EN

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SG4-I

Safety Light Curtain

Operating instructions

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EN

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Due to the fact that they describe the operation of a safety device, these operating instructions are of a binding nature.

1. General

The SG4 light curtain system is a design-approved, electro-sensitive protection equipment (ESPE) in accordance with EN 61496-1. It's a class 4 Light Curtain, i.e. it's an ESPE for which the safety function remains intact even if several errors occur. Furthermore, it's a category 4 Safety Light Curtain, and is thus a self-testing safety device.
The light curtain system consists of a emitter module and a receiver module. A muting module and a relay unit are available as accessory equipment.

1.1 Function and Use for Intended Purpose

The light curtain monitors the safety field between the emitter and the receiver. If the safety field is penetrated by an obstruction, a switching command is triggered. This switching command may prevent initialization of a hazardous machine motion, or may stop an action which has already been started.
Use of the light curtain is only permissible if:

- Hazardous motion can be stopped by electrical means using the light curtain's safety output
- Adequate detection of possible obstruction is assured with existing resolution
- An application of Light Curtain of Category 4 is permissible.

1.2 Features

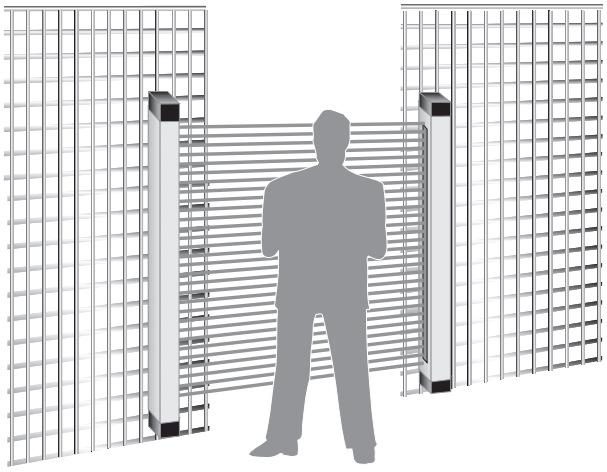
- Safety device per EN 61496-1
- TÜV approved
- Finger protection: 14 mm resolution, 7 m range
- Hand protection: 30 mm resolution, 20 m range
- Visible red light
- PNP semiconductor safety outputs
- PNP signal output
- Fix Blanking
- Floating Blanking
- Auto Floating Blanking
- Electronically reduced resolution
- Simple cascading
- Serial interface with visualization program
- Restart inhibit
- Monitoring of external relays
- Muting (optional)
- Relay unit (optional)
- Coding

1.3 Applications Examples

Safety protection at:

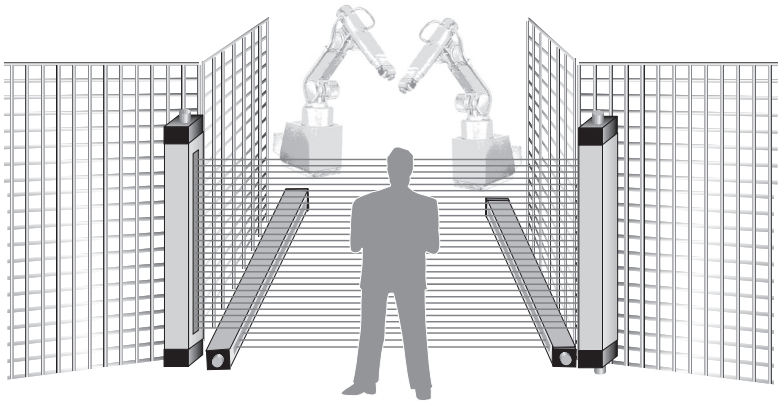
- Presses
- Saws
- Textile machinery
- Transfer lines, assembly lines
- Automatic insertion equipment
- Packaging machines
- Rotary indexing machines
- Woodworking machines

1.3.1 Single Curtain Protection



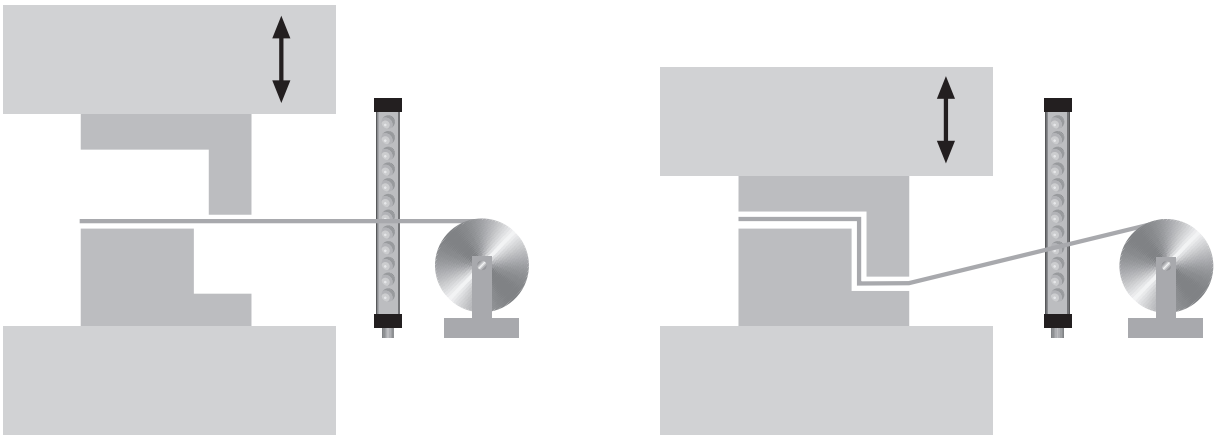
Example: securing an area

1.3.2 Cascading Two Light Curtains



Example: securing off an area plus side-stepping protection

1.3.3 Use at Brake Presses



Example: floating blanking

1.4 Brief Explanation of Function- and Operating Modes

Auto Floating Blanking
This operating mode is the same as Floating Blanking, except that in this case the object (for example a skid carrier or lifting forks) moves through and exits the safety field. The direction at which the object enters and exits the safety field, as well as its dwell time within the safety field, must be defined. Any other intrusions into the safety field cause the safety output to switch and stop hazardous motion.

Cascading
Safety devices can be series connected such that they all drive a single safety output in order to monitor several safety fields simultaneously. Cascaded safety devices demonstrate the same performance characteristics as a single safety device.

Contactor Monitoring
An operating mode for which switching performance of the contacts at an external relay is dynamically monitored. The contacts must close fully within a specified period of time.

Fix Blanking
This operating mode is required for applications including objects which continuously protrude into the safety field, thus interrupting specific light beams originating from the safety light curtain. Intrusions into any other point within the safety field cause the output to switch and stop hazardous motion.

Floating Blanking
This operating mode is the same as Fix Blanking, except that in this case the object (for example a cable or a cutting edge) is permitted to move within the safety field. Any other intrusions into the safety field cause the safety output to switch and stop hazardous motion.

Reduced Resolution
This function reduces the resolution electronically. Thus objects that are smaller than the selected resolution don't deactivate the safety output. The function can also be used to prevent machining chips from interfering with correct functioning of the safety light curtain.

Restart Inhibit
A function which prevents a machine from starting up automatically after it has been switched on. The machine can only be enabled by activating an acknowledgement key.

Safety Operating Mode
In this operating mode, the switching outputs are disabled when the safety field is penetrated. The switching outputs are automatically enabled after penetration of the safety field is ended.

Safety Output – OSSD (Output Signal Switching Device)
The output of the contactless safety device which is connected to the machine controls. The safety output is deactivated when the safety field is interrupted.

Signal Output
A semiconductor output for auxiliary functions without safety monitoring.

Start-Up Inhibit
This function is activated along with the „Restart Inhibit Function". When power supply is switched on (e.g. after a power failure), the safety outputs (OSSD) remain in the off state. Acknowledgement is accomplished by activating an acknowledgment key.

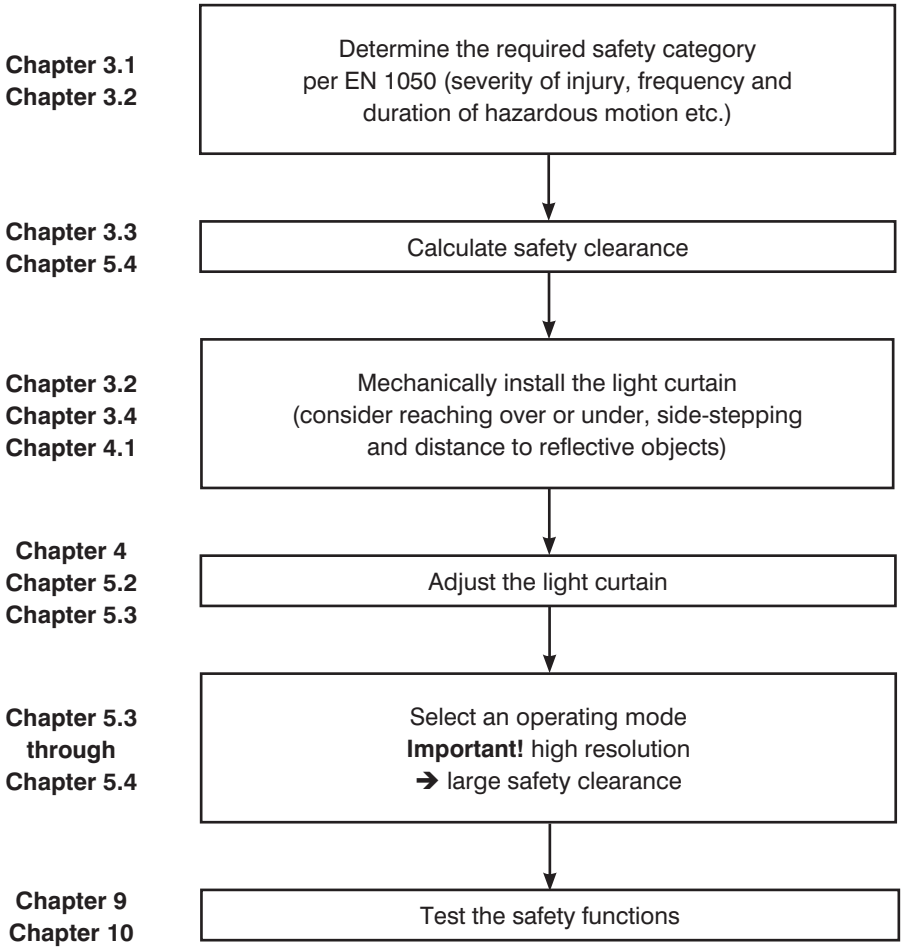
1.5 Explanation of symbols

Points up suggestion and tips, which simplify the handling of the safety light curtain.

Points at a measure to prevent a concrete danger.

Points at functions, which can only be configured by means of software (PC).

2. Initial Start-Up Flowchart



3. Important Notes Concerning Use

3.1 General Comments

The use of contactless safety devices is regulated by official directives. National and international regulations apply to the safe utilisation of contactless safety devices, in particular:

- EN standards
- Accident prevention regulations
- EC Machinery Directive
- Occupational health and safety requirements

ESPE may only be used at power operated machinery whose controls can be electrically influenced such that hazardous motion can be stopped immediately in all operating phases.

If other light beams occur in an application (e.g. infrared controllers, emission due to welding sparks or the effects of stroboscope light), additional measures may be necessary in order to assure that the ESPE does not fail in a dangerous mode.

Testing must be performed by an expert prior to initial start-up of ESPE. Testing must establish flawless interaction of the contactless safety device together with the controls of the power operated machinery, and correct installation in accordance with these safety precautions.

The cascading terminals on the sensor and the receiver may only be used to connect additional Safety Light Curtains. Connection of other power consumers is impermissible.

The following standards must be observed during use of the light curtain:

EN ISO 13855	Machine safety: arrangement of safety devices in consideration of approach speeds of body parts
EN ISO 12100	Machine safety: General design guidelines – risk assessment and risk minimization
EN ISO 13857	Machine safety: Safety distances to prevent hazard zones being reached by upper and lower limbs
EN 349	Machine safety: Minimum gaps to avoid crushing of parts of the human body
EN ISO 13850	Machine safety: emergency stop devices
EN ISO 14119	Machine safety: Interlocking devices associated with guards

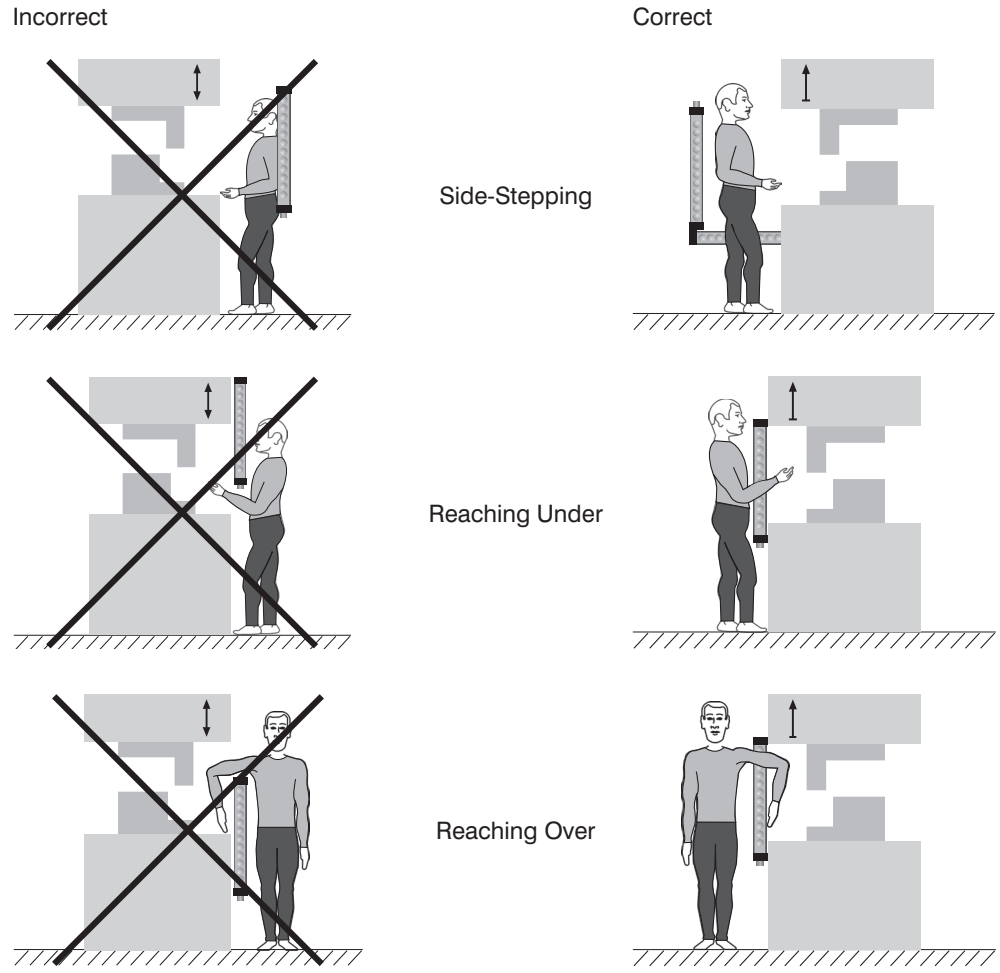
All specified data make reference to the following revision level: 17.10.2017

Technical changes to the product described herein, printing errors and/or any possible incompleteness of this product description may not be construed as cause for asserting any legal claims whatsoever against wenglor sensoric GmbH.

3.2 Securing the Danger Zone

The danger zone must be secured by means of the light curtain alone, or by means of the light curtain in combination with additional mechanical safety devices. Reaching around, over and/or under the safety field must be prevented in any case. It must be impossible to approach the point of danger without passing through the safety field.
The safety field is located between the line at which light is emitted at the emitter and the line at which light is received at the receiver. The boundaries of the safety field are identified on the devices.

Examples:



3.3 Calculating Safety Clearance per EN ISO 13855

Calculation of safety clearance S is based upon the EN ISO 13855 standard. However, if any special directives and standards apply to the respective machine, these must be taken into consideration as well. Each contactless safety device must be mounted such that stepping or reaching into the danger zone is precluded. If required, this may also be accomplished by means of additional, mechanical safety devices.

Safety clearance S is the minimum distance in mm, measured from the danger zone to the safety field, and is calculated as follows:

$$S = (K \times T) + C \quad \text{or} \quad S = K \times (t1 + t2) + C$$

S = minimum clearance in mm, measured from the danger zone to the safety field
K = approach speed in mm per second
T = total response time (t1 + t2) in seconds
t1 = light curtain response time in seconds
t2 = machine or process over-travel time in seconds
C = additional clearance depending upon resolution d in mm
d = resolution (is increased for operation with reduced resolution)

Over-Travel Time T

Due to the fact that interrupting the safety field during hazardous motion does not result in immediate stopping of the machine, over-travel time T must be taken into consideration. **The distance between the safety field and the point of danger must thus be large enough to assure that the point of danger cannot be reached until hazardous motion has come to a standstill.**

Total over-travel time T is the sum of maximum response time of the contactless safety device (t1) and maximum over-travel time of the hazardous motion (t2). Machine over-travel time must be determined by means of repeated measurement prior to initial start-up, and each time the machine is retooled (set up)

The response time of the ESPE depends upon the height of the safety field (see table).

Emitter (S) or Receiver (E) Type Designation	Field Height in mm	Number of Beams	Response Time in ms t1
SG4-14Ix015C1	164	21	6
SG4-14Ix030C1	314	42	11
SG4-14Ix045C1	464	63	16
SG4-14Ix060C1	614	84	21
SG4-14Ix075C1	764	105	26
SG4-14Ix090C1	914	126	31
SG4-14Ix105C1	1064	147	36
SG4-30Ix015C1	180	9	3,3
SG4-30Ix030C1	330	18	5,7
SG4-30Ix045C1	480	27	8,2
SG4-30Ix060C1	630	36	10,0
SG4-30Ix075C1	780	45	12,0
SG4-30Ix090C1	930	54	14,0
SG4-30Ix105C1	1080	63	16,0
SG4-30Ix120C1	1230	72	18,5
SG4-30Ix135C1	1380	81	20,4
SG4-30Ix150C1	1530	90	23,4
SG4-30Ix165C1	1680	99	25,8
SG4-30Ix180C1	1830	108	27,0

Approach/Reach-In Speed Constant K
Amongst other factors, safety clearance depends upon the maximum reach-in or walking speed of the person penetrating the safety field.

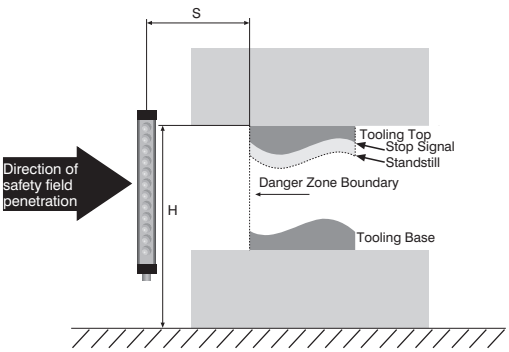
Safety Margin C
Safety margin C depends upon the respective resolution of the light curtain..

3.3.1 Direction of Approach to the Safety Field

3.3.1.1 Perpendicular Approach to the Safety Field

The following equations apply: **S = (K × T) + C** or **S = K × (t1 + t2) + C**

Resolution d	≤ 40 mm	> 40 mm < 70 mm	> 70 mm
Margin C	8 (d – 14 mm)	850 mm	850 mm
Reach-in speed K (per standard)	2000 mm/s at S ≤ 500 mm 1600 mm/s at S > 500 mm	1600 mm/s	1600 mm/s
Note		Height of the upper-most beam from the floor ≥ 900 mm Height of the lower-most beam from the floor ≤ 300 mm (≤ 200 mm for children)	Applicable standards for contactless safety devices with several individual beams must be observed



A minimum clearance of S = 100 mm must be maintained (resolution ≤ 14 mm)
A minimum clearance of S = 150 mm must be maintained (resolution ≤ 30 mm)

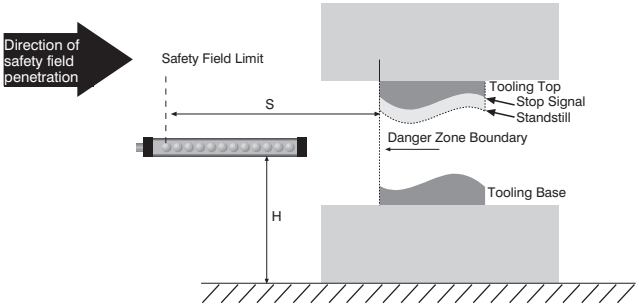
3.3.1.2 Parallel Approach to the Safety Field

If the light curtain is installed as shown in the figure below, the height of the safety field from the floor may not exceed 1000 mm. If H is greater than 300 mm, access to the danger zone from underneath the safety field may go undetected! In the case of children, undetected access may occur at a height of only 200 mm.

The lowest permissible safety field installation height H min depends upon the resolution of the safety light curtain, in order to assure reliable detection of a human leg or ankle

The following equations apply: **S = (K × T) + C** or **S = K × (t1 + t2) + C**

Reference height H	200 mm < H < 1000 mm if H > 300 access to the danger zone from underneath the safety field may go undetected!
Margin C	1200 mm – 0,4 × H Cmin ≥ 850 mm
Reach-in speed K	1600 mm/s
Minimum height Hmin	= 15 × (d – 50 mm)



Required safety light curtain resolution for any given height must thus be calculated as follows.

Resulting resolution d	= H/15 + 50 mm

A minimal clearance of S = 850 mm must be maintained.
Safety clearance is the distance between the danger zone and the light curtain beam which is farthest from the danger zone.

3.3.2 Sample Calculations

Example 1: Light curtain with a safety field height of 764 mm, **vertical installation**, 14 mm resolution

Assuming:	light curtain response time SG4-14Ix075C1	t1 = 26 ms
	machine over-travel time	t2 = 20 ms
	light curtain resolution	d = 14 mm
	approach speed	K = 2000 mm or 1600 mm/s

Safety clearance S = $K \times (t1 + t2) + C$, since light curtain resolution is < 40 mm is $C = 8 \times (d - 14\ mm)$

Safety clearance S = $K \times (t1 + t2) + 8 \times (d - 14\ mm) = 2000\ mm/s \times (0{,}026\ s + 0{,}02\ s) + 8 \times (14\ mm - 14\ mm)$
$= 92$ mm

Safety clearance S = $K \times (t1 + t2) + 8 \times (d - 14\ mm) = 1600\ mm/s \times (0{,}026\ s + 0{,}02\ s) + 8 \times (14\ mm - 14\ mm)$
$= 73{,}6$ mm

A safety clearance of 92 mm must be selected. Due to the fact that safety clearance is less than 500 mm, K = 2000 mm/s must be used for calculation purposes.

However, since both calculated safety clearances S are less than 100 mm, a minimum clearance of S = 100 mm applies

This example demonstrates that calculations must always be performed using both approach speeds!

Example 2: Light curtain with a safety field height of 764 mm, **horizontal installation**, 30 mm resolution

Assuming:	light curtain response time SG4-30Ix075C1	t1 = 12 ms
	machine over-travel time	t2 = 20 ms
	light curtain resolution	d = 30 mm (electronically reduced to 42 mm)
	approach speed	K = 1600 mm/s
	installation height	500 mm

Safety clearance S = $K \times (t1 + t2) + C$, height is decisive regarding C in this case: $\mathbf{C = 1200 - 0{,}4 \times H}$

Safety clearance S = $K \times (t1 + t2) + (1200 - 0{,}4 \times 500\ mm)$
$= 1600\ mm/s \times (0{,}012\ s + 0{,}02\ s) + (1200\ mm - 0{,}4 \times 500\ mm) = 1051{,}2$ mm

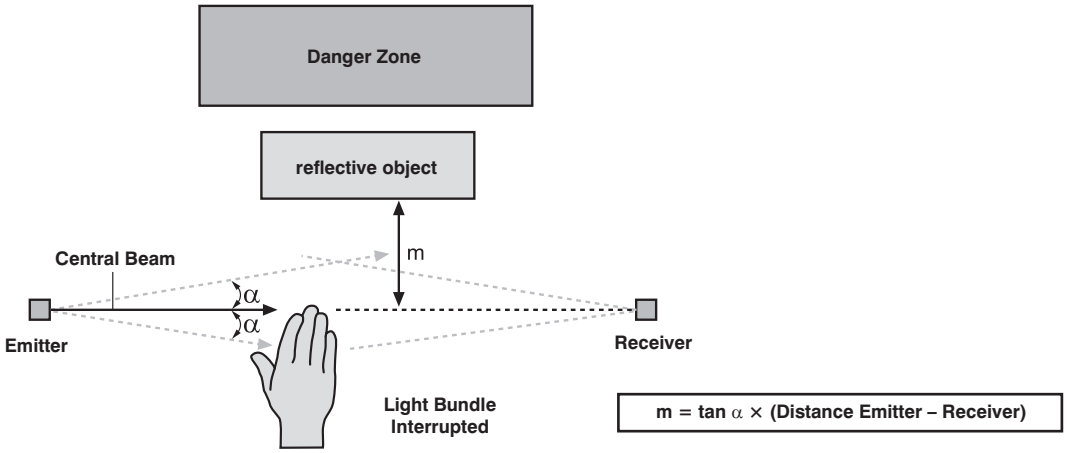
The following points must be observed:

1. Calculated resulting resolution is independent of light curtain resolution:
   max. resulting resolution: $d = H/15 - 50\ mm = 500\ mm/15 + 50\ mm = 83$ mm

2. A resolution of less than 50 mm cannot be implemented with this setup: min. height $= 15 \times (d - 50\ mm)$

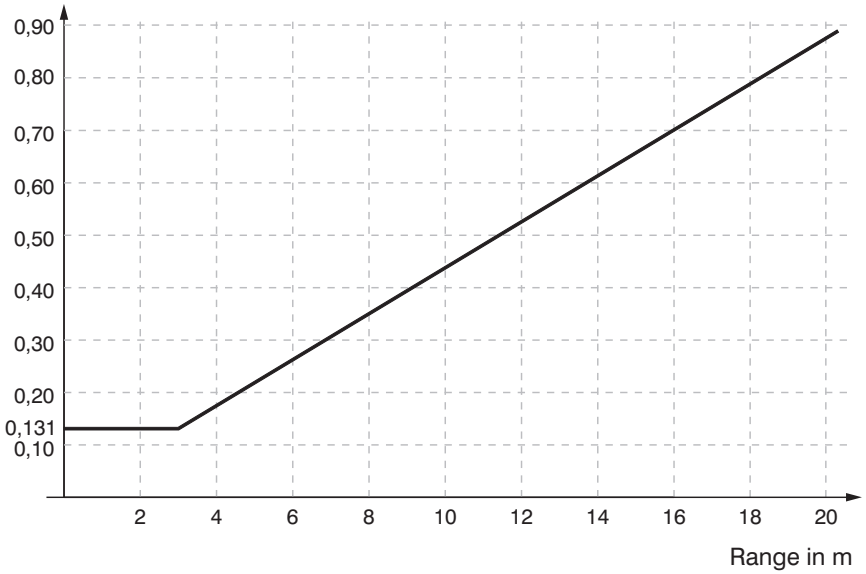
3.4 Minimum Clearance to Reflective Surfaces

If reflective surfaces are located within the aperture angle between the emitter and the receiver, reflection may result which could cause an obstruction to go undetected. For this reason, a minimum clearance m between reflective objects and the optical axis must be maintained.
Beam angles are taken from the IEC 61496-2 standard. They represent worst case values. Actual values are lower.



α = aperture angle of emitter and receiver optics
α = ±2,5°

Minimum Clearance m in m



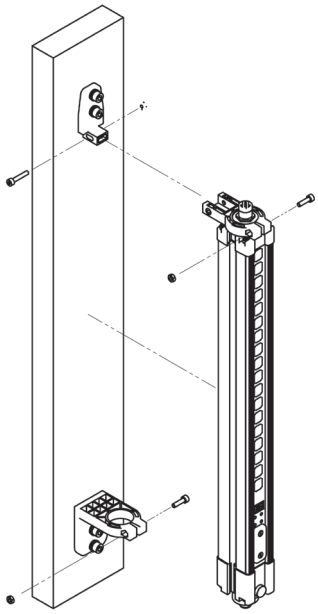
4. Connection and Installation to the Machine

4.1 Installation

There are three options for mounting the emitter and the receiver.

- Attachment with BEF-SET-33 (included)
- Attachment with BEF-SET-18 (accessory)
- Attachment with BEF-SET-36 (installation in safety column)

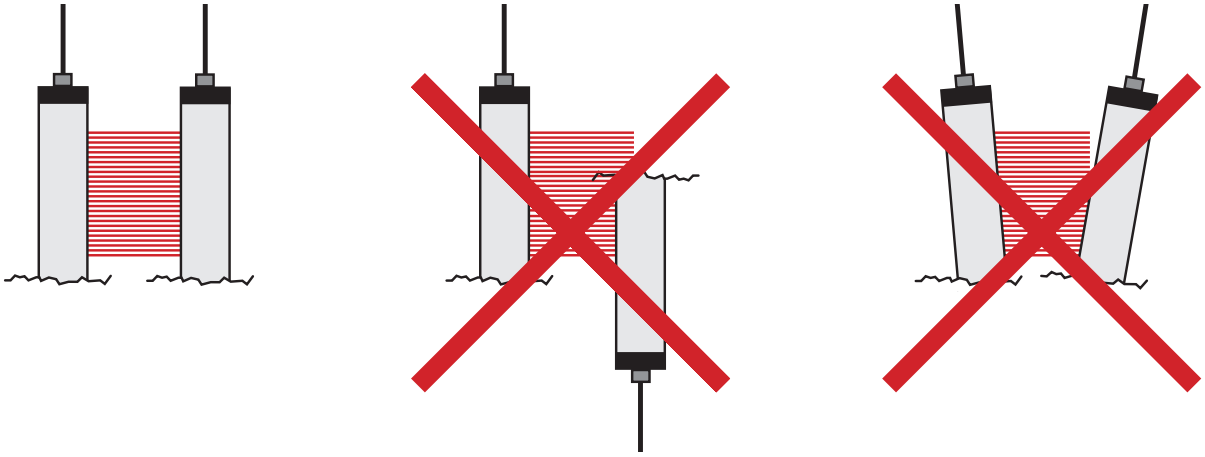
Mounting with the BEF-SET-33



First secure the mounting clamp to the Light Curtain with the screws. The screws should remain accessible after mounting. In this way, the Light Curtain can be adjusted at a later point in time.
The Light Curtain is then attached to the machine etc. with the BEF-SET-33. Avoid excessively small (minimal protection against vibration) or large (possible damage to the retainer) tightening torques for the mounting components.

The mounting screws and nuts are not included in the scope of delivery.

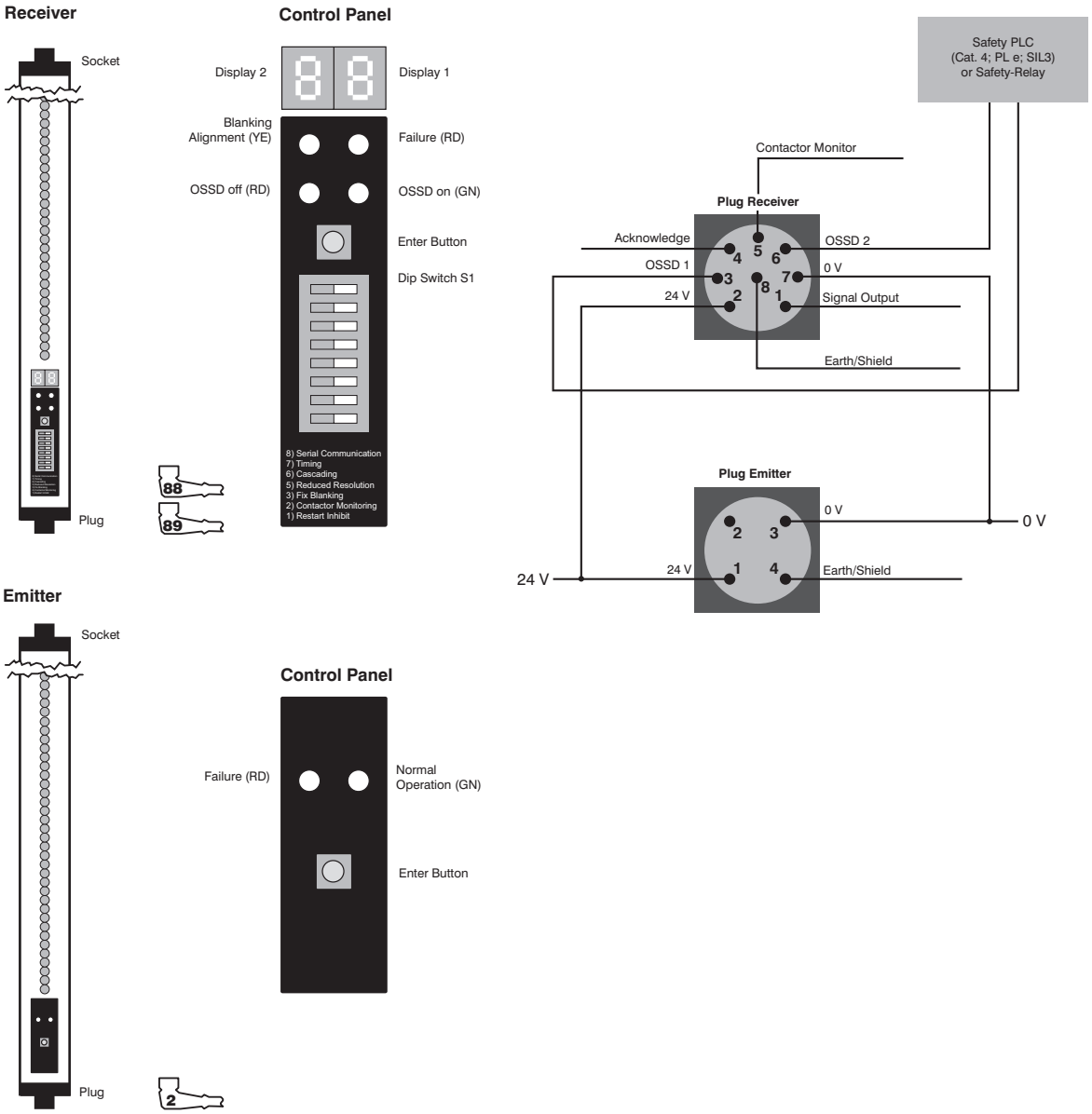
In order to assure flawless functioning of the light curtain, the two matched components (emitter and receiver) must be aligned to one another.
It is advisable to mount the light curtain for initial start-up such that alignment can still be adjusted to an adequate extent. wenglor offers accessories which allow for easy adjustment.



The controls must be accessible for initial start-up and maintenance. These are located on the side from which the beam is emitted (emitter), or the side at which the beam is received (receiver).
Space requirements for mounting and dismantling depend upon the type of utilized accessories.

The machine controls must be connected to the light curtain ‘s safety output either directly or via the PLC (Cat. 4; PL e; SIL3). General safety regulations and all applicable standards and mechanical engineering directives must be observed as well. Two-channel redundant wiring to the controls of the hazardous machine must be adhered to strictly. 24 V DC supply power must be fed to the light curtain from a PELV power pack.

Basic Schematic Diagram



Connector Pin Assignments for Safety Operation Mode

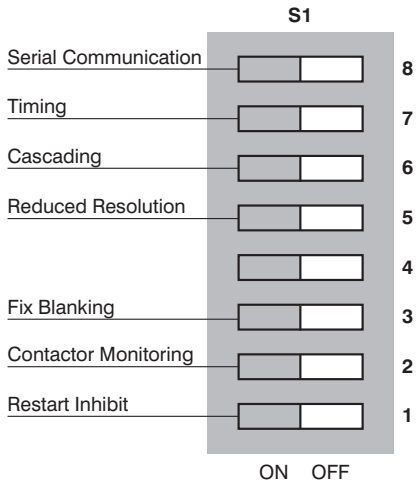
Required system components:
1 × emitter, 1 × receiver
1 × connector cable for emitter
1 × connector cable for receiver

From **to**

Emitter Wiring		
Pin 1	24 V DC	Supply Voltage 24 V DC
Pin 2	unused	
Pin 3	Ground (0 V)	Supply Voltage 0 V
Pin 4	Earth/Shield	Operational earth

Receiver Wiring		
Pin 1	Signal output	free
Pin 2	24 V DC	Supply Voltage 24 V DC
Pin 3	OSSD1 output	PLC or relay
Pin 4	Acknowledge	free
Pin 5	Contactor monitor	free
Pin 6	OSSD 2 output	PLC or relay
Pin 7	Ground (0 V)	Supply Voltage 0 V
Pin 8	Earth/shield	Operational earth

DIP Switch Settings: Receiver



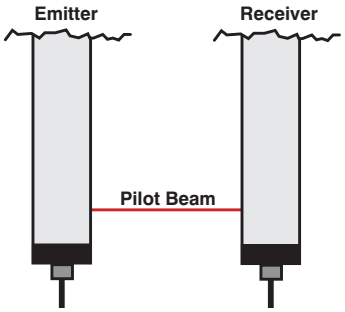
4.2 Default Settings

The Light Curtain offers various types of functions without any additional devices. The following table provides an overview of possible functions, as well as the product's respective default settings.

Function Type	Default Settings
Safety Operating Mode	Active
Start-Up inhibit and Restart Inhibit	Not active
Contactor Monitoring	Not active

5. Operating the Light Curtain

5.1 Pilot Beam



The pilot beam is used to synchronise the light curtain.
It is the closest beam to the display and may not be continuously interrupted.

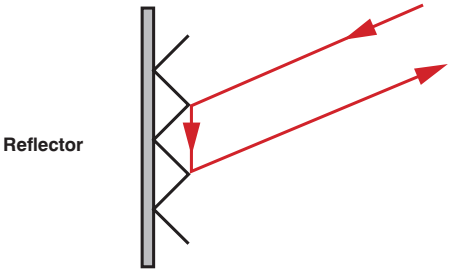
5.2 Adjustment

The purpose of adjustment is to accurately set the light curtain receiver to the required range. Adjustment must be performed after mechanical installation of the light curtain. After the light curtain has been adjusted, it immediately switches to the respectively selected operating state as soon as supply power is applied.

The necessary degree of alignment depends on the distance between transmitter and receiver (see table on page 18). If the necessary degree of alignment has been achieved, this value must be accepted by means of the Enter key.

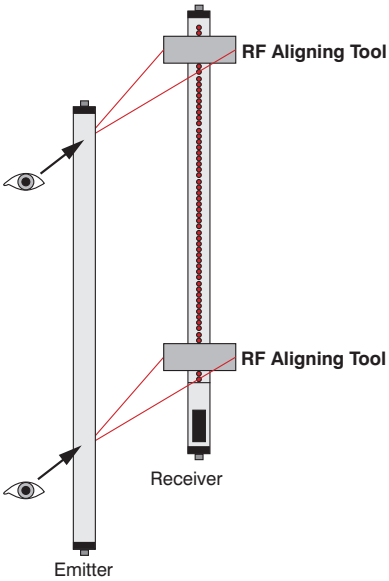
5.2.1 Using the Aligning Tool

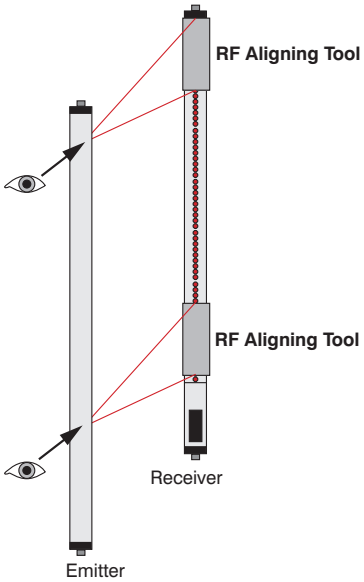
The RF aligning tool is extremely helpful thanks to the use of visible red light.
The function of the aligning tool is based upon the principle of a reflector.
The arriving light beam is reflected back in exactly the same direction from which it originated.
For an easier adjustment the special alignment optic SZ0-LAH1 can be used.



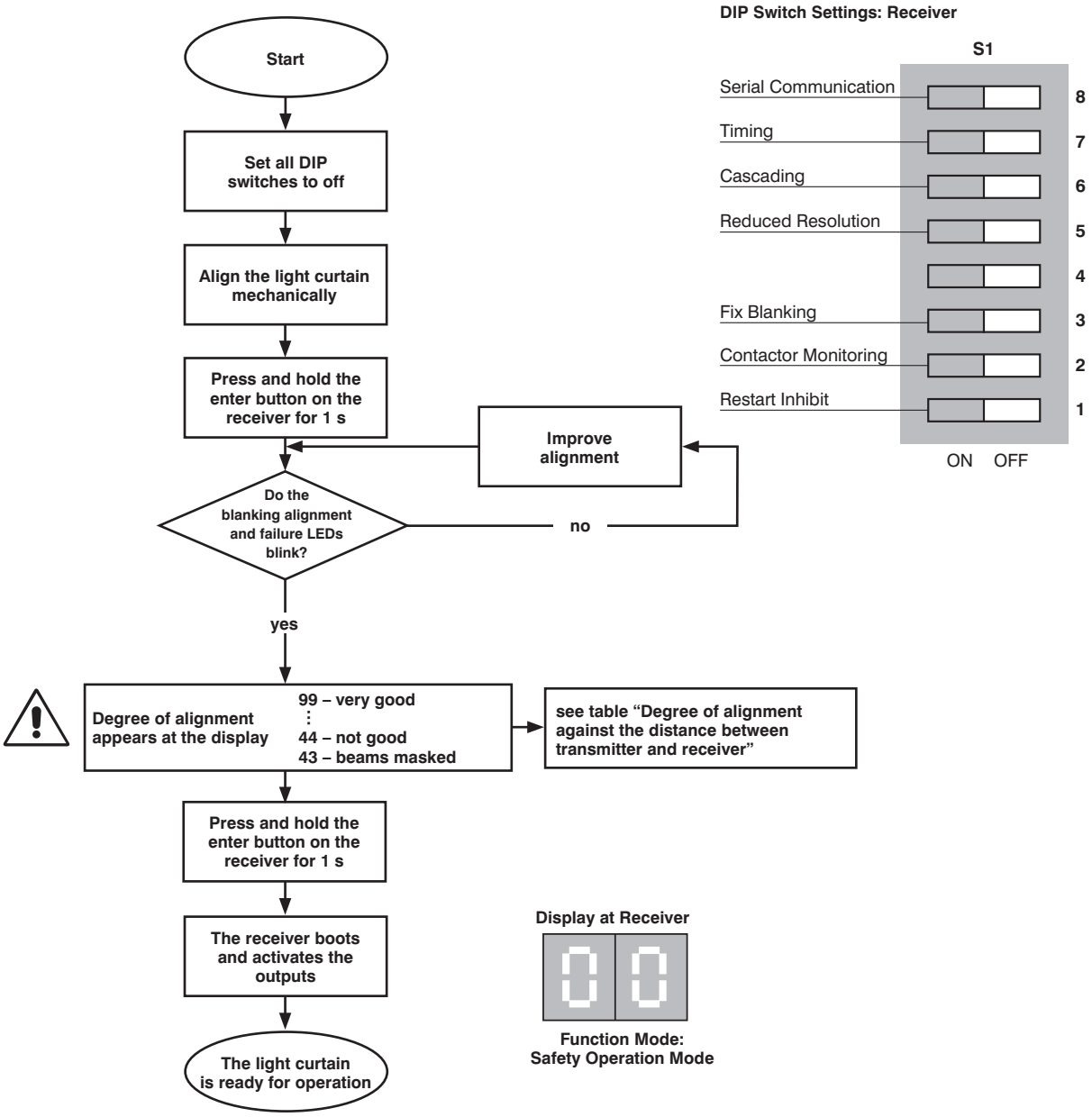
Procedure:

- Position the aligning tools at the top and bottom in front of the receiver.
- Observe the aligning tools from the emitter (look from the emitter to the receiver).
- Adjust the emitter such that the reflected spot is situated at the centre of the respective RF aligning tool.





5.2.2 Adjustment Procedure



Distance transmitter – receiver			
Without deflection mirror	**With 1 deflection mirror**	**With 2 deflection mirrors**	**Degree of alignment**
≤ 3 m	≤ 2,7 m	≤ 2,4 m	96 imperatively necessary
3…7 m (finger protection) 3…20 m (hand protection)	2,7…6,3 m (finger protection) 2,7…18 m (hand protection)	2,4…5,6 m (finger protection) 2,4…16 m (hand protection)	96, 78, 68, 56 preferred > 43 necessary

Tab.: Degree of alignment against the distance between transmitter and receiver

The following must be observed:
The safety field's pilot beam may not be continuously interrupted.

The adjustment procedure must be repeated each time the device is remounted (e.g. change in operating range).

5.3 Function Modes

The Light Curtain can be used with four different function types:

- Safety operating mode
- Start-Up inhibit and restart inhibit
- Contactor monitoring

These functions, and how to set them up at the Light Curtain, are explained in detail below. The Start-Up inhibit and restart inhibit function types are treated as a single topic based upon the same setup procedure.

5.3.1 Safety Operating Mode

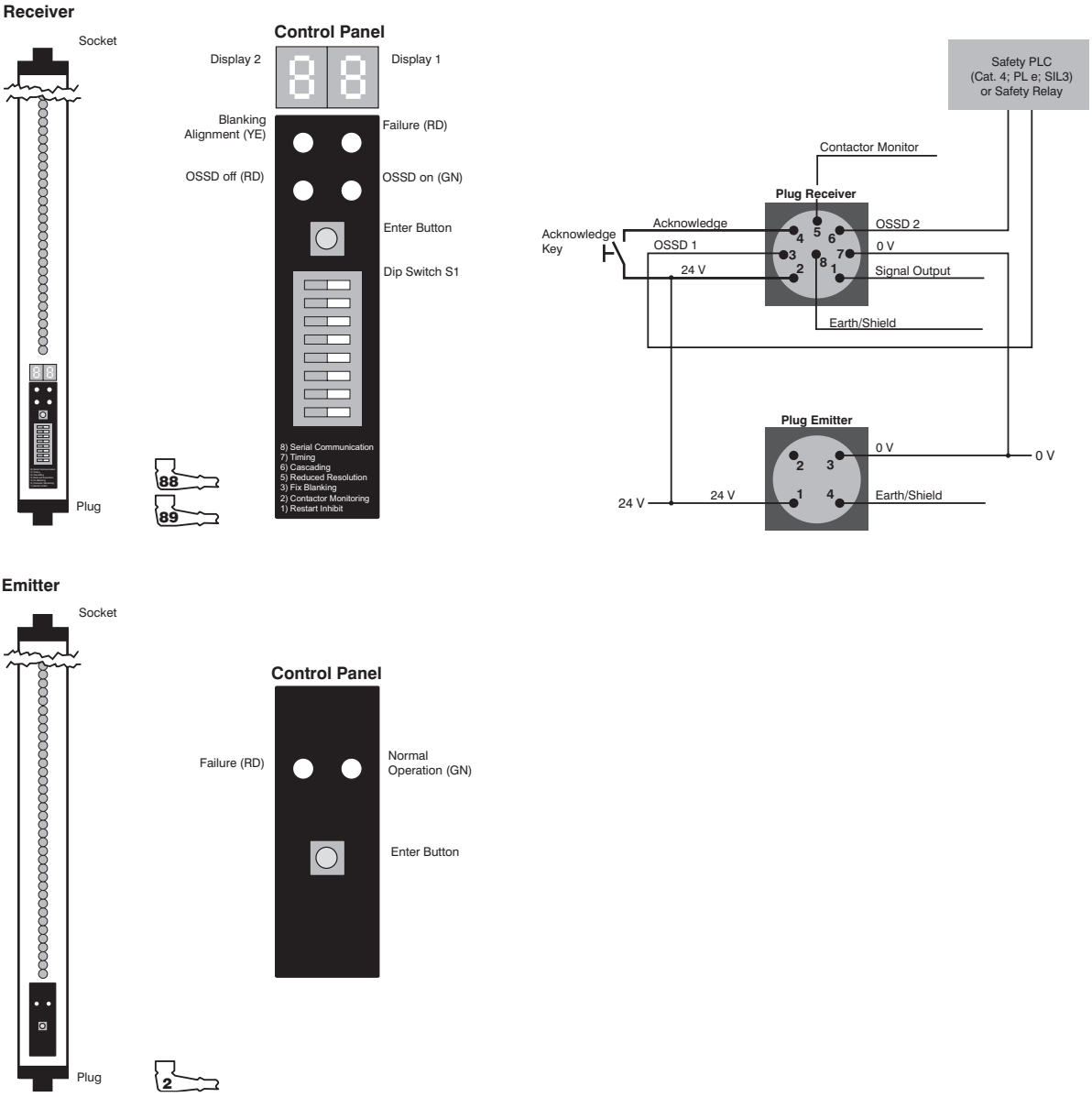
This function type is preselected at the factory (see also section 4.2). When the Light Curtain is set up in accordance with section 5.2, the device is in the safety operating mode.

5.3.2 Start Inhibit and Restart Inhibit

After correct adjustment, the light curtain is ready for operation. If restart inhibit is active, the machine is not re-enabled after the safety field has been interrupted until the acknowledgement button has been activated.
If the restart inhibit function has been activated, start-up inhibit is active as well. This means that the machine, or the light curtain, must be enabled by means of the acknowledgement button when the machine is first switched on.
If the Restart Inhibit function is combined with the operation mode Fix Blanking, Floating Blanking, Auto Floating Blanking or Reduced Resolution, first configure the respective operation mode, then activate the function.

The acknowledgement button has to be mounted in order that the whole danger zone can be seen while pressing the acknowledgement button.
Acknowledgement must originate from outside of the protected area, from a location at which the protected area and all of the effected working area can be clearly observed.
The button for the acknowledgement input may not be accessible from inside the protected area.

Schematic Diagram, Restart Inhibit



Connector Pin Assignments for Function Type Restart Inhibit

Required system components:
1 × emitter, 1 × receiver
1 × external pushbutton or PLC contact
1 × connector cable for emitter
1 × connector cable for receiver

From **to**

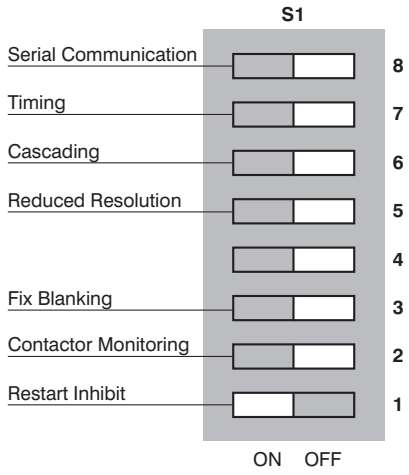
Emitter Wiring		
Pin 1	24 V DC	Supply Voltage 24 V DC
Pin 2	Unused	
Pin 3	Ground (0 V)	Supply Voltage 0 V
Pin 4	Earth/shield	Operational earth

Receiver Wiring		
Pin 1	Signal output	free
Pin 2	24 V DC	Supply Voltage 24 V DC
Pin 3	OSSD 1 Output	PLC or relay
Pin 4	Acknowledge	Pushbutton (normally open) 24 V DC
Pin 5	Contactor monitor	free
Pin 6	OSSD 2 Output	PLC or relay
Pin 7	Ground (0 V)	Supply Voltage 0 V
Pin 8	Earth/shield	Operational earth

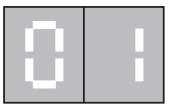
Setup Procedure

If the function type is combined with an operating mode, the operating mode must first be set up. The Start-Up inhibit (restart inhibit) function is then activated by appropriately setting the restart inhibit DIP switch.

DIP Switch Settings: Receiver



Display at Receiver



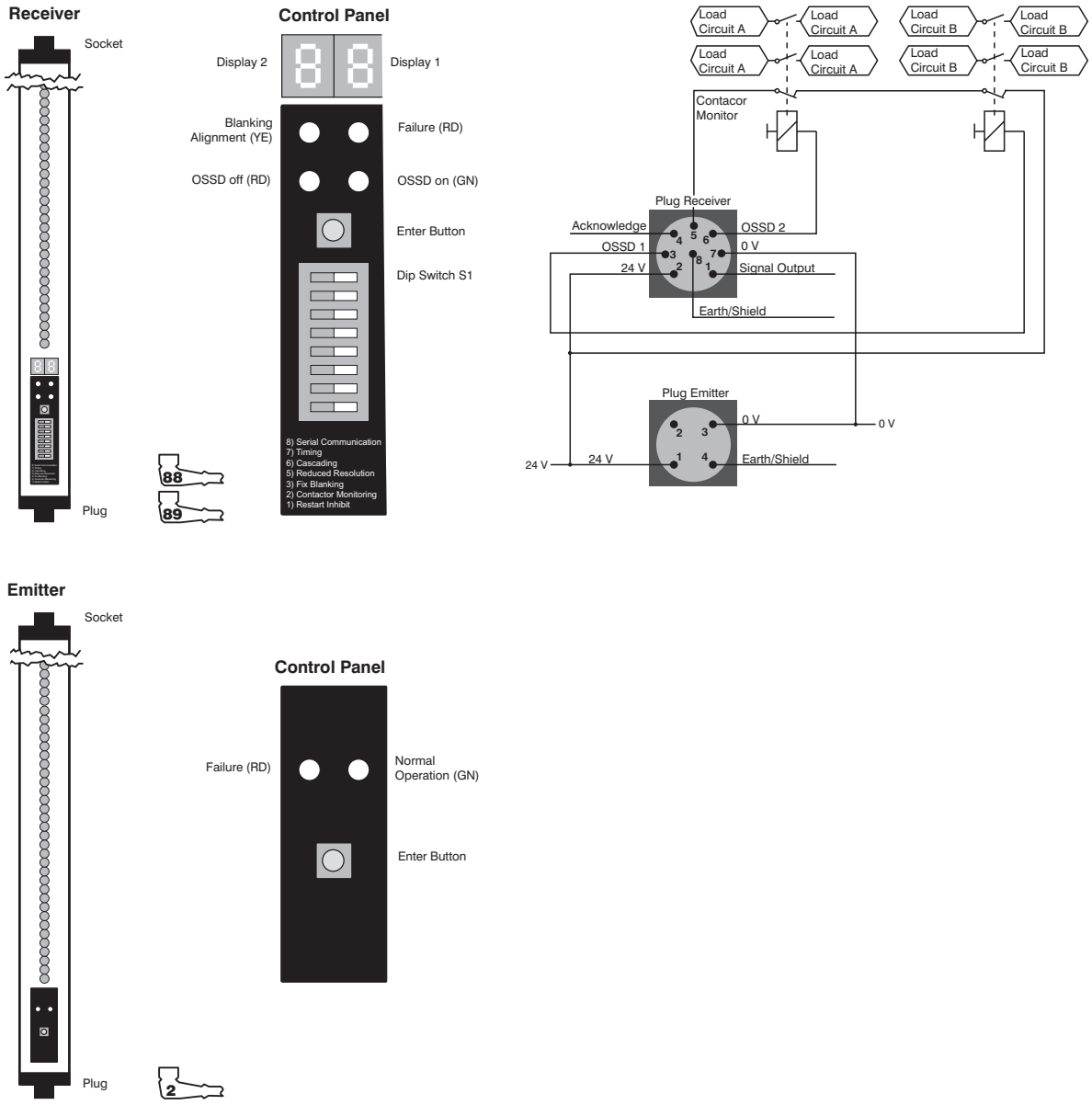
Function Mode:
Restart Inhibit

5.3.3 Contactor Monitoring

The contactor monitoring function ascertains whether or not externally connected contactors are switched within the specified period of time. The contactor monitoring input is monitored for a low flank to this end. Switching time may not exceed **200 ms**. This function only provides for additional safety if positively driven external contactors are utilized.

24 V are returned to the contactor monitoring input via an available NC contact at the external contactor.
If the Contactor Monitoring function is combined with the operation mode Fix Blanking, Floating Blanking, Auto Floating Blanking or Reduced Resolution, first configure the respective operation mode, then activate the function.

Schematic Diagram, Contactor Monitoring



Connector Pin Assignments for Function Type Contactor Monitoring

Required system components:
1 × emitter, 1 × receiver
1 × relay unit/external, positively driven relay
1 × connector cable for emitter
1 × connector cable for receiver

From		to
Emitter Wiring		
Pin 1	24 V DC	Supply Voltage 24 V DC
Pin 2	Unused	
Pin 3	Ground (0 V)	Supply Voltage 0 V
Pin 4	Earth/shield	Operational earth

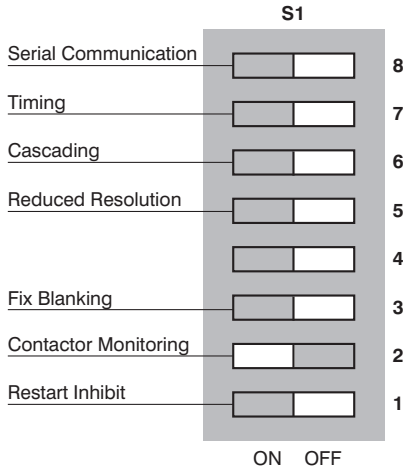
Receiver Wiring		
Pin 1	Signal Output	free
Pin 2	24 V DC	Supply Voltage 24 V DC
Pin 3	OSSD 1 Output	PLC or relay
Pin 4	Acknowledge	free
Pin 5	Contactor monitor	24 V via contactor (NC contact)
Pin 6	OSSD 2 Output	PLC or relay
Pin 7	Ground (0 V)	Supply Voltage 0 V
Pin 8	Earth/shield	Operational earth

24 V are returned to pin 5 via an available NC contact in the contactor monitoring mode.

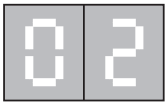
Setup Procedure

If the function type is combined with an operating mode, the operating mode must first be set up. The Contactor monitoring mode is then activated by appropriately setting the Contactor monitoring DIP switch.

DIP Switch Settings: Receiver



Display at Receiver



Function Mode:
Contactor Monitoring

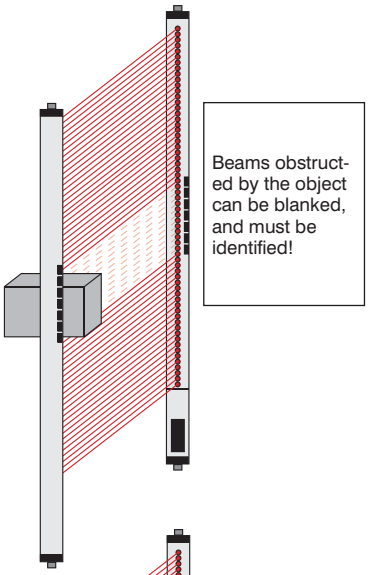
5.4 Blanking Options

All of the blanking options described below influence reliable recognition of objects by the light curtain. Before using a blanking option, always check to make sure it is permissible. Due to the fact that resolution is changed in some cases, resolution must be taken into consideration in calculating safety clearance.

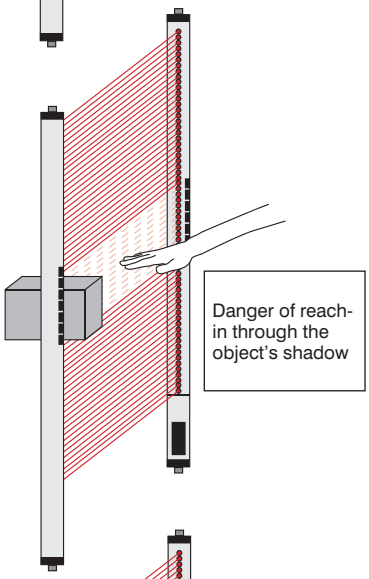
5.4.1 Fix Blanking

Various applications which make use of safety light curtains necessitate that certain objects protrude into the safety field during the entire duration of operation. In order to accommodate operating conditions of this sort, certain beams (which are always obstructed) can be blanked. If these blanked beams are not obstructed, the safety output cannot be activated.

5.4.1.1 Principle

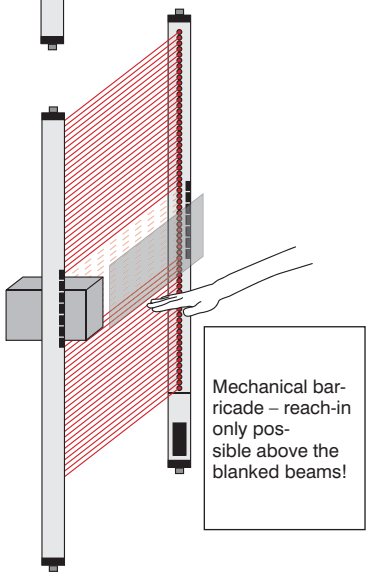


A fixed object is always located at the same position within the safety field.
The beams which are obstructed by this object can be blanked.
There is a limit to the number of beams which can be blanked (see table 1 on page 36).
The blanked beams must be identified with the included blanking stickers.
If the object is removed from the path of a blanked beam, the safety output is switched immediately.
In the fix blanking mode, resolution is the same as it would be without blanking, i.e. 14 mm, 30 mm or reduced resolution (see "Calculating Safety Clearance")!



Impermissible:

In this case it would be possible to access the point of danger via the object's "shadow"!

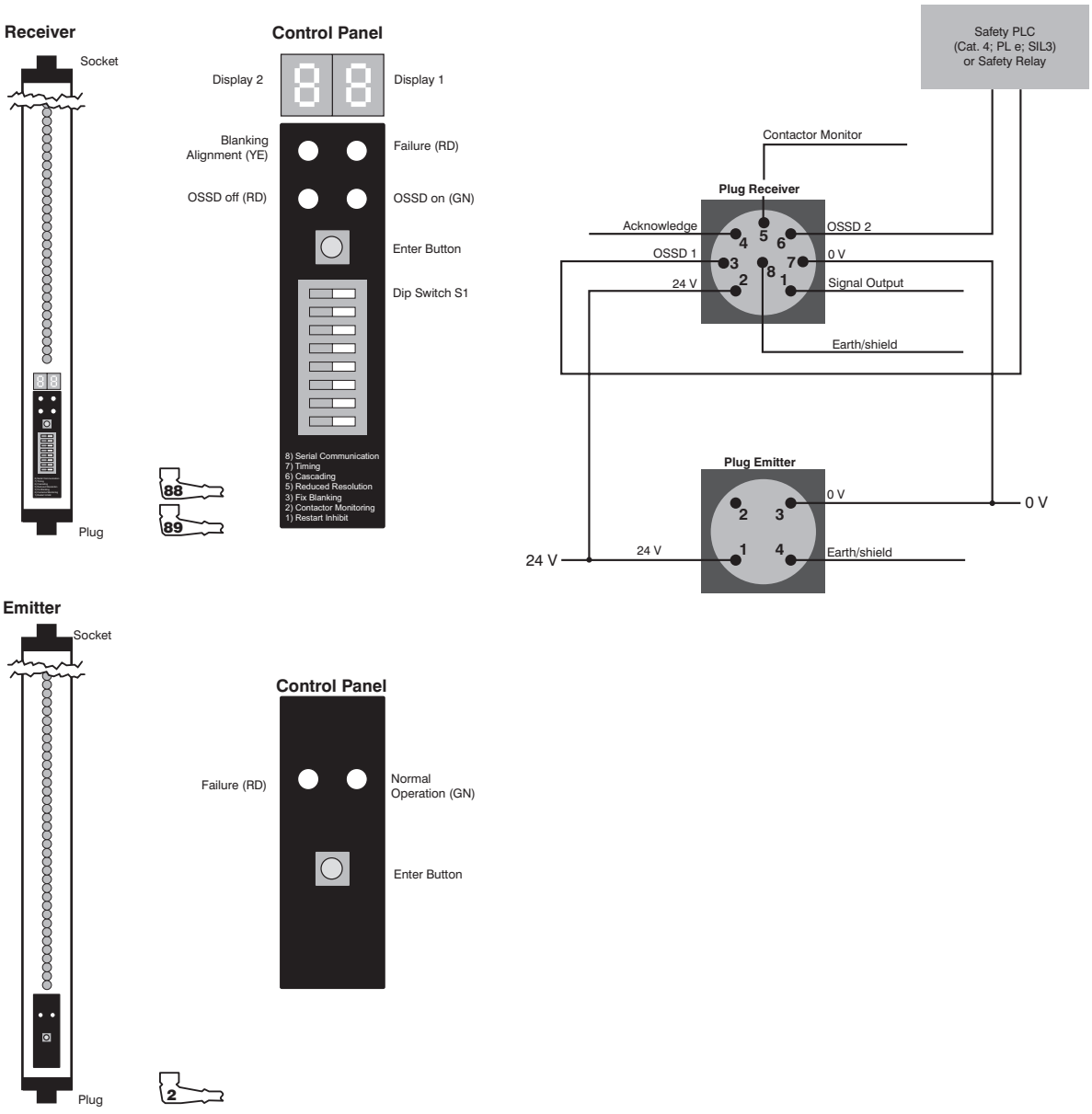


Permissible:

If beams have been blanked, other precautions must be implemented which preclude any access to the point of danger via the object's shadow (mechanical curtain).

Please observe the following:
The "restart inhibit" and "contactor monitoring" functions can be activated as required in the fix blanking operating mode.
The first beam must not be blanked.

Schematic Diagram, Fix Blanking



Connector Pin Assignments for Safety Operation with Fix Blanking

Required system components:
1 × emitter, 1 × receiver
1 × connector cable for emitter
1 × connector cable for receiver

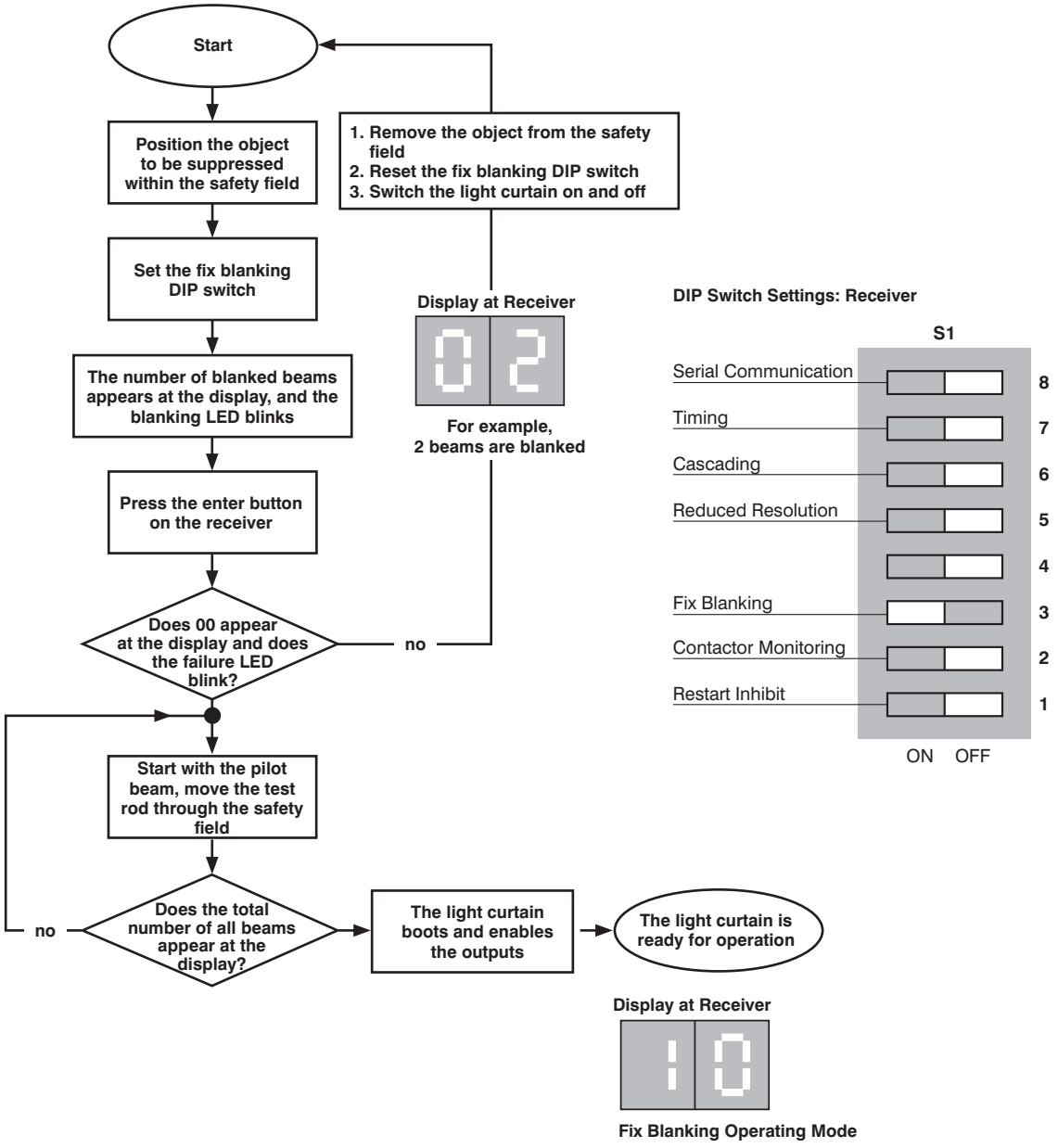
From **to**

Emitter Wiring		
Pin 1	24 V DC	Supply Voltage 24 V DC
Pin 2	Unused	
Pin 3	Ground (0 V)	Supply Voltage 0 V
Pin 4	Earth/shield	Operational earth

Receiver Wiring		
Pin 1	Signal output	Unused
Pin 2	24 V DC	Supply Voltage 24 V DC
Pin 3	OSSD 1 output	PLC or relay
Pin 4	Acknowledge	free
Pin 5	Contactor monitor	free
Pin 6	OSSD 2 output	PLC or relay
Pin 7	Ground (0 V)	Supply Voltage 0 V
Pin 8	Earth/shield	Operational earth

Up to 25 % of the beams, but no more than 20 beams in all, can be blanked in the fix blanking operating mode.

5.4.1.2 Fix Blanking Procedure



The following must be observed:
The safety field's pilot beam may not be continuously interrupted.

5.4.1.3 Calculating Safety Clearance

Safety clearance is calculated with the same method used for a non-blanked safety light curtain. Mechanical curtains must be utilized in order to assure that fix blanked beams cannot be penetrated.

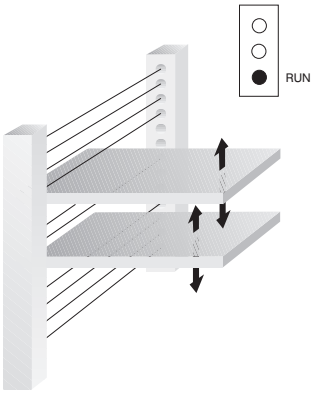
5.4.2 Floating Blanking

In certain applications, objects protrude continuously into the safety field, although their positions cannot be precisely pinpointed. Objects of this sort may include cables which are located within the safety field for technical reasons, or tools which pass through the safety field. The “floating blanking” function is intended for use in these applications.

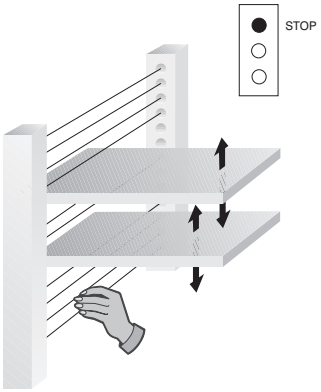
Differentiation is made between two types of floating blanking:

- Floating blanking
- Auto floating blanking

5.4.2.1 Principle



Up to 3 objects can pass through the safety field without causing the safety output to switch. The beams which are obstructed by the objects are adapted to the respective size of the object, and are muted accordingly.
There is a limit to the number of beams which can be blanked (see table 1 on page 36).

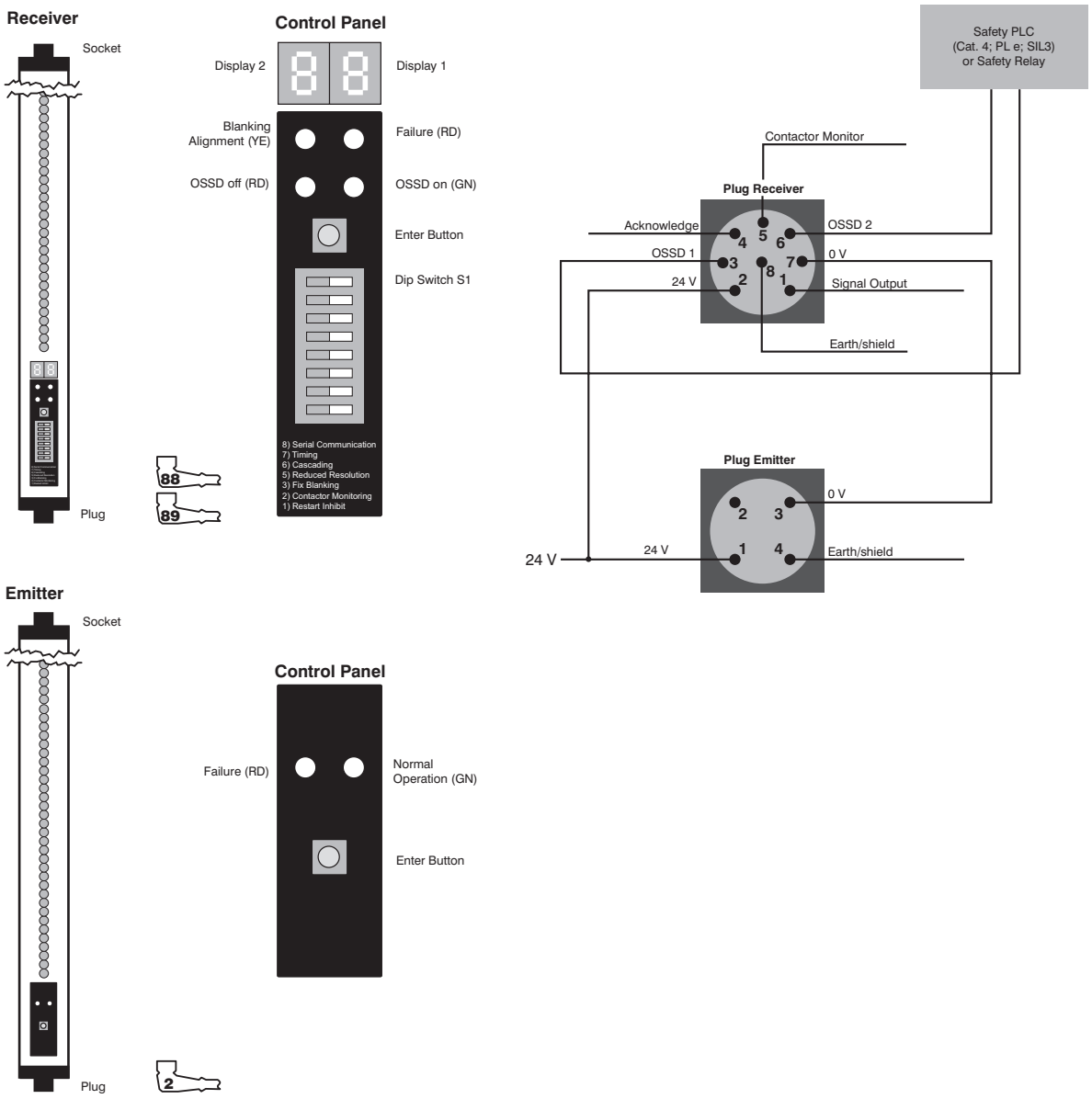


The safety output is not switched until additional beams above and beyond the blanked beams have been interrupted, for example if someone reaches into the safety field

Prerequisites for use:

- The operating mode “Floating Blanking” can only be parameterized over the serial interface. (vide operating instructions B-wsafe)
- **Testing must be performed in order to determine whether or not floating blanking can be used, where-by all possible object arrangements (practical experience) have to be tested.**
- The “restart inhibit” and “contactor monitoring” functions can be activated as required in the floating blanking operating mode.
- **Safety clearance is influenced by floating blanking ➔ section 5.4.2.2**
- The first beam must not be blanked

Schematic Diagram, Floating Blanking



Please observe the following:
The “restart inhibit” and “contactor monitoring” functions can be activated as required in the floating blanking operating mode.

Connector Pin Assignments for Safety Operation with Floating Blanking

Required system components:
1 × emitter, 1 × receiver
1 × connector cable for emitter
1 × connector cable for receiver

From		to
Emitter Wiring		
Pin 1	24 V DC	Supply Voltage 24 V DC
Pin 2	Unused	
Pin 3	Ground (0 V)	Supply Voltage 0 V
Pin 4	Earth/shield	Operational earth

Receiver Wiring		
Pin 1	Signal output	Muting indicator muting terminal
Pin 2	24 V DC	Supply Voltage 24 V DC
Pin 3	OSSD 1 output	PLC or relay
Pin 4	Acknowledge	free
Pin 5	Contactor monitor	free
Pin 6	OSSD 2 output	PLC or relay
Pin 7	Ground (0 V)	Supply Voltage 0 V
Pin 8	Earth/shield	Operational earth

5.4.2.2 Floating Blanking Procedure

The parameters for this function type can only be configured via the serial port. Connection to a PC is described in section 6.3. The required wsafe software can be downloaded along with instructions from the wenglor website.

5.4.2.3 Calculating Safety Clearance

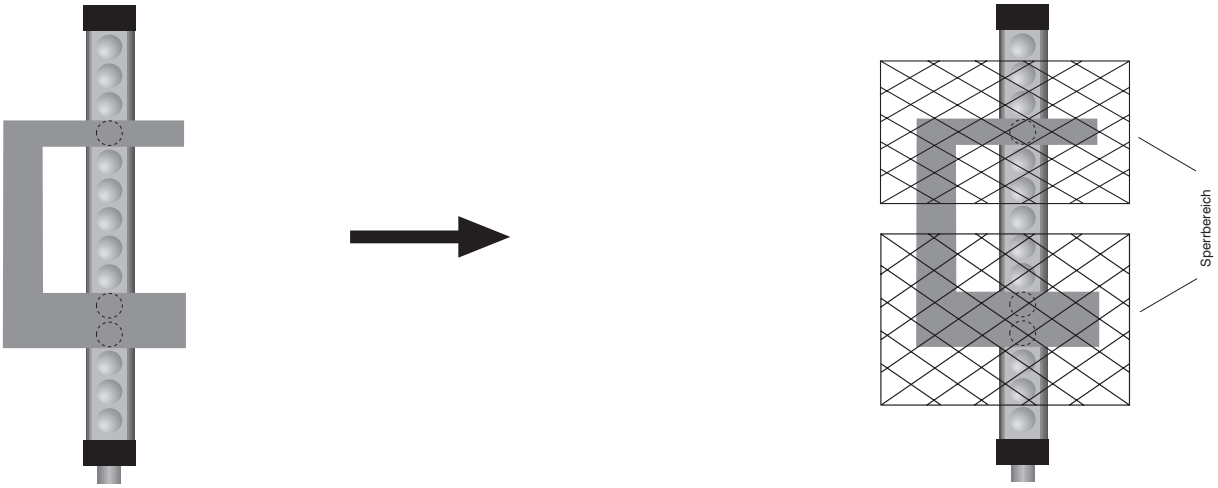
Whether or not penetration into the exclusion area is possible plays a significant role in calculating safety clearance. The exclusion area results from the maximum number of obstructed beams and the shape of the object.
The maximum numbers of obstructed beams results from configuring Floating - resp. Auto Floating Blanking with the visualization software wsafe (vide paragraph 6.3)

Exclusion Areas

Example 1: Number of beams obstructed by the object: 5
Max. number of floating beams: 6
Difference: 1

If penetration into the exclusion area is possible, resulting resolution (max. number of floating beams) amounts to 6 beams in the example (resulting resolution = 56 mm, see “Resulting Resolution” table).

Example 2: Number of beams obstructed by the object: 3
Max. number of floating beams 5
Difference: 2



If penetration into the exclusion zone is not possible, light curtain resolution remains unchanged. The maximum number of floating beams is otherwise used to determine resolution.

Table: Resulting Resolution with Floating Blanking and Auto-Floating Blanking

Max. Number of Floating Beams (wsafe)	Resolution d for SG4-14 (finger protection) 7 mm Steps	Resolution d for SG4-30 (hand protection) 17 mm Steps
1	21 mm	47 mm
2	28 mm	64 mm
3	35 mm	81 mm
4	42 mm	98 mm
5	49 mm	
6	56 mm	
7	63 mm	
8	70 mm	
9	77 mm	
10	84 mm	
11	91 mm	
12	98 mm	
13	105 mm	
14	112 mm	
15	119 mm	
16	126 mm	
17	133 mm	
18	140 mm	
19	147 mm	
20	154 mm	

1st sample calculation:: SG4-30Ix030C1

Assuming:	Light Curtain response time	t_1 = 5,7 ms
	Machine over-travel time	t_2 = 20 ms
	Approach speed	K = 2000 ms
	1 obstructed beam	d = 47 mm

Because resolution is greater than 40 mm
C = 850 mm (see safety clearance calculation in section 3.3, „Calculating Safety Clearance per EN ISO 13855“)

Due to the fact that a safety clearance of 500 mm results alone from C, we only need to use K = 1600 mm/s for our calculation.

$S = (K \times T) + C = 1600 \text{ mm/s} \times 0{,}0257 \text{ s} + 850 \text{ mm} = 891{,}12 \text{ mm}$

2nd sample calculation: SG4-30Ix030C1

Assuming:	Light Curtain response time	t_1 = 5,7 ms
	Machine over-travel time	t_2 = 20 ms
	Approach speed	K = 2000 ms
	4 obstructed beams	d = 98 mm

Because resolution is greater than 70 mm, C = 1200 mm (see safety clearance calculation in section 3.3, „Calculating Safety Clearance per EN ISO 13855“)

Due to the fact that a safety clearance of 500 mm results alone from C, we only need to use K = 1600 mm/s for our calculation.

$S = (K \times T) + C = 1600 \text{ mm/s} \times 0{,}0257 \text{ s} + 1200 \text{ mm} = 1241{,}12 \text{ mm}$

Is the exclusion area correctly barricaded, calculation could be run with a resolution of d = 30 mm

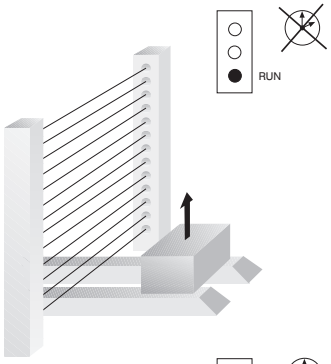
$S = (K \times T) + C = 2000 \text{ mm/s} \times 0{,}0257 \text{ s} + 8\ (30 \text{ mm} - 14 \text{ mm}) = 179{,}4 \text{ mm}$

5.4.3 Auto Floating Blanking

This operating mode is required for applications with moving objects which continuously move through and exit the safety field (e.g. skid carriers and forklifts), thus interrupting specific light curtain beams in a defined fashion. Intrusions into any other point within the safety field cause the safety output to switch and stop hazardous motion. As opposed to floating blanking, not only is the geometry of the object significant for correct functioning, but rather entry of the object into the safety field as well. The object enters the safety field via the uppermost or lowermost light curtain beam. The period of time during which the object is permitted to dwell within the safety field is limited.

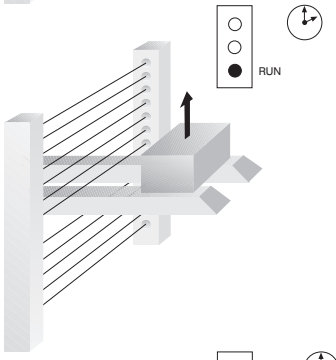
Setup for this function is performed via the serial interface by means of a host PC.

5.4.3.1 Principle



= Active Time Limiting

If the safety field of a light curtain with floating blanking is entirely free of obstructions, the safety output is not deactivated.

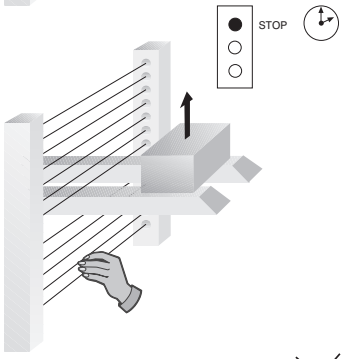


The order in which safety field beams are obstructed must always start at the top or the bottom.

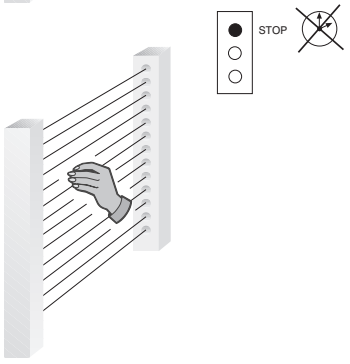
Only one object can pass through the safety field without causing the safety output to switch. The beams which are obstructed by the object are adapted to its size, and are muted accordingly.

There is a limit to the number of beams which can be blanked (see table 1 on page 36).

The period of time during which the object is permitted to dwell within the safety field is limited



The safety output is switched when additional beams above and beyond the blanked beams have been interrupted, for example if someone reaches into the safety field.



The safety output is switched if the safety field is penetrated at the middle.

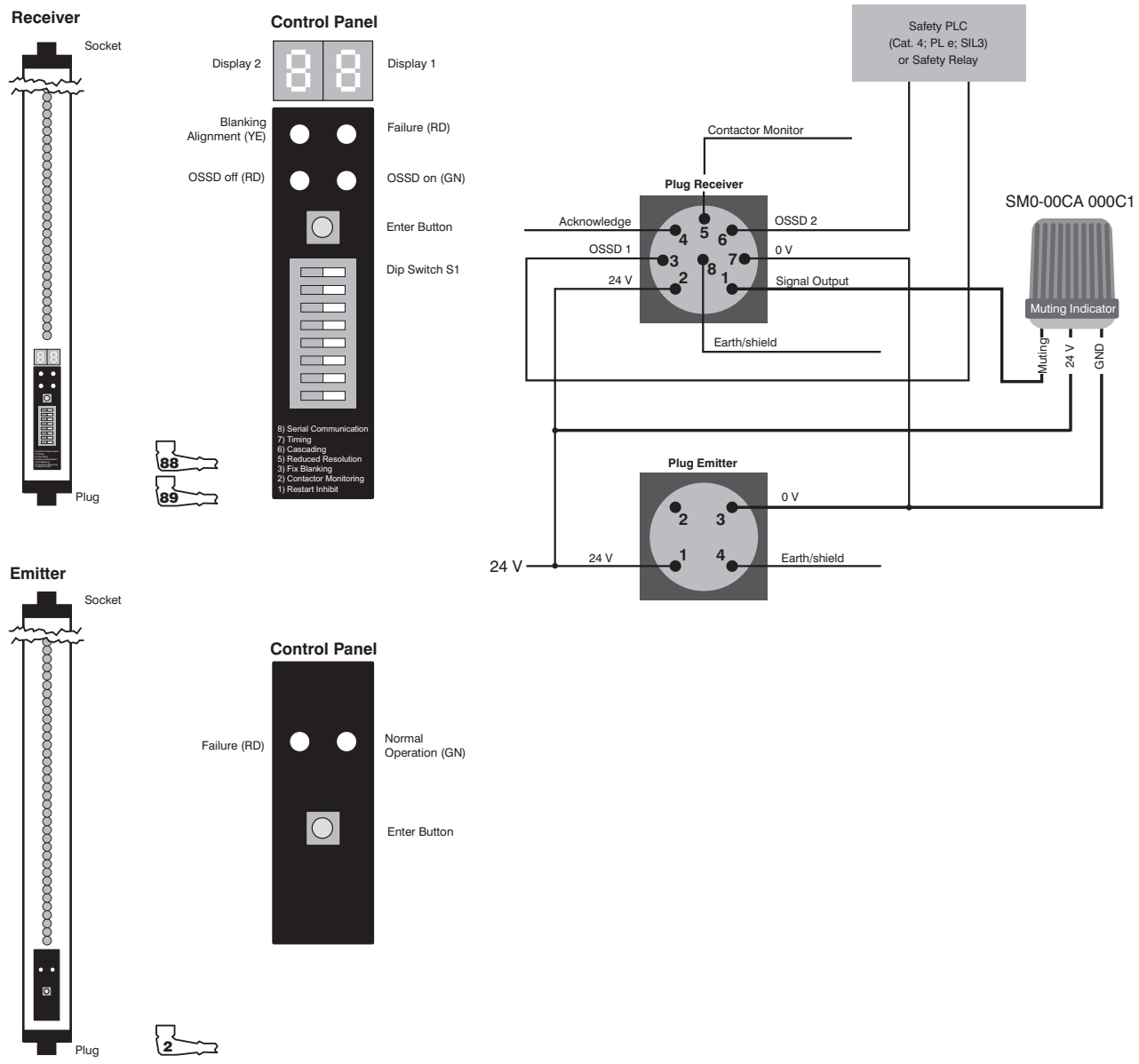
Prerequisites for use:

- Only those objects which actually protrude into or pass through the safety field during operation may be used for the configuration.
- Testing must be performed in order to determine whether or not floating blanking can be used, whereby all possible object arrangements (practical experience) have to be tested.
- The “restart inhibit” and “contactor monitoring” functions can be activated as required in the auto-floating blanking operating mode.
- A warning lamp must be additionally connected.
- Safety clearance is influenced by auto-floating blanking.
- The operation mode „Auto Floating Blanking“ can only be parameterized via the serial interface. (view operating instruction B-wsafe)

5.4.3.2 Auto Floating Blanking Procedure

The configuration of the operating mode is made like in case of Floating Blanking (section 5.4.2.2)

Schematic Diagram, Auto-Floating Blanking



Please observe the following:

The “restart inhibit” and “contactor monitoring” functions can be activated as required in the auto-floating blanking operating mode.

Connector Pin Assignments for Safety Operation with Auto-Floating Blanking

Required system components:
1 × emitter, 1 × receiver
1 × connector cable for emitter
1 × connector cable for receiver
1 × Mutingmelder

From		**to**
Emitter Wiring		
Pin 1	24 V DC	Supply Voltage 24 V DC
Pin 2	Unused	
Pin 3	Ground (0 V)	Supply Voltage 0 V
Pin 4	Earth/shield	Operational earth

Receiver Wiring		
Pin 1	Signal output	Muting indicator muting terminal
Pin 2	24 V DC	Supply Voltage 24 V DC
Pin 3	OSSD 1 output	PLC or relay
Pin 4	Acknowledge	free
Pin 5	Contactor monitor	free
Pin 6	OSSD 2 output	PLC or relay
Pin 7	Ground (0 V)	Supply Voltage 0 V
Pin 8	Earth/shield	Operational earth

The object may be moved in the auto-floating blanking operating mode. Important: A warning lamp must be installed!

Warning lamp Wiring		
GND	Ground (0 V)	Supply Voltage 0 V
24 V	24 V DC	Supply Voltage 24 V DC
Return	Signal return	Unused
Muting	Signal	Receiver pin1, signal output

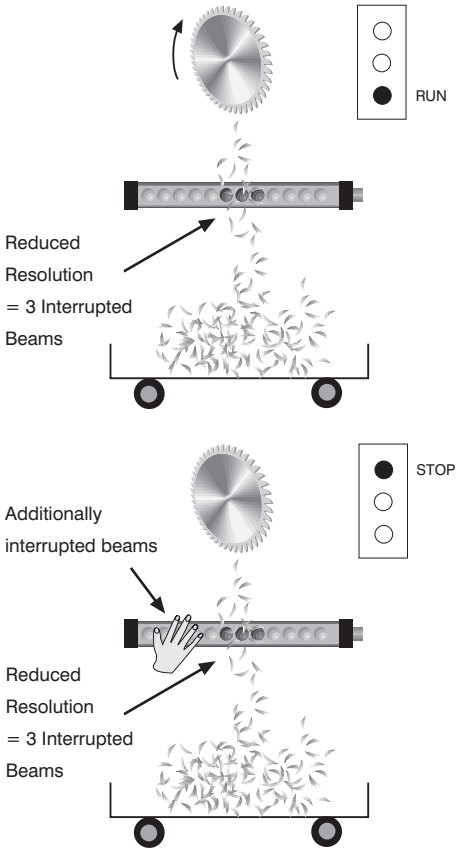
5.4.3.3 Calculating Safety Clearance

When calculating the safety clearance for the auto floating blanking mode, the same rules and requirements must be observed as is also the case with the floating blanking mode (see section 5.4.2.3).

5.4.4 Reduced Resolution

Light curtain resolution can be reduced with the help of the reduced resolution function. As opposed to light curtains with mechanically reduced resolution, electronically reduced resolution provides for significantly greater functional reserves. This is due to the fact that objects which are smaller than the selected resolution do not cause the safety output to switch where electronically reduced resolution is utilized.
The required resolution is configured by means of teach-in with the desired objects.
Resolution is set such that the objects can pass through the safety field at any point without causing the safety output to switch. With the help of the table, the displayed value can be converted to the resulting resolution in order to determine safety clearance.

5.4.4.1 Principle



A certain number of adjacent beams can be interrupted with reduced resolution without causing the safety output to switch (see table). Light curtain resolution is thus changed.

In this way, objects which are smaller than the reduced resolution value can be passed through the safety field

If an object which is larger than the selected resolution passes through the safety field (e.g. intrusion), the safety output is switched!

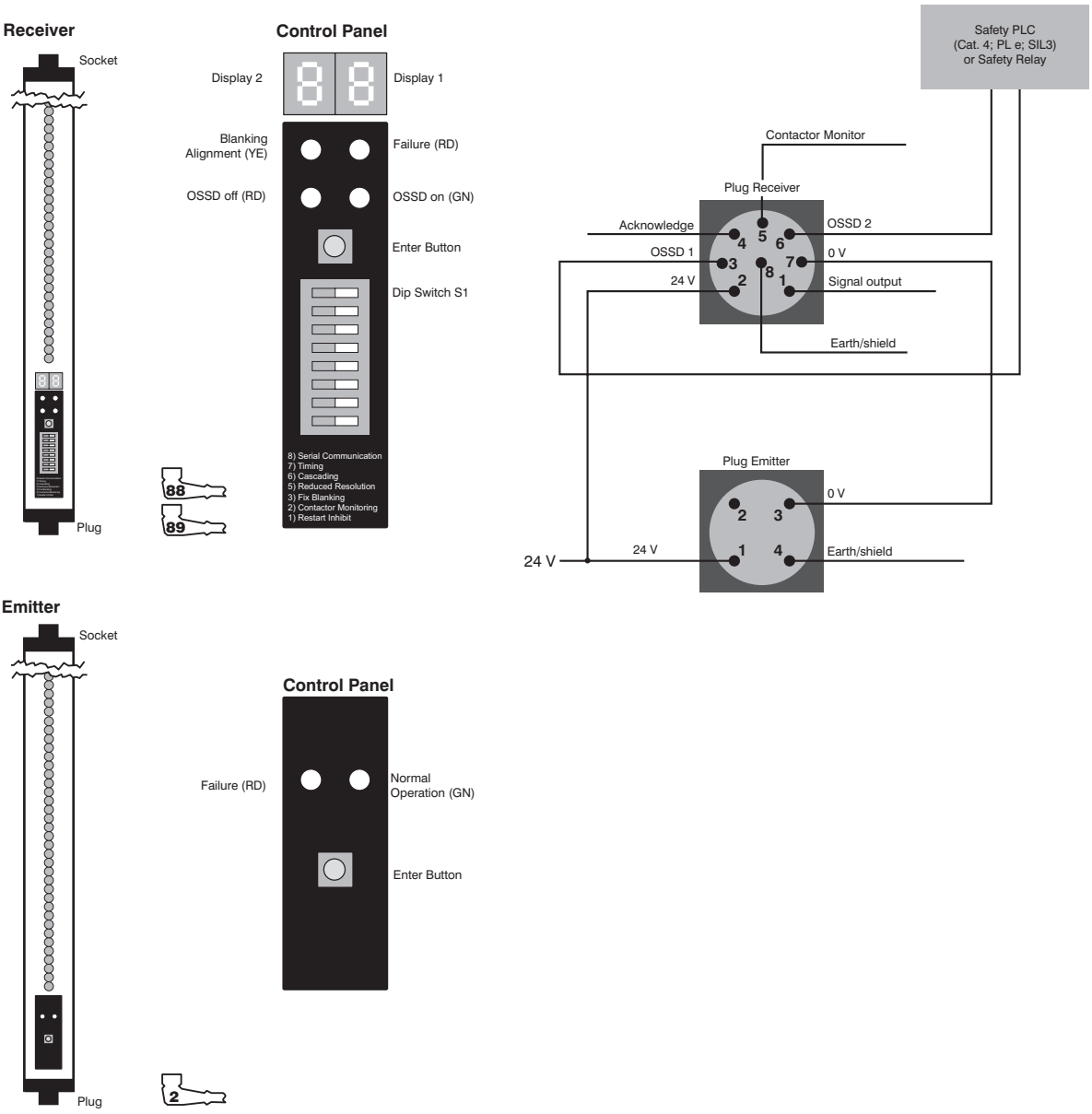
Light curtain resolution is identical to electronically reduced resolution in the “reduced resolution” operating mode (see table).

Number of muted beams	Resolution **d** for SG4-14 (Finger protection) 7 mm steps	Resolution **d** for SG4-30 (Hand protection) 17 mm steps
1	21 mm	47 mm
2	28 mm	64 mm
3	35 mm	81 mm
4	42 mm	98 mm
5	49 mm	
6	56 mm	
7	63 mm	
8	70 mm	
9	77 mm	
10	84 mm	
11	91 mm	
12	98 mm	
13	105 mm	

The following points must be observed:

- **Safety clearance is altered through the use of reduced resolution, and must therefore be recalculated (section 5.4.4.3).**
- The “restart inhibit” and “contactor monitoring” functions can be activated as required in the reduced resolution operating mode.

Schematic Diagram, Reduced Resolution



Connector Pin Assignments for Safety Operation with Reduce Resolution

Required system components:
1 × emitter, 1 × receiver
1 × connector cable for emitter
1 × connector cable for receiver

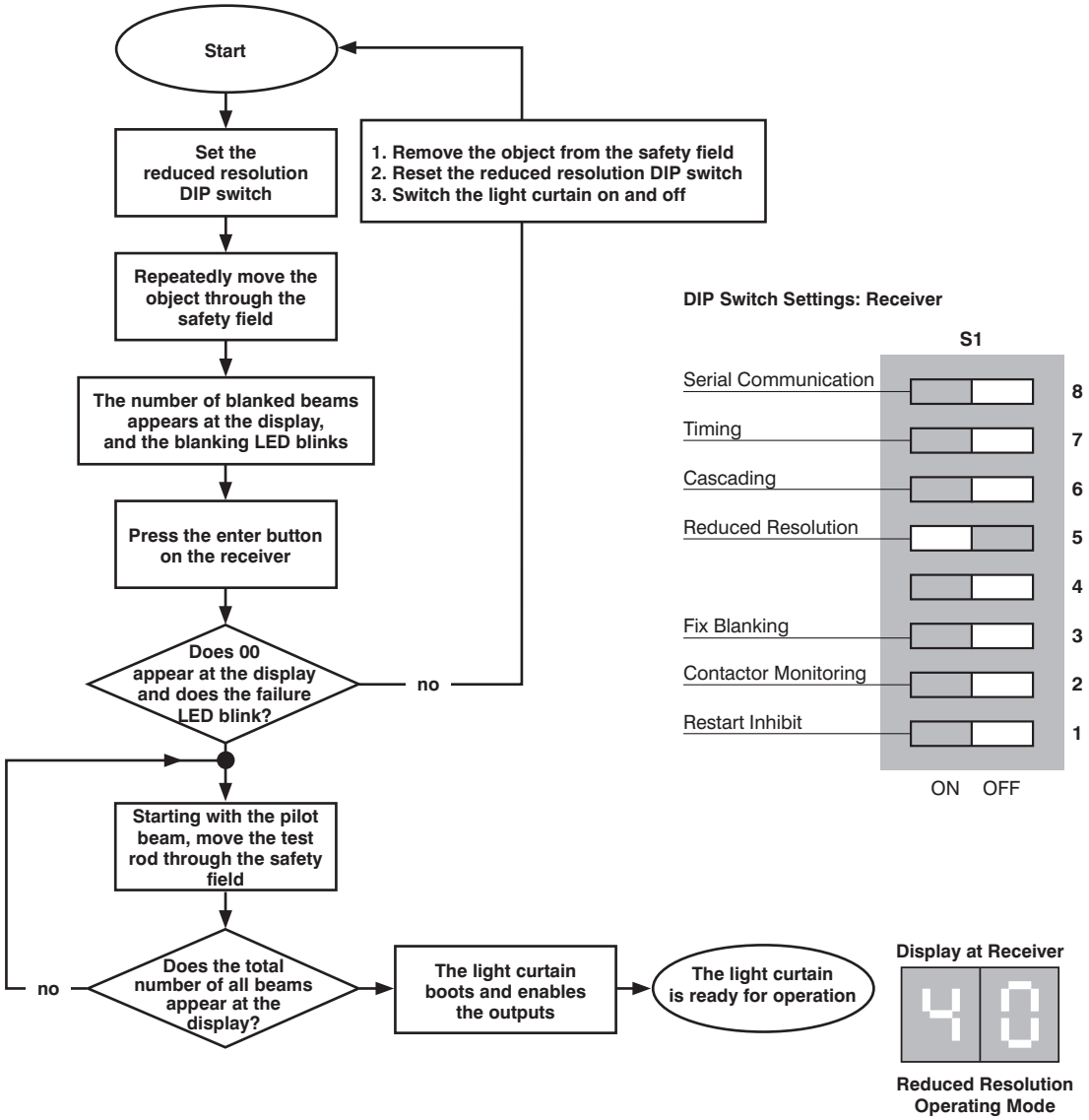
From **to**

Emitter Wiring		
Pin 1	24 V DC	Supply Voltage 24 V DC
Pin 2	Unused	
Pin 3	Ground (0 V)	Supply Voltage 0 V
Pin 4	Earth/shield	Operational earth

Receiver Wiring		
Pin 1	Signal output	Muting indicator muting terminal
Pin 2	24 V DC	Supply Voltage 24 V DC
Pin 3	OSSD 1 output	PLC or relay
Pin 4	Acknowledge	free
Pin 5	Contactor monitor	free
Pin 6	OSSD 2 output	PLC or relay
Pin 7	Ground (0 V)	Supply Voltage 0 V
Pin 8	Earth/shield	Operational earth

Changes in the calculation of safety clearance must be taken into consideration in the “reduced resolution” operating mode.

5.4.4.2 Reduced Resolution Procedure



The following must be observed:
The safety field’s pilot beam may not be continuously interrupted.

5.4.4.3 Calculating Safety Clearance

Light curtain resolution is identical to electronically reduced resolution in the “reduced resolution” operating mode (see table).

Table: Reduced Resolution

- Finger protection: max. reduced resolution = 105 mm
- Hand protection: max. reduced resolution = 98 mm

Number of muted beams	Resolution **d** for SG4-14 (Finger protection) 7 mm steps	Resolution **d** for SG4-30 (Hand protection) 17 mm steps
1	21 mm	47 mm
2	28 mm	64 mm
3	35 mm	81 mm
4	42 mm	98 mm
5	49 mm	
6	56 mm	
7	63 mm	
8	70 mm	
9	77 mm	
10	84 mm	
11	91 mm	
12	98 mm	
13	105 mm	

Recalculation of safety clearance SG4-14Ix075C1: $S = (K \times T) + 8 \times (d - 14\ mm)$

Assuming: Light Curtain response time $t_1 = 26$ ms
Machine over-travel time $t_2 = 20$ ms

$S = (K \times T) + 8 \times (d - 14\ mm)$

Example 1: light curtain resolution: d = 14 mm (electronically reduced to 35 mm), vertical installation:

$S = 2000\ mm/s \times 0{,}046\ s + 8\ (35\ mm - 14\ mm) = 260\ mm$
(without reduced resolution: S = 100 mm minimum clearance)

Example 2: light curtain resolution: d = 14 mm (electronically reduced to 42 mm), vertical installation:

Because resolution is greater than 40 mm, C = 850 mm (see section 3.3, „Calculating Safety Clearance per EN ISO 13855“).

Due to the fact that a safety clearance of 500 mm results alone from C, we only need to use K = 1600 mm/s for our calculation.

$S = 1600\ mm/s \times 0{,}046 + 850 = 923{,}6\ mm$

These examples demonstrate that a larger safety clearance results from a lower resolution.
A side-stepping safety device may be required in this case!

5.4.5 Summary of Blanking Options

	Fix Blanking	Floating Blanking	Auto Floating Blanking	Reduced Resolution
Object moves	No	Only within the safety field	Inside and outside of the safety field	Inside and outside of the safety field
Removal of obstruction from the safety field	Causes switching of the safety output	Causes switching of the safety output	Does not cause switching of the safety output	Does not cause switching of the safety output
Number of objects	Unlimited	Max. 3	1	Unlimited
Direction of motion	None	Any	Motion must start at the top or the bottom	Any
Time limit	None	None	Max. 260 seconds	None
Resolution	Resolution is the same as for an unblanked light curtain, because mechanical barricading is required	If the exclusion area is completed obstructed, resolution cor responds to the light curtain's default resolution. Otherwise, the max. number of floating beams must be taken into consideration	The max. number of floating beams must be taken into consideration	Corresponds to selected, electronically reduced resolution
Read-out at display	1×, 6× (interface is active)	7× (interface is active)	8× (interface is active) Blanking/Setup LED blinks = safety field unobstructed/Blanking/Setup LED lit = floating blanking mode	4×, 9× (interface is active)
Max. number of obstructed beams	25 % of total number of beams (up to 20)	25 % of total number of beams (up to 20)	25 % of total number of beams (up to 20)	13 for SG4-14 4 for SG4-30
Configuration	Teach-in, interface	interface	interface	Teach-in, interface

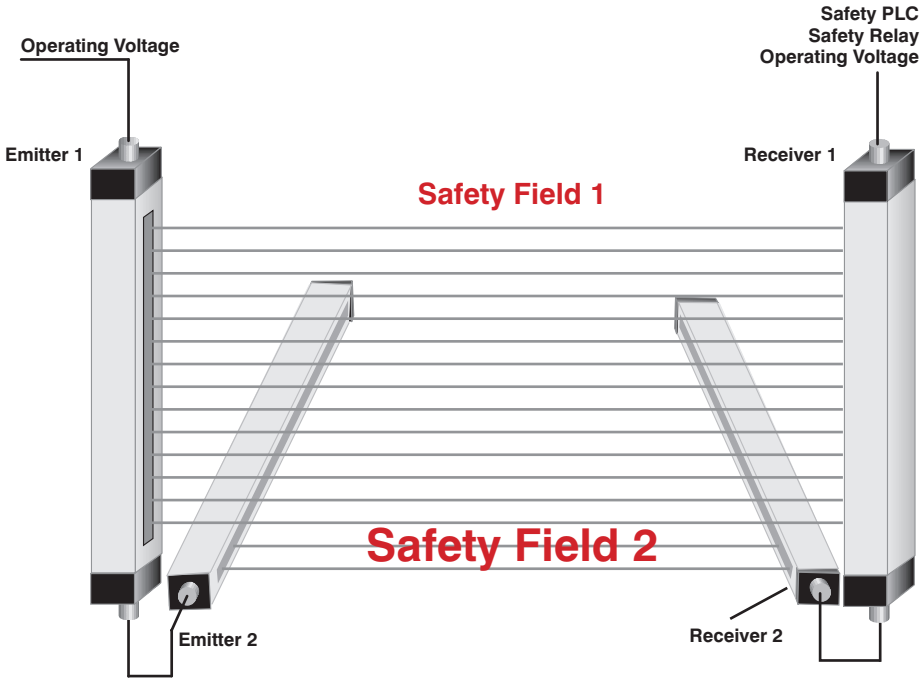
5.5 Cascading (Linking Several Light Curtains)

Neighboring danger zones can be secured by means of cascading. For example, an area can be protected against side-stepping in a very simple fashion. The fact that both safety fields act upon a single common safety output is an important advantage which facilitates connection to the machine.
If the Cascading function is combined with the operation mode Fix Blanking, Floating Blanking, Auto Floating Blanking or Reduced Resolution, first configure the respective operation mode, then activate the function.

5.5.1 Principle

- By interconnecting several receivers, they can be linked such that they all act upon a single safety output.
- **Response time is increased by 1 ms per additional receiver.**
- It is not advisable to cascade more than 5 devices.
- **A minimum clearance of 2 m between light curtains must be maintained in order to prevent interactive influence amongst the utilized light curtains (see section 3.4). Even if interactive influence occurs, system safety is nevertheless maintained in any event.**
- In the operation mode „cascading“ the safety light curtains have to be encoded.

5.5.2 Cascading Procedure



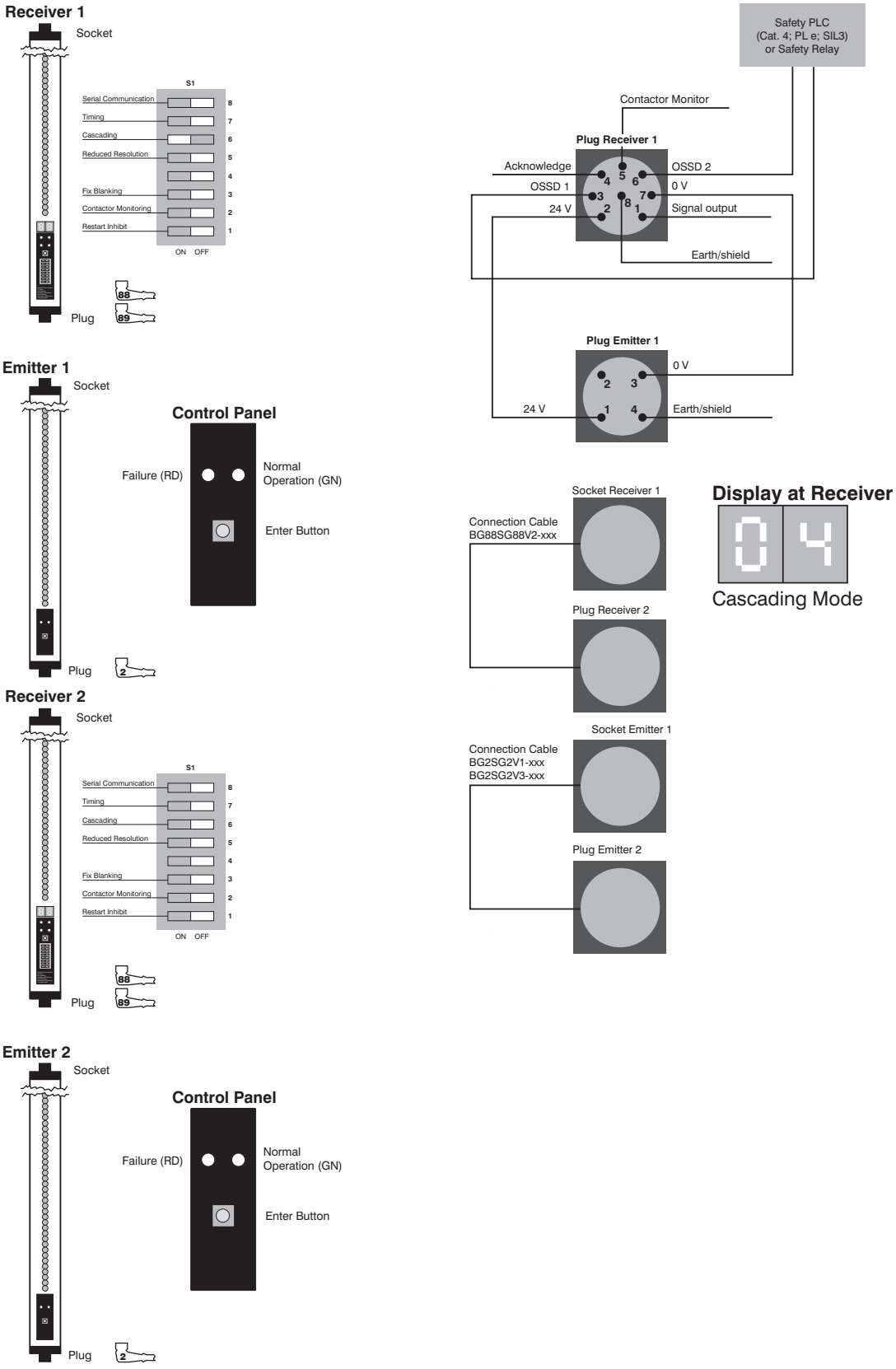
- The safety output at receiver 1 is active, and is connected to the machine **in accordance with** applicable regulations.
- The **cascading DIP switch** is set at receiver 1.

- The cascading DIP switches are set at all downstream receivers as well, **except for the last receiver in the series.**
- Obstructions at all safety fields, or system errors, act upon the single common safety output and cause it to switch.

- Individual settings at each given light curtain (e.g. contactor monitoring, restart inhibit, blanking etc.) only effect the respective light curtain itself - not all cascaded curtains. However, if the safety output of any given light curtain is switched, the common safety output at the first light curtain is switched as well!
- To inhibit manipulations at the DIP Switch, it is lockable (see also section 6.3, „Connection to a PC“).

- Attention, the operation mode contactor monitoring must only be set at the receiver 1.

Schematic Diagram, Cascading



5.5.3 Functions

	Receiver 1	Receiver 2	Effect on common output
Restart inhibit	Activated		Must be acknowledged after penetration into safety field 1/2.
		Activated	Must be acknowledged after penetration into safety field 2.
	Activated	Activated	not reasonable, because an interference of safety field 2 has to be acknowledged twice.
Contactor monitoring	Activated		Downstreamed contactor of receiver 1 is controlled.
		Activated	Monitoring of the downstreamed contactor not possible.
Fix Blanking Floating Blanking Auto Floating Blanking Reduced resolution	Activated		Acts upon common output. The function affects safety field 1 only. Connection of an external warning indicator lamp isn‘t possible.
		Activated	Acts upon common output. The function affects safety field 2 only. Connection, of an external warning indicator lamp isn‘t possible.
	Activated	Activated	Acts of common output. The function affects both safety fields, but the warning indicator lamp does only indicate the status of safety field 1.

Connector Pin Assignments for Safety Operation with Cascading

Required system components:
2 × emitters, 2 × receivers
1 × connector cable for emitter
1 × connector cable for receiver
1 × connector cable

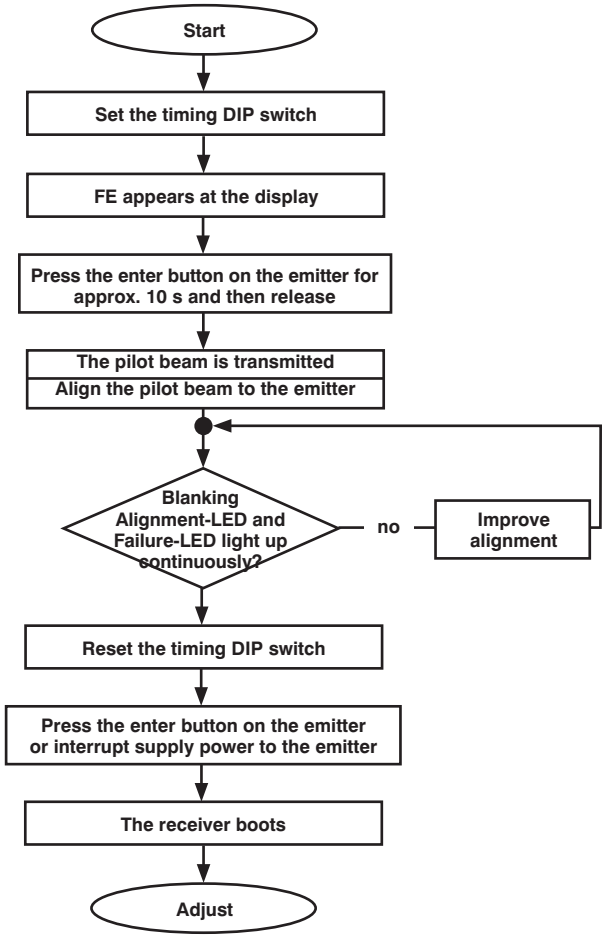
From		To
Emitter Wiring		
Pin 1	24 V DC	Supply Voltage 24 V DC
Pin 2	Unused	
Pin 3	Ground (0 V)	Supply Voltage 0 V
Pin 4	Earth/shield	Operational earth

Receiver Wiring		
Pin 1	Signal output	Muting indicator muting terminal
Pin 2	24 V DC	Supply Voltage 24 V DC
Pin 3	OSSD 1 output	PLC or relay
Pin 4	Acknowledge	free
Pin 5	Contactor Monitor	free
Pin 6	OSSD 2 output	PLC or relay
Pin 7	Ground (0 V)	Supply Voltage 0 V
Pin 8	Earth/shield	Operational earth

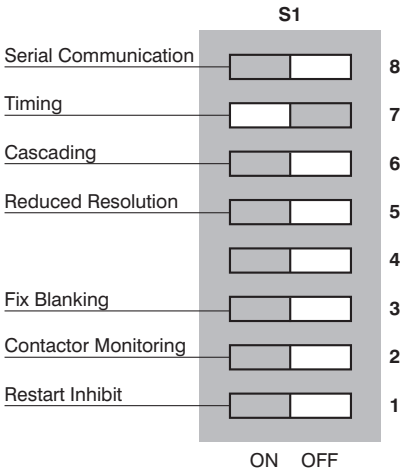
Connector cable from socket 2 at receiver 1 to socket 1 at receiver 2
Connector cable from socket 4 at emitter 1 to socket 3 at emitter 2

5.5.4 Coding

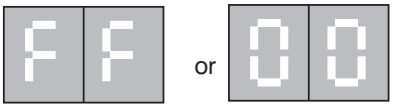
wenglor light curtains are coded at the factory in order to assure that any given emitter is only capable of influencing its own corresponding receiver. The coding of the light curtain can be changed during initial start-up. Coding is initialized as follows:



DIP Switch Settings: Receiver



Display at Receiver



FF: Emitter switched off
00: Emitter switched ont

In order to reset to standard encoding (default status), please proceed as follows:

Same procedure as above, but only press and hold the enter button on the emitter for a duration of 1 to 3 seconds. The red error indicator must not light up while the enter button is being pressed and held. If the red error indicator lights up, the enter button has been pressed and held too long.

Alternatively the following procedure can be used:

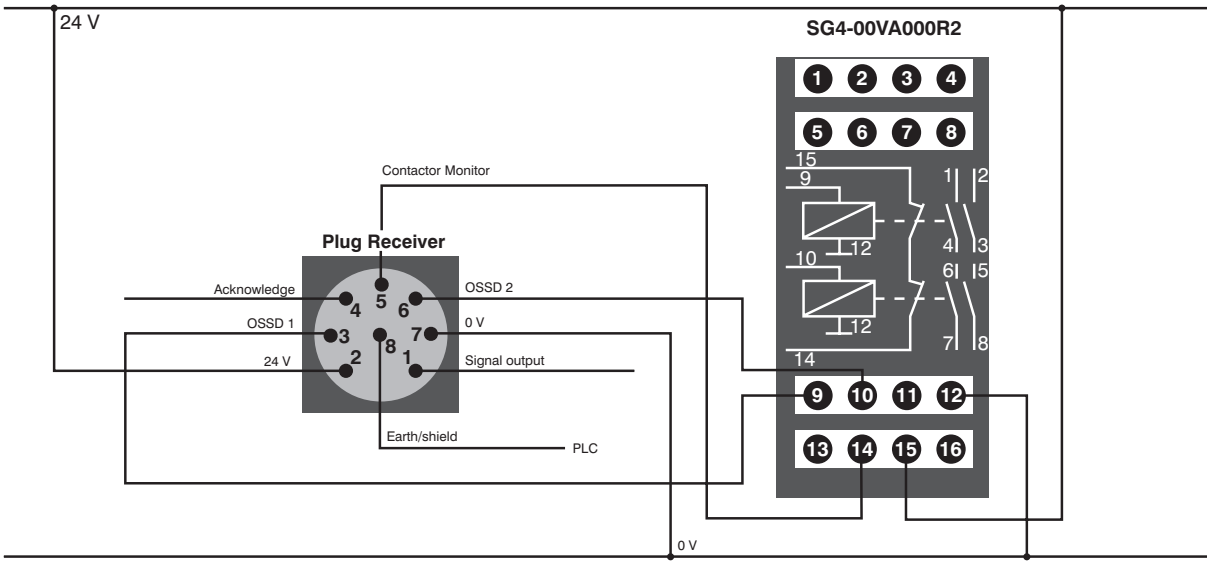
Safety Light Barriers-System	Type of coding
Emitter 1 / Receiver 1	Standard coding (Delivery status)
Emitter 2 / Receiver 2	Coding according to flow diagram chapter 5.5.4
Emitter 3 / Receiver 3	Standard coding (Delivery status)
Emitter 4 / Receiver 4	Coding according to flow diagram chapter 5.5.4
Emitter 5 / Receiver 5	Standard coding (Delivery status)

6. Expanding the Light Curtain System

6.1 Relay Unit

The SG4-00VA000R2 relay unit is equipped with two failsafe floating relay outputs. The terminals are connected to the load circuit. The use of a spark arrestor significantly increases the service life of the relay contact. Two-channel redundant wiring must also be observed when the relay unit is utilized. Both contacts must be used for load current control.
Response times are increased by 8 ms when the relay unit is used.

Schematic Diagram, Relay Unit Connection

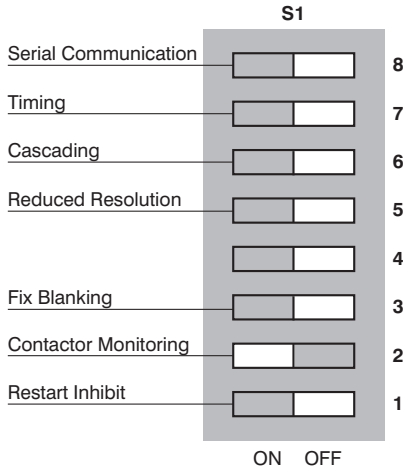


Relay Unit Terminal Assignments

Required system components:
1 × emitter, 1 × receiver
1 × cable
1 × connector cable
1 × relay unit

From	Function	To
Relay Unit Connections		
Terminal 1	NO, 13	Machine contact
Terminal 2	NO, 23	Machine contact
Terminal 3	NO, 24	Machine contact
Terminal 4	NO, 14	Machine contact
Terminal 5	NO, 43	Machine contact
Terminal 6	NO, 33	Machine contact
Terminal 7	NO, 34	Machine contact
Terminal 8	NO, 44	Machine contact
Terminal 9	OSSD 1	Pin 3 socket 1 (receiver)
Terminal 10	OSSD 2	Pin 6 socket 1 (receiver)
Terminal 11		Unused
Terminal 12	0 V Ground	Pin7 socket 1 (receiver)
Terminal 13		Unused
Terminal 14	Contactor monitor	Pin 5 socket 1 (receiver)
Terminal 15	24 V	Pin 2 socket 1 (receiver)
Terminal 16		Unused

DIP Switch Settings: Receiver



6.2 Muting Module

The PMUT-X1P add-on module allows for muting mode operation with the light curtain. Certain objects can be passed through the safety field without switching the safety output in muting mode. For example, material can be fed through the safety field, although reach-in or step-in is nevertheless detected. The muting module allows different types of muting and cyclic operation modes. The use is described in the operating instruction of the muting module.

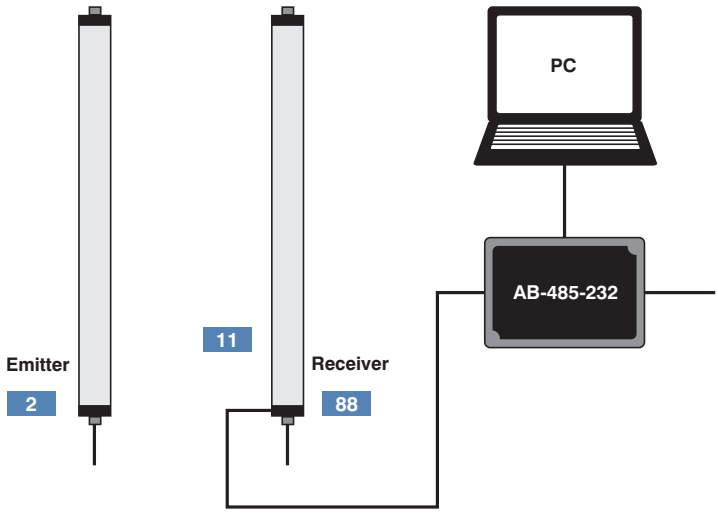
6.3 Connection to a PC

The light curtain receiver is equipped with an RS 485 interface. The A485-232 adapter box can be used for connection to a PC. In order to activate the interface, the “serial communication” DIP switch must be set to the “on” position. wsafe host software allows for configuration and read-out of the light curtain. Operating instructions for the host software can be downloaded from the wenglor website at www.wenglor.com.

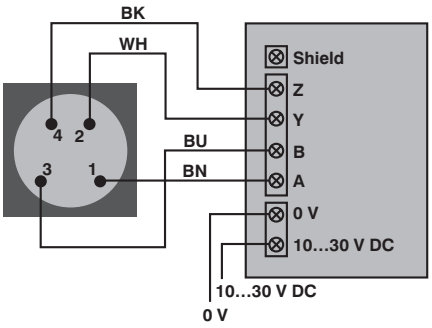
That encloses:

- Creation of various operating profiles
- Set-up of users with various authority levels
- Safety field visualisation
- Configuration of blanking, floating blanking and reduced resolution characteristics
- Activation of restart inhibit, contactor monitoring and cascading
- Diagnosis
- Locking of the DIP switch

Principle



Schematic Diagram, Connection to a PC

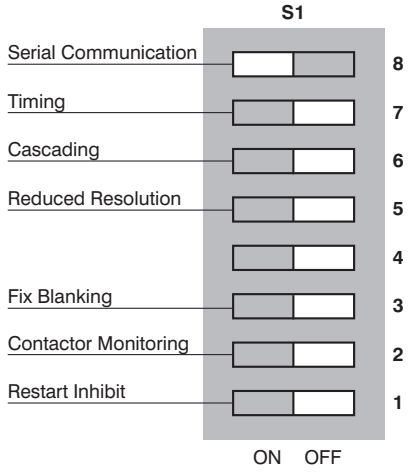


Terminal Assignments for Connection to a PC

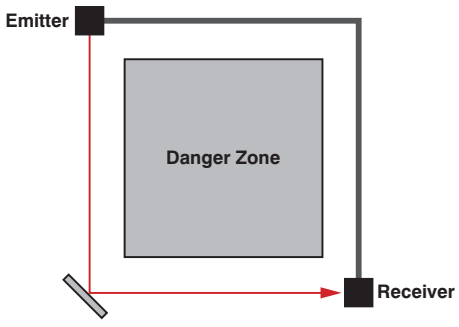
Required system components:
1 × emitter, 1 × receiver
1 × connector cable for emitter
1 × connector cable for receiver
1 × connector cable from A485-232 to receiver
1 × A485-232

From	Function	To plug
A485-232 Adapter Box Connection		
Terminal A	Data cable	Pin 1 (BN)
Terminal B	Data cable	Pin 3 (BU)
Terminal Y	Data cable	Pin 2 (WH)
Terminal Z	Data cable	Pin 4 (BK)
Terminal 10…30 V	24 V	Supply Voltage
Terminal 0 V	0 V Ground	Supply Voltage

DIP Switch Settings: Receiver



6.4 Path-Folding Mirror



Possible applications can be significantly expanded through the use of a path-folding mirror. These path-folding mirrors are available in two different variants:

- Without housing: SLUxxxxV1
- With safety column: SZ000EUxxxNN01

A danger zone can be secured at several sides using only one light curtain with the help of a wenglor path-folding mirror. Range is reduced by approximately 10 % per utilized mirror.
For an easier adjustment the special alignment optic SZ0-LAH01 can be used.

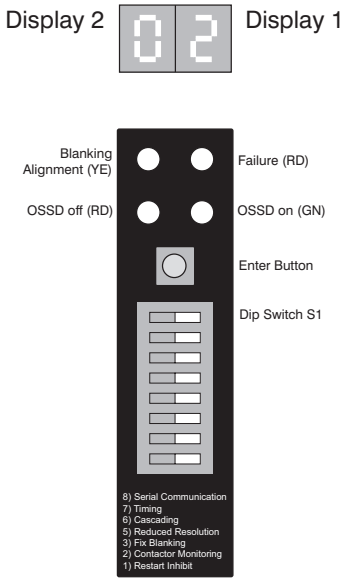
7. Display

7.1 Display of Operating Modes

During normal operation, operating modes and functions appear at the receiver's display. If any errors should occur, the error LED lights up and a corresponding error code is displayed. Additional information is read out at the setup LED. The output LED indicates the current output status.

Display 1	Restart inhibit	Contactor Monitoring	Cascading
0			
1	Activated		
2		Activated	
3	Activated	Activated	
4			Activated
5	Activated		Activated
6		Activated	Activated
7	Activated	Activated	Activated

Control Panel



Display 2	Fix Blanking	Floating Blanking	Auto Floating Blanking	Reduced Resolution	Interface
0					
1	Activated				
4				Activated	
5					Activated
6	Activated				Activated
7		Activated			Activated
8			Activated		Activated
9				Activated	Activated

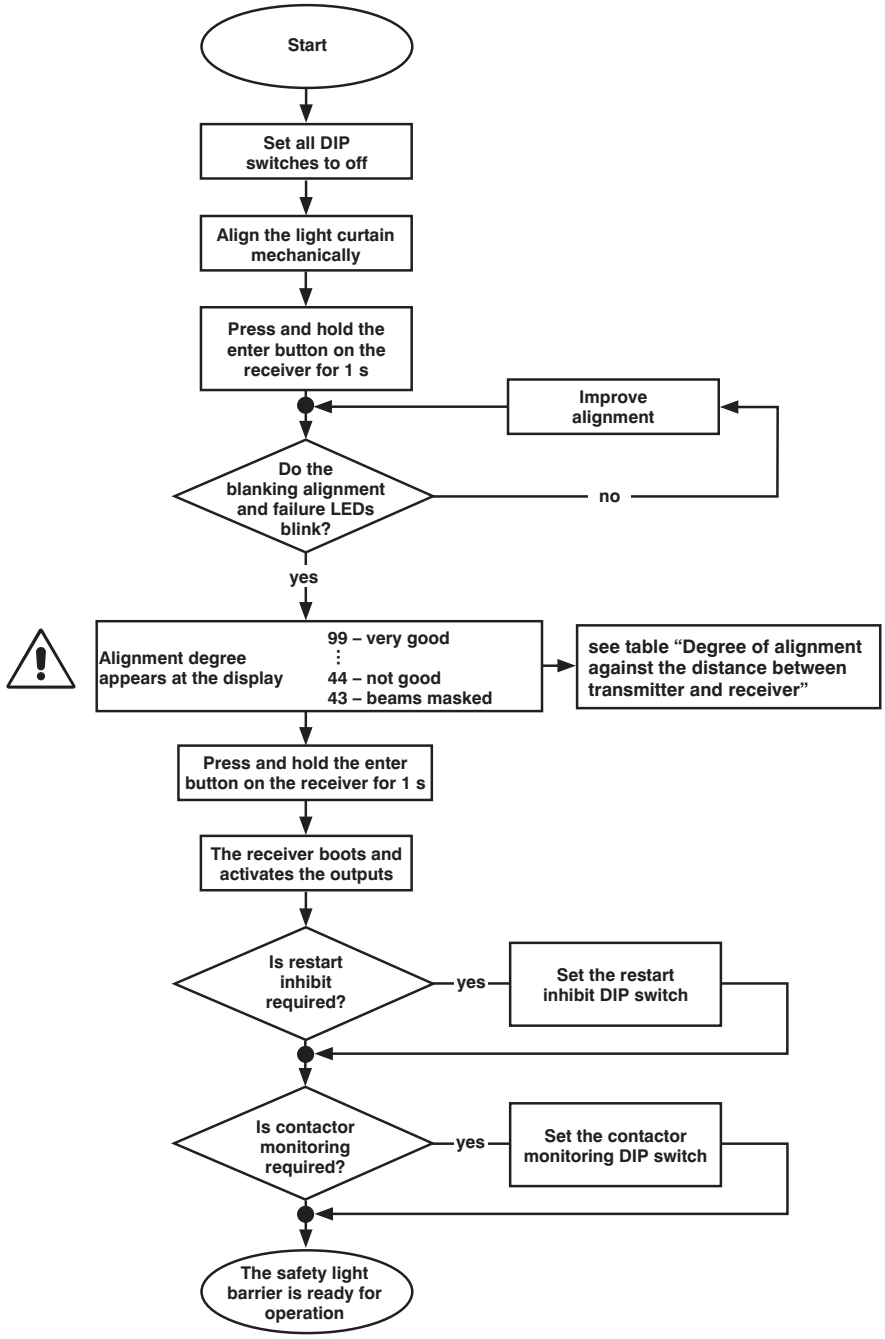
7.2 Diagnostic information

Diagnostic Code	Cause	Remedy
FF**	No synchronisation, pilot beam is obstructed.	Free up the pilot beam or readjust the light curtain.
15, 45	Leakage of data in safety light curtain.	Encode anew, if necessary contact technical support.
18, 48, 17, 47	Influence through ambient light, other sensor, overmodulation (emitter too close to receiver) or wrong coding.	Remove receiver from the cone of light of the interrupting sensor or encode light curtain and set up new.*
19, 49	Leakage of data in safety light curtain or wrong coding.	Encode anew, if necessary contact technical support.
1A, 4A	Leakage of data in safety light curtain or wrong coding.	Encode anew, if necessary contact technical support.
1B, 4B	Connection to the contactor not duly, contactor switches to slow, contactor monitoring activated by mistake.	Contactor and cabling control. Push enter button receiver.*
1C, 4C	Connection to the contactor not duly, contactor monitoring activated by mistake.	Contactor and cabling control. Push enter button receiver.*
1D, 4D	Connection to slave savety barrier has broken down.	Check connection to the slave, press the enter button on the receiver.
1F, 4F	Positive short at output, connection between the two outputs or excessive capacitive load.	Eliminate short circuit *
20, 50	Mistake at output.	Contact technical support.*
22, 52	Short-circuit to ground at output or wrong coding.	correct short-circuit to ground, encode anew, if necessary contact technical support *
23, 53	Working resistance not duly or wrong coding.	Encode anew, if necessary contact technical support.*
06	Leakage of data in safety light curtain.	Contact technical support.
FE**	Occurs during coding only.	Stop coding

* The error reset is executed by switching off the supply voltage of the receiver
** Error LED doesn't shine

Do not operate in case of indeterminate malfunctioning
The machine must be shut down if the error cannot be unequivocally clarified or reliably eliminated.

8. Condensed Start-Up Instructions



Distance transmitter – receiver			
Without deflection mirror	**With 1 deflection mirror**	**With 2 deflection mirrors**	**Degree of alignment**
≤ 3 m	≤ 2,7 m	≤ 2,4 m	96 imperatively necessary
3…7 m (finger protection) 3…20 m (hand protection)	2,7…6,3 m (finger protection) 2,7…18 m (hand protection)	2,4…5,6 m (finger protection) 2,4…16 m (hand protection)	96, 78, 68, 56 preferred > 43 necessary

Tab.: Degree of alignment against the distance between transmitter and receiver

9. Inspection Instructions

The inspections described below serve to confirm compliance with specified safety requirements set forth in national/international regulations, in particular the safety requirements included in the machinery directive and the directive concerning safety and health requirements for the use of work equipment (EC conformity).
The inspections also serve to detect influences which effect the device's protective action, as well as any other unusual ambient influences.

9.1 Inspection Prior to Initial Start-Up

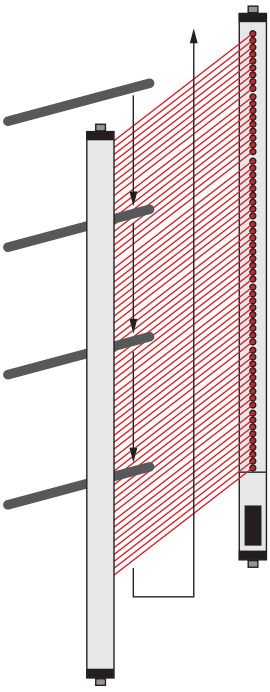
Inspection prior to initial start-up, conducted by trained personnel, is intended to assure that the electro-sensitive protective equipment (ESPE), as well as any other safety components, have been correctly selected in accordance with local ordinances, and that they provide the required protection when used for their intended purpose.

- Inspection of ESPE in accordance with local ordinances. Inspection for correct attachment of the safety device, correct electrical connection to the controller and effectiveness in all of the machine's operating modes.
- The same inspection requirements apply if the machine in question has been shut down for a lengthy period of time and after significant modifications or repairs, if these may influence safety in any way.
- Observe regulations regarding the training of operating personnel by experts before operators begin work. The company which operates the machine is responsible for training.

9.2 Daily Inspection and Maintenance of the Effectiveness of the Safety Device

Regular inspections must be completed in accordance with local ordinances. They serve the purpose of detecting changes to (e.g. over-travel time), or manipulation of the machine and the safety devices.
National regulations for occupational health and safety and machine-specific directives apply to the performance of daily tests.

Daily inspections must be conducted by a person who has been authorized and engaged to do so by the company which operates the machine when work begins, and whenever a new shift is started.
The effectiveness of the ESPE must be tested with supply power to the ESPE switched on, and supply power to the hazardous motion of the machine switched off. Testing is conducted with the help of a suitable test rod, and never by manually reaching into the danger zone. The diameter of the test rod must not be larger than the resolution selected for the equipment. Resolution must be determined in accordance with section 5.4.2.2 for the floating blanking / auto floating blanking mode, and in accordance with section 5.4.4.3 for the reduced resolution mode. The test rods for the full resolution and fix blanking modes must have a diameter of 14 mm (finger protection) and 30 mm (hand protection).
The safety field's upper and lower limits are identified on the devices.



Each light beam between the emitter and the receiver must be inspected by obstructing each beam with the test rod. The test rod must be moved slowly through the safety field in accordance with the adjacent diagram.

The red "OSSD OFF" indicator on the receiver must be continuously lit as long as the safety field is penetrated.

Furthermore, it must be determined whether or not it is only possible for persons and individual limbs to enter the danger zone exclusively by passing through the safety field between the emitter and the receiver. The ESPE, as well as all utilized accessories (connector cables, mounting kit), must be inspected for wear, damage, excessive contamination and correct mounting. If any impairment of the device's safety function is detected during daily testing or during operation, all work at the respective machine must be immediately stopped.

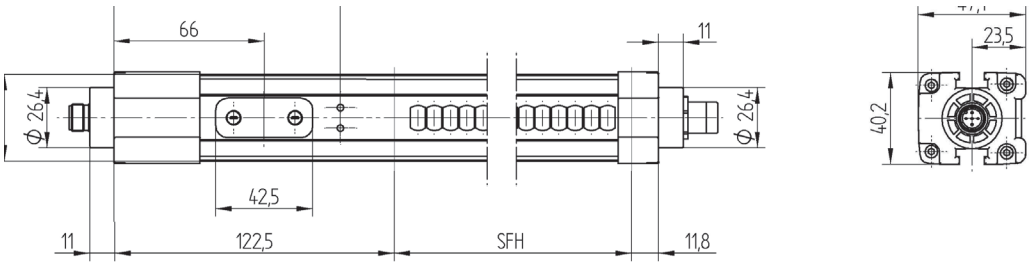
10. Environmentally Sound Disposal

The SG4 light curtain neither contains nor gives off any environmentally harmful substances. It consumes only a minimum of energy and resources.

Disposal:
Light curtains which are no longer usable must be disposed of in accordance with all respectively valid, national waste disposal regulations. The light curtains' housings are made of aluminium, and can be disposed of at an appropriate recycling centre. All electronic components must be disposed of as special waste.
wenglor® sensoric gmbh does not accept the return of unusable or irreparable devices.

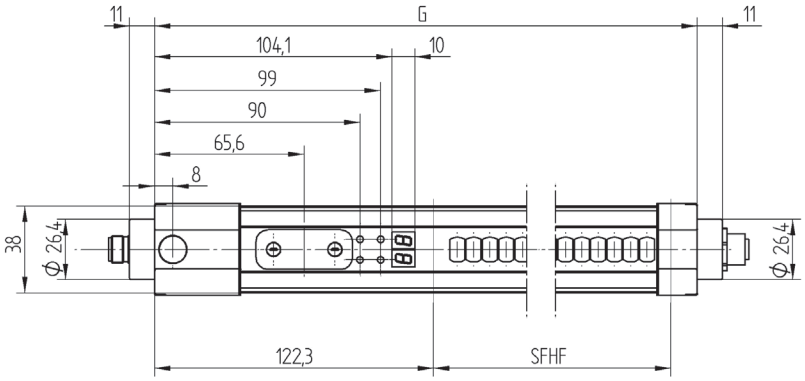
11. Dimensional Drawings

11.1 Finger Protection Emitter



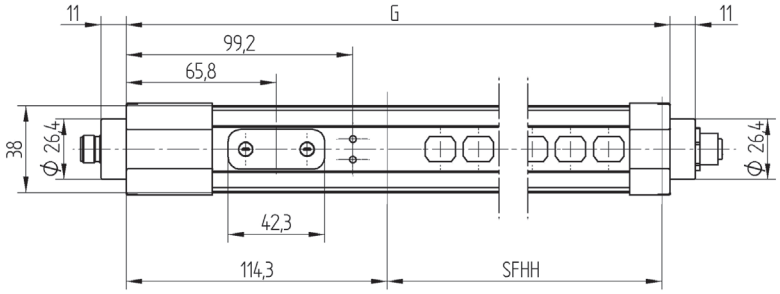
	Overall Length in mm (dimension G)	Finger protection Safety Field Height in mm (SFHF)
SG4-14IS015C1	298,1	163,8
SG4-14IS030C1	448,3	314,0
SG4-14IS045C1	598,5	464,2
SG4-14IS060C1	748,7	614,4
SG4-14IS075C1	898,9	764,6
SG4-14IS090C1	1049,1	914,8
SG4-14IS105C1	1199,3	1065,0

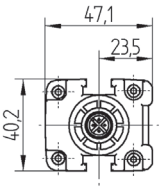
11.2 Finger Protection Receiver



	Overall Length in mm (dimension G)	Finger protection Safety Field Height in mm (SFHF)
SG4-14IE015C1	298,1	163,8
SG4-14IE030C1	448,3	314,0
SG4-14IE045C1	598,5	464,2
SG4-14IE060C1	748,7	614,4
SG4-14IE075C1	898,9	764,6
SG4-14IE090C1	1049,1	914,8
SG4-14IE105C1	1199,3	1065,0

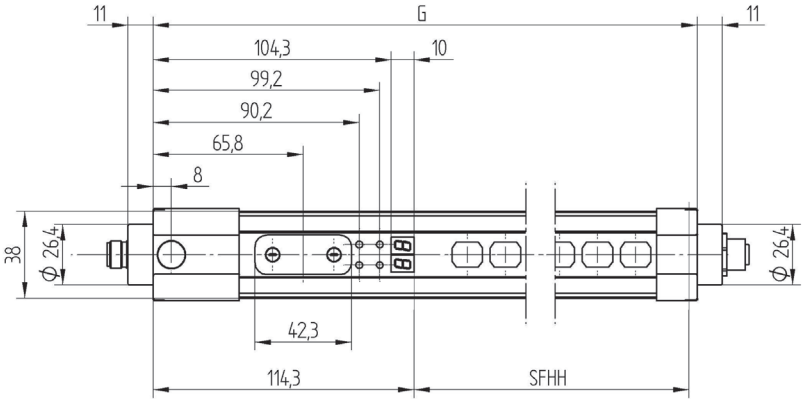
11.3 Hand Protection Emitter

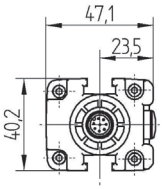




	Overall Length in mm (dimension G)	Hand protection Safety Field Height in mm (SFHH)
SG4-30IS015C1	298,1	180,2
SG4-30IS030C1	448,3	330,4
SG4-30IS045C1	598,5	480,6
SG4-30IS060C1	748,7	630,8
SG4-30IS075C1	898,9	781,0
SG4-30IS090C1	1049,1	931,2
SG4-30IS105C1	1199,3	1081,4
SG4-30IS120C1	1349,5	1231,6
SG4-30IS135C1	1499,7	1381,8
SG4-30IS150C1	1649,9	1532,0
SG4-30IS165C1	1800,1	1682,2
SG4-30IS180C1	1950,3	1832,4

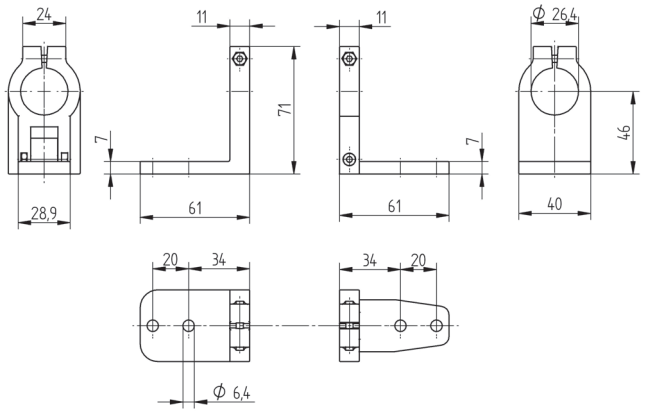
11.4 Hand Protection Receiver





	Overall Length in mm (dimension G)	Hand protection Safety Field Height in mm (SFHH)
SG4-30IE015C1	298,1	180,2
SG4-30IE030C1	448,3	330,4
SG4-30IE045C1	598,5	480,6
SG4-30IE060C1	748,7	630,8
SG4-30IE075C1	898,9	781,0
SG4-30IE090C1	1049,1	931,2
SG4-30IE105C1	1199,3	1081,4
SG4-30IE120C1	1349,5	1231,6
SG4-30IE135C1	1499,7	1381,8
SG4-30IE150C1	1649,9	1532,0
SG4-30IE165C1	1800,1	1682,2
SG4-30IE180C1	1950,3	1832,4

11.5 Mounting Bracket BEF-SET-33



12. Technical Data

12.1 Safety Light Curtains

Type Type 4 per EN 61496
Safety category Cat. 4 per EN ISO 13849-1

Performance Level PL e per EN ISO 13849-1

PFHd SG4-14: 4,22 × 10-8 1/h
SG4-30: 3,08 × 10-8 1/h

Service life TM 20 a

Resolution SG4-14: 14 mm
SG4-30: 30 mm

Range SG4-14: 0, 25…7 m
SG4-30: 0,5…20 m

Aperture angle + /–2,5°

Safety field height and response time

Emitter (S) or Receiver (E) Type Designation	Field Height in mm	Number of Beams	Response Time in ms t1
SG4-14Ix015C1	164	21	6
SG4-14Ix030C1	314	42	11
SG4-14Ix045C1	464	63	16
SG4-14Ix060C1	614	84	21
SG4-14Ix075C1	764	105	26
SG4-14Ix090C1	914	126	31
SG4-14Ix105C1	1064	147	36
SG4-30Ix015C1	180	9	3,3
SG4-30Ix030C1	330	18	5,7
SG4-30Ix045C1	480	27	8,2
SG4-30Ix060C1	630	36	10
SG4-30Ix075C1	780	45	12
SG4-30Ix090C1	930	54	14
SG4-30Ix105C1	1080	63	16
SG4-30Ix120C1	1230	72	18,5
SG4-30Ix135C1	1380	81	20,9
SG4-30Ix150C1	1530	90	23,4
SG4-30Ix165C1	1630	98	25,8
SG4-30Ix180C1	1830	108	27

Supply power, receiver	24 V DC ±10 % 6 W; PELV per EN 50178	
Supply power, emitter	24 V DC ±10 % 6 W; PELV per EN 50178	
Fuse	1,5 A	
Outputs		
Safety outputs	2 ea. semiconductor, PNP	
Output current		
with ohmic, inductive load	2 ea. 300 mA	
Max. voltage in off state	< 1 V	
Max. voltage drop in on state	< 2 V	
Max. residual current	< 2 mA	
Max. capacitive load		
Load current = 0 mA		
OSSD1	< 80 nF	
OSSD2	< 20 nF	
Load current = 300 mA	< 1 µF	
Max. ohmic cable resistance between OSSD and load	< 1 W	
Signal output	1 ea. semiconductor, PNP/200 mA	
Short-circuit proof	yes	
Overload protection	yes	
Interface		
Specification	RS-485	
Baud rate	9600 Baud	
Configuration	8 N1	
Contactor monitoring input		
Max. changeover time	200 ms	
Electrical Connection		
Emitter	M12 (S2)	4 × 0.25 mm²
Receiver	M12 (S80)	8 × 0.25 mm²
Interface	M8 (S7)	4 × 0.12 mm²
Safety class	III	
Protection	IP67	
Dimensions	39 × 48 × depth	
Ambient temperature	–20 °C ... 50 °C	
Storage temperature	–25 °C ... 70 °C	
Relative humidity	95 %	
Vibration resistance	10 g/10 Hz/55 Hz according IEC 60068-2-6	
Shock resistance	10 g/16 ms according IEC 60068-2-29	
	20 g/12 ms	

12.2 System Components

12.2.1 Relay Unit Type 2/Type 4 SG4-00VA000R2

Output	2 sets of 2 NO contacts
Response time	8 ms
Contact load	
Max. switching capacity	1500 VA/AC
Voltage/Current/	
Switching Cycles $B10_d$	250 V AC / 4 A / 180 000
	24 V DC / 4 A / 1 400 000
	24 V DC / 2 A / 3 000 000
Mechanical Service Life	10 000 000 Cycles
Recommended spark arrestor	110 to 230 V load circuit: R = 220 W, C = 0.22 μF
	24 to 48 V load circuit: R = 22 W, C = 0.22 μF
Dimensions	114.5 × 99 × 22,6
Conductor cross-section	0,2…2,5 mm²
Protection	IP20
Mounting	35 mm top-hat rail per EN 60715
Fuse Required	4 A delay fuse
Contact Resistance	≤ 100 mW / 1 A / 24 V DC
	≤ 20 W / 10 mA / 5 V DC
Minimum Load	> 50 mW

12.2.2 Adapter Box RS-232 to A485-232

Power supply	10…30 V, 2,4 W bei 24 V
Dimensions	35 × 65 × 50 mm
Protection	IP65
Mounting	35 mm top-hat rail per EN 60715

12.2.3 Laser Alignment Aid SZ0-LAH1

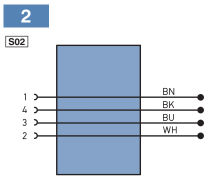
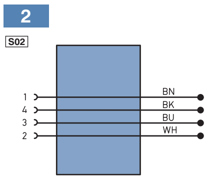
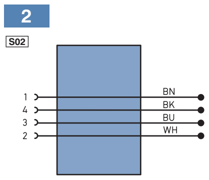
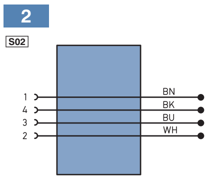
Voltage Supply	3 V (2 × 1,5 AA battery)
Type of light	Laser (red)
Laser Safety Class	2

12.2.4 Mounting Elements

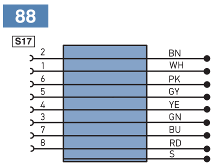
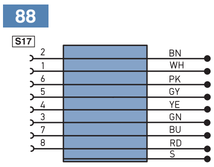
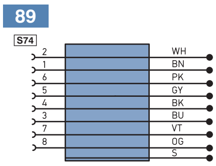
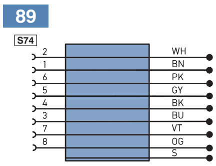
BEF-SET-18	for T-Notch
BEF-SET-36	for mounting inside the Protection Housing

12.2.5 Connection Line

M12 × 1, 4-pin

Length	Angle Plug		Straight Plug	
	PVC	PUR	PVC	PUR
				
2 m	S29-2M	—	S23-2M	S23-2MPUR
5 m	S29-5M	S29-5MPUR	S23-5M	S23-5MPUR
10 m	S29-10M	—	S23-10M	S23-10MPUR

M12 × 1, 8-pin

Length	Straight Plug	Angle Plug	Straight Plug	Angle Plug
			PUR	
				
2 m	S88-2MPUR	S88W-2MPUR	ZAS89R201	ZAS89R202
5 m	—	S88W-5MPUR	ZAS89R501	ZAS89R502
10 m	S88-10MPUR	S88W-10MPUR	ZAS89R601	ZAS89R602
20 m	S88-20MPUR	—	ZAS89R701	—

12.2.6 Connection Cables

M12 × 1, 4-pin

Length	Straight Plug	
	PVC	PUR
2,0 m	BG2SG2V1-2M	BG2SG2V3-2M

M12 × 1, 8-pin

Length	Straight Plug
2,0 m	BG88SG88V2-2M

12.2.7 Interface Cable

Length	Straight Plug
10 m	S11-10M

13. Checklist for Initial Start-Up

This checklist is intended to provide assistance during initial start-up. It does not eliminate the need for testing before initial start-up, or for periodic tests conducted by appropriately trained persons.

1. Standards and Directives, ESPE Selection		
Are the safety precautions based upon the directives/standards which are applicable for the machine?	Yes	No
Are the utilized directives and standards listed in the declaration of conformity?	Yes	No
Is the safety device in compliance with the required safety level?	Yes	No
2. Safety Clearance		
Has safety clearance been calculated in accordance with the valid formulas for securing points of danger, and in consideration of resolution, ESPE response time, response time of any utilized safety interface and machine over-travel time?	Yes	No
Has machine over-travel time been measured, specified, documented (at the machine and/or in the machine's documentation) and adapted to the ESPE installation setup.	Yes	No
Has the safety clearance between the point of danger and the safety field been adhered to?	Yes	No
3. Access to the Point of Danger		
Is it only possible to access the point of danger via the ESPE's safety field?	Yes	No
Is it assured that persons are unable to remain within the danger zone unprotected (e. g. by means of mechanical protection against side-stepping, or by means of cascading), and are the implemented measures protected against manipulation?	Yes	No
Have additional mechanical protective measures been installed which prevent reaching under, over or around the safety field, and are they protected against manipulation?	Yes	No
4. Installation		
Have the components of the ESPE been correctly attached and secured against loosening, shifting and rotation after adjustment?	Yes	No
Is the external condition of the ESPE and all associated accessories flawless?	Yes	No
Has the control device for resetting the ESPE been correctly installed outside of the danger zone, and is it functional?	Yes	No
5. Incorporation into the Machine		
Have the safety outputs (OSSDs) been incorporated into the downstream machine controls in accordance with the required controller category, and have they been connected in accordance with the wiring diagrams?	Yes	No
Are the switching elements which are controlled by the ESPE (e. g. contactors, valves) monitored?	Yes	No
6. Functionality		
Is the ESPE effective during the entire duration of the machine's hazardous motion?	Yes	No
If a hazardous state has been initialized, is it stopped when the ESPE is switched off, if the operating mode or any of the function types are changed, or if switching to another safety device occurs?	Yes	No
Are the specified safety functions effective for each and every configuration?	Yes	No
Has the safety function been tested in accordance with the inspection instructions included in the operating instructions?	Yes	No
Has range been correctly configured?	Yes	No

14. Certification

The SG4 safety light curtain system has received the following approvals:

15. EU Declaration of Conformity

EU Konformitätserklärung
EU Declaration of Conformity (DoC)

wenglor
the innovative family

Name und Anschrift des Herstellers / Name and address of manufacturer:

wenglor sensoric GmbH
wenglor Straße 3
88069 Tettnang / GERMANY

Diese Erklärung gilt für die folgenden Produkte: This declaration applies to the following products:

SG4-14IS...C1
SG4-14IE...C1

Wir bestätigen die Übereinstimmung mit den grundlegenden Anforderungen der Europäischen Richtlinien

We confirm compliance with the essential requirements of the European Directives

Richtlinie / Directive		Fundstelle / Reference	
EMV / EMC	2014/30/EU	Amtsblatt / Official Journal	L96 29.03.2014
Maschinen / MD	2006/42/EG	Amtsblatt / Official Journal	L157 9.06.2006

Folgende harmonisierte Normen wurden angewandt:

EN 61496-1:2013 (Type 4)
EN 61496-2:2013 (Type 4)

The following harmonized standards have been used:

EN ISO 13849-1:2008 (Cat. 4, PL e)
EN 50178:1997
EN 61000-6-4:2007/A1:2011

Produkt-Beschreibung

Sicherheits-Lichtvorhang
Berührungslos wirkende Schutzeinrichtung
Sicherheits-Bauteil nach 2006/42/EG Anhang IV
Seriennummer: Lt. Typenschild

Product description

Safety Light Curtain
Electro-Sensitive Protective Equipment
Safety component per 2006/42/EC annex IV
Serial Number: See rating plate

Benannte Stelle / Zertifikat Nr.
TÜV SÜD Product Service GmbH
Ridlerstraße 65
D-80339 München

Notified Body / Certificate Nr.
NB Nr. 0123
Z10 14 12 40594 029

Dr. Alexander Ohl ist bevollmächtigt, die technischen Unterlagen zusammenzustellen.

Dr. Alexander Ohl is authorized to compile the technical documentation.

Diese Erklärung stellvertretend für den Hersteller wird abgegeben durch:

On account of the manufacturer, this declaration is given by:

Dr. Alexander Ohl
Leiter Forschung & Entwicklung / Head of Research & Development

Tettnang, 20.04.2016
Ort / Place — Datum / Date

i.V.
Unterschrift / Signature

wenglor sensoric elektronische Geräte GmbH · wenglor Straße 3 · 88069 Tettnang · GERMANY · www.wenglor.com

Subject to change without notice. Translation of the Original Operating Instruction.