM-ER-1690-XX	1690	1744	1763
SLC240COM-ER-1770-XX	1770	1824	1843
SLC240COM-ER-1850-XX	1850	1904	1923
SLC240COM-ER-1930-XX	1930	1984	2003

3.8.2 Dimensions emitter and receiver SLG240COM

All measurements in mm.



Type	A Beam distance	B Mounting dimension	C Total lenght	L1	L2
SLG240COM-ER-0500-02	500	584	603	358.5	357.5
SLG240COM-ER-0800-03	400	884	903	258.5	257.5
SLG240COM-ER-0900-04	300	984	1003	258.5	257.5

L1 = Mounting distance (mm) between floor and slotted hole centre (short end cap)
L2 = Mounting distance (mm) between floor and slotted hole centre (diagnostic window)

The overall length Ls (dimension end cap with regard to the cable connection up to the connector M12) of the sensors is calculated in the following way:

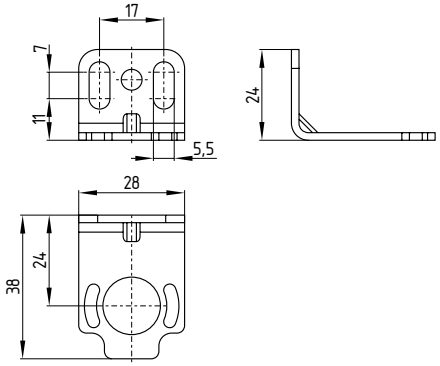
Ls = size B - 13 mm

Example: SLC240COM-ER-0970-xx
Ls = 1024 - 13 = 1011 mm

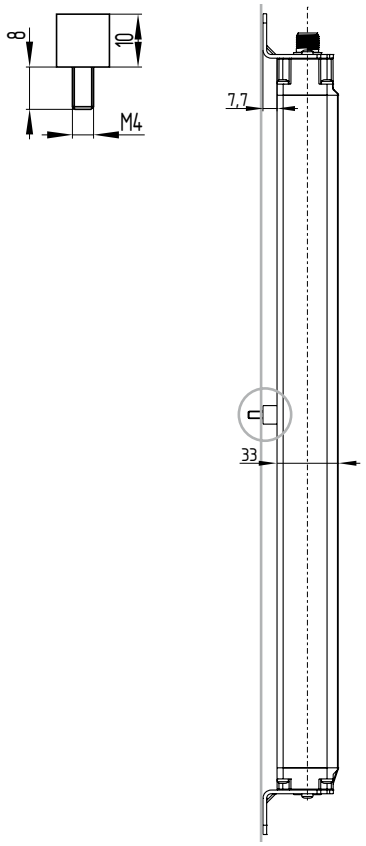
3.9 Fixing

3.9.1 Accessories included in delivery

Mounting kit MS-1100
The mounting kit consists of four steel brackets and eight fixing screws (Torx plus 10IP).

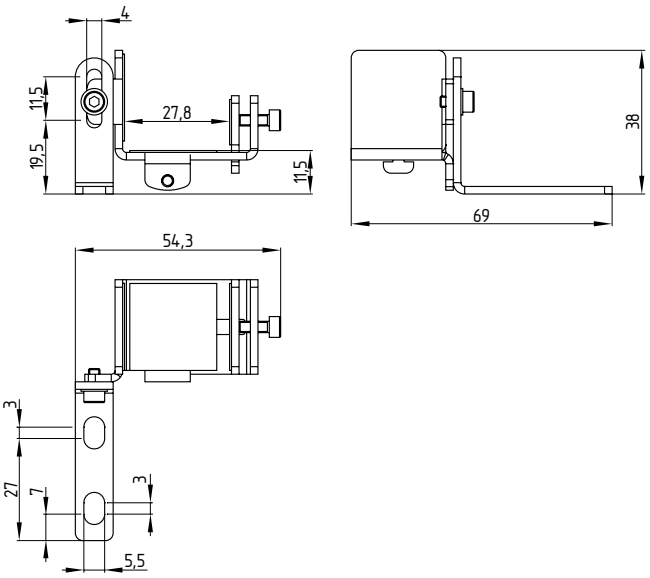


MSD5 spacer
The set comprises two spacers and is included in the delivery from a protection field height of 1050 mm. The spacers must be used in case of vibrations.



3.9.2 Optional accessories

Centre support MS-1110
The mounting kit consists of two steel brackets and four spacers for central fixing.



Connecting cable for emitter / receiver (4-pole)

Item Number	Designation	Description	Length
101207741	KA-0804	Female connector M12, 4-pole	5 m
101207742	KA-0805	Female connector M12, 4-pole	10 m
101207743	KA-0808	Female connector M12, 4-pole	20 m

Connecting cable for receiver (5-pole)*

Item Number	Designation	Description	Length
101209949	A-K5P-M12-S-G-5M-BK-2-X-A-1	Female connector M12, 5-pole	5 m
101209948	A-K5P-M12-S-G-15M-BK-2-X-A-1	Female connector M12, 5-pole	15 m

* For use in restart interlock mode or, if required, for adapting the operating parameters (parameter setting)

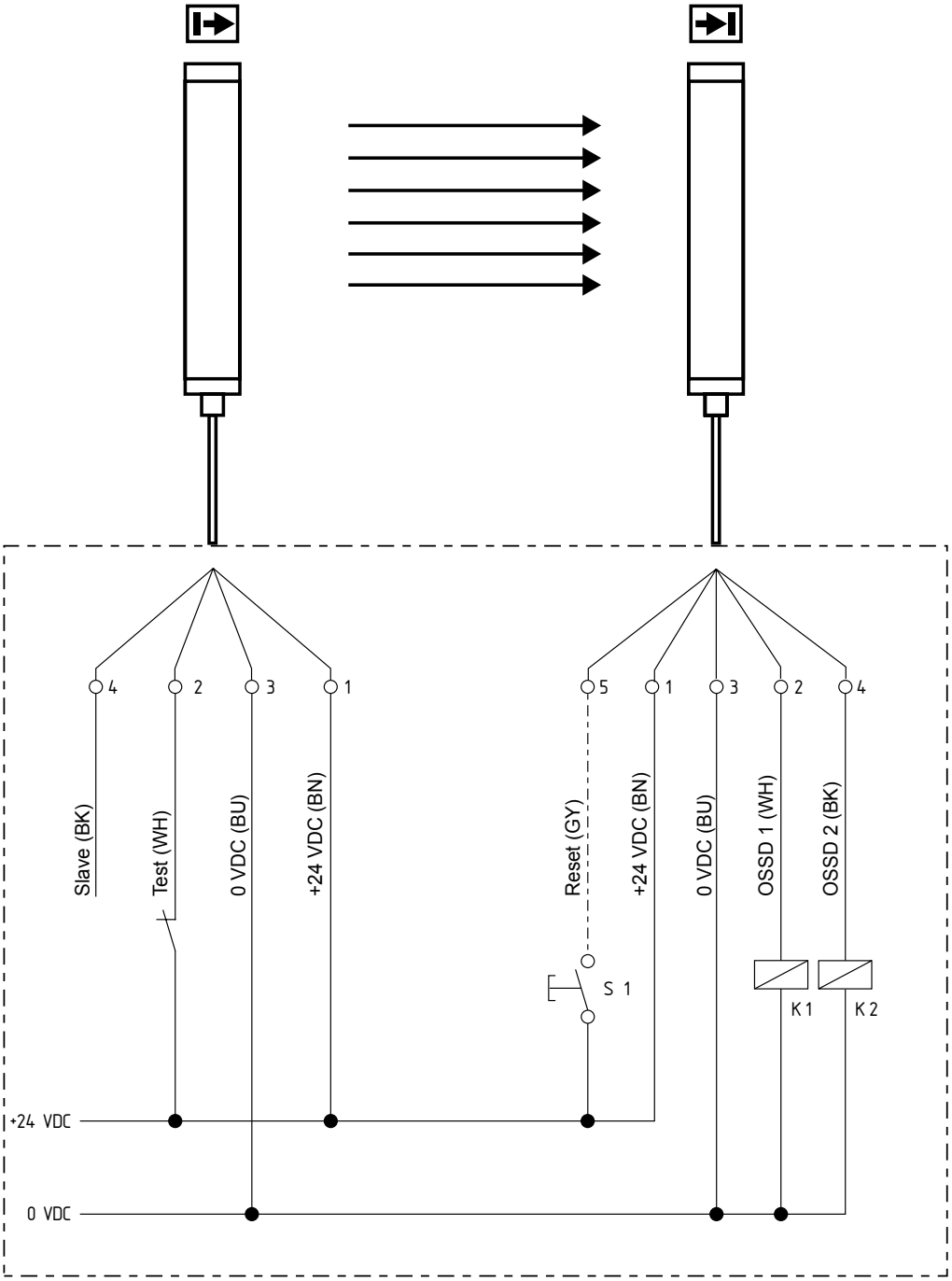
Test rod PLS
The test rod is used for testing the protection field.

MSD4 Vibration damper
The set comprises: eight 15 x 20 mm vibration dampers, eight M5 cylinder head screws with hexagon socket head, eight spring washers. Assembly with MS-1100.

The MSD4 vibration damper kit is recommend to be used for damping vibrations and oscillations on the AOPD. For applications with higher mechanical stresses, e.g. presses, punching machines, we recommend the MSD4 kit. In this way, the availability of the AOPD is increased.

4. Rear side Electrical connection

4.1 Wiring example SLC/SLG240COM

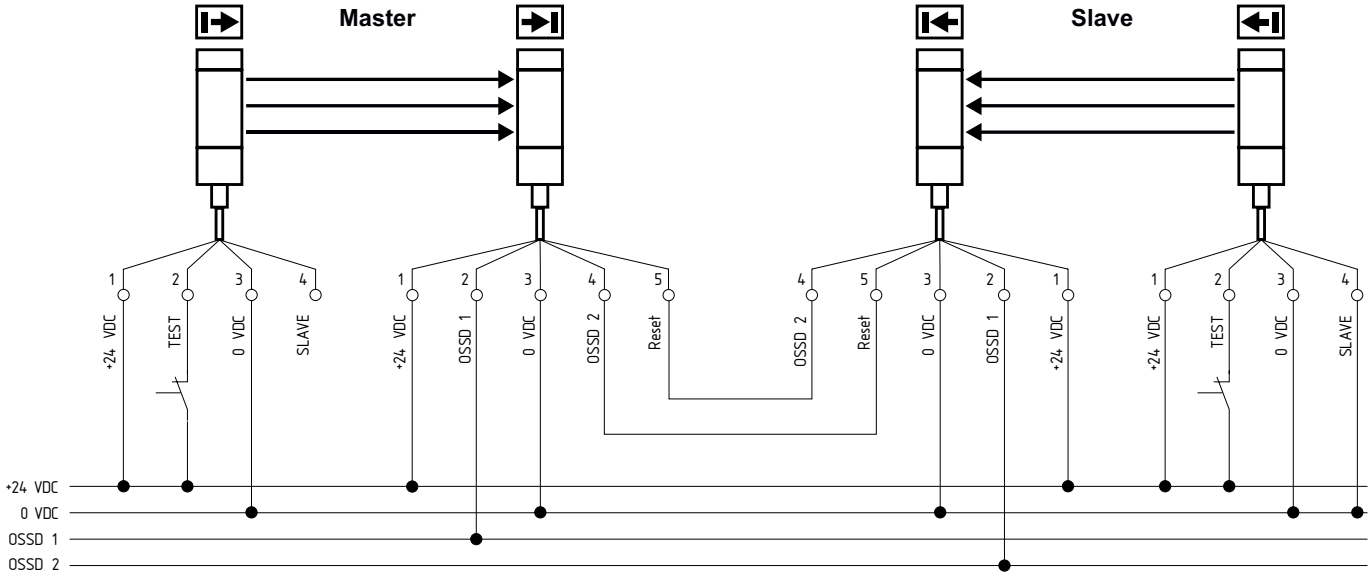


Protective mode / Automatic active:
Delivery state (Pushbutton S1 not connected)

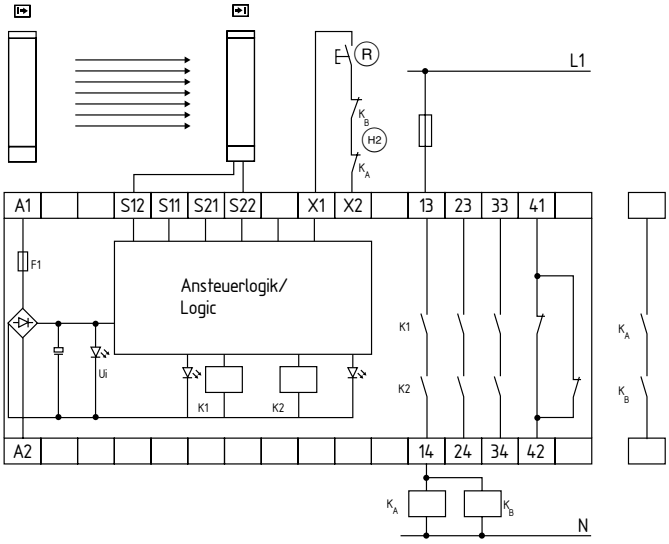
Restart Interlock (manual reset) active:
Refer to the chapter: operating mode activate restart interlock (Pushbutton S1 connected)

K1, K2:	Relay for processing the switching outputs OSSD 1, OSSD 2
S1:	Pushbutton for restart (optional)
Test:	Test input connected to +24VDC, self-test during operation

4.2 Circuit diagram SLC/SLG240COM – series-wiring



4.3 Wiring example with safety-monitor module

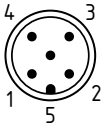


Key safety monitoring module

- Contactor control K_A and K_B at X1/X2
- Command device Ⓡ Restart interlock restart at X1/X2
- OSSD outputs at S12 and S22
- QS-switch = nQS, deactivate cross-wire short detection

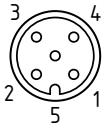
4.4 Connector configuration Receiver, Emitter & Cable

RECEIVER
SLC Connector
M12, 5-pole



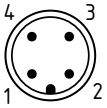
		Designation	Description
1	BN	24 VDC	Power supply
2	WH	OSSD 1	Safety output 1
3	BU	0 VDC	Power supply
4	BK	OSSD 2	Safety output 2
5	GY	Reset	Restart interlock (manual reset)

Cable: Connector
female M12, 5-pole



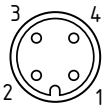
It is possible to use the Automatic operating mode with a 4-pole cable (without pin 5 restart interlock).

EMITTER
SLC Connector
M12, 4-pole



		Designation	Description
1	BN	24 VDC	Power supply
2	WH	Test	Test input
3	BU	0 VDC	Power supply
4	BK	Slave	Series wiring

Cable: Connector
female M12, 4-pole



The colour codes are only valid for the cable types mentioned below "optional accessories".

For UL evaluated products we do recommend to use the UL style cable 20549.

5. Set-up and maintenance

5.1 Check before start-up

Before commissioning, the following items must be checked by the responsible person.

Wiring check prior to start-up

1. The voltage supply is a 24V direct current power supply (see technical specifications), which meets the CE Directives, Low Voltage Directives. A power downtime of 20 ms must be bridged.
2. Presence of a voltage supply with correct polarity at the AOPD.
3. The connecting cable of the emitter is correctly connected to the emitter and the connecting cable of the receiver correctly to the receiver.
4. The double insulation between the connections of the OSSDs and an external potential is assured.
5. The outputs OSSD 1 and OSSD 2 are not connected to +24 VDC.
6. The connected switching elements (load) are not connected to +24 VDC.
7. If two or more AOPDs are used within close range to each other, an alternating arrangement must be observed. Any mutual optical interference of the systems must be prevented.

Switch the AOPD on and check the operation in the following way:
The component performs a system test for approx. 2 seconds after the operating voltage has been switched on. After that, the outputs are enabled if the protection field is not interrupted. The status indication at the receiver is on.

In case of incorrect functionality, please follow the instructions listed in the chapter Fault diagnostic.

5.2 Maintenance

Do not use the AOPD before the following inspection is terminated. An incorrect inspection can lead to serious and mortal injuries.

Conditions

For safety reasons, all inspection results must be archived. The operating principle of the AOPD and the machine must be known in order to be able to conduct an inspection. If the fitter, the planning technician and the operator are different persons, please make sure that the user has the necessary information at his disposal to be able conduct the maintenance.

5.3 Regular check

A regular visual inspection and functional test, including the following steps, is recommended:

1. Both sensors do not have any visible damage.
2. The optics cover is not scratched or soiled.
3. Hazardous machinery parts can only be accessed by passing through the detection zone of the AOPD.
4. The staff remains within the detection area, when works are conducted on hazardous machinery parts.
5. The safety distance of the application exceeds the mathematically calculated one.

Operate the machine and check whether the hazardous movement stops under the hereafter mentioned circumstances.

1. Hazardous machine parts do not move when the protection field is interrupted.
2. The hazardous machine movement is immediately stopped, when the protection field is interrupted with the test rod immediately before the emitter, immediately before the receiver and in the middle between the emitter and the receiver.
3. No hazardous machine movement when the test rod is within the protection field.
4. The hazardous machine movement comes to standstill, when the voltage supply of the AOPD is switched off.

5.4 Half-yearly inspection

The following items must be checked every six months or when a machine setting is changed.

1. Machine stops or does not inhibit any safety function.
2. No machine modification or connection change, which affects the safety system, has taken place.
3. The outputs of the AOPD are correctly connected to the machine.
4. The total response time of the machine does not exceed the response time calculated during the first putting into operation.
5. The cables, the connectors, the caps and the mounting angles are in perfect condition.

5.5 Cleaning

If the optics cover of the sensors is extremely soiled, the OSSD outputs can be disabled. Clean with a clean, soft cloth with low pressure.
The use of agressive, abrasive or scratching cleaning agents, which could attack the surface, is prohibited.

6. Diagnostic

The receiver is equipped with an integrated signal light in the transparent end cap. The signal light indicates the operating status or, in the event of a fault, a fault code.

6.1 Indication of configuration when system starts

Five seconds after the system starts, the receiver indicates the active operating parameters through a sequence of pulses. Here, the number of pulses represents the active parameters respectively. There is a break of two seconds each time the parameters are displayed.

Pulses	Status
2	P2: Blanking non-changeable objects with moveable edges
3	P3: Blanking of changeable objects with one beam
4	P4: Blanking of changeable objects with two beams
5	P5: Master with series-wiring
6	P6: Slave with series-wiring

When active operating parameters are displayed, only the number of pulses are relevant. The signal colour represents the active operating state.

6.2 Status display

Operating condition	Display	Description
OSSD ON	Green, static	Status of OSSD safety switch outputs is ON, protection field is clear.
OSSD OFF	Red, static	Status of OSSD safety switch outputs is OFF, the protection field is interrupted.
Restart interlock (manual reset)	Yellow, static	Restart interlock is active, protection zone is clear, enable signal expected.
Error	Red, pulses	Fault status, see section on fault indication
Parameter setting	Cyan, pulses Magenta, pulses	See section Parameter setting.
Alignment aid, indication of signal strength	Yellow, pulse Green, pulse	See section Alignment aid.
Display of signal strength	Green, one pulse for every 5 seconds	Signal strength not sufficient, see section Indication of signal strength

6.3 Fault diagnostic

If there is a fault, red stays on and the fault number is indicated by way of OFF impulses. The number of impulses indicates the number of the fault.

Fault no.	Fault feature	Action
1	Wiring fault	Check connection on receiver, see section Electrical connection.
2	Voltage fault in external power supply.	UB = 24V / DC ± 10%, power source and primary voltage check. The AOPD re-starts after a fault is indicated three times.
3	Voltage fault in safety output OSSD 1 or OSSD 2.	Check connections of both safety switch outputs for short circuit or connection to other signal sources (0V or 24V). Deactivate cross wire monitoring of downstream systems.
5	Fault in blanking of stationary objects	Check whether the blanked object was moved away from protection zone or whether the position was changed.
6	Incorrect configuration data	Repeat parameter setting
7	Internal fault during self-test and diagnosis.	Restart the system, exchange components if there is a permanent fault indication.

7. Disassembly and disposal

7.1 Disassembly

The safety switchgear must be disassembled in a de-energised condition only.

7.2 Disposal

The safety switchgear must be disposed of in an appropriate manner in accordance with the national prescriptions and legislations.

8. Appendix

8.1 Contact

Consultancy / Sales:
K.A. Schmersal GmbH & Co. KG
Möddinghofe 30
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Fax: +49 (0)2 02 - 64 74 - 100

You will also find detailed information regarding our product variety on our website: www.schmersal.com

Repair handling / shipping:
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9. EU Declaration of conformity

EU Declaration of conformity

SCHMERSAL

Original

Safety Control GmbH
Am Industriepark 2a
84453 Mühldorf / Inn
Germany

We hereby certify that the hereafter described components both in their basic design and construction conform to the applicable European Directives.

Name of the component:	SLC240COM SLG240COM	
Type:	See ordering code	
Description of the component:	Safety light curtain / safety light grid	
Relevant Directives:	Machinery Directive EMC-Directive RoHS-Directive	2006/42/EC 2014/30/EU 2011/65/EU
Applied standards:	EN 61496-1:2013, EN 61496-2:2013, EN ISO 13849-1:2015, EN 62061:2005 + A1:2013	
Notified body for the prototype test:	TÜV NORD CERT GmbH Langemarckstr. 20, 45141 Essen ID n°: 0044	
EC-prototype test certificate:	44 205 16019909	
Person authorised for the compilation of the technical documentation:	Oliver Wacker Möddinghofe 30 42279 Wuppertal	
Place and date of issue:	Mühldorf, July 10, 2017	

SLC-SLG240COM-A-EN

Authorised signature
Klaus Schuster
Managing Director

Authorised signature
Christian Spranger
Managing Director

The currently valid declaration of conformity can be downloaded from the internet at www.schmersal.net.

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