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SEFGxxx

Safety Light Curtain

IO-Link®

Operating Instructions

Original of the operating instructions
Subject to technical changes
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1. General

1.1 Information Concerning these Instructions

- These instructions apply to the following safety light curtains:
  - SEFG Muting
  - SEFG Muting / Blanking
  - For the exact order designation, see “16.3 Order Notes” on page 184

- They make it possible to use the product safely and efficiently.
- These instructions are an integral part of the product and must be kept on hand for the entire duration of its service life.
- Local accident prevention regulations and national occupational health and safety directives must be observed.
- The product is subject to further technical development, and thus the information contained in these operating instructions may also be subject to change.

The current version can be found at www.wenglor.com in the product’s separate download area.

NOTE!
The operating instructions must be read carefully before using the product and must be kept on hand for later reference.

1.2 Target Group

- These operating instructions are aimed at developers, planners, installers, owners and machine operators who want to safeguard their systems with safety technology from wenglor sensoric GmbH (referred to in the following as “wenglor”).
- The instructions are also aimed at qualified specialist personnel, who are commissioning the SEFG safety light curtain for the first time, maintaining it or integrating it in a machine with accessories and additional products where applicable.

1.3 Explanations of Symbols

- Safety precautions and warnings are emphasized by means of symbols and attention-getting words.
- Safe use of the product is only possible if these safety precautions and warnings are adhered to.

The safety precautions and warnings are laid out in accordance with the following principle:

ATTENTION-GETTING WORD!
Type and source of danger!
Possible consequences in the event that the hazard is disregarded.
- Measures for averting the hazard.

The meanings of the attention-getting words, as well as the scope of the associated hazards, are listed below:

	DANGER! This word indicates a hazard with a high degree of risk which, if not avoided, results in death or severe injury.
	WARNING! This word indicates a hazard with a medium degree of risk which, if not avoided, may result in death or severe injury.
	CAUTION! This word indicates a hazard with a low degree of risk which, if not avoided, may result in minor or moderate injury.
	ATTENTION! This word draws attention to a potentially hazardous situation which, if not avoided, may result in property damage.
	NOTE! A note draws attention to useful tips and suggestions, as well as information regarding efficient, error-free use.

1.4 Limitation of Liability

- The product has been developed in consideration of the current state-of-the-art, as well as applicable standards and guidelines. Subject to change without notice.
- A valid declaration of conformity can be found at www.wenglor.com in the product's separate download area.
- wenglor excludes all liability in the event of:
  - Non-compliance with the instructions,
  - Installation errors,
  - Use of the product for purposes other than those intended,
  - Use by untrained personnel,
  - Use of unapproved spare parts and accessories,
  - Unapproved modification of products.

These operating instructions do not imply any guarantee from wenglor with regard to the described procedures or specific product characteristics.
wenglor assumes no liability for printing errors or other inaccuracies contained in these operating instructions, unless wenglor was verifiably aware of such errors at the point in time at which the operating instructions were prepared.

1.5 Copyrights

- The contents of these instructions are protected by copyright law.
- All rights are reserved by wenglor.
- Commercial reproduction or any other commercial use of the provided content and information, in particular graphics and images, is not permitted without previous written consent from wenglor.

2. For Your Safety

2.1 Use for Intended Purpose

The product is based on the following functional principle:

Safety Light Curtain
The Light Curtain monitors the safety field between the emitter and the receiver. If the safety field is penetrated by an object, 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.

As part of an overall system, the task of this product is to carry out safety-related functions. However, the correct overall function must be ensured by the system or machine manufacturer.

Use of the Light Curtain is only permissible if:

- Hazardous motion can be stopped by electrical means using the Light Curtain's safety output
- The safety clearance between the ESPE and a hazardous machine motion is complied with at all times.
- Additional mechanical safety equipment is installed so that the safety field must be passed through to access hazardous machine parts.
- Care is taken during installation to ensure that the personnel always remain outside the danger zone for machine operation.
- Regular safety inspections are carried out.
- Adequate detection of possible obstructions is assured with existing resolution
- The use of a light curtain, type 4 / Performance Level PL e / SIL 3 / SIL CL 3, was deemed permissible following an extensive risk analysis.

This product can be used in the following industry sectors:

- Special machinery manufacturing
- Pharmaceuticals industry
- Electronics industry
- Chemicals industry
- Heavy machinery manufacturing
- Clothing industry
- Glass industry
- Agriculture industry
- Logistics
- Plastics industry
- Steel industry
- Alternative energy
- Automotive industry
- Woodworking industry
- Printing industry
- Raw materials extraction
- Food industry
- Consumer goods industry
- Aviation industry
- Paper industry
- Packaging industry
- Other
- Construction industry

2.2 Use for Other than the Intended Purpose

- The product is not suitable for use in potentially explosive atmospheres.
- The product may only be used with accessories supplied or approved by wenglor, or in combination with products approved by wenglor. A list of approved accessories and combination products can be accessed at www.wenglor.com on the product detail page.
- The product is not suitable for use in outdoor weather.

DANGER!
Risk of personal injury or property damage in case of use for other than the intended purpose!
Use for other than the intended purpose may lead to hazardous situations.
- Observe instructions regarding use for intended purpose.

2.3 Personnel Qualifications

- Suitable technical training is a prerequisite.
- In-house electronics training is essential.
- Trained personnel who use the product must have uninterrupted access to the operating instructions.

DANGER!
Risk of personal injury or property damage in case of incorrect initial start-up, operation and maintenance!
Personal injury and damage to equipment may occur.
- Adequate training and qualification of personnel.

2.4 Modification of Products

DANGER!
Risk of personal injury or property damage if the product is modified!
Personal injury and damage to equipment may occur. Non-observance may result in loss of the CE mark and the guarantee may be rendered null and void.
- Modification of the product is impermissible.

2.5 Important Safety Precautions

2.5.1 Important Safety Precautions for Machine Manufacturers

DANGER!
Risk of safety device failure
If this warning is not observed, body parts and people to be protected may not be detected.

- The national directives and safety regulations resulting from this application (e.g. accident prevention) must be observed.
- A risk assessment must be carried out.
- Depending on the application, a check must be carried out to determine whether additional protective measures are required.
- The safety light curtain and associated components must not be tampered with or modified.
- Light curtains must not influence each other. Different beam codings can be used where required (see section 7.1, page 109).
- No repair work may be carried out on the device and its components. An incorrect repair could render the protection function ineffective.

2.5.2 Important Safety Precautions for Machine Operators

DANGER!
Risk of safety device failure
If this warning is not observed, body parts and people to be protected may not be detected.

- If changes are made to the electrical integration in the machine control or the mechanical installation of the safety light curtain, a new risk assessment must be carried out.
- The safety light curtain and associated components must not be tampered with or modified.
- No repair work may be carried out on the device and its components. An incorrect repair could render the protection function ineffective.

2.6 General Safety Precautions

NOTE!

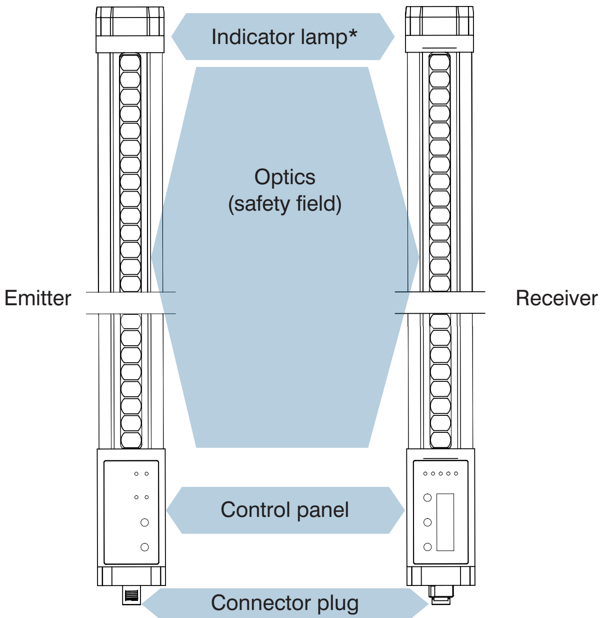
- These instructions are an integral part of the product and must be kept on hand for the entire duration of its service life.
- In the event of possible changes, the respectively current version of the operating instructions can be accessed at www.wenglor.com in the product's separate download area.
- Read the operating instructions carefully before using the product.
- Additional measures may be necessary in order to assure that the ESPE does not fail in a dangerous fashion due to other types of light which are used in a special application (e.g. emission due to welding sparks or the effects of stroboscope lights) (EN 61496-2, Para. 7ff)

2.7 Approvals and IP Protection

3. Product Description

The SEFG safety light curtain is a piece of electro-sensitive protective equipment (ESPE) used to safeguard danger points, danger zones and accesses to machines.
The ESPE monitors the safety field between the emitter and the receiver.
When an object penetrates the safety field and one or multiple beams are interrupted, a switch command is triggered on both safety outputs. Together with the downstream evaluation, this prevents a hazardous motion from being initiated or interrupts an action that has already been initiated.
Objects that protrude into the safety field on the system side can be hidden in blanking operating modes.

The ESPE consists of the following components:



* On the emitter, the indicator lamp has no lighting function

Figure 1: Product structure

This product has the following properties:

- ESPE type 4, per EN 61496-1
- PL e per EN ISO 13849-1 and SIL 3 per EN 62061
- Finger protection: 14 mm resolution, 0.25 m to 7 m range or
- Hand protection: 30 mm resolution, 0.25 m to 20 m range
- Visible red light
- Blanking function
  - Electronically reduced resolution
  - Fix blanking (without/with edge tolerance)
  - Floating blanking
- Muting function
  - Cross muting
  - Two sensor linear muting
  - Four sensor linear muting (with sequence/time monitoring)
  - Different, adjustable muting functions
- Restart inhibit and safety operating mode (automatic restart)
- Contactor monitoring (monitoring of external switching elements)
- Cascading
- Integrated indicator lamp
- Alphanumeric display (16-segment, 4-digit)
- Memory card (microSD)
- IO-Link 1.1 interface (not safety-related)

NOTE!
The performance characteristics differ depending on the device type, see “5.2.1 Functions Overview” on page 49.

4. Technical Data
4.1 General Technical Data

For US and Canada:
Device to be supplied by a certified Class 2 power supply that complies with the requirements according NEC and CEC.

	Order no. Finger protection	Order no. Hand protection
Emitter	SEFG531…SEFG542	SEFG511...SEFG522
Receiver	SEFG631…SEFG642 SEFG671…SEFG682	SEFG611 ...SEFG622 SEFG651 ...SEFG662
Set	SEFG431…SEFG442 SEFG471…SEFG482	SEFG411 ...SEFG422 SEFG451 ...SEFG462
Optical data		
Resolution	14 mm	30 mm
Range	0.25 m…7 m	0.25 m…20 m
Safety field height	150 mm…1800 mm	
Aperture angle	± 2.5°	
Wavelength emitter	typ. 630 nm	
Coated optics:	Yes	
Ambient light immunity (for continuous light)	10,000 Lux	
Electrical data		
Response time	See section 4.2, page 17	
Processing time muting signals	95 ms	
Supply voltage	19.2…28.8 V DC (24 V DC +/–20 %) (SELV-, PELV power supply unit), it must be possible to bridge power failures of 20 ms (EN 60204-1)	
Safeguarding the supply voltage, inputs	max. 2 A	
Current consumption (Ub = 24 V) receiver	≤ 350 mA (without load)	
Current consumption (Ub = 24 V) emitter	≤ 100 mA	
Internal fuse	2 A	
Temperature range*	–30…55 °C	
Storage temperature	–30…70 °C	
Relative humidity	≤ 95 %, non-condensing	
Vibration resistance	5 g (10 to 55 Hz)	
Shock resistance	10 g / 16 ms	
Short-circuit proof	Yes	
Reverse polarity protected and overload-proof	Yes	
Protection class	III	
Max. cable length**	< 35 m/0.25 mm² < 50 m/0.34 mm² < 72 m/0.50 mm²	

Safety outputs OSSD	
Safety outputs OSSD	PNP semiconductor
Number of safety outputs	2
Switching current safety output	≤ 300 mA
Leakage current safety output	≤ 2 mA
Voltage drop at safety output	≤ 2.3 V
Max. voltage in off state	< 2 V
Max. capacitive load	≤ 1 µF
Max. inductive load	≤ 2.2 mH
Test pulse width, rate	<300 µs; typ. 20 ms
Restart time after intervention	typ. 2×response time
Signal output	
Signal output	IO-Link interface (C/Q)
Number of signal outputs	1
Switching current signal output	≤ 100 mA
Voltage drop signal output	< 3 V
Inputs	
Voltage range	–30…+30 V DC SELV / PELV
Switching thresholds	Low: < 5 V; < 2 mA high: > 11 V; 6…30 mA
Mechanical data	
Housing material	Aluminum
Degree of protection	IP65, IP67
Connection type emitter	M12 plug, 5-pin
Connection type receiver	M12 plug, 8-pin (system connection) M12 socket, 8-pin (extension connection)
Technical safety data	
ESPE type (EN 61496)	4
Performance level (EN ISO 13849-1:2015)	Cat. 4 PL e
Safety integrity level (EN 62061)	SIL 3, SIL cl 3
PFHd*	≤ 1.8 * 10-8
MTTFd	> 100a
Mission time TM (EN ISO 13849-1:2015)	20 years

* The values apply for operating altitudes of up to 2,000 m above sea level.
For operating altitudes between 2,000 m and 4,000 m, the following values in the table below apply:

Operating altitude above sea level	Max. ambient temperature during operation	PFHd value
> 2.000 m … ≤ 3.000 m	+50° C	≤ 2,1× 10-08
> 3.000 m … ≤ 4.000 m	+45° C	≤ 2,1× 10-08

NOTE!
Use at altitudes above 4,000 m is not permitted.

** The max. cable length must also be complied with for receivers in a cascade.

	Finger protection	Hand protection
Functions		
Finger protection	Yes	No
Hand protection	No	Yes
Safety operating mode	Yes	
Restart inhibit	Yes	
Contactor Monitoring	Yes	
Muting	Yes	
Blanking	SEFG431...SEFG442 and SEFG411...SEFG422	

The following table specifies the tightening torques of the plugs and mounting options in order to assure compliant, error-free operation:

Connection type	Tightening torque (Nm)
M12	0.4

NOTE!
- The response time of the ESPE depends upon the height of the safety field and the selected operating mode.
- The response time for “Basic setting” applies for:
  - Full resolutions
  - Fix blanking without edge tolerance
- The response time for “Special setting” applies for:
  - Reduced resolution
  - Fix blanking with edge tolerance
  - Floating blanking

4.2 Response times

Finger protection				Response time [ms]	
SEFG Muting	**SEFG Muting/Blanking**	**SFH [mm]**	**Number beams**	**Basic setting**	**Special setting**
SEFG471	SEFG431	159	15	9.0	13.0
SEFG472	SEFG432	309	30	10.8	15.7
SEFG473	SEFG433	460	45	12.6	18.4
SEFG474	SEFG434	610	60	14.4	21.1
SEFG475	SEFG435	760	75	16.2	23.8
SEFG476	SEFG436	910	90	18.0	26.5
SEFG477	SEFG437	1061	105	19.8	29.2
SEFG478	SEFG438	1211	120	21.6	31.9
SEFG479	SEFG439	1361	135	23.4	34.6
SEFG480	SEFG440	1511	150	25.2	37.3
SEFG481	SEFG441	1662	165	27.0	40.0
SEFG482	SEFG442	1812	180	28.8	42.7

Hand protection				Response time [ms]	
SEFG Muting	**SEFG Muting/Blanking**	**SFH [mm]**	**Number beams**	**Basic setting**	**Special setting**
SEFG451	SEFG411	159	8	8.2	11.8
SEFG452	SEFG412	309	15	9.0	13.0
SEFG453	SEFG413	460	23	10.0	14.5
SEFG454	SEFG414	610	30	10.8	15.7
SEFG455	SEFG415	760	38	11.8	17.2
SEFG456	SEFG416	910	45	12.6	18.4
SEFG457	SEFG417	1061	53	13.6	19.9
SEFG458	SEFG418	1211	60	14.4	21.1
SEFG459	SEFG419	1361	68	15.4	22.6
SEFG460	SEFG420	1511	75	16.2	23.8
SEFG461	SEFG421	1662	83	17.2	25.3
SEFG462	SEFG422	1812	90	18.0	26.5

4.3 Weight Tables

Resolution	SEFG Muting	SEFG Muting/Blanking	Max. weight per component [kg]
14 mm 30 mm	SEFGx71; SEFGx51	SEFGx31; SEFGx11	0.51
14 mm 30 mm	SEFGx72; SEFGx52	SEFGx32; SEFGx12;	0.80
14 mm 30 mm	SEFGx73; SEFGx53	SEFGx33; SEFGx13	1.08
14 mm 30 mm	SEFGx74; SEFGx54	SEFGx34; SEFGx14	1.37
14 mm 30 mm	SEFGx75; SEFGx55	SEFGx35; SEFGx15	1.65
14 mm 30 mm	SEFGx76; SEFGx56	SEFGx36; SEFGx16	1.94
14 mm 30 mm	SEFGx77; SEFGx57	SEFGx37; SEFGx17	2.23
14 mm 30 mm	SEFGx78; SEFGx58	SEFGx38; SEFGx18	2.51
14 mm 30 mm	SEFGx79; SEFGx59	SEFGx39; SEFGx19	2.80
14 mm 30 mm	SEFGx80; SEFGx60	SEFGx40; SEFGx20	3.08
14 mm 30 mm	SEFGx81; SEFGx61	SEFGx41; SEFGx21	3.37
14 mm 30 mm	SEFGx82; SEFGx62	SEFGx42; SEFGx22	3.66

4.4 Housing Dimensions Safety Light Curtain

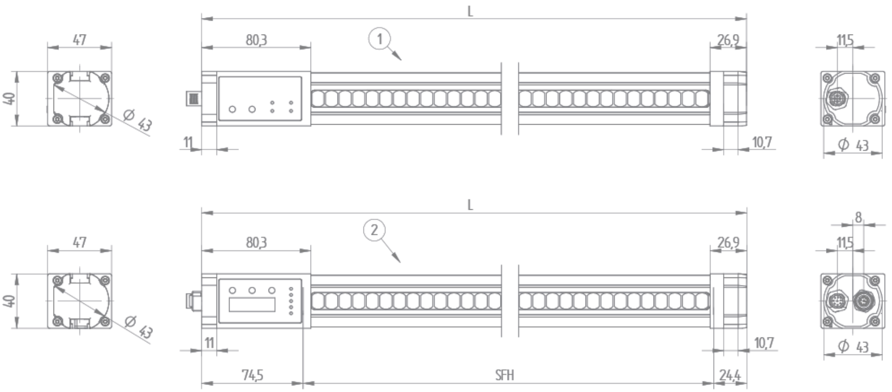


Figure 2: Overall housing dimensions: 1=Emitter, 2=Receiver, SFH=Safety field height

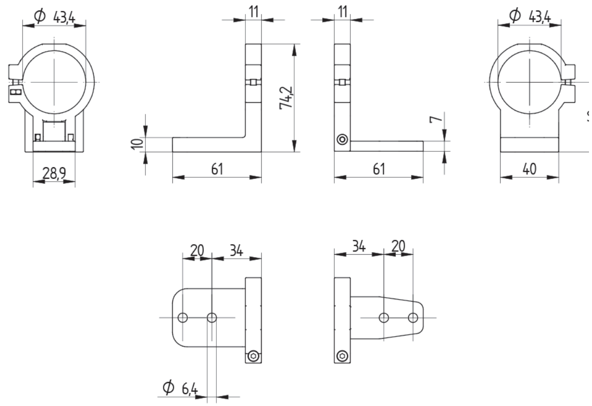
NOTE!

- The lower boundary of the safety field (control panel) is indicated by a line on the ESPE.
- The upper boundary of the safety field is located on the bottom end of the indicator lamp cap and is also indicated by a line.

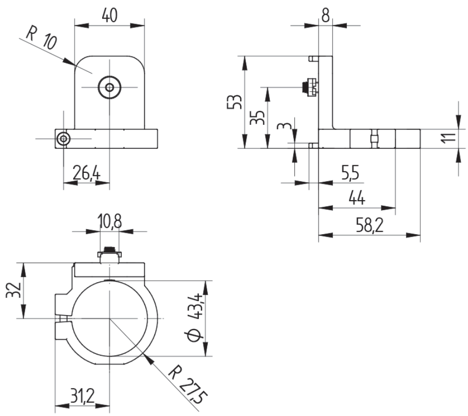
Resolution	**SEFG Muting**	**SEFG Muting/Blanking**	**SFH [mm]**	**Length device L [mm]**
14 mm 30 mm	SEFGx71; SEFGx51	SEFGx31; SEFGx11	159	258
14 mm 30 mm	SEFGx72; SEFGx52	SEFGx32; SEFGx12;	309	408
14 mm 30 mm	SEFGx73; SEFGx53	SEFGx33; SEFGx13	460	559
14 mm 30 mm	SEFGx74; SEFGx54	SEFGx34; SEFGx14	610	709
14 mm 30 mm	SEFGx75; SEFGx55	SEFGx35; SEFGx15	760	859
14 mm 30 mm	SEFGx76; SEFGx56	SEFGx36; SEFGx16	910	1009
14 mm 30 mm	SEFGx77; SEFGx57	SEFGx37; SEFGx17	1061	1160
14 mm 30 mm	SEFGx78; SEFGx58	SEFGx38; SEFGx18	1211	1310
14 mm 30 mm	SEFGx79; SEFGx59	SEFGx39; SEFGx19	1361	1460
14 mm 30 mm	SEFGx80; SEFGx60	SEFGx40; SEFGx20	1511	1610
14 mm 30 mm	SEFGx81; SEFGx61	SEFGx41; SEFGx21	1662	1760
14 mm 30 mm	SEFGx82; SEFGx62	SEFGx42; SEFGx22	1812	1911

4.5 Housing Dimensions, Mounting Technology

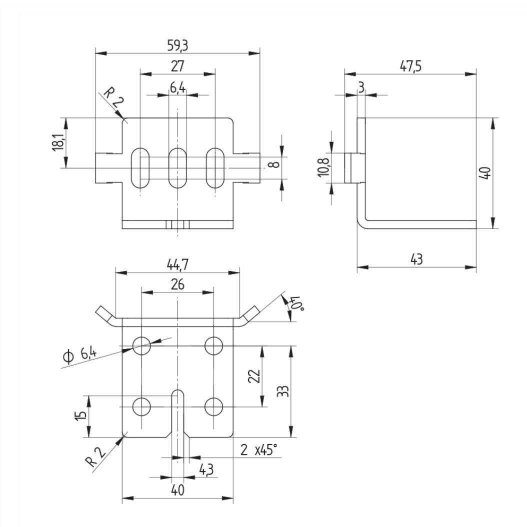
Mounting bracket ZEFX001
- For attachment to the ends (top/bottom) of the ESPE
- Scope of delivery: 1 piece
- Including screws and washers



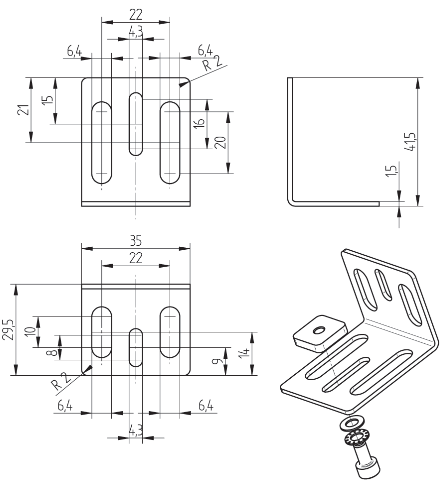
Mounting bracket ZEFX002
- For attachment to the ends (top/bottom) of the ESPE
- Installation in protection column Z2SSxxx
- Scope of delivery: 2 pieces
- Including screws, washers and slot nut



Mounting bracket ZEFX003
- For attachment to the profile at the side of the ESPE
- Installation in protection column Z2SSxxx
- Scope of delivery: 2 pieces
- Including screws, washers and slot nut



Mounting bracket ZEMX001
- For wall/profile mounting
- Scope of delivery: 2 pieces
- Including screws, washers and slot nuts

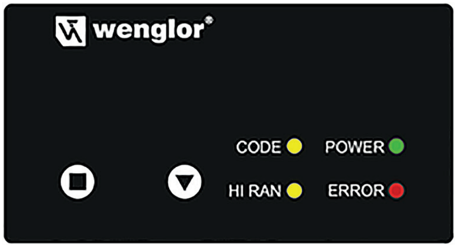


4.6 Control Panel

The different operating and parametrization states of emitters and receivers are shown via the LEDs and the segment display (receivers only).

4.6.1 Control panel emitter

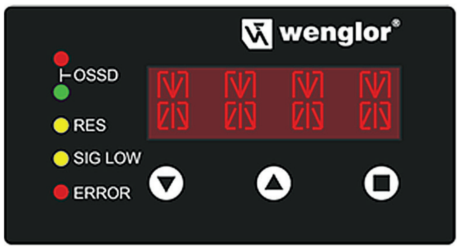
LEDs			
Display		**Color**	
1	Power Supply voltage	Green	(GN)
2	CODE Beam coding	Yellow	(YE)
3	HI RAN High range	Yellow	(YE)
4	ERROR Error	Red	(RD)



Input elements			
Apply		Menu down	

4.6.2 Control panel receiver

LEDs			
Display		**Color**	
1	OSSD Switching state OSSDs	Red	(RD)
2		Green	(GN)
3	RES confirmation requirement	Yellow	(YE)
4	SIG LOW Weak signal	Yellow	(YE)
5	ERROR Error	Red	(RD)



Display element		Input elements		
Display	Color	Menu down	Menu up	Apply
4 digit 16-segment display	Red			

4.7 Scope of Delivery

The SEFG4xx (set) consists of the following components:

- Emitter (SEFG5xx) and receiver (SEFG6xx) with the same safety field height
- Quick-start guide
- CD operating instructions
- Test rod according to the resolution of the ESPE
  - Ø 14 mm – ZEMG003
  - Ø 30 mm – ZEMG004
- Label “regular inspection”
- Mounting bracket (ZEFX001)

4.8 System Overview

Connection Equipment (Selection)

M12×1; 5-pin (Emitter)		
Straight, PVC	S35G-5M	5 m
Straight, PUR	ZAS35R501 ZC4L001	5 m 10 m
Angled, PVC	S35W-3M S35W-5M	3 m 5 m
M12×1; 4-pin (Emitter)		
Straight, PVC	S23-2M S23-5M S23-10M	2 m 5 m 10 m
Straight, PUR	S23-2MPUR S23-5MPUR S23-10MPUR	2 m 5 m 10 m
Angled, PVC	S29-2M S29-5M	2 m 5 m
Angled, PUR	S27-2MPUR S27-5MPUR	2 m 5 m
M12×1; 8-pin (Receiver, system connection)		
Straight, PUR	ZAS89R201 ZAS89R501 ZAS89R601	2 m 5 m 10 m
Angled, PUR	ZAS89R202 ZAS89R502 ZAS89R602	2 m 5 m 10 m
M12×1; 8-pin (Receiver, expansion Connection)		
Straight, PUR	BG88SG88V2-2M	2 m

Mounting Technology

ESPE at top/bottom	ZEFX001*
ESPE at slot in side	ZEMX001
ESPE at top/bottom in protection column	ZEFX002
ESPE at slot in protection column	ZEFX003

Protection Column

With protective screen	Z2SS001 Z2SS002 Z2SS003	930 mm 1380 mm 1830 mm
With path-folding mirror	Z2SU001 Z2SU002 Z2SU003	930 mm 1380 mm 1830 mm
For muting	Z2SM001 Z2SM002 Z2SM003	930 mm 1380 mm 1830 mm
Floor mounting	ZMBSZ0001	
Wall mounting	ZMBSZ0002	

Muting Sets

Cross muting	Z2MG001
Two sensor linear muting	Z2MG002
Four sensor linear muting	Z2MG003

Safety Relay

Basic module	SR4B3B01S SR4D3B01S SG4-00VA000R2
Add-on module	SR4E4D01S

Complementary Products

Laser alignment tool	Z98G001
LED light strips	Z99G001 – Z99G015
Connection box	ZFBB001
Path-folding mirror	Z2UG001 Z2UG002 Z2UG003 Z2UG004
micro SD card	ZNNG013
T-plug	ZC7G001

Spare Parts

Protective Screens for Protection Column	Z0030 Z0031 Z0032
Test Rod	ZEMG003 ZEMG004 ZEMG009 ZEMG010
Muting Sensor System	ZMZG001
Muting Reflector System	ZMZG002
Mounting Bracket	ZMZG003
Cable Holder	ZMZG004

Software

DNNF005 (wTeach2)
DNNF019 (IO-Link Device Tool)

Legend

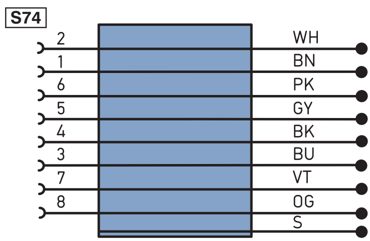
Required Accessories ●———●
Optional Accessories □- - - - -□
Included in scope of delivery *

4.9 Accessory Products

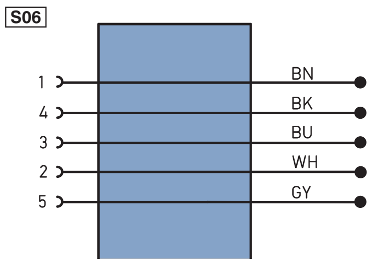
4.9.1 Mounting Elements

Order no.	Figure	Material	Assembly note
ZEFX001 (scope of delivery)		Plastic PA	• Mounting on ends (top/bottom) of the ESPE
ZEFX002		Plastic PA	• Mounting on ends (top/bottom) of the ESPE • Installation in safety column Z2SSxxx
ZEFX003		Stainless steel	• Mounting on the side profile of the ESPE • Installation in safety column Z2SSxxx
ZEMX001		Stainless steel	• Mounting on the side profile of the ESPE

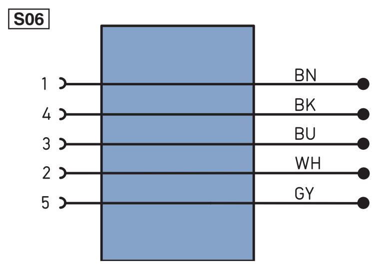
4.9.2 Connection Lines

M12×1; 8-pin (PUR)				
		Angle plug		Straight plug
S74				
89				
Receiver	2 m	ZAS89R202		ZAS89R201
	5 m	ZAS89R502		ZAS89R501
	10 m	ZAS89R602		ZAS89R601
	20 m	–		ZAS89R701

M12×1; 5-pin (PUR)				
			Straight plug	
S06				
35				
Emitter	5 m			ZAS35R501
	10 m			ZC4L001

M12×1; 5-pin (PVC)				
		Angle plug	Straight plug	
S06				
35				
Emitter	3 m	S35W-3M		
	5 m	S35W-5M		S35G-5M

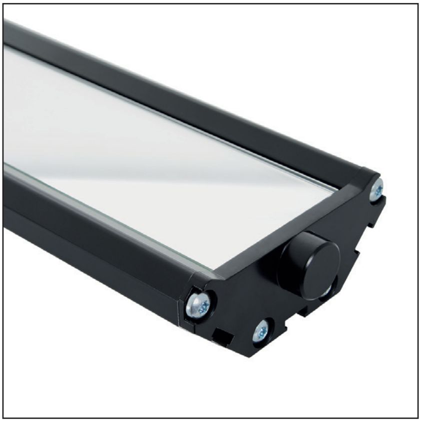
4.9.3 Connection Cables

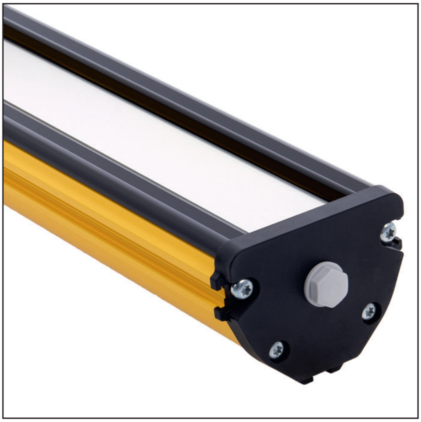
M12×1; 5-pin (PVC)		
	Straight plug	
S18 88 88s		
Receiver (cascading)	2 m PUR	BG88SG88V2-2M

4.9.4 Safety Relays

Order number	Use
SG4-00VA000R2	Basic module
SR4B3B01S	Basic module
SR4D3B01S	Basic module with off-delay
SR4E4D01S	Add-on module

4.9.5 Path-Folding Mirrors



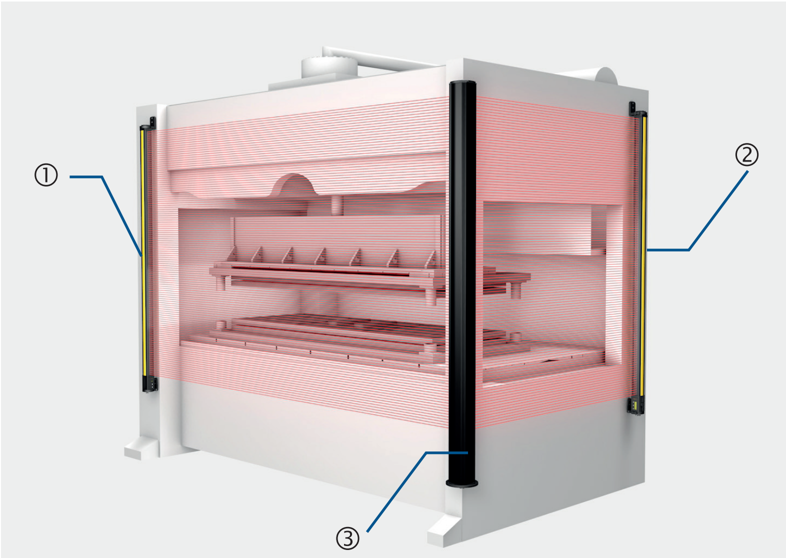


Possible applications can be significantly expanded through the use of a path-folding mirror.
The wenglor path-folding mirror can therefore secure a danger zone from several sides with just one ESPE.

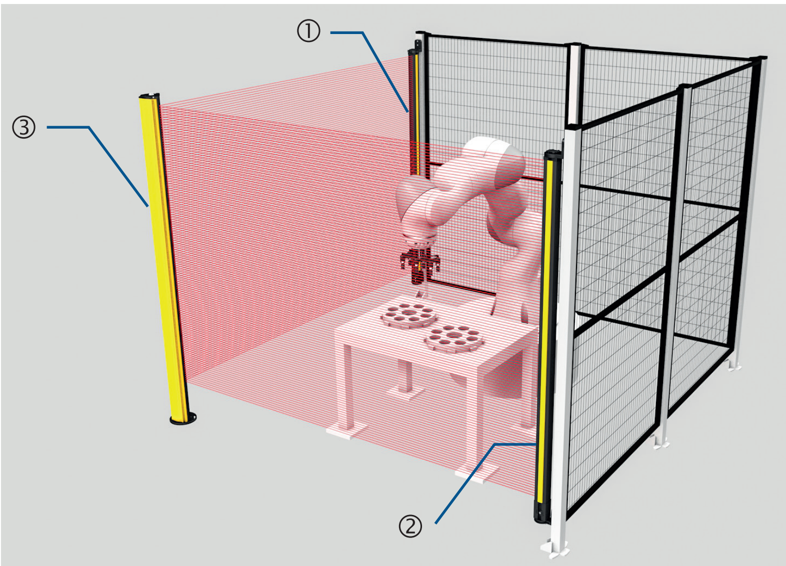
NOTE!
The range of the ESPE is reduced by approximately 10% per utilized mirror.

Order number	Mirror length	Housing material	Mounting
Path-folding mirror			
Z2UG001	80 mm	Aluminum	BEF-SET-33, ZEMX001, ZEMX002
Z2UG002	750 mm	Aluminum	BEF-SET-33, ZEMX001, ZEMX002
Z2UG003	1350 mm	Aluminum	BEF-SET-33, ZEMX001, ZEMX002
Z2UG004	1900 mm	Aluminum	BEF-SET-33, ZEMX001, ZEMX002
Safety column with path-folding mirror			
Z2SU001	1252 mm	Aluminum	ZMBSZ001, ZMBSZ002
Z2SU002	1703 mm	Aluminum	ZMBSZ001, ZMBSZ002
Z2SU003	1830 mm	Aluminum	ZMBSZ001, ZMBSZ002

Application example

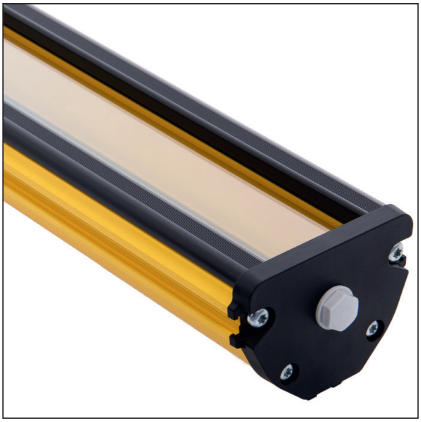


1 Emitter
2 Receiver
3 Path-folding mirror Z2UGxxx



1 Emitter
2 Receiver
3 Safety column with path-folding mirror Z2SU00x

4.9.6 Safety Columns



- The safety columns enable ESPE to be used in tough environments and protect them from mechanical damage.
- The muting booms Z2MGxxx (see section 4.9.9, page 32) can also be mounted on the safety columns.
- Floor or wall fastening is possible depending on the mounting used.

Order number	Installation space	Housing material	Material protective disc
Safety column with protective disc			
Z2SS001	1252 mm	Aluminium	Polycarbonate
Z2SS002	1703 mm	Aluminium	Polycarbonate
Z2SS003	2153 mm	Aluminium	Polycarbonate
Safety column for muting			
Z2SM001	1252 mm	Aluminium	-
Z2SM002	1703 mm	Aluminium	-
Z2SM003	2153 mm	Aluminium	-
Required mounting			
ZMBSZ001	Floor mounting	Aluminium	-
ZMBSZ002	Wall mounting	Stainless steel	-

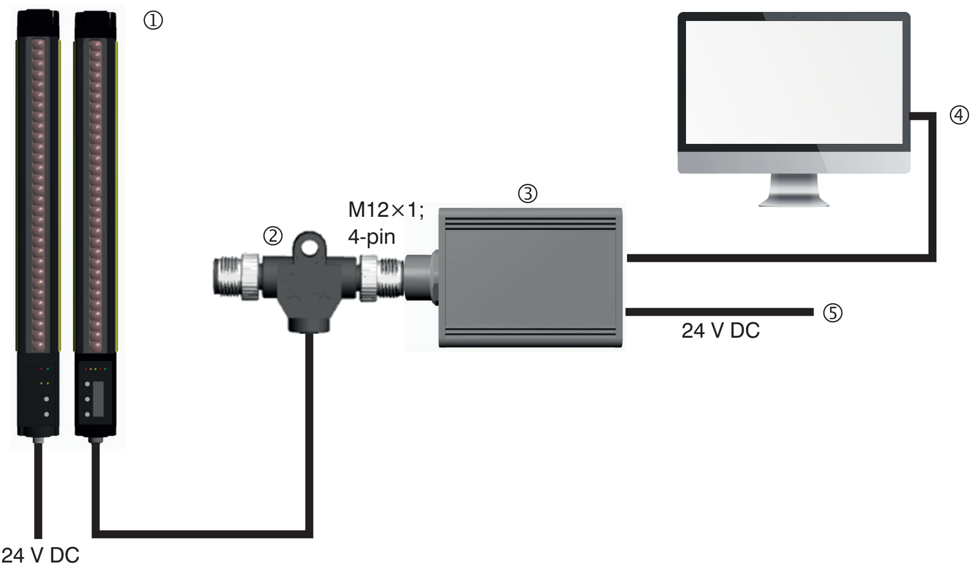
4.9.7 IO-Link Master

Order number	Interface
EFBL001	USB
EFBL003	USB
EP0L001	ProfiNet, Ethernet/IP
ZAI72AN01	Profibus

4.9.8 T-Plug ZC7G001 (IO-Link Signal)

Connecting the T-plug to the receiver and connecting an IO-Link master EFBL003 enables the IO-Link connection of the device to be used. This guarantees the IO-Link signal extraction and enables the wTeach2 software to be used.

PC connection:



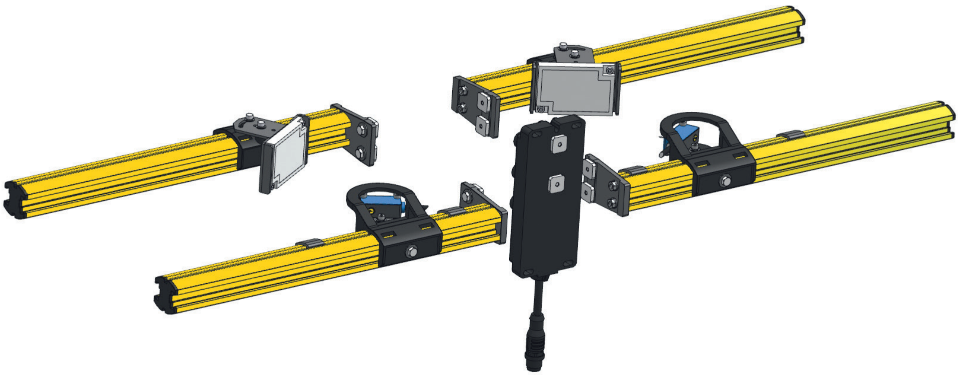
① SEFG / SEFB receiver (IO-Link device)
② Connection cable ZC7G001
③ IO-Link master EFBL003
④ PC with USB port
⑤ Power supply for the IO-Link master

4.9.9 Muting Boom

- The wenglor muting sets enable quick initial start-up of muting solutions.
- The sets contain all required components, pre-assembled on muting booms for implementing standard muting solutions.
- The retro-reflex sensors P1KL020 are used as muting sensors, together with the reflector RE6040BA.
- Connection equipment and mounting technology in the required quantities are included.

The following muting sets are available:
- Z2MG001: Cross-muting (2 sensors)
- Z2MG002: two sensor linear muting (2 sensors)
- Z2MG003: four sensor linear muting (4 sensors)

Z2MG001



Z2MG002

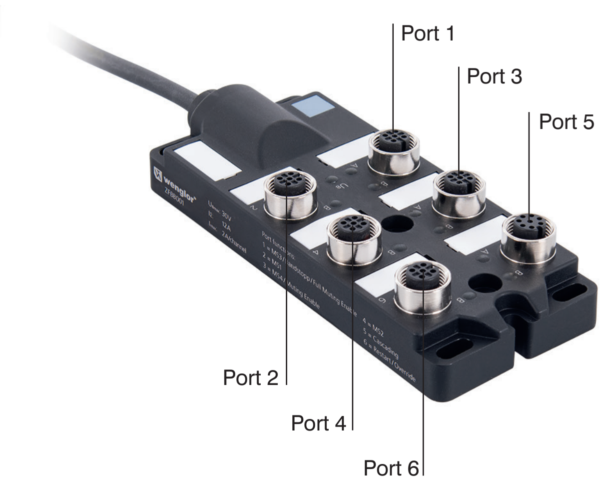
Z2MG003

Further information can be found in the operating instructions for the muting sets.

4.9.10 Muting Connection Box ZFBB001

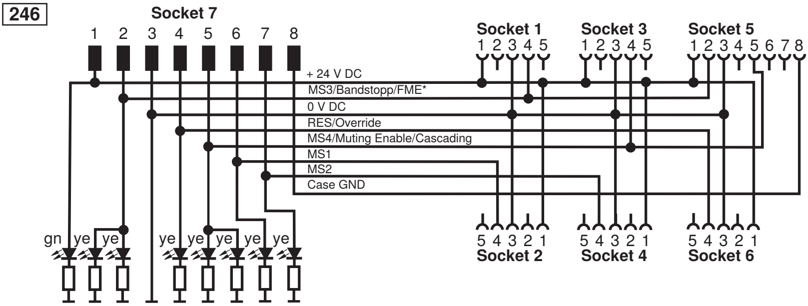
The muting connection box ZFBB001 is connected to the extension connection of the ESPE. The following functions can be implemented with the relevant parametrization of the ESPE:

- Confirmation of restart inhibit and override (connection of a button)
- Cascading (two sensor muting and cascading are possible at the same time)
- Two sensor muting
- Four sensor muting
- Belt stop
- Muting enable
- Full Muting Enable



Port	Connection	Use
1	M12×1, 5-pin	MS3, belt stop/Full Muting Enable
2	M12×1, 5-pin	MS1
3	M12×1, 5-pin	MS4, Muting Enable
4	M12×1, 5-pin	MS2
5	M12×1, 8-pin	Cascading
6	M12×1, 5-pin	RES, override
Connection cable	Cable1 m, M12×1, 8-pin	Connection to extension connection ESPE

Further information can be found in the operating instructions for the ZFBB001.



*FME = Full Muting Enable

NOTE!

- Cross-connections between muting signals must be prevented via protected routing of cables. For further information, refer to EN ISO 13849-2, table D.4.
- All connections must be sealed with cables or blanking plugs (to retain the IP degree of protection).

4.9.11 Laser Alignment Tool Z98G001

Further information can be found in the operating instructions for the Z98G001.

4.9.12 LED Light Strips Z99G001

Further information can be found in the operating instructions for the Z99G001.

4.9.13 microSD Card

A microSD card can be used for easy duplication of configurations. The microSD card can be used as described in section 5.2.6.6.1, page 104.

4.9.14 Parametrization Software wTeach2

The wenglor software wTeach2 can be used for easy parametrization and status monitoring.
The connection takes place via the IO-Link master EFBL003.

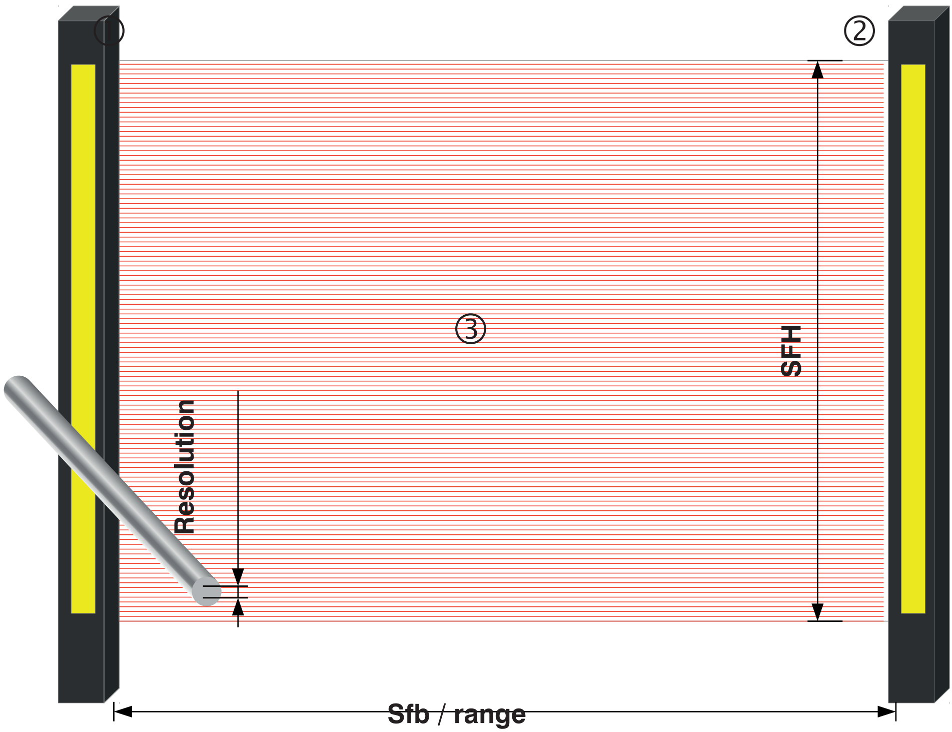
Further information can be found in the operating instructions for the DNNF005.

5. Project Engineering

This chapter contains important information for correct integration of the ESPE in the machine.

5.1 Engineering

5.1.1 Safety Field



① = emitter
② = receiver
③ = safety field
SFH = safety field height
Sfb = safety field width Range
Resolution d

Safety field
The safety field is the area of the ESPE where an object (e.g. person or object) is detected according to the resolution.

Safety field height
The safety field height describes the dimension of the range within which a standardized test object (test rod) is recognized by the ESPE. It depends on the size of the safety light curtain.

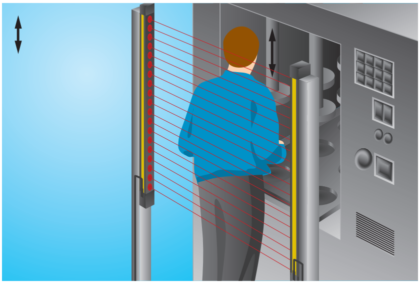
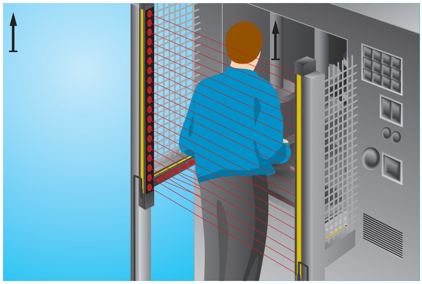
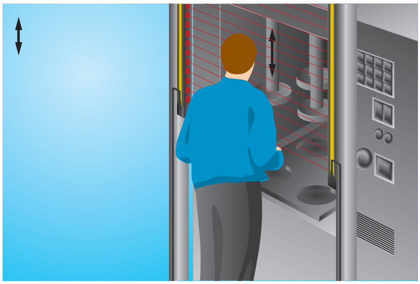
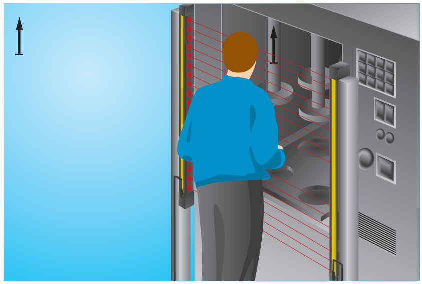
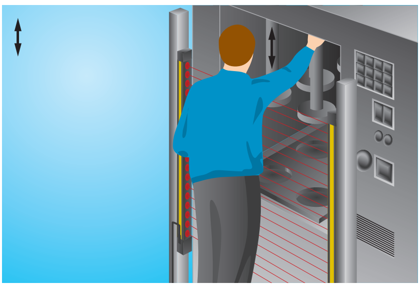
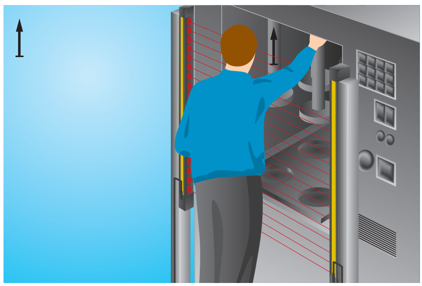
Safety field width
The safety field width is the clearance between the emitter and receiver. The safety field width must not change during operation.

Range
The range is the mechanically usable distance between the emitter and receiver. Using path-folding mirrors reduces the range.

Resolution
The resolution of a safety light curtain is the object size that can be recognized at any point within the safety field, and which thus results in a shutdown command. It corresponds to the diameter of the corresponding test rod and, with the SEFG, can be 30 mm (hand protection) or 14 mm (finger protection).

5.1.2 Securing the Danger Zone

The danger zone must be secured by means of the ESPE alone, or by means of the ESPE in combination with additional mechanical safety devices.
Reaching round the sides, over or underneath must be prevented.
The danger zone may only be accessible via the ESPE's safety field.
All properties of the safety field (see section 12.2, page 164) must be taken into account. The exact values can be found in the technical data (see section 4, page 15).

Incorrect		Correct
	Side-stepping	
	Reaching under	
	Reaching over	

DANGER!
Risk of personal injury or property damage in case of non-compliance!
The system's safety function is disabled.
Personal injury and damage to equipment may occur.
- The danger zone must be secured as outlined in the instructions.

5.1.3 Safety Clearance

5.1.3.1 General Information

The safety clearance is the minimum distance between the safety field of an ESPE and the danger zone. It's task is to prevent the danger zone from being reached before the hazardous motion is completed.
In accordance with ISO 13855, the safety clearance is influenced by the following factors:

- Stopping time of the machine (time from the triggering of the sensor to the completion of the hazardous motion)
- Response time of the entire safety equipment (ESPE, machine, downstream safety evaluation)
- Approach speed
- Resolution of the ESPE
- Type of approach (vertical, horizontal or at an angle)

5.1.3.2 Calculating the Safety Clearance

The general formula for calculating the safety clearance S is:

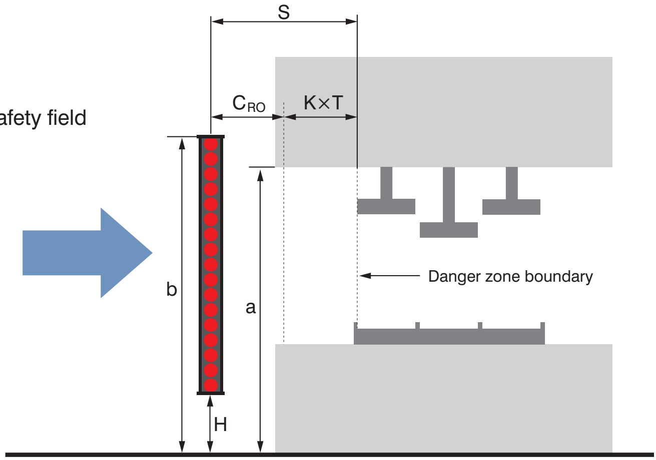
$$S = (K \times T) + C \quad \text{or} \quad S = K \times (t_1 + t_2 + t_3) + C$$

S [mm]	Safety clearance, measured from the danger zone to the safety field
K [mm/s]	Approach speed
C	Additional clearance based on the relevant approach to the safety field
T [s]	Total response time $(t_1 + t_2)$
T [s]	Total response time $T = (t_1 + t_2 + t_3)$
t_1 [s]	Response time of the ESPE
t_2 [s]	Response time of the safety switching device
t_3 [s]	Machine over-travel time
d [mm]	Resolution of the ESPE

5.1.3.2.1 Safety Clearance for Vertical Approach to the Safety Field

a [mm] = height of the danger zone
b [mm] = height of the top edge of the safety field

H [mm] = reference height, height of the safety field above ground



NOTE!

- If H ≤ 300 mm → , the danger that access to the danger zone from underneath the safety field may go undetected must be avoided.
- If H < 200 mm → , the danger that access to the danger zone by children from underneath the safety field may go undetected must be avoided.
- Height of topmost beam ≤ 900 mm →, the danger of the safety field being stepped over must be prevented.

We differentiate between two different safety clearances when calculating vertical safety fields.

- **S_{RT} Safety clearance for access through the safety field**
- **S_{RO} Safety clearance for access over the safety field**

Both of these must be calculated.
The larger of the two values S_{RT} and S_{RO} must be used.

$S_{RT} = K \times T + C_{RT}$

S_{RT}	Safety clearance for access through the safety field RT = Reach through
K	Approach speed with vertical safety field K = 2000 mm/s K = 1600 mm/s (if $S_{RT} > 500$ mm)
T [s]	Total response time $T = (t_1 + t_2 + t_3)$
t_1 [s]	Response time of the ESPE
t_2 [s]	Response time of the safety switching device
t_3 [s]	Machine over-travel time
C_{RT}	Supplement for access through the safety field status depending on the resolution of the ESPE With a resolution of 14…40 mm: $C_{RT} = 8 \times (d - 14\text{ mm})$ With a resolution of > 40 mm: $C_{RT} = 850$ mm (standard value for arm length)

$S_{RO} = K \times T + C_{RO}$

S_{RO}	Safety clearance for access over the safety field RO = Reach over
K	Approach speed with vertical safety field K = 2000 mm/s K = 1600 mm/s (if $S_{RO} > 500$ mm)
T [s]	Total response time, $T = (t_1 + t_2 + t_3)$
t_1 [s]	Response time of the ESPE
t_2 [s]	Response time of the safety switching device
t_3 [s]	Machine over-travel time
C_{RO}	Supplement for access over the safety field status Value in accordance with table from EN ISO 13855 (see below)

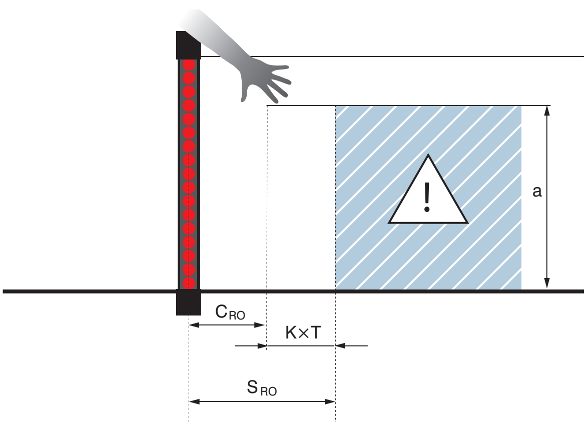


Figure 3: Relationship between C_{RO} and S_{RO}

a [mm] Height of the danger zone	C_{RO} **[mm]** Additional horizontal clearance from the danger zone											
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
	b [mm] Height of the top edge of the safety field											
	900	1000	1100	1200	1300	1400	1600	1800	2000	2200	2400	2600

Table 8.2.2: Extract from table 1, EN ISO 13855

Procedure when working with table 8.2.2:

Required	**b**	**S → C_{RO}**	**a**
Known	**a, S → C_{RO}**	**a, b**	**S → C_{RO}, b**
1.	In the left column, search the row with the known value **a**	Select the next smallest **b**-value	Select the next smallest **b**-value
2.	In the relevant row, search the column with the next highest value for $\mathbf{C_{RO}}$	In the relevant column, search the row with the next highest value for **a**	In the relevant column, search the row with the next lowest value for $\mathbf{C_{RO}}$
3.	At the bottom end of the column, you will find the relevant value for **b**	At the point of intersection between row and column, you will find the value for $\mathbf{C_{RO}}$	In this row, go to the left column. Here, you will find the value for **a**.

NOTE!

- If the actual values for a and b are between the values in the table, the next highest value from the table must be selected.
- A top safety field edge of under 900 mm does not provide adequate protection against bypassing or crossing over.
- A bottom safety field edge of over 300 mm does not provide adequate protection against crawling through.

DANGER!

Risk of personal injury or property damage in case of non-compliance with the safety field specifications!

The system's safety function is disabled.

Personal injury and damage to equipment may occur.

- Observe the safety field specifications!

Sample calculation:

An ESPE with a resolution of 30 mm and a SFH of 1,500 mm (SEFG420) is to be used to safeguard the area. The required safety clearance must be calculated.

- Response time of the ESPE t_1 = 16.2 ms
- Over-travel time of the safety switching device t_2 = 15 ms
- Machine over-travel time t_3 = 300 ms
- Resolution of the ESPE d = 30 mm
- Height of the danger zone a = 1,600 mm
- Reference height H = 100 mm
- Height of the safety field above ground b = 1,600 mm (SFH + H)

Step 1: Calculate the safety clearance S_{RT} for reaching through

S_{RT} = 2,000 mm/s × (t_1 + t_2 + t_3) + C_{RT}
S_{RT} = 2,000 mm/s × (0.0162 s + 0.015 s + 0.3 s) + 8 ×(30 mm – 14 mm)
S_{RT} = 790 mm
→ Because SRT > 500 mm → re-calculation with K = 1,600 mm/s

S_{RT} = 1,600 mm/s × (0.0162 s + 0.015 s + 0.3 s) + 8 ×(30 mm – 14 mm)
S_{RT} = 657.92 mm

Step 2: Determine the additional clearance C_{RO}

- Find height a in table: → here: a = 1,600 mm
- Find height b in table: → here: b = 1,600 mm
- Take the value for C_{RO} from the intersection point of the two axes: → here: C_{RO} = 750 mm

Step 3: Calculate the safety clearance S_{RO} for reaching over

S_{RO} = 2.000 mm/s × (t_1 + t_2 + t_3) + C_{RO}
S_{RO} = 2,000 mm/s × (0.0162 s + 0.015 s + 0.3 s) + 750 mm
S_{RO} = 1,412.4 mm
→ Because S_{RO} > 500 mm → re-calculation with K = 1,600 mm/s
S_{RO} = 1,600 mm/s × (0.0162 s + 0.015 s + 0.3 s) + 750 mm
S_{RO} = 1,279.92 mm

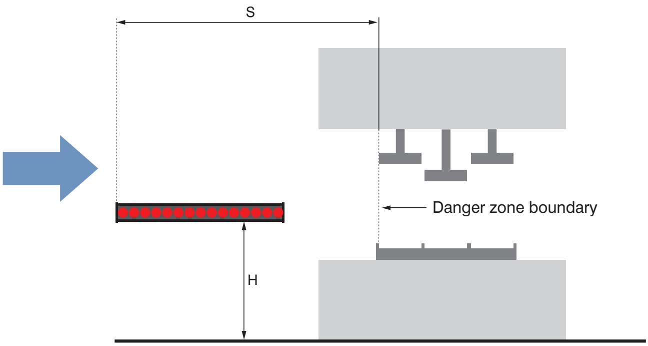
Step 4: Compare the safety clearance S_{RO} and S_{RT}

S_{RT} = 657.92 mm
S_{RO} = 1,279.92 mm
S_{RO} > SRT , i.e. the safety clearance to be used is 1,279.92 mm.

If the safety clearance of 1,279.92 mm is too large, the SFH can be increased from 1,500 mm to 1,650 mm (SEFG421), thus reducing the supplement to C_{RO} = 450 mm.

This adjustment results in the following:
S_{RO} = 2.000 mm/s × (t_1 + t_2 + t_3) + C_{RO}
S_{RO} = 2,000 mm/s × (0.0172 s + 0.015 s + 0.3 s) + 450 mm
S_{RO} = 1,114.4 mm
→ Because S_{RO} > 500 mm → re-calculation with K = 1600 mm/s
S_{RO} = 1,600 mm/s × 0.0172 s + 0.015 s + 0.3 s) + 450 mm
S_{RO} = 981.52 mm

5.1.3.2.2 Safety Clearance for Horizontal Approach to the Safety Field



S = (K × T) + C or S = (1,600 mm/s × T) + (1,200 mm – 0.4 × H)

S [mm]	Safety clearance S = (1600 mm/s × T) + (1200 mm – 0.4 × H) S may not be ≤ 850 mm S is between the danger zone and the furthest beam of the sensor.
K [mm/s]	Approach speed for horizontal approach to the safety field K = 1600 mm/s
T [s]	Total response time $T = (t_1 + t_2 + t_3)$
t1 [s]	Response time of the ESPE
t2 [s]	Response time of the safety switching device
t3 [s]	Machine over-travel time
C [mm]	Margin C = 1200 mm – 0.4 × H $C_{min} \geq 850$ mm
H	Height of the safety field 200 mm < H < 1000 mm
H_{min}	Minimum permissible mounting height (never smaller than 0) $H_{min} = 15 \times (d - 50\text{ mm})$
d	Resolution of the ESPE d = (H / 15) + 50 mm Required resolution must be calculated for the specified height.

Sample calculation:

An ESPE with a resolution of 30 mm and a SFH of 900 mm (SEFG416) is to be used to safeguard the area. A check must be carried out to determine whether the selected ESPE is suitable.

Step 1: Calculate safety clearance

- Response time of the ESPE — $t_1 = 12.6$ ms
- Response time of the safety switching device — $t_2 = 15$ ms
- Machine over-travel time — $t_3 = 30$ ms
- Resolution of the ESPE — $d = 30$ mm
- Reference height — $H = 500$ mm

$S = 1{,}600\ \text{mm/s} \times (0.0126\ \text{s} + 0.015\ \text{s} + 0.03\ \text{s}) + 1{,}200\ \text{mm} - (0.4 \times 500\ \text{mm})$
$S = 1{,}092.16\ \text{mm}$

The selected ESPE has a SFH of 900 mm.
This means it is lower than the required safety clearance. An ESPE with a longer SFH must be selected.

Step 2: Recalculation of safety clearance

An ESPE with a resolution of 30 mm and a SFH of 1,200mm (SEFG418) is to be used to safeguard the area. A check must be carried out to determine whether the selected ESPE is suitable.

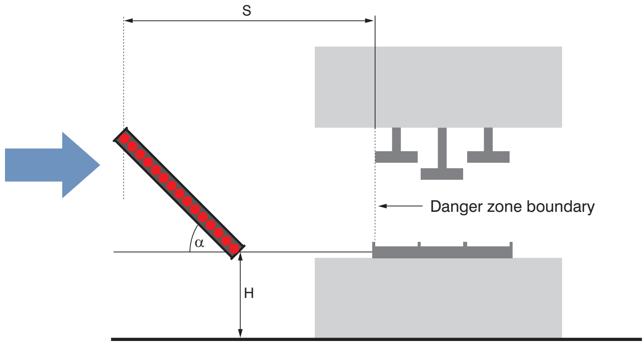
- Response time of the ESPE — $t_1 = 14.4$ ms
- Response time of the safety switching device — $t_2 = 15$ ms
- Machine over-travel time — $t_3 = 30$ ms
- Resolution of the ESPE — $d = 30$ mm
- Reference height — $H = 500$ mm

$S = 1{,}600\ \text{mm/s} \times (0.0144\ \text{s} + 0.015\ \text{s} + 0.03\ \text{s}) + 1{,}200\ \text{mm} - (0.4 \times 500\ \text{mm})$
$S = 1{,}095.04\ \text{mm}$

The selected ESPE has a SFH of 1,200 mm.
It is therefore larger than the calculated safety clearance in the application and can be used.

5.1.3.2.3 Safety Clearance for Angled Approach to the Safety Field

The following versions apply for applications with 5° < α < 85°.

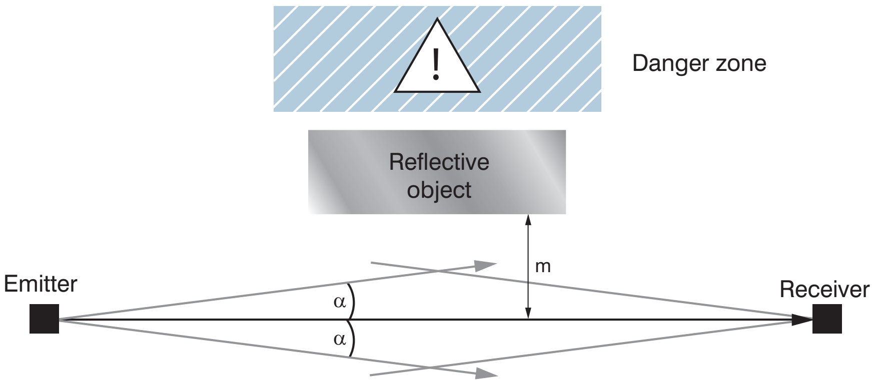


Angle α	> 30°	< 30°
Calculation in accordance with	vertical approach (see section 5.1.3.2.1, page 40)	horizontal approach (see section 5.1.3.2.2, page 45)
Safety clearance	Distance between the point of danger and the closest light beam.	Distance between the point of danger and the furthest light beam.
Note		The height of the furthest light beam may not be ≤ 1000 mm. The following applies to the closest light beam: $H = 15 \times (d - 50\ mm)$ & $d = H/15 + 50\ mm$

5.1.4 Minimum Clearance to Reflective Surfaces

DANGER!
Risk of personal injury or property damage with reflective surfaces within the aperture angle between the emitter and receiver!
The system's safety function is disabled.
Personal injury and damage to equipment may occur.
- Minimum clearance (m) from reflective surfaces to the optical axis must be adhered to.

m = tan α × clearance from emitter to receiver
m = tan 2.5° × clearance from emitter to receiver



The minimum clearance from reflective surfaces must be calculated depending on the distance between the emitter and receiver with an aperture angle of ±2.5°.

Distance between the emitter and receiver [m]	Minimum clearance m [mm]
0.25 ... 3.0	131
4	175
5	218
10	437
15	655
20	873

5.2 Functions

This section contains important information on the functions of the ESPE and their usage conditions.

5.2.1 Functions Overview

Detailed descriptions of the individual functions can be found in the following sections.

	Section	SEFG muting	SEFG muting/ blanking
Operational functions			
Safety operating mode / automatic restart	Section 5.2.3.1	X	X
Restart inhibit (RES)	Section 5.2.3.2	X	X
Contactor monitoring (EDM)	Section 5.2.3.3	X	X
Beam coding	Section 5.2.3.4	X	X
Cascading	Section 5.2.3.6	X	X
Range switching	Section 5.2.3.5	X	X
Muting functions			
Cross muting	Section 5.2.4.3	X	X
Two sensor linear muting	Section 5.2.4.4	X	X
Four sensor linear muting (sequence monitoring)	Section 5.2.4.5	X	X
Four sensor linear muting (time monitoring)	Section 5.2.4.6	X	X
Adjustable muting duration	Section 5.2.4.7.2	X	X
Belt stop signal	Section 5.2.4.7.3	X	X
Muting enable	Section 5.2.4.7.4	X	X
Direction setting	Section 5.2.4.7.5	X	X
Muting end through clearing of the ESPE	Section 5.2.4.7.6	X	X
Partial muting	Section 5.2.4.7.7	X	X
Full Muting Enable	Section 5.2.4.7.8	X	X
Gap suppression	Section 5.2.4.7.9	X	X
Override	Section 5.2.4.7.10	X	X
Blanking functions			
Fix blanking	Section 5.2.5.2	–	X
Fix blanking with edge tolerance	Section 5.2.5.3	–	X
Floating blanking	Section 5.2.5.4	–	X
Reduced resolution	Section 5.2.5.5	–	X

Non-safety-related functions			
Measured value read-out	Section 5.2.6.1	X	X
Display setting (segment display)	Section 5.2.6.2	X	X
Signal output	Section 5.2.6.3	X	X
Integrated indicator lamp	Section 5.2.6.4	X	X
Alignment aid (signal strength)	Section 5.2.6.5	X	X
microSD memory card	Section 5.2.6.6	X	X
Password protection	Section 5.2.6.7	X	X
IO-Link 1.1 interface	Section 5.2.6.8	X	X

X = function included
– = function not included

5.2.2 Combinable Functions

	Safety operating mode / automatic restart	Start-up disabling and restart inhibit	Contactor monitoring	Beam coding	Cascading	Muting (complete)	Partial muting	Fix blanking	Fix blanking with edge tolerance	Floating blanking	Reduced resolution	Full resolution
Safety operating mode / automatic restart												
Start-up disabling and restart inhibit	□											
Contactor monitoring	■	■										
Beam coding	■	■	■									
Cascading	■	■	■	■								
Muting (complete)	□	■	■	■	⊙							
Partial muting	□	■	■	■	⊙	□						
Fix blanking	■	■	■	■	■	■	□					
Fix blanking with edge tolerance	■	■	■	■	■	■	□	□				
Floating blanking	■	■	■	■	■	■	□	□	□			
Reduced resolution	■	■	■	■	■	■	□	□	□	□		
Full resolution	■	■	■	■	■	■	■	□	□	□	□	

■ Permitted

□ Not permitted

⊙ Two sensor muting: combinable
Four sensor muting: not combinable

5.2.3 Operational Functions

5.2.3.1 Safety Operating Mode (Automatic Restart)

In this operating mode, the switching outputs are disabled when the safety field is penetrated. The switching outputs are automatically enabled after interruption of the safety field has ended.
A check must be carried out to determine whether safety operating mode is permitted for the application.

WARNING!
- Start-up disabling and restart inhibit is required for access protection.
- Operating the ESPE with automatic restart is only permitted in exceptional cases and in specific conditions.

Note that:

The safety operating mode is parametrized on the receiver.

If the restart inhibit (RES) is deactivated, safety operating mode is activated automatically.

5.2.3.2 Start-Up Disabling and Restart Inhibit (RES)

- Once the safety field is penetrated, this operating mode prevents the machine from restarting automatically by ensuring that the OSSDs remain in off state.
- This status is retained even when the supply voltage is switched on again (e.g. after a power failure).
- The OSSDs are only enabled again when an acknowledgment key is pressed.

NOTE!
- The acknowledgment key must be located outside the danger zone.
- From the location of the acknowledgment key, the operator must have a clear view of the danger zone to ensure a safe restart.
- Depending on the constellation of the ESPE, a restart inhibit (prevents start-up after an error or safety field penetration) or start inhibit (prevents start-up after switch-on) can be displayed for the machine.

DANGER!
Risk of fatal injury due to unintentional start and restart!
- It is important to ensure that the acknowledgment key can not be actuated from inside the danger zone.
- Ensure that there is no one in the danger zone before releasing the start-up disabling and restart inhibit.
- The ESPE can not check whether the machine control has start-up disabling and restart inhibit. Ensure that there is always an active start-up disabling and restart inhibit.

Note that:

- The restart inhibit (RES) is parametrized on the receiver.
- Enable via the signal sequence (RES input) 0 → 1 → 0
- The 1-signal must last for 0.1 s…4 s.
- If the restart inhibit is deactivated, safety operating mode / automatic restart is activated automatically.

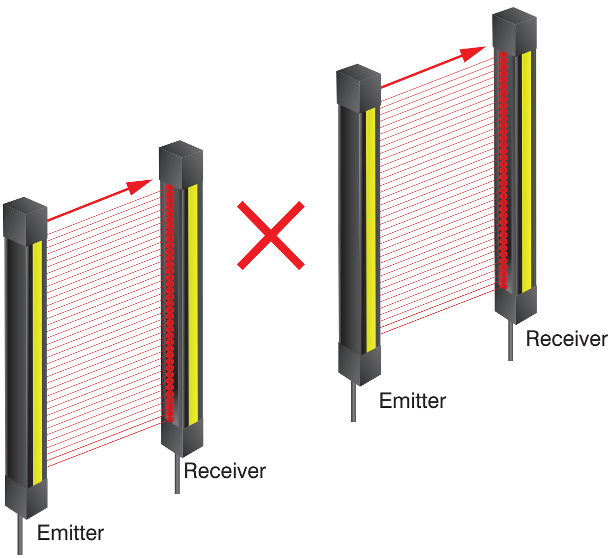
5.2.3.3 Contactor Monitoring (EDM)

- The contactor monitoring carries out dynamic monitoring of the switching behavior of externally connected NC contacts.
- After every switch-on and switch-off process of the OSSDs, the feedback signal must have the correct switching status within the specified time.
- This enables malfunctions on the contactors (e.g. welding of the contacts) to be detected.

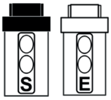
- The contactor monitoring (RES) is parametrized on the receiver.
- If the connected contactors do not switch in the expected time, the ESPE switches to safe state (OSSD OFF, ERROR).
- The contactor monitoring functions only as a safety mechanism if the contactor has positively driven NC contacts.

5.2.3.4 Beam Coding

- To avoid mutual interference, it is important to ensure that, for systems in close proximity to each other, a receiver is only reached by the light from the corresponding emitter.
- If this cannot be prevented through mechanical shielding or through the installation (see “7.1 Positioning the ESPE” on page 109), beam coding can help here.
- • If beam coding parameters are configured for both the emitter and the receiver, the receiver can generally differentiate between beams from its designated emitter and beams from other emitters.



Note that:
- The receiver only detects beams which correspond to its code.
- The first and the last beam in the safety field act as synchronization beams. One synchronization beam is sufficient for the receiver to assign the coding and to synchronize the emitter and receiver.



- The beam coding is parametrized on the emitter and receiver.
- There is a choice between coding ON and coding OFF.
- The setting for matched emitters and receivers must be identical (both coding ON or both coding OFF).

5.2.3.5 Range

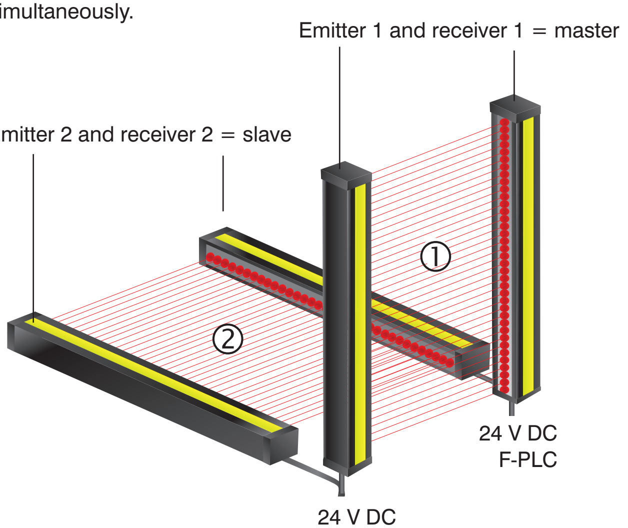
- The range is the mechanically usable distance between the emitter and receiver.
- In order to prevent potential oversteering with short working distances and to limit the aperture angle, it must be possible to set the range.
- The setting takes place on the emitter.

DANGER!
- The range must be set to suit the safety field width in the application to rule out ESPE malfunctions.
- An incorrectly set range poses a risk to persons or the machine.

Range	High (delivery state)	Low
14 mm	3.0...7.0 m	0.25...3.5 m
30 mm	7.5...20.0 m	0.25...8.0 m

5.2.3.6 Cascading

ESPE can be connected so that they all drive a single safety output in order to monitor several safety fields simultaneously.



- The fact that the safety fields of several ESPE drive a shared safety output simplifies the connection to the machine control.
- Cascaded ESPE demonstrate the same performance characteristics as a single ESPE.
- Cascading can be used to secure adjacent danger zones (e.g. protection against side-stepping).

Note that:

- The cascading is parametrized on the receiver.
- The terms 'Master' or 'Slave' are used to differentiate between the components:
  - Master – component with direct connection to the machine control
  - Slave – components with connection to the master
- Every SEFG device can take on the role of the master or the slave.

Conditions:
- **No more than 3 sensors can be cascaded together.**
- **The response time is extended by the response time of the upstream receiver with each downstream receiver.**
- If mutual interference between the beam paths is possible, the sensors must be coded (see "5.2.3.4 Beam Coding" on page 53).
- Individual settings on an ESPE only apply for the relevant system. But switching off an ESPE always impacts the shared safety output.
- **The function types contactor monitoring and restart inhibit may only be parametrized on the master.**

Example for determining the response time:

- Cascading of 2× SEFG413
- Response time t_{Master} = 10 ms
- Response time t_{Slave} = 10 ms
- Response time $t_{Casc} = t_{Master} + t_{Slave}$ = 10 ms + 10 ms
- Response time t_{Master} = 20 ms

5.2.3.6.1 Cascading via Extension Connection of the ESPE

Multiple SEFG sensors can be cascaded easily via the receiver extension connection.
The following setup is required:
- The receiver MASTER is connected to the machine control via the **system connection**.
- The receiver MASTER is connected to the **system connection** of the receiver SLAVE via the **extension connection** (connection cable M12 8-pin).
- All emitters in the cascade must be connected separately to the supply voltage (connection cable M12 4/5-pin).

For details on the electrical connection, see "16.2.3 Connection Examples Cascading" on page 182.

5.2.3.6.2 Cascading via Muting Connection Box ZFBB001

If muting and cascading are to take place at the same time, this can be achieved easily via the connection box ZFBB001.

The following setup is required:
- The receiver MASTER is connected to the machine control via the **system connection**.
- The receiver MASTER is connected to the connection box ZFBB001 via the **extension connection**.
- The receiver SLAVE is connected to Port 5 of the connection box via the **system connection** with a M12 8-pin connection cable.
- All emitters in the cascade must be connected separately to the supply voltage (connection cable M12 4/5-pin).

For details on the electrical connection, see "16.2.3 Connection Examples Cascading" on page 182.

5.2.3.6.3 Cascading of Other Safety Sensors with OSSD Outputs

WARNING!
- Cascading safety sensors with OSSD outputs is not permitted.
- If these sensors are used, incorrect signals may impair the safety function.

5.2.3.6.4 Cascading of Contact-based Safety Components

WARNING!
- Contact-based safety circuits (e.g. emergency stop switches or mechanical door switches) may not be cascaded with the ESPE.
- If these sensors are used, incorrect signals may impair the safety function.

5.2.4 Muting

Muting is a function that safely bridges the ESPE for a short time so that objects can be moved through the safety field without the OSSDs switching off.
The muting cycle is activated as soon as the responsible sensors detect an object. When arranging them, it is therefore important to ensure that the muting cycle can not be triggered by a person.
We differentiate between linear muting and cross muting. With a linear arrangement, several sensors are arranged one behind the other. With cross muting, two sensors are arranged so that their beams cross.

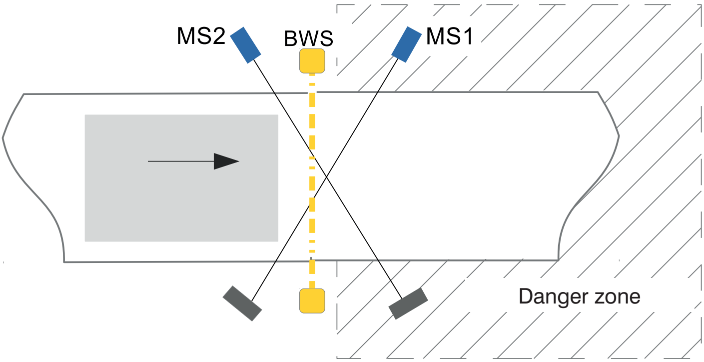
Additional signals, for example from muting sensors or a PLC, are required to activate the muting function. This means that the ESPE can check that the muting takes place correctly and guarantee that a person entering the danger zone is still reliably detected.

The basic requirements for starting a valid muting sequence are:
- OSSDs in ON state (safety field of the ESPE free)
- Muting sensors in OFF state (no object detected)

General muting process

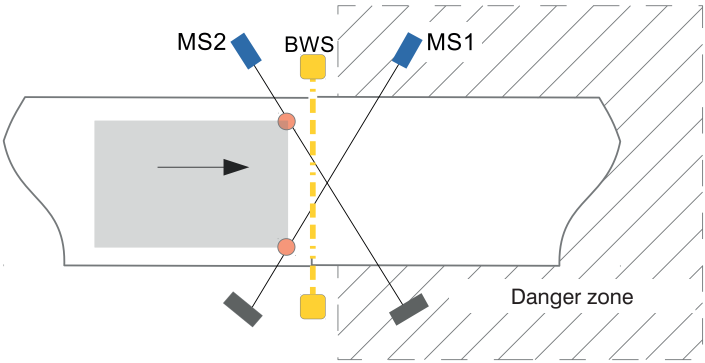
1 Muting object is transported in the direction of the danger zone.

Safety field: free
MS: free (signal 0)
OSSDs: on
Muting: inactive



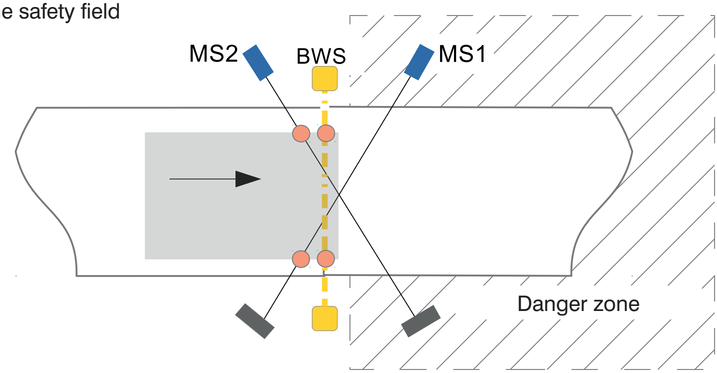
2 Muting object actuates muting sensors

Safety field: free
MS: actuated (signal 1)
OSSDs: on
Muting: active



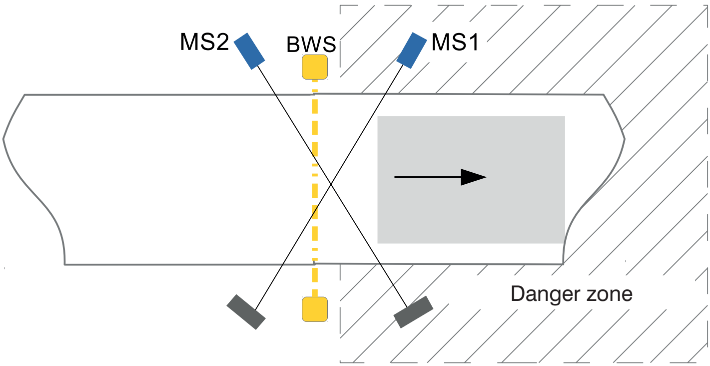
3 Muting object moves through the safety field

Safety field: interrupted
MS: actuated (signal 1)
OSSDs: on
Muting: active



4 Muting object moves into the danger zone and frees ESPE and MS.

Safety field: free
MS: free (signal 0)
OSSDs: on
Muting: inactive



DANGER!
- The muting must be triggered by at least two independent signals.
- The use of software-controlled signals (e.g. PLC) is permitted if at least one signal comes from another source (e.g. from a sensor).

NOTE!
- For easy initial start-up, wenglor offers muting sets (Z2MGxxx), which can be mounted directly on the ESPE or the safety column Z2SSxxx.
- Further details are available in the standard IEC 62046.

5.2.4.1 Muting Signals

Muting signals are for:
- Detecting the material (object) to be transported
- Forwarding the detection signal to the ESPE to activate muting
- Detecting the removal of the object
- Forwarding the free signal to the ESPE to deactivate muting

Muting signals can be generated, for example, by:
- Optical sensors, e.g.:
  - Retro-reflex sensors
  - Through-beam sensors
  - Reflex sensors
- Inductive sensors
- Signals from the software (e.g. control)

NOTE!
- When using connection box ZFBB001, the output of the muting sensor must be on Pin 4.
- Please note the following switching characteristics when using optical sensors:
  - Through-beam sensor: dark switching (normally closed) (PNP NC)
  - Reflex sensor: light switching (normally open) (PNP NO)
  - Retro-reflex sensor: dark switching (normally closed) (PNP NC)

DANGER!
- A muting signal must not be connected to multiple inputs. Each signal must only be assigned to one input.
- The user must take suitable measures (see EN ISO 13849-2, Tab. D.4) to prevent cross-connection between muting signals.

DANGER!
- When mounting the MS, ensure that people are still reliably detected by the ESPE and that they can not initiate or carry out a valid muting sequence.
- The formula listed for the relevant muting types must be used for calculating the minimal clearance.

ATTENTION!
When mounting the MS, ensure that the material is detected correctly. The actual means of transport (e.g. pallet) should not be detected.

NOTE!
- The suitable MS should be chosen depending on the properties of the material to be detected. For metal objects, for example, it is advisable to use inductive sensors.
- The correct parametrization must be observed depending on the sensor type used. For reflex sensors with background suppression, for example, the sensor must be configured so that the object is detected at an adequate distance from the safety field of the ESPE, while larger distances are suppressed.

5.2.4.2 Muting Visualization

- The receivers have an integrated illuminated cap (see “5.2.6.4 Integrated Indicator Lamp” on page 102), which shows the muting status.
- A continuous white light signals an active muting sequence.
- It is also possible to connect an external muting lamp on the signal output.

5.2.4.3 Cross Muting

Cross muting enables an object to be transported in or out of the danger zone.
For this, two muting sensors are arranged so that their beams cross. The **point of intersection is within the danger zone.**

The distances a and b represent the distances between the muting object and a separating safeguard (fence). They must be designed so that no one can enter the danger zone unnoticed while the muting object is passing through the ESPE.

A sample arrangement with retro-reflex sensors is shown in Figure 4.

As soon as MS1 and MS2 have been activated, the muting function is active. The actuation sequence of the sensors is unimportant here. MS1 and MS2 must be activated by a muting object within 4 s. They may also switch at the same time.

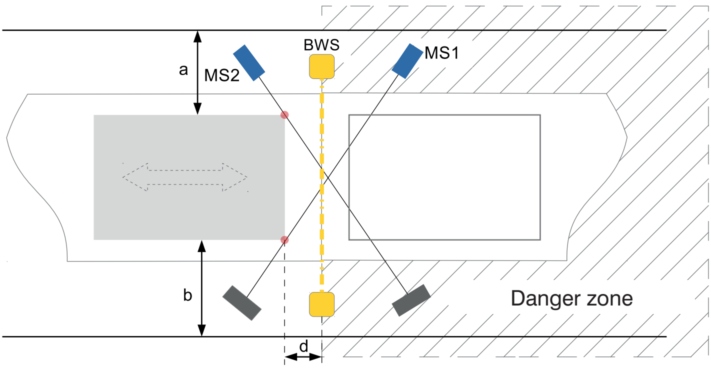


Figure 4: Arrangement cross-muting with retro-reflex sensors

Calculating the minimum distance

$$d \geq v \times (t_{ESPE}+t_{MS})$$

d [m]	Minimum distance between the detection points of the MS and the safety field of the ESPE (see Figure 4)
v [m/s]	Speed of the material on the conveyor line
t_{ESPE} [s]	Processing time muting signals Is the time required by the ESPE for processing all muting signals. The value can be found in the technical data section 4.1, page 15 .
t_{MS} [s]	Response time MS

ATTENTION!

- The calculated distance value does not refer to the intersection point of MS1 and MS2, but to the detection point of the sensor on the object.
- The distance of the intersection point of the MS from the safety field of the ESPE must be less than 200 mm and must be **within the danger zone**. It must be kept as small as possible.
- To prevent manipulation with the feet, the intersection point of the MS **must be at the height of the lowest beam of the ESPE or higher.**
- MS1 and MS2 should be mounted at **different heights** where possible to make manipulation more difficult.

Example:

• Belt speed	$v = 0.5 \frac{m}{s}$
• Processing time muting signals	$t_{ESPE} = 95$ ms
• Response time MS	$t_{MS} = 1$ ms

$$d \geq v \times (t_{ESPE}+t_{MS}) = 0.5 \frac{m}{s} \times (0.095+0,001)s = 0.048 \text{ m}$$

The minimum distance of the two detection points on the object from the ESPE safety field is 48 mm. Depending on the width of the muting object, the two sensors must be positioned under the following conditions:

- MS1 and MS2 detect the object at a minimum distance of d = 48 mm
- The intersection point of MS1 and MS2 is located as close as possible to the safety field of the ESPE, but no more than 200 mm away.

Valid muting sequence:

	Action	Comments
1. Muting start	MS1 and MS2 are activated.	Both sensors must be activated within a time frame of 4 seconds.
2. Muting active	MS1 and MS2, penetration of the safety field.	The safety field is interrupted, the OSSDs remain in the ON state.
3. Muting end	MS1 or MS2 are inactive or the maximum muting duration is reached.	

Signal path

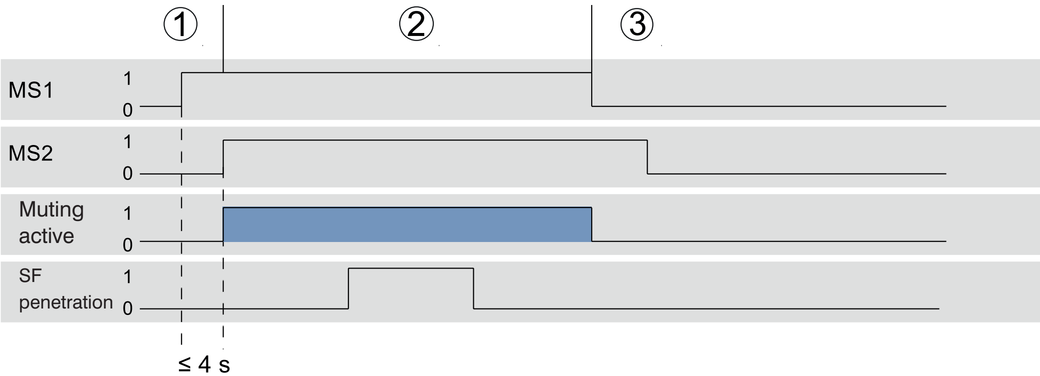


Figure 5: Signal path during cross-muting

NOTE!

- The safety can be increased further by positioning the MS at different heights, as their fields of view do not cross at points in this case.
- If the function “Muting end through clearing of the ESPE” is activated, the muting sequence ends as soon as the safety field is free again.
- The “Gap suppression” function can increase the availability of the system by accepting signal interruptions < 250 ms on the muting sensors.

5.2.4.4 Two Sensor Linear Muting

The two sensor linear muting enables the user to transport an object out of the danger zone. The two MS are located within the danger zone, so that it is not possible to activate the muting from outside the danger zone.

Muting is active as soon as MS1 and MS2 are activated. MS1 must be activated first, followed by MS2 within 4 seconds. The order must be observed here.

The distances a and b represent the distances between the muting object and a separating safeguard (fence). They must be designed so that no one can enter the danger zone unnoticed while the muting object is passing through the ESPE.

A sample arrangement of the sensors is shown in Figure 6 .

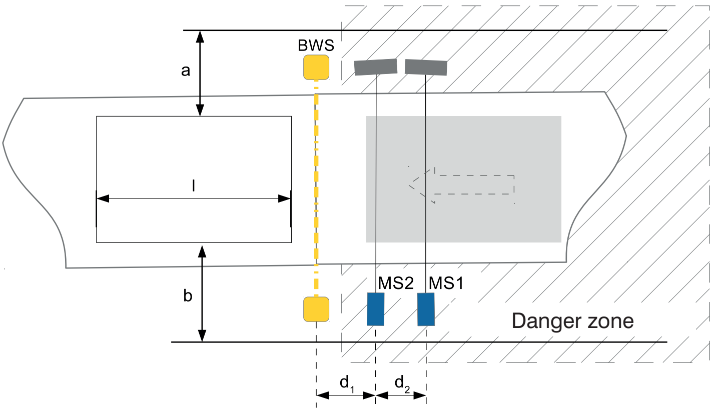


Figure 6: Arrangement two sensor linear muting

Calculating the minimum distance

$$d_{1/2} \geq v \times (t_{ESPE} + t_{MS})$$

d_1 [m]	Minimum distance between MS2 and safety field of the ESPE (see Figure 6)
d_2 [m]	Minimum distance between MS1 and MS2 (see Figure 6)
v [m/s]	Speed of the material on the conveyor line
t_{ESPE} [s]	Processing time muting signals: Is the time required by the ESPE for processing all muting signals. The value can be found in the technical data section 4.1, page 15 .
t_{MS} [s]	Response time MS
a, b	Distances

NOTE!
In order to carry out a valid muting sequence, the object must have at least the length l (with $l = d_1 + d_2$).

Example:

- Belt speed $v = 0.5\,\frac{m}{s}$
- Processing time muting signals $t_{ESPE} = 95$ ms
- Response time MS $t_{MS} = 1$ ms

$$d_{1/2} \geq v \times (t_{ESPE} + t_{MS}) = 0.5\,\frac{m}{s} \times (0.095 + 0.001)s = 0.048\text{ m}$$

The minimum distance between the two MS and the distance of the MS2 to the safety field of the ESPE is 48 mm. Accordingly, the muting object must have a minimum length of 96 mm.

Valid muting sequence:

	Action	Comments
1. Muting start	MS1 is activated first, followed by MS2.	Both sensors must be activated within a time frame of 4 seconds.
2. Muting active	MS1 and MS2 active. Penetration of the safety field (muting object passes through ESPE).	The safety field is interrupted, the OSSDs remain in the ON state.
3. Muting active	MS1 or MS2 are inactive.	Muting remains active.
4. Muting end	MS1 or MS2 are inactive for longer than 4 seconds. The safety field is cleared again. Maximum muting duration is reached.	Depending on which status is reached first.

Signal path

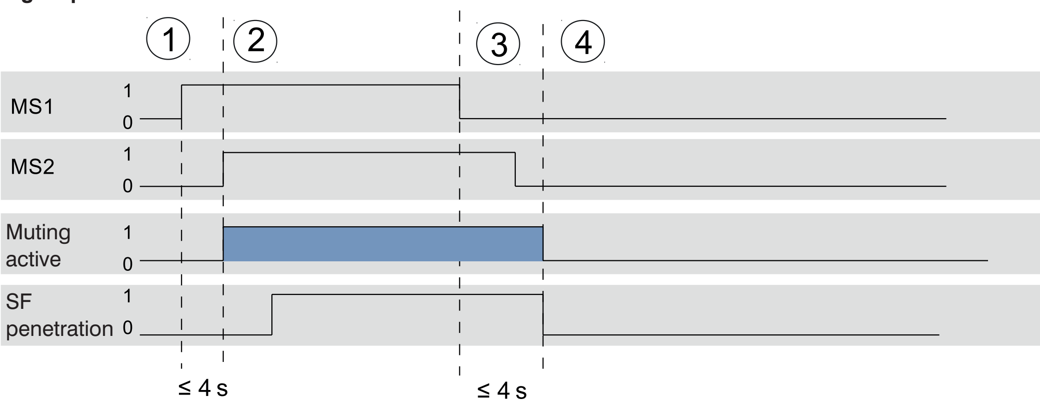


Figure 7: Signal path with two sensor linear muting

5.2.4.5 Four Sensor Linear Muting with Sequence Monitoring

The four sensor linear muting with sequence monitoring enables the user to transport an object into or out of the danger zone. Two MS are located inside and two MS are located outside the danger zone.

The distances a and b represent the distances between the muting object and a separating safeguard (fence). They must be designed so that no one can enter the danger zone unnoticed while the muting is activated. The separating safeguard must therefore be installed directly behind the ESPE to prevent bypassing.

NOTE!

- The four sensor linear muting with sequence monitoring checks the correct activation sequence of the MS. MS1 or MS4 must be activated first. MS2 or MS3 must then be activated depending on which of the sensors was approached.
- The "direction setting" function can be used to restrict the permissible direction of the object transport to one direction.
- The four sensor linear muting with sequence monitoring does not use time monitoring when activating the individual MS. A time restriction is only possible via the maximum muting duration MMD.
- If the function "Muting end through clearing of the ESPE" is activated, the muting sequence ends as soon as the safety field is free again.
- The "Gap suppression" function can increase the availability of the system by accepting signal interruptions of less than 250 ms on the MS.
- Due to the lack of time monitoring, this function should only be used if no other muting type is suitable.

For better understanding, the scenario of material movement into the danger zone is outlined below (Figure 8). If the object is to be transported out of the danger zone, the designation MS1 should be replaced with MS4, MS2 with MS3, etc.

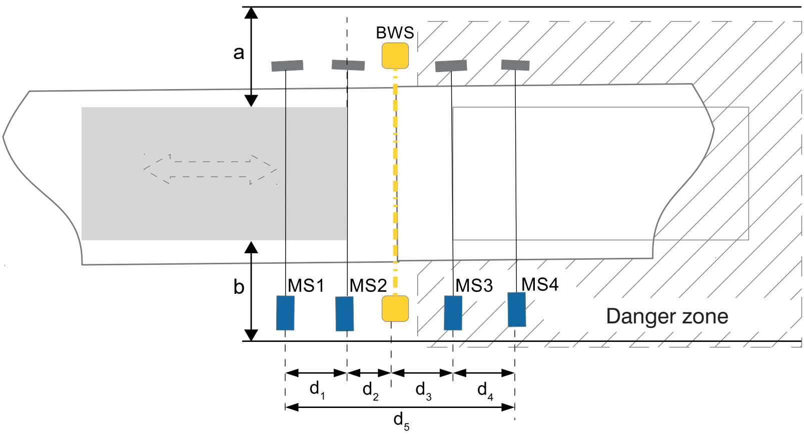


Figure 8: Arrangement four sensor linear muting with sequence monitoring

Calculating the minimum distance

$$d_{1/2/3/4} \geq v \times (t_{ESPE}+t_{MS})$$

d_1 [m]	Minimum distance between MS1 and MS2 (see Figure 8)
d_2 [m]	Minimum distance between MS2 and safety field of the ESPE (see Figure 8)
d_3 [m]	Minimum distance between the safety field of the ESPE and MS3 (see Figure 8)
d_4 [m]	Minimum distance between MS3 and MS4 (see Figure 8)
d_5 [m]	Size of the muting range (see Figure 8)
v [m/s]	Speed of the material on the conveyor line
t_{ESPE} [s]	Processing time muting signals Is the time required by the ESPE for processing all muting signals. The value can be found in the technical data section 4.1, page 15 .
t_{MS} [s]	Response time MS
a, b	Distances

NOTE!

- The muting object must be at least long enough that all 4 MS are triggered at the same time during the muting sequence. This parameter is indicated by the value d_5.

ATTENTION!

- The distance d_5 must be at least 500 mm.
- To reduce the risk of unintentional triggering of the MS, the distance d_1 and d_4 must be at least 250 mm.
- To make it more difficult to bypass the safety devices, the distances d_2 and d_3 must be max. 200 mm each.

Example:

- Belt speed $v = 0.5 \frac{m}{s}$
- Processing time muting signals $t_{ESPE} = 95$ ms
- Response time MS $t_{MS} = 1$ ms

$$d_{1/2/3/4} \geq v \times (t_{ESPE}+t_{MS}) = 0.5 \frac{m}{s} \times (0.095+0.001)s = 0.048 \text{ m}$$

Based on this calculation, each of the MS should be mounted at least 48 mm apart. The following minimum distances apply, however, due to the restrictions outlined above:

d_1: 250 mm
d_2: 48 mm
d_3: 48 mm
d_4: 250 mm
d_5: 596 mm → The muting object must have a minimum length of 596 mm.

Valid muting sequence:

	Action	Comments
1. Muting start	MS1 is activated first, followed by MS2.	
2. Muting active	MS1 and MS2 active, penetration of the safety field (muting object moves through ESPE).	The safety field is interrupted, the OSSDs remain in the ON state.
3. Muting active	MS1, MS2, penetration of the safety field and MS3 active.	Muting remains active.
4. Muting active	MS1, MS2, penetration of the safety field, MS3 and MS4 active.	
5. Muting active	MS2, penetration of the safety field, MS3 and MS4 active.	MS1 has become inactive.
6. Muting active	Penetration of the safety field, MS3 and MS4 active.	MS2 has become inactive.
7. Muting active	MS3 and MS4 active.	Safety field is cleared again.
8. Muting end	MS3 or MS4 are inactive or the maximum muting duration is reached.	

Signal path

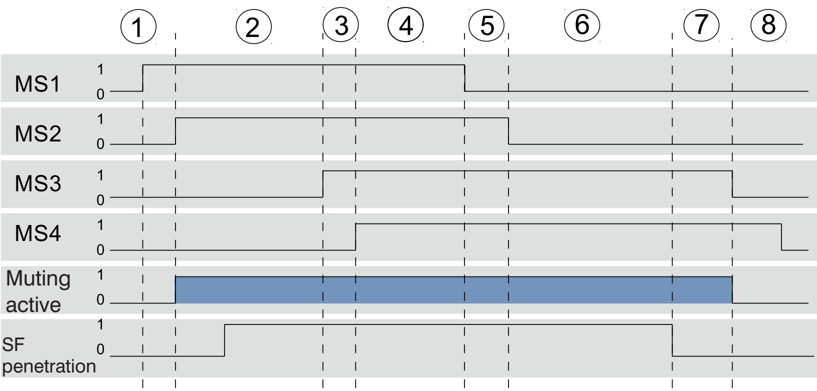


Figure 9: Signal path for the four sensor linear muting with sequence monitoring

5.2.4.6 Four Sensor Linear Muting with Time Monitoring

The four sensor linear muting with time monitoring enables an object to be transported into or out of the danger zone. Two MS are located inside and two MS are located outside the danger zone.

The distances a and b represent the distances between the muting object and a separating safeguard (fence). They must be designed so that no one can enter the danger zone unnoticed while the muting is activated. The contact-based safeguard must therefore be installed directly behind the ESPE to prevent bypassing.

NOTE!

- The four sensor linear muting with time monitoring checks the correct activation sequence of the MS and the time required.
- Depending on which MS is activated first, the following MS must also be activated within 4 s. (Transport into the danger zone: MS1 → MS2; transport out of the danger zone: MS4 → MS3)
- The “direction setting” function can also be used to restrict the permissible direction of the object transport to one direction.
- If the function “Muting end through clearing of the ESPE” is activated, the muting sequence ends as soon as the safety field is free again.
- The “Gap suppression” function can increase the availability of the system by accepting signal interruptions of less than 250 ms on the MS.

For better understanding, the scenario of material movement into the danger zone is outlined below (see Figure 10). If the object is to be transported out of the danger zone, the designation MS1 should be replaced with MS4, MS2 with MS3, etc.

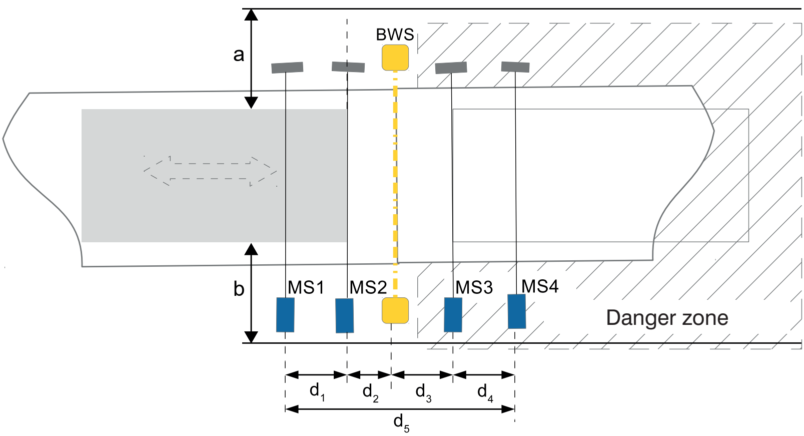


Figure 10: Arrangement four sensor linear muting with time monitoring

Calculating the minimum distance

$$d_{1/2/3/4} \geq v \times (t_{ESPE} + t_{MS})$$

d_1 [m]	Minimum distance between MS1 and MS2 (see Figure 10)
d_2 [m]	Minimum distance between MS2 and safety field of the ESPE (see Figure 10)
d_3 [m]	Minimum distance between the safety field of the ESPE and MS3 (see Figure 10)
d_4 [m]	Minimum distance between MS3 and MS4 (see Figure 10)
d_5 [m]	Size of the muting range (see Figure 10)
v [m/s]	Speed of the material through the safety field
t_{ESPE} [s]	Processing time muting signals Is the time required by the ESPE for processing all muting signals. The value can be found in the technical data section 4.1, page 15.
t_{MS} [s]	Response time MS
a, b	Distances

NOTE!
The length of the transported object must correspond at least to the distance from the first MS to the last MS. This parameter is indicated by the value d_5.

ATTENTION!
- The distance d_5 must be at least 500 mm.
- To reduce the risk of unintentional triggering of the muting sensors, the distance d_1 and d_4 must be at least 250 mm. The two distances do not have to be identical.
- To make it more difficult to bypass the safety devices, the distances d_2 and d_3 must be max. 200 mm each.
- The MS must be positioned so that they detect the object and not the pallet or the transport unit.

Example:
- Belt speed — $v = 0.5\ \frac{m}{s}$
- Processing time muting signals — t ESPE = 95 ms
- Response time MS — t MS = 1 ms

$$d_{1/2/3/4} \geq v \times (t_{ESPE} + t_{MS}) = 0.5\ \frac{m}{s} \times (0.095 + 0.001)s = 0.048\ m$$

Based on this calculation, each of the MS should be mounted at least 48 mm apart. The following minimum distances apply, however, due to the restrictions outlined above:

- d_1: 250 mm
- d_2: 48 mm
- d_3: 48 mm
- d_4: 250 mm
- d_5: 596 mm → The muting object must have a minimum length of 596 mm.

Valid muting sequence:

	Action	Comments
1. Muting start	MS1 → MS2 are active	Both sensors must be activated within a time frame of 4 seconds.
2. Muting active	MS1 → MS2 are active → penetration of the safety field	The safety field is interrupted, the OSSDs remain in the ON state.
3. Muting active	MS1 → MS2 → penetration of the safety field → MS3 active	Muting remains active.
4. Muting active	MS1 → MS2 → penetration of the safety field → MS3 → MS4 are active	MS3 and MS4 must be activated within a time frame of 4 seconds.
5. Muting end	MS3 or MS4 are inactive or the maximum muting duration is reached.	

Signal path

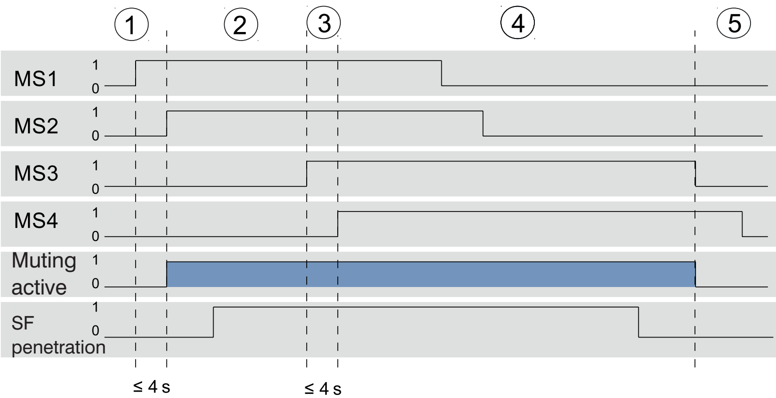


Figure 11: Signal path for the four sensor linear muting with time monitoring

5.2.4.7 Muting Functions

5.2.4.7.1 Combinable Muting Functions

Signal input and configuration									Parameters configuration			
Muting types	**MS1**	**MS2**	**MS3**	**MS4**	**Override**	**Muting enable**	**Belt stop**	**Full muting enable**	**Partial muting**	**Direction setting**	**End due to clearing of the ESPE**	**Gap suppression**
Cross muting	X	X	–	–	X	X	0	0	X	–	X	X
Two sensor linear muting	X	X	–	–	X	X	0	0	X	–	X*	X
Four sensor linear muting with sequence monitoring	X	X	X	X	X	–	–	–	X	X	X	X
Four sensor linear muting with time monitoring	X	X	X	X	X	–	–	–	X	X	X	X

X : Additional function may be used
0 : Additional function may be used, but not at the same time as the other marked functions
– : Additional function may not be used
* : Function is activated automatically by the operating mode

NOTE!
All muting functions are parametrized on the receiver. The parametrization can take place via the control panel or IO-Link.

5.2.4.7.2 Muting Duration

The maximum duration of a valid muting sequence is time-restricted to help prevent manipulation.
Once the maximum muting duration MMD has expired (300 seconds or 8 hours depending on the parametrization), the muting is ended automatically and the safety function is active again.

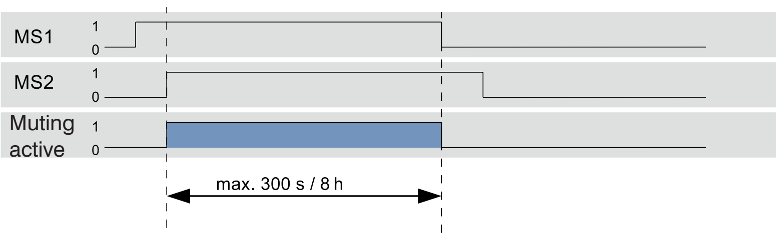


Figure 12: Muting duration using cross-muting as an example

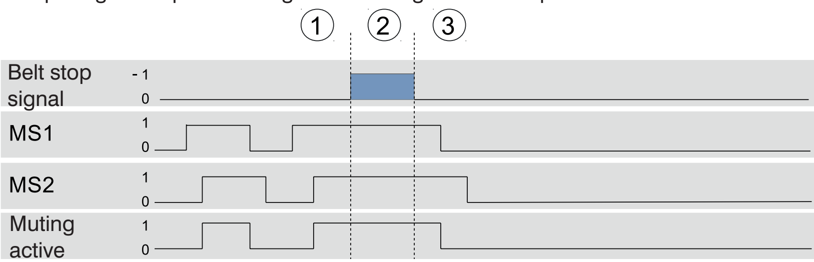
5.2.4.7.3 Belt Stop Signal

The parameterizable “belt stop signal” function enables a high system availability for applications where the conveyor belt is stopped operationally. It stops the muting sequence temporarily.
To this end, if there is an active signal on the “belt stop signal” input, the timers that monitor the initiation and maintenance of the muting sequence are paused. If the signal changes to 0, the muting sequence is continued and the timers continue to count.

Process for interrupting the muting sequence

		Condition	Comment
1.	Normal muting sequence	“Belt stop signal” on 0	Muting sequence takes place as normal
2.	Muting sequence is interrupted	“Belt stop signal” on 1	Timers for monitoring the muting sequence are interrupted
3.	Normal muting sequence	“Belt stop signal” on 0	Timers continue to count. Muting sequence is continued

Sample signal sequence using cross-muting as an example:



Safety during belt stop:
To make it more difficult to bypass the ESPE with the belt stop function active, the following actions cause the muting to be cancelled:
- Changes to the safety field status (penetration → no penetration or no penetration → penetration) and
- Changes to muting signals.

This means that the muting remains active during existing penetration (e.g. pallet interrupts ESPE), but a change in the safety field status with the belt at a standstill causes the muting to be cancelled, as it is assumed that a person is trying to bypass the ESPE.
3 seconds after the belt stop signal, the ESPE continues monitoring the MS.

NOTE!
- The maximum duration of an active belt stop signal is 8 h. After this time, the muting sequence is continued automatically.
- The belt stop function must also be configured on the ESPE. Otherwise, the “belt stop signal” input is not taken into account.
- For information on status messages, see section 13.3.3, page 171.
- The belt stop function uses the same input as the Full Muting Enable function.

5.2.4.7.4 Muting Enable

The “Muting Enable” function is intended to provide added safety for the user when working with muting. If the function is activated during parametrization, the “Muting Enable” input is evaluated. The muting can now be enabled or blocked using the external Muting Enable signal.
If the Muting Enable input is active, muting is initiated with a valid muting sequence. If the Muting Enable input is inactive, the muting function is blocked and can not be initiated.

Sample process for activating the muting

		Condition	Comment
1.	Muting enable is activated	Function is activated in the parametrization	Basic requirement for using the function
2.	Muting inactive	“Muting Enable” input is activated by an external signal	–
3.	Muting inactive	“Muting Enable” input is active and MS1 is active	–
4.	Muting active	MS1 and MS2 are active	“Muting Enable” signal may only become inactive if muting becomes active. From this point, the input is no longer taken into account during the active muting cycle.

The figure shows a valid signal path as an example.

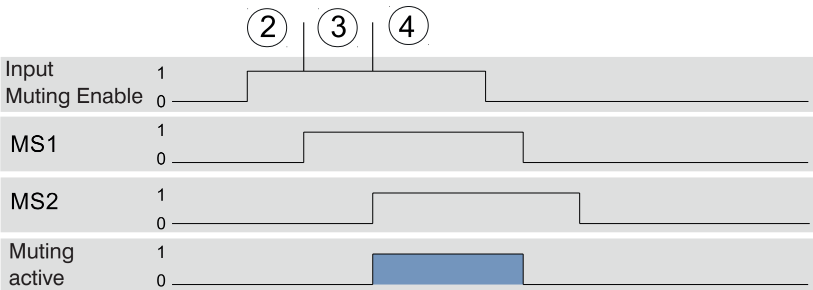


Figure 13: Signal path Muting Enable

NOTE!
If the “Muting Enable” function is activated in the parametrization, the “Muting Enable” input must be active at the latest by the start of a valid muting sequence.

5.2.4.7.5 Direction Setting (Only for Four Sensor Muting)

This function increases the safety during muting by specifying and checking the sequence of the activation and deactivation of the MS. If an object passes through the safety field in a direction other than the one defined, the muting cycle is not initiated.

Setting options

Setting	Condition
Direction A	MS1 or MS2 are activated before MS3 or MS4
Direction B	MS4 or MS3 are activated before MS2 or MS1
Deactivated	No direction specification

NOTE!
- This function is only relevant for muting types where it is possible to differentiate between the direction of transport (see section 5.2.4.5, page 65 and section 5.2.4.6, page 68).
- If the direction specification is deactivated, a cycle must be run through completely before a muting cycle can be started in the opposite direction. If a change in direction takes place while a muting cycle is in progress, this is likely to violate a time or sequence condition. If the safety field is penetrated during this process, this can cause the OSSDs to switch off.

5.2.4.7.6 Muting End Through Clearing of the ESPE

The “Muting End Through Clearing of the ESPE” function enables the muting to be deactivated as soon as an object has been transported out of the safety field of the ESPE. This shortens the muting time and improves safety.
A sample signal sequence based on cross-muting is shown in Figure 14.

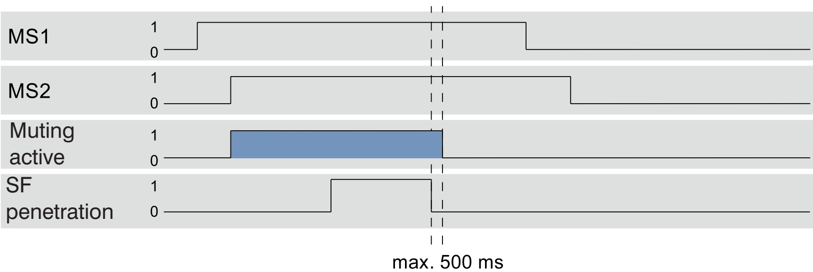


Figure 14: Signal path muting end through clearing of the ESPE

NOTE!
- Ending the muting after the ESPE are cleared takes place with a time delay of max. 500 ms.
- With two sensor linear muting, the “Muting End Through Clearing of the ESPE” function is activated automatically. It can be parametrized with the other muting types.

5.2.4.7.7 Partial Muting

The “Partial Muting” function can be used to secure the danger zone even more effectively. With this approach, only part of the ESPE (e.g. at object height) is hidden within a valid muting sequence, while the other light beams remain permanently active and cause the OSSDs to be switched off if interrupted.

① Area 1

The area is exempted from the muting.
Here, the beams of the ESPE are permanently active independently from the muting sequence.

② Area 2

Area is muting-relevant.
Here, the beams of the
ESPE are bridged depending on the muting sequence.

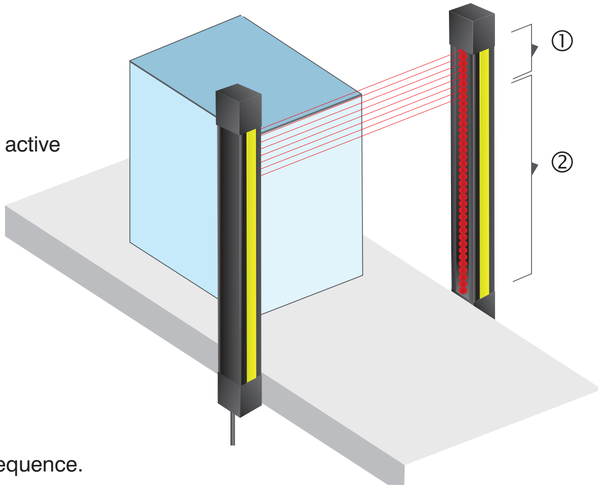


Figure 15: Partial muting

NOTE!

- Area 2 (muting area) can be taught-in by transporting the object into the safety field and teaching in the number of hidden beams.
- Area 2 consists of cumulated beams. For the muting, the area between the first and the last defined beam is activated.
- If area 1 is penetrated during an active muting sequence, the muting is ended.
- With the additional function “Full Muting Enable” (section 5.2.4.7.8, page 76) muting can be extended to the entire safety field. This means that a single object with a greater height can be transported through the safety field.

5.2.4.7.8 Full Muting Enable

For applications where the object height varies, the muting can be extended to the total safety height of the ESPE at specific times with the “Full Muting Enable” function. This function should only be used if “Partial Muting” was activated beforehand.

Usage condition

	Condition	Comment
1.	“Full Muting_Enable” is parametrized.	Basic requirement for activating the function
2.	Signal_FulLinear-Muting_Enable, MS1 and MS2 are not active.	
3.	Signal_FulLinear-Muting_Enable becomes active, MS1 and MS2 are inactive.	The signal FulLinear-Muting_Enable must be active until both muting signals are applied and muting is activated.
4.	MS1 and MS2 become active within 30 seconds and muting is therefore active.	

Figure 16 shows the signal path for the individual steps.

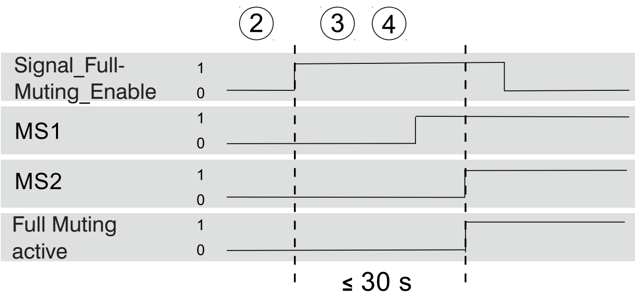


Figure 16: Valid signal sequence for activating Full Muting Enable

NOTE!
- The activation of the “Full Muting Enable” function via a valid signal sequence causes the following muting cycle to take place over the entire height of the ESPE. It does not initiate a muting cycle itself, however.
- Once the muting cycle is complete, the function is no longer active and the usage conditions must be repeated for another “Full Muting”.
- The “Full Muting Enable” function uses the same input as the “Belt Stop” function.

5.2.4.7.9 Gap Suppression

For transport items with gaps, brief interruptions in the muting signal are to be expected. The “Gap Suppression” function ensures that a brief interruption in the detection does not result in the muting being terminated. If the function is activated, interruptions of up to 250 ms are accepted in the signal from a MS.

DANGER!
- The “gap suppression” delays the termination of the muting by 250 ms.
- The user must ensure that, despite the set off-delay, no person can enter the danger zone.

5.2.4.7.10 Override

In some cases, a valid muting sequence can be interrupted due to the conveyor belt stopping, for example. In this case, the object stops and prevents a valid muting sequence from being carried out. The Override function enables the object to be transported out of the muting area despite the safety field being penetrated.

Usage condition

		Condition	Comment
1.	Condition for override	Override function is parametrized. A penetration of the safety field is detected and at least 1 MS is active.	With two sensor linear muting, the status of the MS is not taken into account.
2.	Override is requested	Valid signal sequence on the “Override” input	See Figure 17
3.	Active override	“Override” input is active and at least 1 MS is active and penetration of the safety field is detected.	–
4.	Override ended	• “Override” input inactive or • Safety field free and no MS active or • Maximum override duration exceeded	Depending on which status is reached first. Maximum override duration: 150 s

Figure 17 shows a sample signal sequence during override.

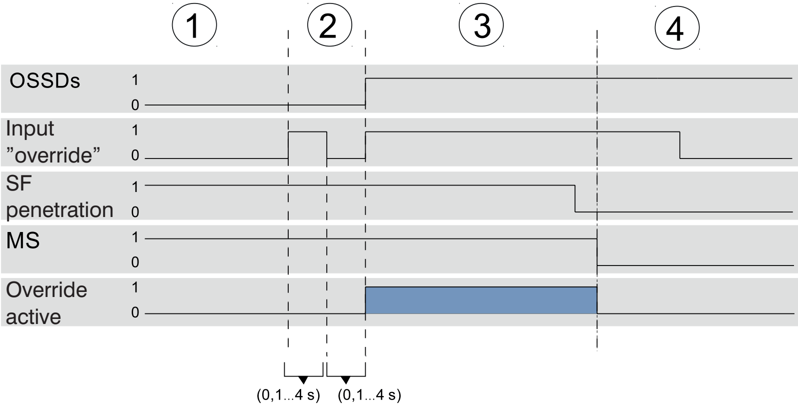


Figure 17: Signal sequence with override

DANGER!

- There must be no persons in the danger zone during override.
- The entire danger zone must be clearly visible by the operator during the override.

NOTE!

- While the override is active, the illuminated cap of the ESPE flashes white at 1 Hz.
- Irrespective of the operating mode “Restart inhibit”, the OSSDs also remain in the ON state when the safety field is cleared and override is ended.

5.2.5 Blanking

Blanking is required for applications including objects which continuously protrude into the safety field, thus interrupting specific light beams of the ESPE. In order to maintain a high availability of the application even under these conditions, the interrupted beams are excluded from the evaluation during "blanking". A safety field penetration at any other point of the ESPE switches the OSSDs and stops the hazardous motion.

DANGER!

- All blanking functions described below impact reliable detection by the ESPE. A check should therefore be carried out as part of a risk assessment to determine whether its use is appropriate and permissible.
- Depending on the parametrized function, the resolution and the response time of the ESPE may vary. This must be taken into account when calculating the safety clearance.
- Based on the parametrized function, the safety field must be checked for correct function with the test rod (diameter according to the effective resolution).
- Further requirements and information on the use of the blanking function can be found in the standard IEC 62046.

5.2.5.1 Principle

An object is located permanently in the safety field of the ESPE. To prevent the object from being classed as a penetration, the beams covered by the object can be hidden using the blanking function.

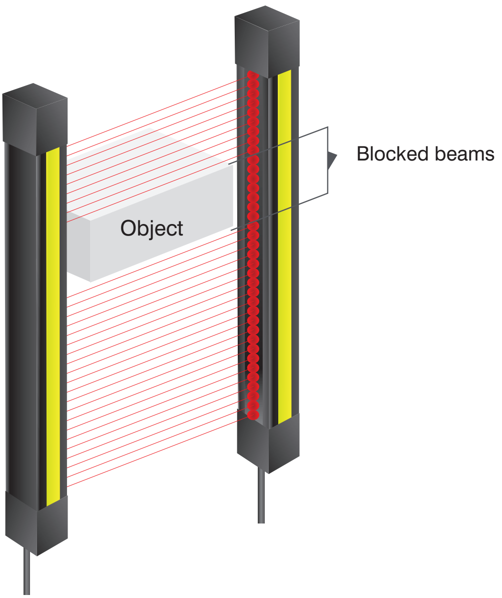
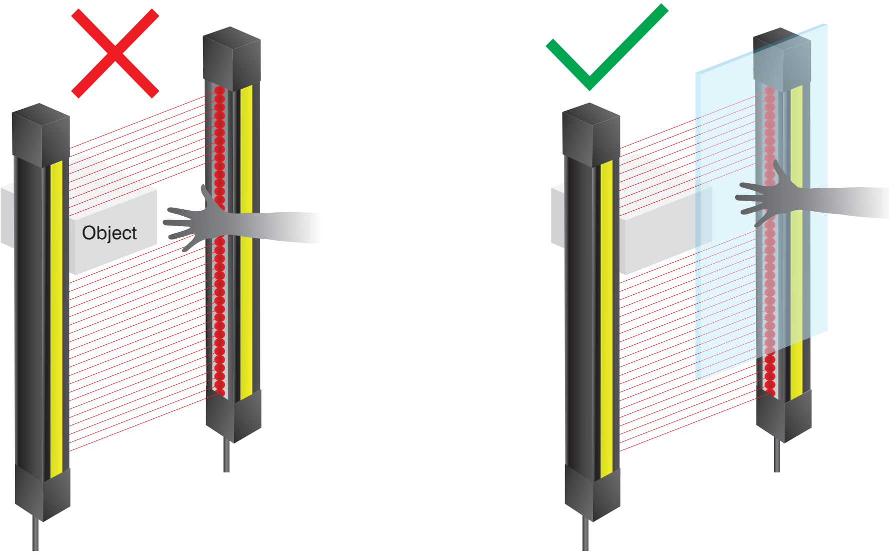


Figure 18: Blanking principle

DANGER!

- The blanking function poses increased risk, as the hidden area of the safety field is not monitored for penetration.
- Additional measures, such as mechanical protection (see Figure 19), should be used to prevent reaching through the hidden beams. It must not be possible to reach through the "shade" of the object.



Impermissible protection from penetration

Mechanical protection from penetration from the side

Figure 19: Required protection when using the blanking function

5.2.5.2 Fix Blanking

If a fixed object is always located in the same position in the safety field, “Fix Blanking” can be used to hide individual beams. It is also possible to hide multiple objects within the safety field.

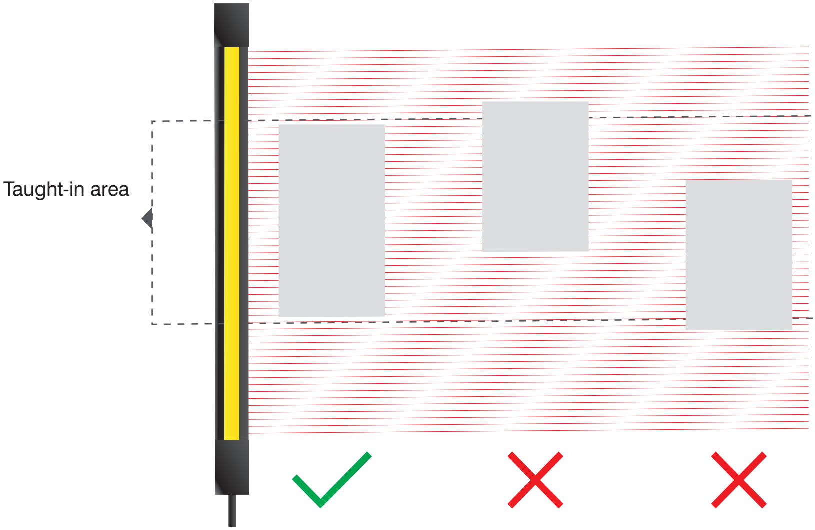
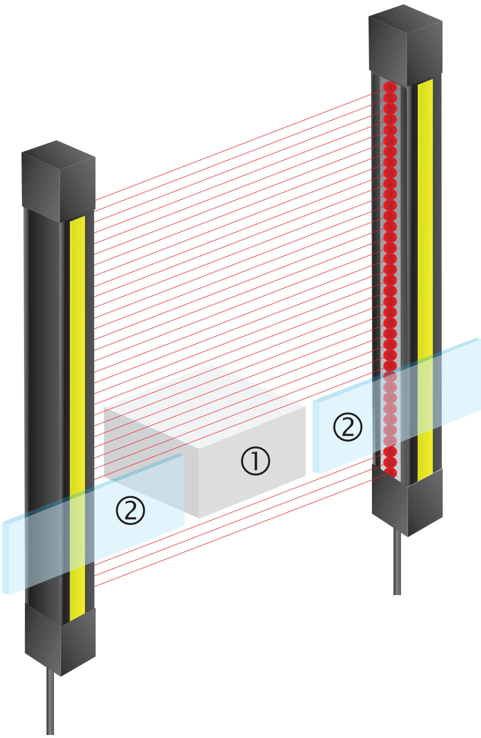


Figure 20: Permissible object positioning with fix blanking

5.2.5.2.1 Conditions of Use

- If a non-hidden beam is covered, this is classed as a penetration and the OSSDs are switched.
- Hidden areas are monitored. beams must not be detected in this area ("monitored blanking"). I.e. they must always be covered by the blanking object. If a hidden beam is uncovered, the receiver enters error state.
- At least 1 synchronization beam and the neighboring beam must not be hidden.
- There must be a distance of at least 1 beam between two hidden areas.
- There is no limit on the number of hidden areas.
- The hidden areas can be taught-in on the receiver of the ESPE or parametrized via IO-Link.

DANGER!
- Hidden areas require a separate risk assessment!
- A hidden area is a "hole in the safety field". The area must therefore be secured by other means, mechanically, for example (see Figure 21).
- A mechanical construction must be installed to ensure that "shadowing" is not possible (see Figure 22).
- The resolution and thus the safety clearance can only be maintained with a suitable mechanical construction around the object in the hidden area.



① Object
② Mechanical construction

Figure 21: Additional safeguard for the hidden area

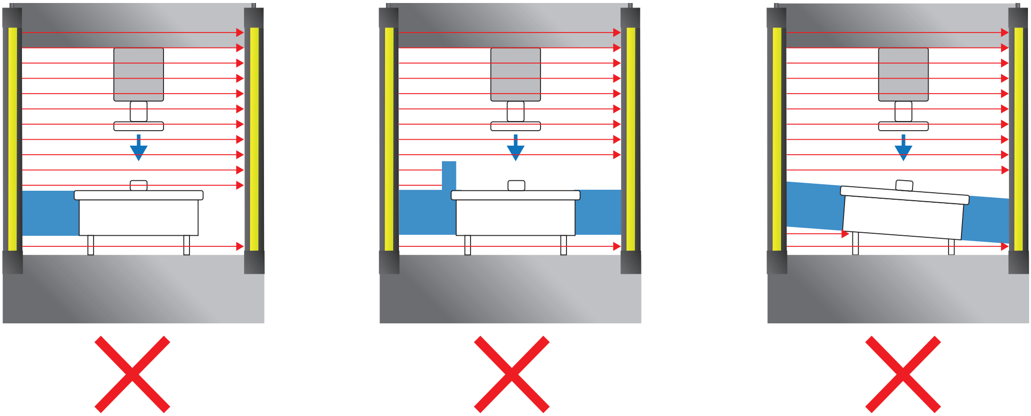


Figure 22: Prevention of shadow formation

5.2.5.2.2 Examples Fix Blanking

Fix blanking with 1 object

	Beam no.					OSSD status
	5	6	7	8	9	
Parameters configuration: hide beam 6 – 7 – 8	○	●	●	●	○	ON
Object movement 1 beam down	●	●	●	○	○	OFF (error)
Object movement 1 beam up	○	○	●	●	●	OFF (error)
Object reduction (2 beams)	○	○	●	●	○	OFF (error)
Object reduction (2 beams)	○	●	●	○	○	OFF (error)
Object increase (4 beams)	●	●	●	●	○	OFF (penetration safety field)
Object increase (4 beams)	○	●	●	●	●	OFF (penetration safety field)
Object reduction (1 beam)	○	○	●	○	○	OFF (error)
Object increase (5 beams)	●	●	●	●	●	OFF (penetration safety field)

Fix blanking with 2 objects

	Beam no.							OSSD status
	5	6	7	8	9	10	11	
Parameters configuration: hide beam 6 – 7 and 9 – 10	○	●	●	○	●	●		ON
Object movement 1 beam down	🔴	🔴	○	🔴	🔴	○	○	OFF (error)
Object movement 1 beam up	○	○	🔴	🔴	○	🔴	🔴	OFF (error)
Object reduction	○	🔴	○	○	🔴	🔴	○	OFF (error)
Objects move and combine into one object	○	🔴	🔴	🔴	🔴	○	○	OFF (error)
Object increase	○	🔴	🔴	○	🔴	🔴	🔴	OFF (penetration safety field)

NOTE!
- If the objects can not be fixed or defined exactly, fix blanking with edge tolerance should be used. This operating mode offers improved availability.

5.2.5.3 Fix Blanking with Edge Tolerance

Fix blanking with edge tolerance can compensate for small movements of a fixed object within the safety field. This takes place with a tolerance of one beam. It is also possible to hide multiple objects within the safety field.

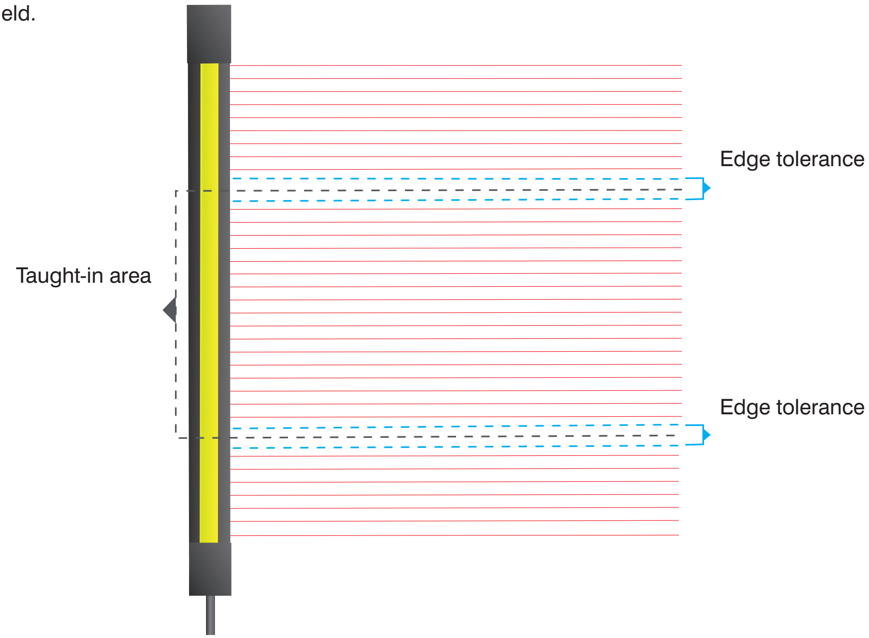


Figure 23: Edge tolerance

5.2.5.3.1 Conditions of Use

- If a non-hidden beam is covered, this is classed as a penetration and the OSSDs are switched.
- Hidden areas are monitored. beams must not be detected in this area ("monitored blanking"). I.e. they must always be covered by the blanking object. If a hidden beam is uncovered, the receiver enters error state.
- The edge tolerance is ± 1 beam.
- The minimum object size is 2 beams
- The following object movements are tolerated, although they are mutually exclusive (see Figure 24):
  - Movement by 1 beam up or down.
  - Increase in the size of the hidden area by 1 beam.
  - Reduction in the size of the hidden area by 1 beam.

- At least 1 synchronization beam and the neighboring beam must not be hidden.
- The distance between two hidden areas depends on their movement within the safety field (Figure 24):
  - No object moves: 1 beam distance
  - One object moves: 2 beams distance
  - Both objects move: 3 beams distance

- There is no limit on the number of hidden areas.
- The hidden areas can be taught-in on the receiver of the ESPE or parametrized via IO-Link.

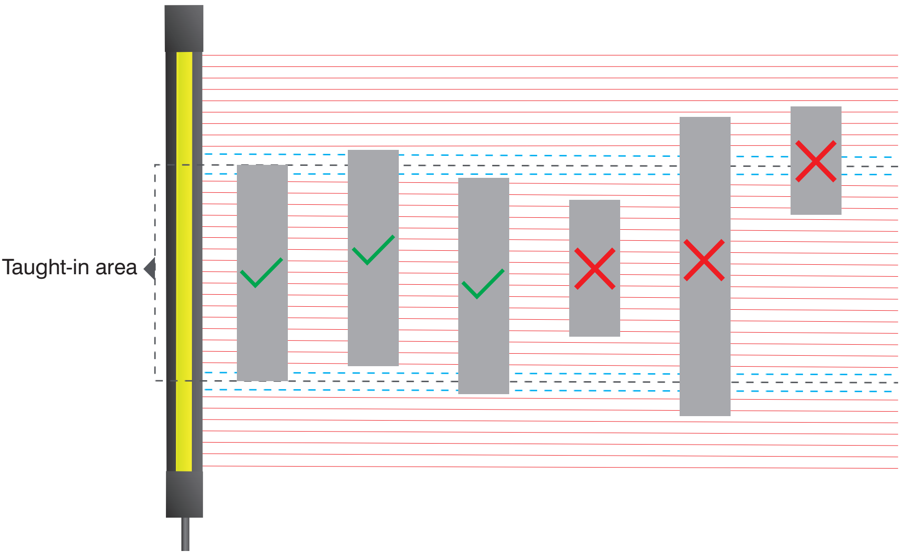


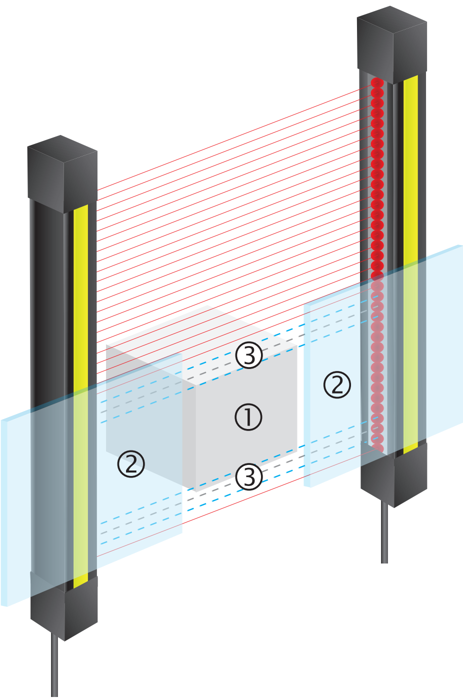
Figure 24: Permissible object movement with fix blanking with edge tolerance

5.2.5.3.2 Effective Resolution for Calculating the Safety Clearance

DANGER!
- The edge tolerance reduces the effective resolution of the ESPE.
- The value for the effective resolution can be found in the tables below.
- A new calculation of the safety clearance taking into account the effective resolution of the ESPE is essential.
- For resolutions > 40 mm, the safety clearance must be calculated with the margin CRT = 850 mm!
- If the effective resolution deviates from the physical resolution of the ESPE as per the data sheet, the effective resolution must be documented and securely mounted on a sign close to the ESPE.
- When calculating the safety clearance for fix blanking with edge tolerance, the response time “special setting” must be used (see Section “4.2 Response times” on page 17).

Effective resolution with construction around the sides of the hidden object
- If a mechanical construction is installed in the hidden area around the object, only the edge tolerance is relevant for the effective resolution (see table below).

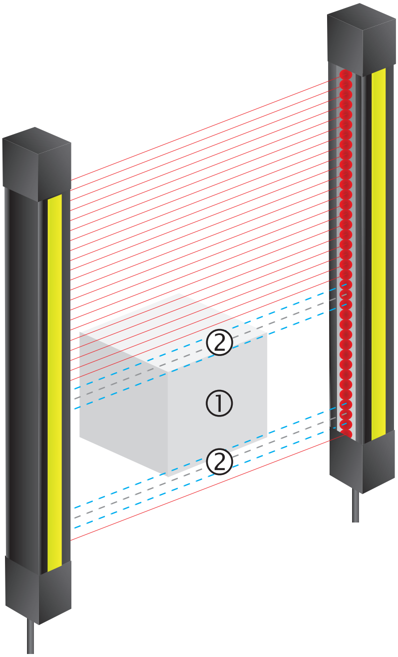
Resolution (data sheet)	Relevant hiding (edge tolerance)	Effective resolution
14 mm	1 beam	24 mm
30 mm	1 beam	50 mm



① Object
② Mechanical construction
③ Edge tolerance

Effective resolution without construction around the sides of the hidden object

- If no mechanical construction is installed in the hidden area, the effective resolution changes according to the maximum object size.



① Object
② Edge tolerance

Resolution (data sheet)	Relevant suppression (blanking area + edge tolerance)	Effective resolution
14 mm	3	44 mm
	4	54 mm
	5	64 mm
	6	74 mm
	7	84 mm
	8	94 mm
30 mm	3	90 mm
	4	110 mm

5.2.5.3.3 Examples Fix Blanking with Edge Tolerance

1 object is hidden

	Beam no.					OSSD status
	5	6	7	8	9	
Parameters configuration: hide beam 6 – 7 – 8	○	●	●	●	○	ON
Object movement 1 beam down	●	●	●	○	○	ON
Object movement 1 beam up	○	○	●	●	●	ON
Object reduction (2 beams)	○	○	●	●	○	ON
Object reduction (2 beams)	○	●	●	○	○	ON
Object increase (4 beams)	●	●	●	●	○	ON
Object increase (4 beams)	○	●	●	●	●	ON
Object movement larger than 1 beam	○	○	○	🔴	🔴	OFF (error)
Object reduction (1 beam)	○	○	🔴	○	○	OFF (error)
Object increase (5 beams)	🔴	🔴	🔴	🔴	🔴	OFF (penetration safety field)

2 objects are hidden

	Beam no.							OSSD status
	5	6	7	8	9	10	11	
Parameters configuration: Hide beam 6 – 7 and 9 – 10 no object moves → 1 beam distance	○	●	●	○	●	●		ON
1 object moves → 2 beams distance	●	●	○	○	●	●	○	ON
2 objects move → 3 beams distance	●	●	○	○	○	●	●	ON
2 objects move → 1 beam distance	○	○	🔴	🔴	○	🔴	🔴	OFF (error)
Object increase (object 1 – 3 beams)	●	●	●	○	●	●	○	ON
Object reduction (object 1 – 1 beam)	○	●	○	○	●	●	○	ON
Objects move and combine into one object	○	🔴	🔴	🔴	🔴	○	○	OFF (error)

5.2.5.4 Floating Blanking

In certain applications, objects which do not have a clear defined position are permanently located in the safety field of the ESPE. These could be cables or tool parts, for example, which move through the safety field for process-related reasons.
The “Floating Blanking” function enables these objects to be hidden.

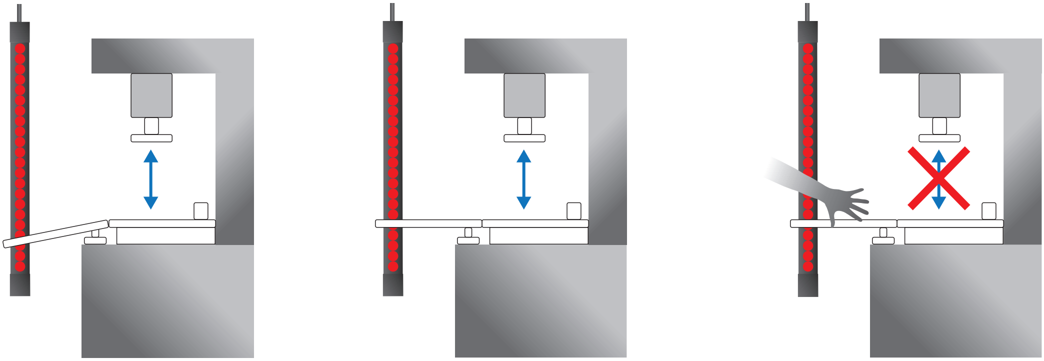


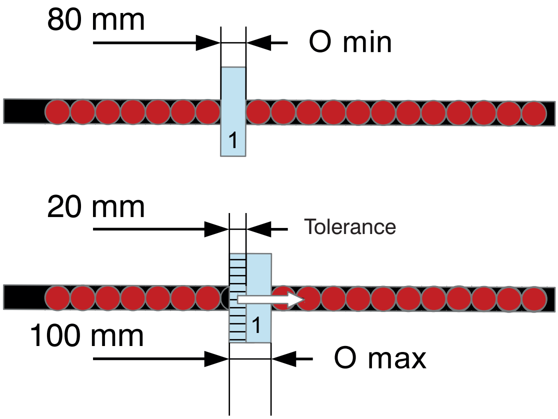
Figure 25: Application example floating blanking

5.2.5.4.1 Conditions of Use

- A blanking configuration is classed as impermissible (OSSDs switch), if
  - The object size (minimum and maximum) in the safety field does not match the parameter configuration.
  - The number of objects in the safety field does not match the parameter configuration.

- If a non-hidden beam is covered, this is classed as a penetration and the OSSDs are switched.
- The minimum object size is 2 beams.
- The ESPE monitors the following parameters (see Figure 26):
  - Number of objects
  - Minimum object size
  - Maximum object size
  - Tolerance (difference between the maximum and minimum object size)

- The tolerance is key for effective resolution (see section 5.2.5.4.2, page 91). This may be a maximum of:
  - 8 beams (for ESPE with 14 mm resolution)
  - 4 beams (for ESPE with 30 mm resolution).
  - The number of objects and tolerance are shown on the receiver control panel during the parameter configuration (see section 9.4.9, page 139)



1: Hidden object
O min: minimum object size
O max: maximum object size
Tolerance: Suppression through object movement

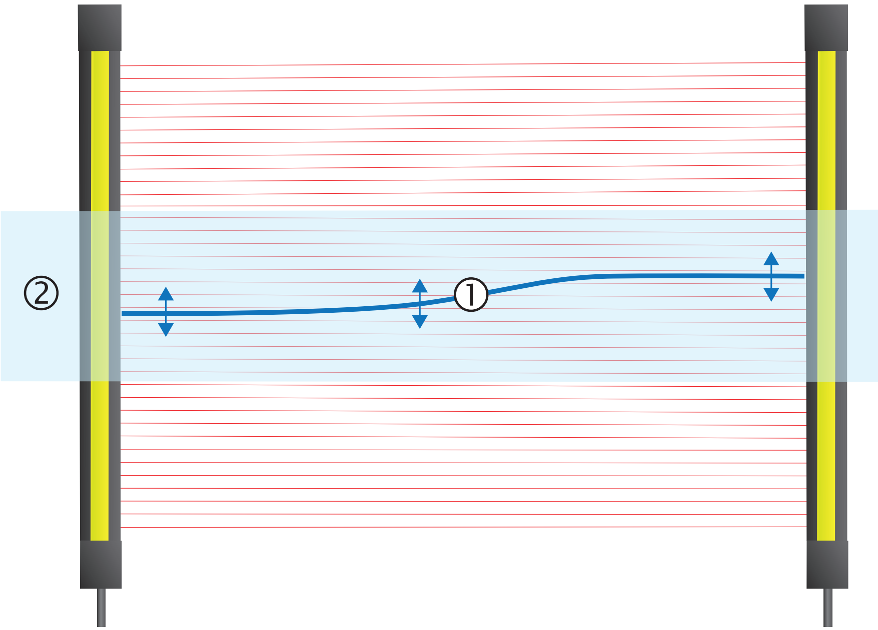
Figure 26: Object monitoring floating blanking

- The maximum object speed is 0.2 m/s.
- Both synchronization beams must not be covered by the objects.
- There must be a distance of at least 3 beams between two hidden areas.
- The number of hidden areas is limited to 3.
- The objects must not leave the safety field (“monitored blanking”).
- Hidden areas are monitored. beams must not be detected in this area (“monitored blanking”). I.e. they must always be covered by the blanking object. If a hidden beam is uncovered, the receiver enters error state.
- The hidden areas can be taught-in on the receiver of the ESPE or via IO-Link.
- During the teach-in process, objects in the safety field should carry out the movements they would carry out during operation.

5.2.5.4.2 Effective Resolution for Calculating the Safety Clearance

DANGER!
- The tolerance reduces the effective resolution of the ESPE.
- The value for the effective resolution can be found in the table below on page 92 .
- A new calculation of the safety clearance taking into account the effective resolution of the ESPE is essential.
- For resolutions > 40 mm, the safety clearance must be calculated with the margin CRT = 850 mm!
- If the effective resolution deviates from the physical resolution of the ESPE as per the data sheet, the effective resolution must be documented and securely mounted on a sign close to the ESPE.
- When calculating the safety clearance for floating blanking, the response time “special setting” must be used (see Section “4.2 Response times” on page 17)

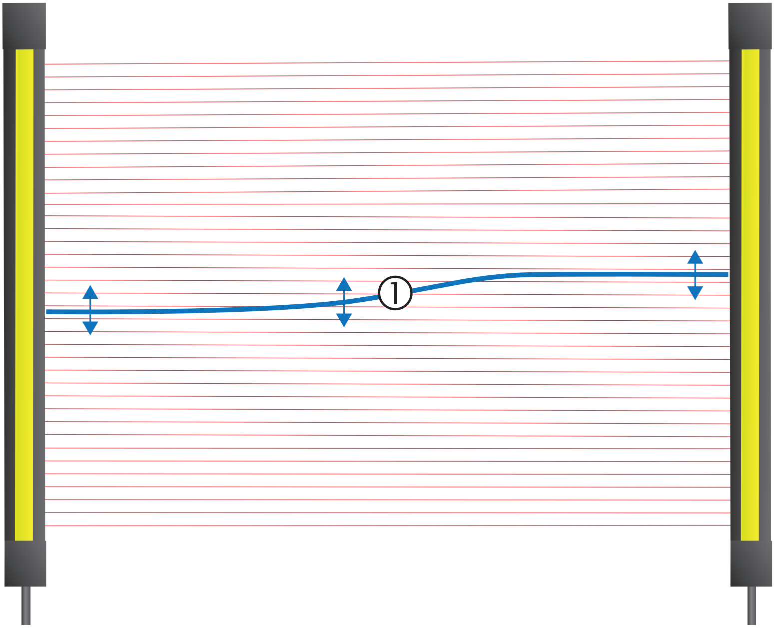
Effective resolution with construction around the sides of the hidden object
- If a mechanical construction is used around the blanking area (object including possible movement) to prevent reaching in, the safety clearance does not change.



① Moving object
② Mechanical construction

Effective resolution without construction around the sides of the hidden object

- If no mechanical construction is installed in the hidden area, the effective resolution changes according to the maximum object size.



1 moving object

Resolution (data sheet)	Relevant hiding (tolerance)	Effective resolution
14 mm	1 beam	24 mm
	2	34 mm
	3	44 mm
	4	54 mm
	5	64 mm
	6	74 mm
	7	84 mm
	8	94 mm
30 mm	1 beam	50 mm
	2	70 mm
	3	90 mm
	4	110 mm

5.2.5.4.3 Examples Floating Blanking

1 Object is hidden
- beams 1 and 15 are synchronization beams
- Parameter configuration:
  - 1 object
  - Object: min. size 2 beams, max. size 4 beams

	Beam no.															OSSD status
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Parameters configuration	○	○	○	●	●	●	○	○	○	○	○	○	○	○	○	ON
Object moves up	○	○	○	○	○	○	○	○	○	●	●	●	○	○	○	ON
Object moves down	○	●	●	●	○	○	○	○	○	○	○	○	○	○	○	ON
Object moves to the end of the ESPE	🔴	🔴	🔴	○	○	○	○	○	○	○	○	○	○	○	○	OFF (error)
Object increases in size (4 beams)	○	○	○	●	●	●	●	○	○	○	○	○	○	○	○	ON
Object increases in size (5 beams)	○	○	🔴	🔴	🔴	🔴	🔴	○	○	○	○	○	○	○	○	OFF (penetration safety field)
Object reduces in size (2 beams)	○	○	○	●	●	○	○	○	○	○	○	○	○	○	○	ON
Object reduces in size (1 beam)	○	○	○	🔴	○	○	○	○	○	○	○	○	○	○	○	OFF (error)
Object disappears from the safety field	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	OFF (error)

2 Objects are hidden

- beams 1 and 15 are synchronization beams
- Parameter configuration:
  - 2 objects
  - Object 1 [O1]: min. size 2 beams, max. size 4 beams
  - Object 2 [O2]: min. size 2 beams, max. size 4 beams

	Beam no.															**OSSD status**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	
Parameters configuration	○	○	○	●	●	●	○	○	○	●	●	●	○	○	○	ON
O1 moves down		●	●	●						●	●	●				ON
O1 moves to the end of the ESPE	🔴	🔴	🔴	○	○	○	○	○	○	🔴	🔴	🔴				OFF (error)
O1 moves up						🔴	🔴	🔴		🔴	🔴	🔴				OFF (error)
O2 moves				●	●	●						●	●	●		ON
O1 and O2 combine into one object						🔴	🔴	🔴	🔴	🔴	🔴					OFF (error)
O1 reduces in size			●	●						●	●	●				ON
O1 increases in size			●	●	●	●				●	●	●				ON
O1 increases in size		🔴	🔴	🔴	🔴	🔴				🔴	🔴	🔴				OFF (penetration safety field)
O2 leaves the safety field				🔴	🔴	🔴										OFF (error)

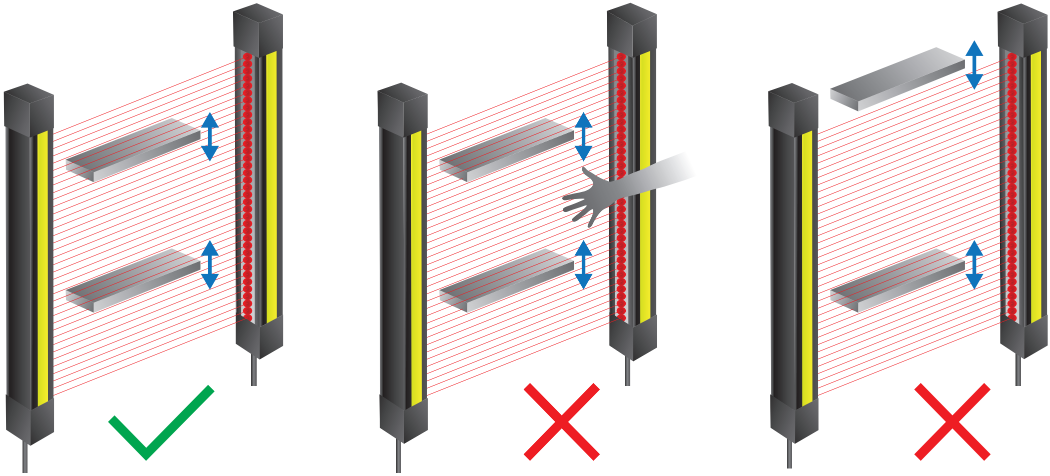


Figure 27: Valid/invalid floating configurations

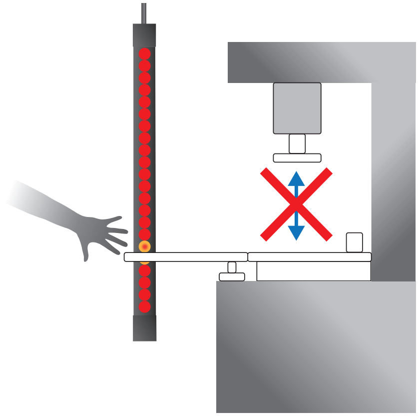
Valid floating blanking Configuration:
- The actual number of objects matches the number taught-in.

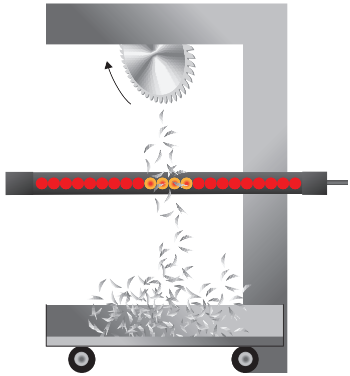
Valid floating blanking configuration, but additional penetration.

Invalid floating blanking configuration:
- The object leaves the safety field
- The actual number of objects no longer matches the number taught-in (monitored blanking).

5.2.5.5 Reduced resolution

- This function reduces the resolution of the ESPE electronically.
- This allows for the selection of an object size, as of which the safety output should be switched.
- Obstructions (chips, cables) which could interrupt the safety field therefore do not cause a switch-off or interrupt the process unnecessarily.
- The parameters for reduced resolution can be configured either on the device or via IO-Link:
  - Teach-in
  - Direct selection of the beams to be reduced (finger protection: up to 8 beams; hand protection: up to 4 beams)





NOTE!

- Objects in the safety field are not monitored for presence or quantity (no “monitored blanking”). This means that sufficiently small objects can be removed from the safety field and brought in again at any point without the ESPE classing this as a penetration.
- Reduced muting can not be combined with partial muting or Full Muting Enable.
- The ESPE should be tested for effective resolution using a test rod.
- Reduced resolution can be taught-in on the receiver of the ESPE or parametrized via IO-Link.

5.2.5.5.1 Effective Resolution for Calculating the Safety Clearance

DANGER!

- The function changes the resolution of the ESPE. The effective resolution is relevant for the safety clearance.
- The safety clearance must be re-calculated when using the reduced resolution.
- For resolutions > 40 mm, the safety clearance must be calculated with the margin CRT = 850 mm! (For details on the calculation, see section 5.1.3.2, page 39)
- When calculating the safety clearance for reduced resolution, the response time “special setting” must be used (see Section “4.2 Response times” on page 17).

Physical resolution (see ESPE data sheet)	Number of blocked beams	Effective resolution	Undetected object size *
14 mm	0	14 mm	–
	1	24 mm	≤ 3 mm
	2	34 mm	≤ 13 mm
	3	44 mm	≤ 23 mm
	4	54 mm	≤ 33 mm
	5	64 mm	≤ 43 mm
	6	74 mm	≤ 53 mm
	7	84 mm	≤ 63 mm
	8	94 mm	≤ 73 mm
30 mm	0	30 mm	–
	1	50 mm	≤ 9 mm
	2	70 mm	≤ 29 mm
	3	90 mm	≤ 49 mm
	4	110 mm	≤ 69 mm

* Objects of the specified size are not detected if they are moving along the safety field at a speed of 0.2 m/s.

5.2.5.5.2 Example Reduced Resolution

- ESPE with 14 mm resolution
- 2 consecutive blanked beams are tolerated → effective resolution 34 mm
- beams 1 and 15 are synchronization beams

	Beam no.															OSSD status
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
No obstruction, no penetration	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	ON
1 obstruction	○	○	○	○	○	●	○	○	○	○	○	○	○	○	○	ON
2 obstructions	○	○	○	○	○	●	●	○	○	○	○	○	○	○	○	ON
3 obstructions	○	○	○	○	○	●	○	○	○	●	●	○	○	○	○	ON
2 obstructions	●	○	○	○	○	○	○	○	○	○	○	○	○	●	●	ON
1 obstruction and penetration	○	○	○	○	○	●	○	○	○	E	E	E	○	○	○	OFF (penetration safety field)

5.2.5.6 Comparison Blanking Functions

	Fix blanking	Fix blanking with edge tolerance	Floating blanking	Reduced resolution
Section	section 5.2.5.2, page 81	section 5.2.5.3, page 84	section 5.2.5.4, page 89	section 5.2.5.5, page 96
Object movement	None	By ± 1 beam within the safety field	Within the safety field	Inside and outside the safety field
Number of objects	Unlimited	Unlimited	Max. 3	Unlimited
	Is monitored	Is monitored	Is monitored	Is not monitored
Distance between the objects	Min. 1 beam	Min. 1 – 3 beams (dep. on no. object movements)	Min. 3	According to re-duced resolution Min. 1 beam
Min. Object size	1 beam @14 mm: 14 mm @30 mm: 30 mm	2 @14 mm: 24 mm @30 mm: 50 mm	2 @14 mm: 24 mm @30 mm: 50 mm	None @14 mm: - @30 mm: -
Max. Object size	Min. 1 synchroni-zation beam and neighboring beam free	Min. 1 synchroni-zation beam and neighbouring beam free	Both synchroniza-tion beams free	According to re-duced resolution
Release of the safety field	OSSDs OFF (error)	OSSDs OFF (error)	OSSDs OFF (error)	OSSD ON
Release of blanked beams	OSSDs OFF (error)	OSSDs OFF (error)	OSSDs OFF (error)	OSSD ON
Resolution with mechanical construction	According to the data sheet	With edge area: According to the data sheet Without edge area: Effective resolution as with blanking of 1 beam	According to the data sheet	Not relevant
Resolution without mechanical con-struction	According to effec-tive resolution	According to effec-tive resolution	According to effec-tive resolution	According to re-duced resolution
Parameters configuration	Teach-in	Teach-in	Teach-in	Teach-in

5.2.6 Non-Safety-Related Functions

5.2.6.1 Measuring Function

- Different measuring functions can be used on the device for controlling system parts, for example. This enables muting parts to be measured or their size checked, among other things.
- The recorded process data can be accessed via IO-Link.

The following values (see Figure 28) can be determined via the measuring function:
- First blocked beam
  - Abb. FBB: First Beam Blocked
  - Shows the position of the first blocked beam (as viewed from the control panel).
  - If the safety field is free: FBB = 0
- Last blocked beam
  - Abb. LBB: Last Beam Blocked
  - Shows the position of the last blocked beam (as viewed from the control panel).
  - If the safety field is free: LBB = 0
- Number of blocked beams
  - Abb. NBB: Numbers of beams Blocked
  - The total number of blocked beams in the safety field (including multiple objects)
- Number of cumulated blocked beams (biggest group: NCBB)
  - Abb. NCBB: Numbers of Cumulated beams Blocked
  - Total number of blocked beams of the largest object
- Number of objects (NOBJ)
  - Abb. NOBJ: Numbers of Objects
  - Number of objects in the safety field

Example of the measuring function

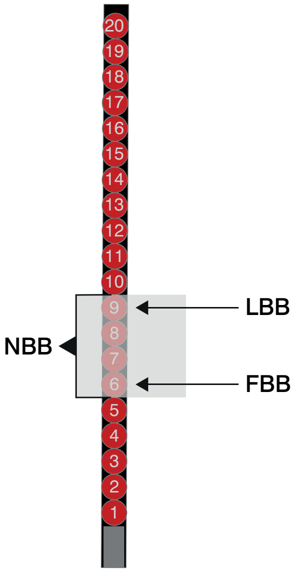
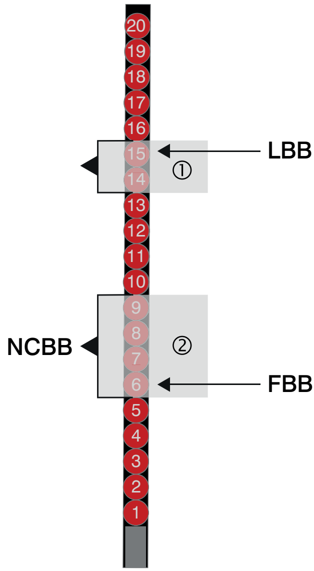
		
FBB – First Beam Blocked	Beam no. 6	Beam no. 6
LBB – Last Beam Blocked	Beam no. 9	Beam no. 15
NBB – Numbers of beams Blocked	4 beams	6 beams
NCBB – Numbers of Cumulated beams Blocked	4 beams	4 beams
NOBJ – Numbers of Objects	1	2

Figure 28: Values of the measuring function

NOTE!

- The measuring function is dependent on the parametrized operating modes and functions. This means that objects, which do not result in a shutdown (e.g. blanking, reduced resolution), are included in the measurement.
- If the receiver is not in synchronous run (e.g. emitter not in operation, safety field completely blocked, error state,...), the value 255 is output for all measurements.

5.2.6.2 Display Settings

- The display setting can be adjusted so that it does not interfere during operation (e.g. at manual work stations).
- The following settings can be selected:

	Standard	Energy saving mode
LEDs	Always active according to status	Always active according to status
Activation segment display	Automatic	Any key pressed or change via a status message
Display duration segment display	Permanent	30 s
Selection	Via parameter configuration	Default Settings

5.2.6.3 Signal Output

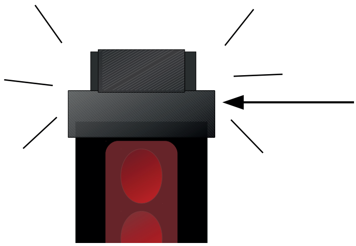
- Pin 6 of the IO-Link output is on the system connection of the receiver. If IO-Link communication is not active, this output can be used as a digital PNP output (signal output).
- The following functions can be assigned to the signal output:

ATTENTION!
On the receiver of the ESPE, Pin 6 (IO-Link output) is not suitable for safety-related use.

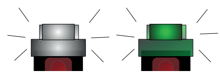
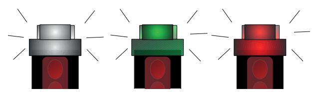
Function	Signal active	Signal inactive
Acknowledgment prompt (default setting)	Acknowledgment required (e.g. following safety field penetration with restart inhibit)	No acknowledgment (e.g. with automatic restart)
OSSD switching states	OSSDs ON	OSSDs OFF
Muting status	Muting active	No muting active
Contamination warning	Contamination or weak signal	Good signal strength
Synchronous run	Receiver is in synchronous run.	Receiver is not in synchronous run, e.g. because: • Safety field is fully covered, • Incorrect alignment, • Emitter not in operation.
Ready state	ESPE ready for operation	ESPE is ready state
Off	Output is deactivated.	

5.2.6.4 Integrated Indicator Lamp

- The receiver of the ESPE has a transparent end cap with integrated indicator lamp.
- Depending on the parameter configuration and sensor, the different status of the ESPE is shown depending on the situation. The integrated indicator lamp is not monitored. This means that an indicator lamp failure has no impact on the function of the ESPE.
- The display of the OSSD status can be deactivated if the display clashes with other indicator displays within the system.
- The muting status display can not be deactivated.



Transparent end cap with integrated indicator lamp

Setting options	Status ESPE	Display indicator lamp		
Muting status	Active	White	Constant	
	Override active	White	Flashing	
	Inactive	Off	Constant	
OSSD and muting status	OSSD on – muting active	White	Constant	
	Override active	White	Flashing	
	OSSD on – muting inactive	Green	Constant	
	OSSD off – muting inactive	Red	Constant	

5.2.6.5 Signal Strength Display

- After the ESPE is switched on, the signal strength is displayed on the receiver for 30 s.
- Display for an unlimited period of time is also possible during parameters configuration.
- For details on the display, see section 10.3, page 155.

5.2.6.6 Memory Function

- The ESPE can be expanded with a microSD memory card (complementary accessories), which can be read and written on.
- This enables a parameter configuration to be transferred from the memory card to the ESPE and a parameter configuration for a ESPE to be saved on the memory card.

NOTE!
The main advantages of the memory function are:
- Easy exchange of parameters,
- Duplication of series parameter configurations,
- Quick transfer of parameters when a device is replaced,
- Archiving configuration files via the PC.

This makes the following scenarios possible for the user:

Procedure	Build a series machine	Initial start-up of the series machine with PC	Initial start-up of the series machine	Light curtain is faulty
Step 1	File with parameter configuration for the ESPE is saved on the PC file system	Parameter configuration of an ESPE takes place via the control panel and is saved on the card	Parameter configuration of an ESPE takes place via the control panel and is saved on the card	The (written) memory card is removed from the faulty ESPE
Step 2	The parameter configuration is transferred to all memory cards	The memory card is removed	The memory card is removed	The memory card is inserted in the new product
Step 3	The memory card is inserted in all ESPE and the parameter configuration is transferred	File with parameter configuration for the ESPE is saved on the PC file system	The memory card is inserted in all other ESPE and the parameter configuration is transferred	The parameter configuration is transferred to the new product
Step 4		The parameter configuration is duplicated on memory cards for all ESPE (via PC)		
Step 5		The memory card is inserted in all ESPE and the parameter configuration is transferred		

5.2.6.6.1 Access to the Memory Card

- The access to the memory card is located on the right side of the control panel for the receiver (see Figure).
- The slot can accept memory cards in microSD format.
- The memory card is protected by a screw-on swivel cover.
- This cover can be loosened and screwed down again with a screwdriver (Torx, size TX10).
- Permissible tightening torque: 0.4 Nm
- The swivel cover must be sealed correctly to guarantee the IP degree of protection and to prevent the cover or the memory card from being lost.
- To remove the card, release the lock by pressing lightly on the card, e.g. with a finger nail.
- When inserting the card in the slot, ensure that it engages again.

Figure 29: Access to the memory card on the ESPE receiver

5.2.6.6.2 Suitable Memory Cards

- Supported memory card types: microSD
- Supported memory capacity: max. 8 GB
- File system: type FAT32
- The microSD card can be removed/replaced at any time (without impairing operation)
- Preferred type (wenglor order no.): ZNNG013

5.2.6.6.3 File System

The following instructions must be followed to guarantee successful use of the microSD card:
- Every ESPE type has its own file with clear designation.
- The file name has the following structure: [Order number receiver].hex (e.g. SEFG631.hex]
- The designation must not be changed (e.g. SEFG631_V1.hex), as it can otherwise no longer be read in by the ESPE.
- If a configuration is written on the memory card by the ESPE, an existing file with the same designation is overwritten.
- The contents of the file itself can not be read and must not be changed.
- The ESPE can not search through folder structures. The desired file must therefore always be located on the top level of the folder. Sub-folders may be created, but are not taken into account by the ESPE.

- The ESPE (e.g. SEFG631) always saves the file in the top level of the microSD card

Name	Type
Machine1_SF1	File folder
Machine1_SF2	File folder
SEFG631	HEX file
SEFG632	HEX file

- Multiple files from different ESPE (e.g.: SEFG631.hex, SEFG632.hex) can be saved in the parent folder.
- The relevant ESPE (e.g. SEFG631) only uses the file with the name assigned to it (e.g: SEFG631.hex).
- The subfolders may also contain files with the same name (e.g.: SEFG631.hex). These are not taken into account by the ESPE (e.g. SEFG631).

5.2.6.7 Password Protection

- The password protection prevents unauthorized and unintentional changes to the ESPE.
- The parameters of the ESPE may only be configured by authorized personnel. The authorized personnel are also responsible for maintaining the safety function.
- The receiver of the ESPE is protected with a 4-digit password.
- The password can be changed by the user (value range 0000 – 9999). If the password is changed, it must be adequately protected.
- In delivery state, the password is: 0000
- Parameter configuration is only possible after the password has been entered.

The password protection function divides the operation into two user levels:

Designation	Worker	Admin
Authorization	Read access	Read and write access
Setting options	None	Changing parameter configurations
Password protection	Not required	Password input required

5.2.6.8 IO-Link Interface (C/Q)

IO-Link is a standardized communication system for connecting intelligent sensors and actuators to an automation system. This takes place via a point-to-point connection.

The IO-Link interface in the SEFG has the following function for the user:
- Saving and reading out parameter data in the ESPE.
- Querying the ESPE status.

At the request of the master (Wake-Up Request, WURQ), the sensor switches to IO-Link mode (communication mode).
If the IO-Link interface is not used for communication, it has the following functions:
- With the receiver, always as a signal output (see “5.2.6.3 Signal Output” on page 101)
- With the emitter, as a digital input (without function).

ATTENTION!
- The IO-Link interface is not safety-related.
- This means that both OSSDs must always be connected in the safety circuit during operation (see section 8, page 114).

NOTE!
- Settings (e.g. range) can be read out by the IO-Link master via the IO-Link parameters. All parameters are set via the software of the IO-Link master.
- Data (e.g. switching statuses, receive signals) of IO-Link products is transferred cyclically to the IO-Link master via the IO-Link process data.
- IO-Link sensors are connected to the IO-Link master. It provides an interface to the higher-level control and controls the communication with the connected IO-Link products.

6. Transport and Storage

6.1 Transport

- Upon receipt of shipment, inspect the goods for damage in transit.
- In the case of damage, conditionally accept the package and notify the manufacturer of the damage.
- Then return the device, making reference to damage in transit.

6.2 Storage

The following points must be taken into consideration with regard to storage:
- Do not store the product outdoors.
- Store the product in a dry, dust-free place.
- Protect the product against mechanical impacts.
- Protect the product against exposure to direct sunlight.

ATTENTION!
Risk of property damage in case of improper storage!
The product may be damaged.
- Comply with storage instructions.

7. Installation

DANGER!
Hazardous machine state
Failure to comply poses risk of fatal injury!
- No hazardous motions must be possible during installation, electrical connection and initial start-up.
- It is important to ensure that the OSSDs of the ESPE have no impact on the machine during installation, electrical connection and initial start-up.

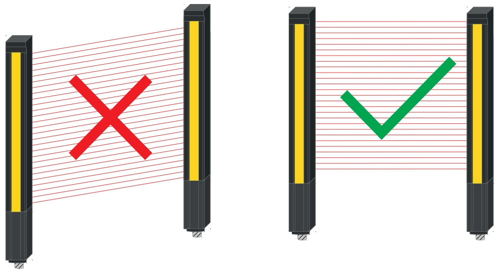
DANGER!
Risk of safety device failure
If this warning is not observed, body parts and people to be protected may not be detected.
In order to ensure that the safety light curtain fulfills its safety function reliably, the following requirements must be met through structural measures:
- It must not be possible to reach over, reach under, reach around or move the safety light curtain.
- The arrangement of the emitter and receiver must ensure that persons or body parts are reliably detected if they enter the danger zone.
- If it is possible for persons to be located between the safety field and the danger area, additional safety measures must be implemented (e.g. restart inhibit).
- When installing the safety light curtain, it must be taken into account that the safety field width must not change when the safety light curtain is active.
- Only mounting elements recommended by wenglor may be used for installation.

DANGER!
Risk of safety device failure
Persons or body parts may not be detected or not detected in time if the instruction is not followed.
- The danger zone must be secured so that it is not possible to reach over, reach under, reach around or side-step.
- Observe the calculated minimum distances for the ESPE.

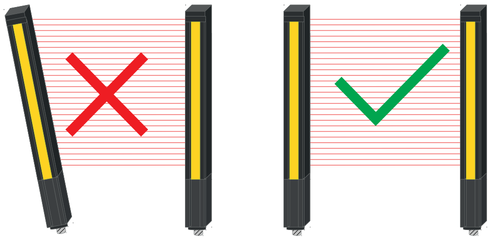
7.1 Positioning the ESPE

The following points must be observed when aligning the ESPE:

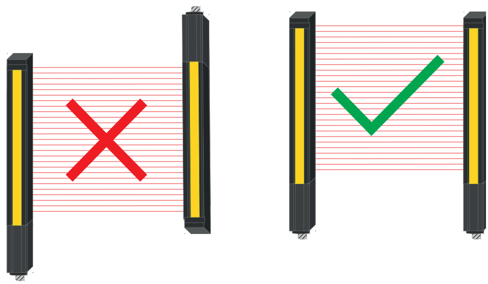
Same mounting height
- The emitter and receiver must be mounted parallel to each other and at the same mounting height.



Parallel alignment
- The emitter and receiver must be mounted so that a rectangular safety field is formed.

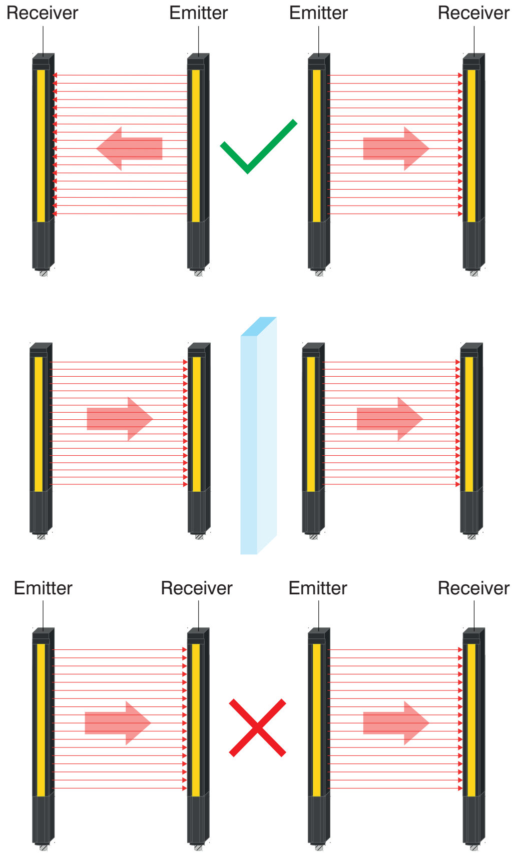


Same alignment in relation to each other
- The plug connectors of the emitter and receiver must point in the same direction.
- They must not be installed turned 180° away from each other.



Multiple systems must not influence each other

- With multiple systems, it is important to ensure that a receiver is only reached by the light from the corresponding emitter.
- This can be guaranteed with the following measures:
  - Anti-parallel arrangement (see Fig.)
  - Shielding (e.g. with dividing walls, see Fig.)
  - Minimum distance at the side = 2 × m (see “5.1.4 Minimum Clearance to Reflective Surfaces” on page 48)
  - Different beam coding (see “5.2.3.4 Beam Coding” on page 53)



7.2 Installation with Mounting Bracket

- Protect the product from contamination during installation.
- Observe all applicable electrical and mechanical regulations, standards, and safety rules.
- Protect the product against mechanical influences.
- Make sure that the sensor is mounted in a mechanically secure fashion.
- Specified torque values must be complied with (see "4.1 General Technical Data" on page 15).
- Use suitable mounting technology in order to ensure correct installation (see "4.5 Housing Dimensions, Mounting Technology" on page 21).

ATTENTION!
Risk of property damage in case of improper installation!
The product may be damaged.
- Comply with installation instructions.

7.2.1 Installation with Mounting Bracket ZEFX001

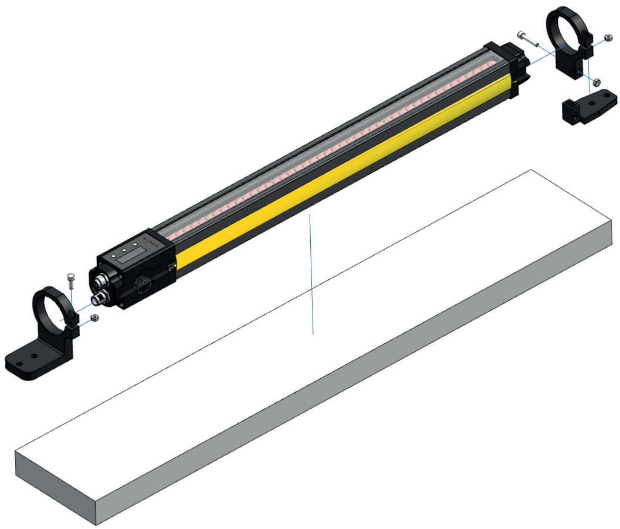


Figure 30: Installation with ZEFX001

7.2.2 Installation with Mounting Bracket ZEFX002

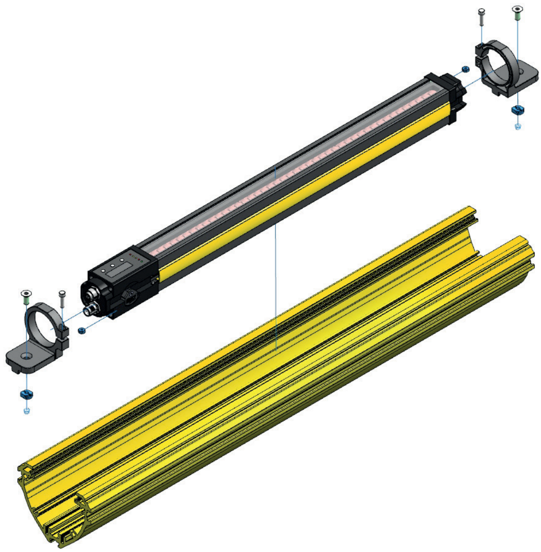


Figure 31: Installation with ZEFX002

7.2.3 Installation with Mounting Bracket ZEFX003

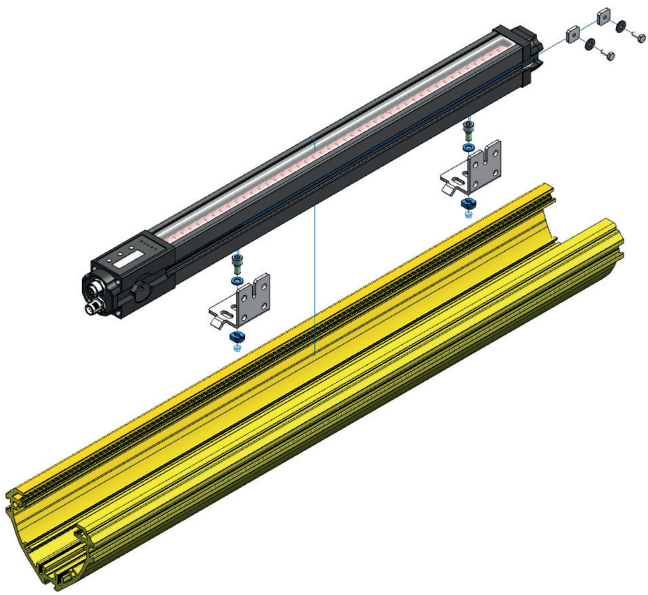


Figure 32: Installation with ZEFX003

7.2.4 Installation with Mounting Bracket ZEMX001

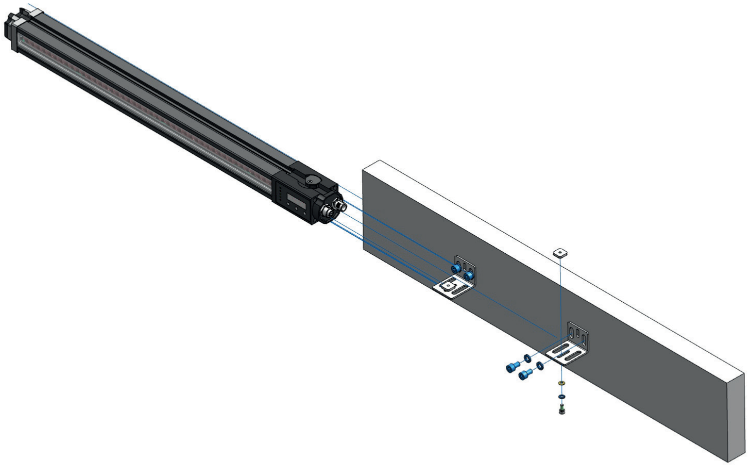


Figure 33: Installation with ZEMX001

7.2.5 Warning Strips

- Both the emitter and the receiver of the ESPE have a yellow warning strip in a side groove on both sides.
- If mounting is to take place over the side groove (see section 7.2.2, page 112, section 7.2.3, page 112, section 7.2.4, page 113), the warning strip must be removed at the relevant point.
- Please proceed as follows to remove the warning strip:
  - Position a small screwdriver at the end of the warning strip and lever it carefully out of the groove.
  - When removing, ensure that no components of the ESPE are damaged to guarantee correct function.
  - To mount the warning strip, position it on the bottom end of the groove and click it in until it has engaged over the entire length of the safety field.
- During this process, ensure that the profile, control panel, indicator lamp or glass are not damaged mechanically.

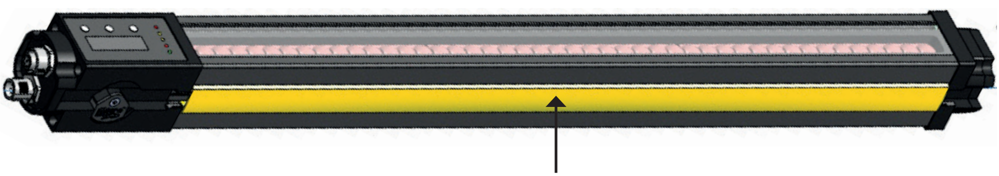


Figure 34: Yellow warning strip

8. Electrical Connection

DANGER!
Hazardous machine state
Failure to comply poses risk of fatal injury!

- No hazardous motions must be possible during installation, electrical connection and initial start-up.
- It is important to ensure that the OSSDs of the ESPE have no impact on the machine during installation, electrical connection and initial start-up.

DANGER!
Risk of safety device failure
Failure to comply poses risk of fatal injury!

- Disconnect the machine from the power supply while carrying out the electrical installation! The machine could start up unintentionally while you are connecting the sensors.
- Both OSSD must be incorporated separately in the machine work circuit. They must not be connected with each other, as signal reliability cannot be guaranteed in this case.
- The downstream safe control must be able to process both OSSD signals separately.

NOTE!
Functional earth can be optionally connected.

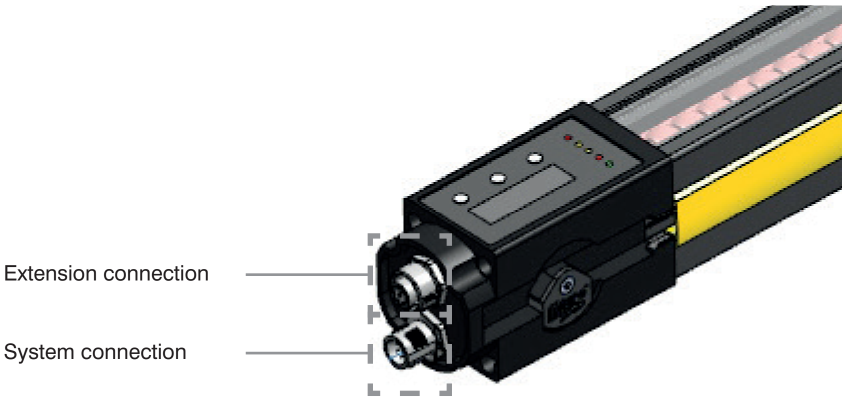
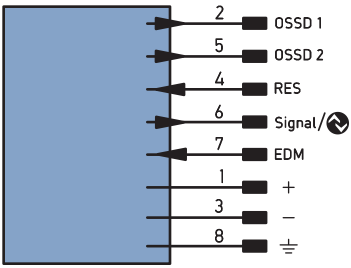


Figure 35: Connection assignment receiver

System connection

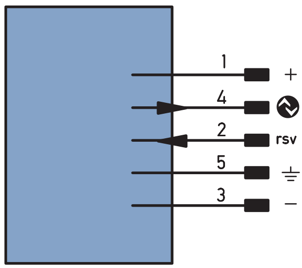
Receiver

1029



Emitter

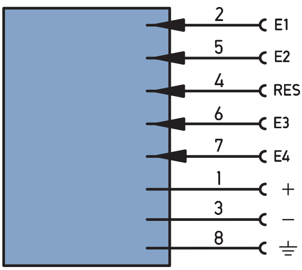
1031



Expansion connection

Receiver

1030



E1 (MS3 / belt stop / Full Muting Enable / cascading)
E2 (MS4 / Muting Enable / cascading)
E3 (MS1)
E4 (MS2)
RES / Override

NOTE!
Pin 1 and Pin 3 on the extension connection are only intended for supplying muting sensors or cascaded receivers (see EN 61496-1, Paragraph 7 a).

The inputs of the extension connection have the following assignment with muting connection box ZFBB001:

Input	Input E1	Input E2	Input E3	Input E4	Input E5
Function	MS3 / MS3 / belt stop / Full Muting Enable / cascading	MS4 / MS4 / Muting Enable / cas-cading	MS1	MS2	RES / override
Port connection box ZFBB001	Port 1	Port 3	Port 2	Port 4	Port 6
Cross muting	Belt stop* or Full Muting Enable*	Muting enable*	Muting sensor	Muting sensor	Acknowledg-ment RES and override
Two sensor linear muting	Belt stop* or Full Muting Enable*	Muting enable*	Muting sensor	Muting sensor	Acknowledg-ment RES and override
Four sensor linear muting	Muting sensor	Muting sensor	Muting sensor	Muting sensor	Acknowledg-ment RES and override

*Optional

Legend

+	Supply Voltage +	
−	Supply Voltage 0 V	
~	Supply Voltage (AC Voltage)	
A	Switching Output	(NO)
Ā	Switching Output	(NC)
V	Contamination/Error Output	(NO)
V̄	Contamination/Error Output	(NC)
E	Input (analog or digital)	
T	Teach Input	
Z	Time Delay (activation)	
S	Shielding	
RxD	Interface Receive Path	
TxD	Interface Send Path	
RDY	Ready	
GND	Ground	
CL	Clock	
E/A	Output/Input programmable	
	IO-Link	
PoE	Power over Ethernet	
IN	Safety Input	
OSSD	Safety Output	
Signal	Signal Output	
BI_D+/-	Ethernet Gigabit bidirect. data line (A-D)	
EN0RS422	Encoder 0-pulse 0-0̄ (TTL)	

PT	Platinum measuring resistor
nc	not connected
U	Test Input
Ū	Test Input inverted
W	Trigger Input
W −	Ground for the Trigger Input
O	Analog Output
O −	Ground for the Analog Output
BZ	Block Discharge
AMV	Valve Output
a	Valve Control Output +
b	Valve Control Output 0 V
SY	Synchronization
SY−	Ground for the Synchronization
E+	Receiver-Line
S+	Emitter-Line
⏚	Grounding
SnR	Switching Distance Reduction
Rx+/−	Ethernet Receive Path
Tx+/−	Ethernet Send Path
Bus	Interfaces-Bus A(+)/B(–)
La	Emitted Light disengageable
Mag	Magnet activation
RES	Input confirmation
EDM	Contactor Monitoring

ENARS422	Encoder A/Ā (TTL)
ENBRS422	Encoder B/B̄ (TTL)
ENA	Encoder A
ENB	Encoder B
AMIN	Digital output MIN
AMAX	Digital output MAX
AOK	Digital output OK
SY In	Synchronization In
SY OUT	Synchronization OUT
OLT	Brightness output
M	Maintenance
rsv	reserved

Wire Colors according to IEC 60757

BK	Black
BN	Brown
RD	Red
OG	Orange
YE	Yellow
GN	Green
BU	Blue
VT	Violet
GY	Grey
WH	White
PK	Pink
GNYE	Green/Yellow

9. Parameters Configuration

9.1 General

The parameters configuration of the ESPE can be carried out via:
- Keys on the emitter (see section 9.3, page 117) and receiver (see section 9.4, page 120)
- IO-Link interface (see section 9.5, page 149)

The following applies invariably:
- Parameter configuration is only possible after the password has been entered.
- The parameter configuration on the sensor has priority over parameter configuration via IO-Link.
- The OSSDs are off during parameter configuration.
- If no key input or input via the IO-Link interface is registered for 300 s, the sensor switches to a safe state.
- The last selected setting resets contradictory settings.

NOTE!
- Changes to the configuration may only be made by authorized personnel.
- The required password must be managed with suitable security.

9.2 Preparation of the Parametrization

Before carrying out a new parameter configuration for an ESPE, the following preparations must be made:
- All new settings (e.g. contactor monitoring, range, beam coding, …) must be planned and documented beforehand.
- A check must be carried out to ensure correct mounting and electrical connection of the ESPE.

9.3 Parametrization of the Emitter

The parameter configuration directly on the sensor takes place via the push buttons on the control panel.

Emitter	
Menu down	Apply
⏷	⏹

NOTE!
If the parameter configuration is interrupted (e.g. due to an interruption in the power supply), this causes the newly selected settings to be lost. In this case, the most recently saved settings are active.

9.3.1 Default Settings

Function	Default settings
Beam coding	Coding OFF
Range	High range

9.3.2 Calling up the Menu (User Level "Admin")

- The configuration menu can be called up from the RUN mode, as well as from error mode.
- To prevent unintentional parameter configurations, the call-up of the configuration menu is divided into the following steps:
  1. Press and hold the "Menu down" key (▼) until the red "ERROR" LED goes out. (approx. 2 s)
  2. Release the key and wait until the red "ERROR" LED lights up again. (approx. 2 s)
  3. As soon as the red "ERROR" LED lights up, press and hold the "Menu down" key (▼) again until the red "ERROR" LED goes out. (approx. 2 s)
  4. Once the button is released, the settings will be called up (see section 9.3.4, page 119).

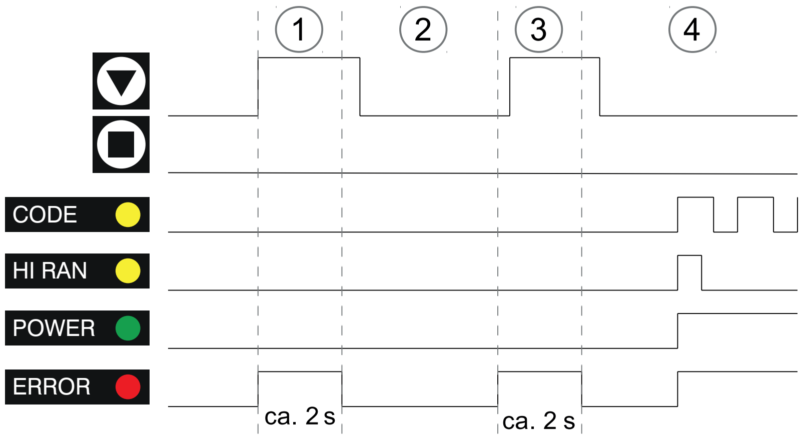
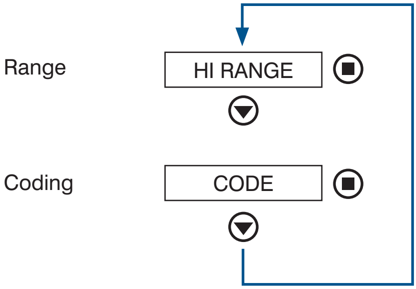


Figure 36: Timing diagram emitter for calling up the menu

9.3.3 Menu Structure

The menu is laid out as follows:



9.3.4 Parametrization of the Range and Coding

- The “Menu down” key (▼) can be used to switch between the two settings (range/coding).
- The “Apply” key (■) changes the setting within the menu item:
  - – Range: Switch between low range and high range,
  - – Coding: Switch between coding ON and coding OFF.
- The current set parameter configuration is indicated by different flashing frequencies:

	Display during parameter configuration	Meaning	Display during operation
High Range	Flashing, duty cycle 15 % LED on LED off	Low range	HI RAN
	Flashing, duty cycle 85 % LED on LED off	High range	HI RAN
CODE	Flashing, duty cycle 15 % LED on LED off	Coding OFF	CODE
	Flashing, duty cycle 85 % LED on LED off	Coding ON	CODE

- To apply the settings, both keys ([menu down ▼] and [apply ■]) must be pressed at the same time until the red “ERROR” LED goes out (approx. 2 s).
- By way of acknowledgment, all LEDs light up at the same time before the final setting is shown according to the status displays (section 11.1.1, page 157).
- If no acknowledgment takes place, the settings are dismissed and the most recent saved setting is applied again.

NOTE!
- When setting the beam coding, the parameters must be configured on both the emitter and receiver (see section 9.4.6, page 127).
- To deactivate the beam coding, it must be deactivated on both the emitter and receiver (see section 9.4.6, page 127).

9.4 Parametrization of the Receiver

The parameter configuration directly on the sensor takes place via the push buttons on the control panel.

Receiver		
Menu down	Menu up	Apply
		

NOTE!
- If the parameter configuration is interrupted (e.g. due to an interruption in the power supply), this causes the newly selected settings to be lost. In this case, the most recently saved settings are active.
- To save changes to the parameter configuration permanently, the save function (see section 9.4.12, page 148) must be used to write them to the device memory via RUN → SAVE. Otherwise, the changes will be lost when the device is restarted.
- If parameters configuration is started from an error state, all settings are reset (see section 9.3.1, page 118).

9.4.1 Default Settings

Function	Default settings
Restart inhibit	Off (safety operating mode / automatic restart)
Contactor Monitoring	Off
Beam coding	Off
Cascading	Off
Muting	Off
Blanking	Off (full resolution)
Resolution	Full
When muting is activated:	
Muting duration	300 s
Belt stop function	Off
Muting enable	Off
Direction setting	Off

Muting end through clearing of the ESPE	Off
Partial muting	Off
Full Muting Enable	Off
Gap suppression	Off
Override	Off
Display and expert menu:	
Display	Energy saving mode
Signal output	Acknowledgment prompt restart inhibit
Indicator lamp	All (muting and OSSD status)
Password protection	active, 0000

9.4.2 Calling up the Menu (User Level "Admin")

- The configuration menu can be called up from the RUN mode, as well as from error mode.
- To prevent unintentional parameter configurations, the call-up of the configuration menu is divided into the following steps:

1. Press and hold the "Menu down" key (▼) until the red "ERROR" LED goes out. (approx. 2 s)
2. Release the key and wait until the red "ERROR" LED lights up again. (approx. 2 s)
3. As soon as the red "ERROR" LED lights up, press and hold the "Menu down" key (▼) again until the red "ERROR" LED goes out. (approx. 2 s)
4. Once the button is released, the user is taken to the password menu (PASS).

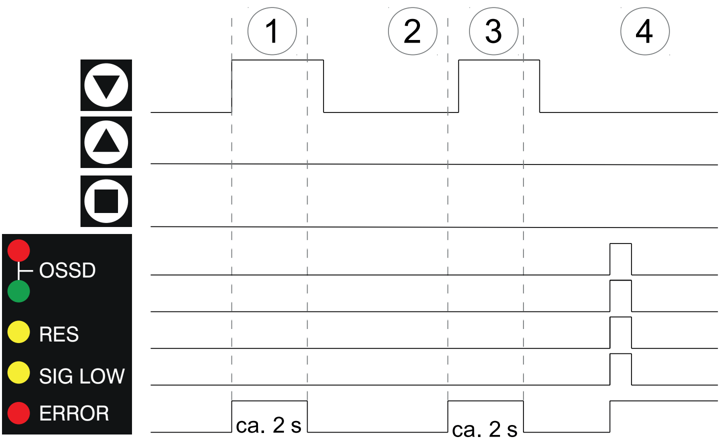
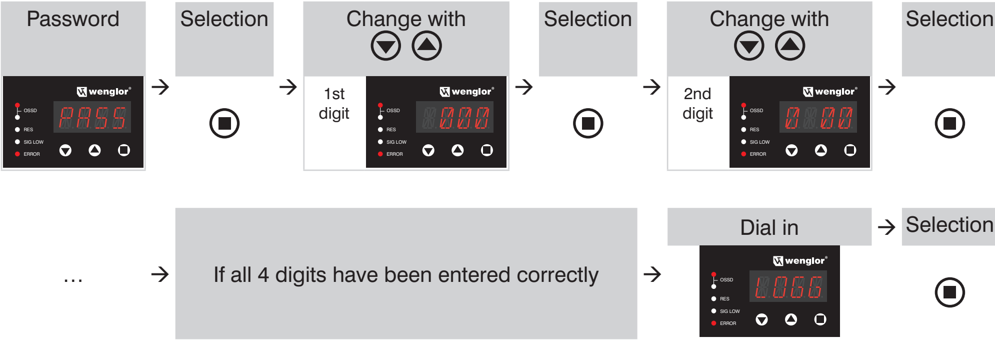


Figure 37: Timing diagram receiver for calling up the menu

Password menu:

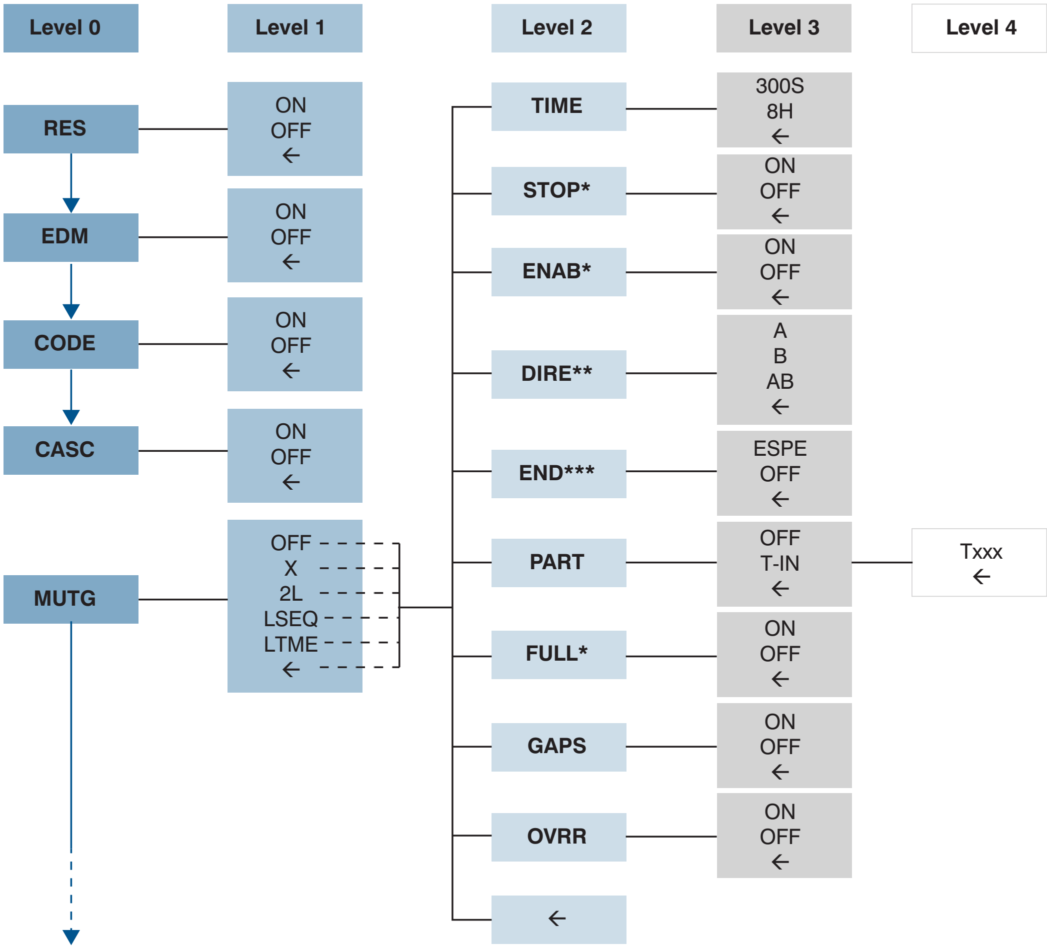
- The current selected digit flashes.



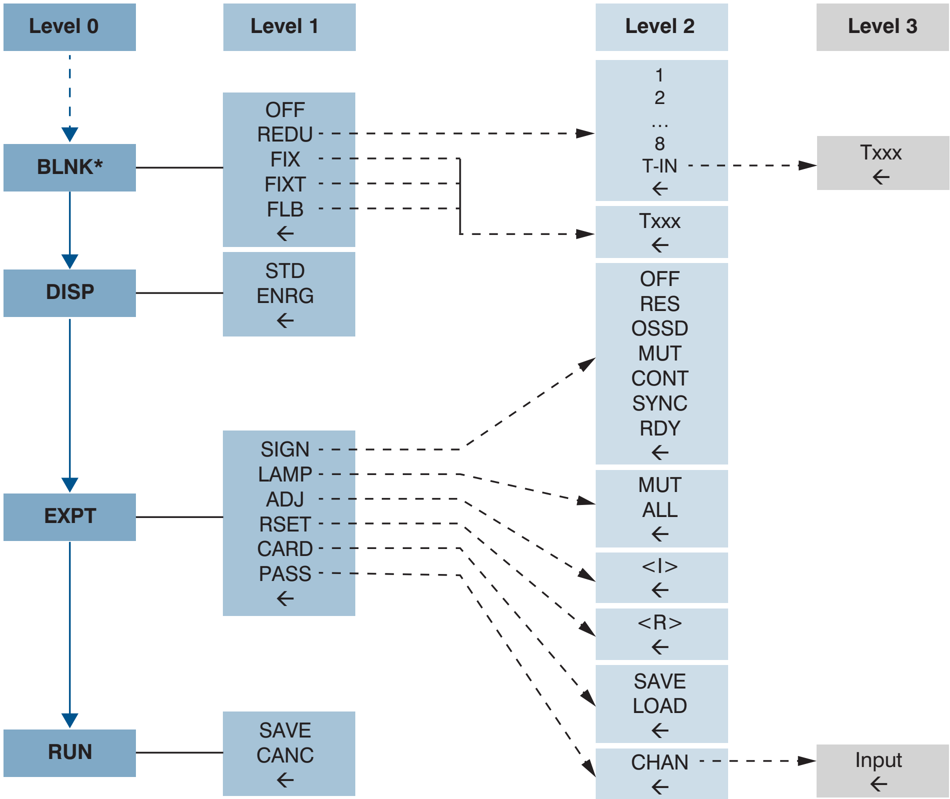
5. Once the password has been entered correctly, the user is taken directly to the main menu (for details on the menu structure, see section 9.4.3, page 122)

9.4.3 Menu Structure

- The complete menu is shown below with the possible settings within the different levels.
- The push buttons (menu down, menu up) can be used to navigate within a menu level.
- The apply key is used to make the desired menu selection and switch to the subordinate menu level (level 1, level 2, level 3, level 4).
- For details on carrying out the parameter configuration for the individual functions, see section 9.4.4, page 125 to section 9.4.12, page 148.



RES	Restart inhibit	**X**	Cross muting	**TIME**	Muting duration	**300S**	300 seconds
EDM	Contactor monitoring	**2L**	Two sensor linear muting	**STOP**	Belt stop	**8H**	8 hours
CODE	Beam coding	**LSEQ**	Four sensor linear muting (sequence monitoring)	**ENAB**	Muting enable	**A**	Direction setting A
CASC	Cascading	**LTME**	Four sensor linear muting (time monitoring)	**DIRE**	Direction settings	**B**	Direction setting B
MUTG	Muting			**END**	Muting end through clearing of the ESPE	**AB**	Direction setting AB
				PART	Partial muting	**ESPE**	Muting end through clearing of the ESPE
ON	Switch on	*	Not with LSEQ and LTME	**FULL**	Full Muting Enable		
OFF	Switch off	**	Not with X and 2L	**GAPS**	Gap suppression	**T-IN**	Teach-in
←	Back	***	Not with 2L	**OVRR**	Override	**Txxx**	Value display Teach-in



BLNK	Blanking
DISP	Display
EXPT	Expert Menu
RUN	Run

REDU	Reduced resolution
FIX	Fix Blanking
FIXT	Fix blanking with edge tolerance
FLB	Floating blanking
STD	Standard
ENRG	Energy saving mode
SIGN	Signal output
LAMP	Indicator lamp
ADJ	Signal strength display
RSET	Reset to default settings
CARD	Access microSD
PASS	Set password
SAVE	Save parameter configuration on the device
CANC	Reject changes

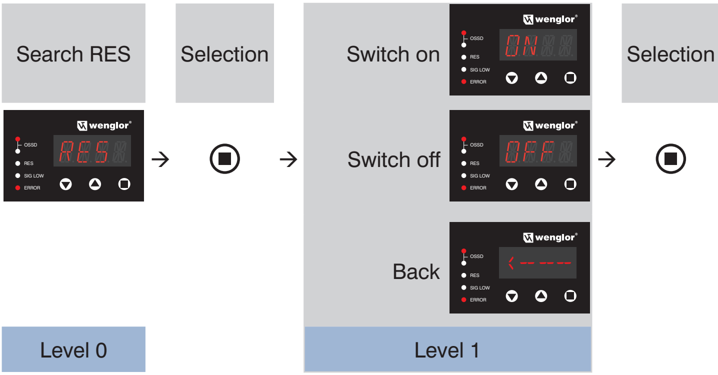
Txxx	Value input Teach-in
RES	Acknowledgment prompt
OSSD	OSSD
MUT	Muting active
CONT	Weak signal/contamination
SYNC	Synchronization run
RDY	Ready state
ALL	Muting- + OSSD display
<I>	Intensity
<R>	Reset
SAVE	Save device parameter configuration to memory card
LOAD	Copy parameter configuration from memory card to device
CHAN	Change password

OFF	Switch off
←	Back

*The blanking function is only available on the devices SEFG411-SEFG442.

9.4.4 Parametrization of the Restart Inhibit (RES)

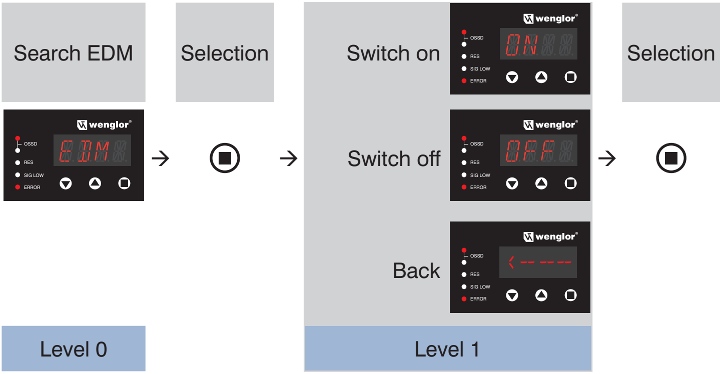
- For more information on the restart inhibit function, see Section “5.2.3.2 Start-Up Disabling and Restart Inhibit (RES)” on page 52.
- The following steps are used for activation or deactivation:



1. Acknowledge the RES mode by pressing the ■ key
2. Choose from “ON”, “OFF” and “<– – –” using the ▼ or ▲ key.
   The parameters to be selected are shown flashing.
3. Acknowledge the selection by pressing the ■ key.
4. A selected parameter is displayed for approx. 2 s, before the display switches back to the upstream level.

9.4.5 Parametrization of the Contactor Monitoring (EDM)

- For more information on the contactor monitoring function, see Section section 5.2.3.3, page 53.
- The following steps are used for activation or deactivation:



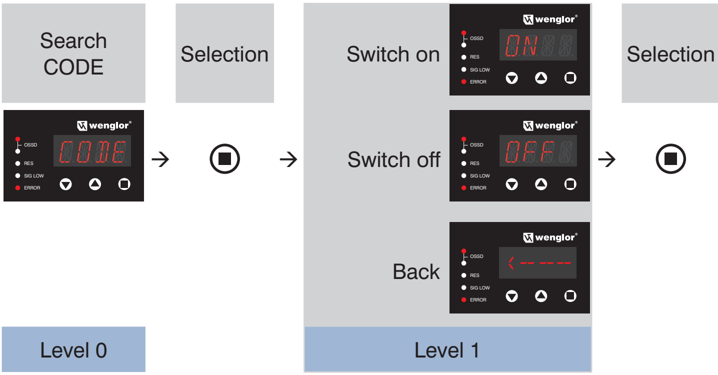
1. Acknowledge the EDM mode by pressing the key
2. Choose from “ON”, “OFF” and “<---” using the or key.

The parameters to be selected are shown flashing.

3. Acknowledge the selection by pressing the key.
4. A selected parameter is displayed for approx. 2 s, before the display switches back to the upstream level.

9.4.6 Parametrization of the Beam Coding (CODE)

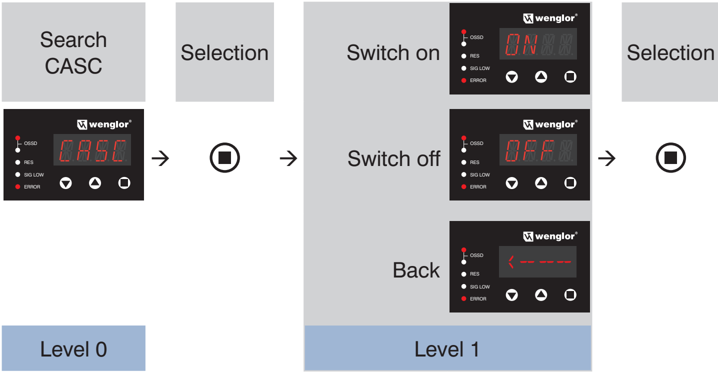
- For more information on the beam coding function (see section 5.2.3.4, page 53).
- If beam coding is used in combination with blanking operating modes and partial muting, beam coding must first be taught in. Blanking or muting objects can then be taught in during an additional parameters configuration procedure.
- The following steps are used for activation or deactivation:



1. Acknowledge the CODE mode by pressing the key
2. Choose from “ON”, “OFF” and “<---” using the or key
   The parameters to be selected are shown flashing.
3. Acknowledge the selection by pressing the key.
4. A selected parameter is displayed for approx. 2 s, before the display switches back to the upstream level.

9.4.7 Parametrization Cascading (CASC)

- For more information on the cascading function, see Section section 5.2.3.6, page 55.
- The following steps are used for activation or deactivation:



1. Acknowledge the CASC mode by pressing the ■ key
2. Choose from “ON”, “OFF” and “<---” using the ▼ or ▲ key.
   The parameters to be selected are shown flashing.
3. Acknowledge the selection by pressing the ■ key.
4. A selected parameter is displayed for approx. 2 s, before the display switches back to the upstream level.

NOTE!
Activating the cascading function deactivates:
- Four sensor linear muting,
- Muting enable,
- Belt stop,
- Full Muting Enable.

9.4.8 Parametrization Muting (MUTG)

- For more information on the muting function, see section 5.2.4, page 57.
- The following steps are used for activation or deactivation:

1. Acknowledge the MUTG mode by pressing the ■ key
2. Choose from “OFF”, “X”, “2L”, “LSEQ”, “LTME” and “<---” using the ▼ or ▲ key.
   The parameters to be selected are shown flashing.
3. Acknowledge the selection by pressing the ■ key.
4. A selected parameter is displayed for approx. 2 s, before the display switches to the next level.

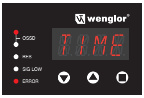
The parameter configuration of the different muting functions is described in more detail in the following sections.

NOTE!
If muting is activated (regardless of the selected muting type), restart inhibit RES is activated automatically.

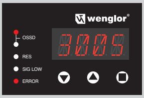
9.4.8.1 Parametrization Cross Muting (X)

- For general information on the cross muting function, see section 5.2.4.3, page 60.
- All settings under the muting function must be carried out in one go. If the cross muting menu item is called up again, the parameter configurations must be set again for the desired options.
- The following selection options are available for cross muting:

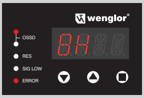
a) Timeout / muting duration



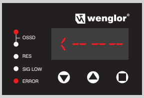
300 sec:



8 hours

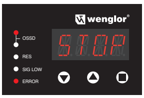


Back

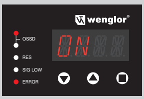


- There is a time limit on the maximum duration of an active muting sequence. There are two values to choose from.
  - 300S: Muting duration max. 300 s
  - 8H: Muting duration max. 8h
- For more information on the “muting duration” function, see section 5.2.4.7.2, page 71.

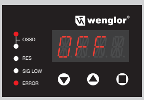
b) Belt stop



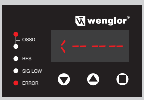
Switch on



Switch off

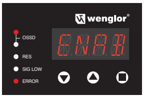


Back

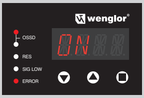


- The “belt stop” function stops the monitored muting counter for as long as a valid signal is present. This means that the muting duration can be extended in the event of process-related mal-functions.
  - ON: Belt stop activated
  - OFF belt stop deactivated
- For more information on the “belt stop” function, see section 5.2.4.7.3, page 72.

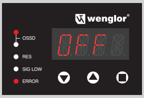
c) Muting enable



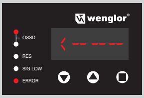
Switch on



Switch off

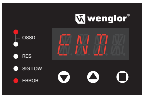


Back

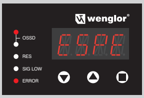


- The muting can be enabled or blocked using the external Muting Enable signal.
  - ON: Muting enable activated. The input is evaluated and is required for initiating muting.
  - OFF: Muting enable input deactivated. The input is not evaluated. Muting can be initiated via a valid sequence.
- For more information on the “Muting Enable” function, see section 5.2.4.7.4, page 73.

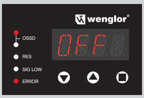
d) Muting end through clearing of the ESPE



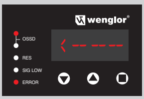
Activate



Switch off



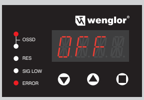
Back



- The “Muting end through clearing of the ESPE” function determines which signal initiates the end of the muting process.
  - ESPE: Muting is ended immediately after the safety field is cleared.
  - OFF: Muting is ended once the valid sequence (MS or set time) is complete
- For more information on the “Muting end through clearing of the ESPE” function, see section 5.2.4.7.6, page 74.

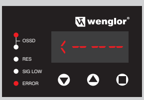
e) Partial muting

Switch off



Teach-in

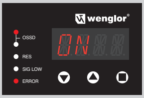
Back



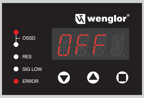
- The “partial muting” function limits the impact of muting to a partial area of the safety field.
  - OFF: No partial muting.
  - T-IN: Teach-in the relevant muting area.
    - To do this, move an object of the desired size into the safety field
    .
    - The display T000 shows the number of beams currently blocked (e.g. T004 → 4 beams)
    - 1 beam is automatically added to the actual object size at the ends of the area to increase the availability through potential tolerances.
    - If no beam was blocked during the teach process, the parameter configuration is not applied.
- For more information on the “partial muting” function, see section 5.2.4.7.7, page 75.

f) Full Muting Enable

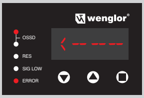
Switch on



Switch off

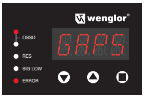


Back

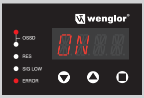


- The “Full Muting Enable” function is suitable for use, in conjunction with “partial muting”, for applications where the object height varies.
  – ON: Partial muting is lifted when a signal is applied and muting acts on the entire safety field height.
  – OFF: Partial muting is active without changes to the safety field height.
- This function should only be used if “Partial Muting” was activated beforehand.
- For more information on the “Full Muting Enable” function, see section 5.2.4.7.8, page 76.

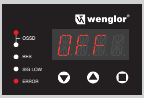
g) Gap suppression



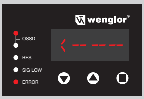
Switch on



Switch off



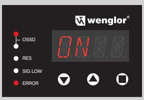
Back



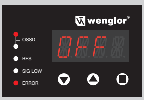
- For transport items with gaps, brief interruptions in the muting signal are to be expected. The “gap suppression” function prevents this from ending the muting function.
  – ON: The muting signals (MS1...MS4) are delayed by 250ms.
  – OFF: No delay of the muting signals
- For more information on the “gap suppression” function, see section 5.2.4.7.9, page 77.

h) Override

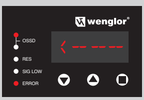
Switch on



Switch off



Back



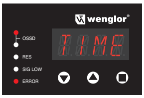
- The “override” function enables the OSSDs to be enabled if a penetration of the safety field is detected and the muting sequence is not valid.
- This can be necessary if a valid muting sequence is interrupted (due to a conveyor belt stop, for example).
  – ON: Override activated.
  – OFF: Override deactivated.
- For more information on the “override” function, see section 5.2.4.7.10, page 77.

NOTE!
- Activating the cross muting function deactivates:
  - Two sensor linear muting,
  - Foursensor linear muting,
  - Direction setting.
- Activating belt stop deactivates Full Muting Enable.
- Activating Full Muting Enable also deactivates belt stop.

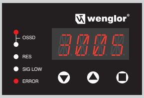
9.4.8.2 Parametrization Two Sensor Linear Muting (2L)

- For general information on the two sensor linear muting function, see section 5.2.4.4, page 63.
- All settings under the muting function must be carried out in one go. If the two sensor linear muting menu item is called up again, the parameter configurations must be set again for the desired options.
- The following selection options are available for two sensor linear muting:

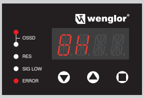
a) Timeout / muting duration



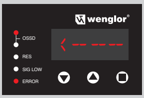
300 sec:



8 hours

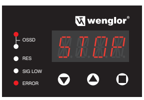


Back

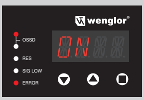


- There is a time limit on the maximum duration of an active muting sequence. There are two values to choose from.
  - 300S: Muting duration max. 300 s
  - 8H: Muting duration max. 8 h
- For more information on the “muting duration” function, see section 5.2.4.7.2, page 71.

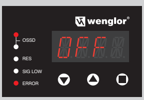
b) Belt stop



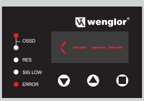
Switch on



Switch off

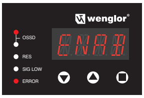


Back

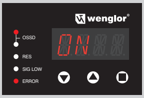


- The “belt stop” function stops the monitored muting counter for as long as a valid signal is present. This means that the muting duration can be extended in the event of process-related mal-functions.
  - ON: Belt stop activated
  - OFF belt stop deactivated
- For more information on the “belt stop” function, see section 5.2.4.7.3, page 72.

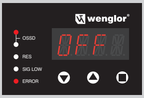
c) Muting enable



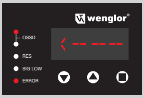
Switch on



Switch off

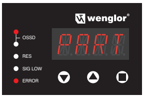


Back

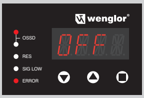


- The muting can be enabled or blocked using the external Muting Enable signal.
  - ON: Muting enable activated. The input is evaluated and is required for initiating muting.
  - OFF: Muting enable input deactivated. The input is not evaluated. Muting can be initiated via a valid sequence.
- For more information on the “Muting Enable” function, see section 5.2.4.7.4, page 73.

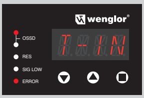
d) Partial muting



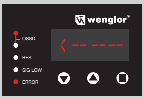
Switch off



Teach-in



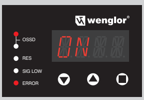
Back



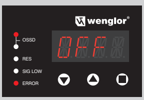
- The “partial muting” function limits the impact of muting to a partial area of the safety field.
  - OFF: No partial muting.
  - T-IN: Teach-in the relevant muting area.
    - To do this, move an object of the desired size into the safety field.
    - The display T000 shows the number of beams currently blocked (e.g. T004 → 4 beams)
    - 1 beam is automatically added to the actual object size at the ends of the area to increase the availability through potential tolerances.
    - If no beam was blocked during the teach process, the parameter configuration is not applied.
- For more information on the “partial muting” function, see section 5.2.4.7.7, page 75.

e) Full Muting Enable

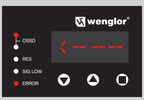
Switch on



Switch off

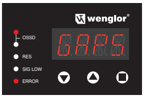


Back

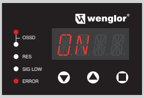


- The “Full Muting Enable” function is suitable for use, in conjunction with “partial muting”, for applications where the object height varies.
  - ON: Partial muting is lifted when a signal is applied and muting acts on the entire safety field height.
  - OFF: Partial muting is active without changes to the safety field height.
- This function should only be used if “Partial Muting” was activated beforehand.
- For more information on the “Full Muting Enable” function, see section 5.2.4.7.8, page 76.

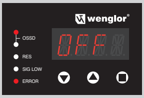
f) Gap suppression



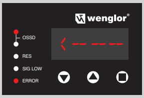
Switch on



Switch off



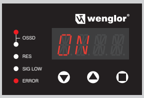
Back



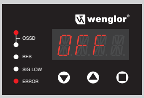
- For transport items with gaps, brief interruptions in the muting signal are to be expected. The “gap suppression” function prevents this from ending the muting function.
  - ON: The muting signals (MS1...MS4) are delayed by 250 ms.
  - OFF: No delay of the muting signals
- For more information on the “gap suppression” function, see section 5.2.4.7.9, page 77.

g) Override

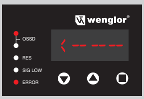
Switch on



Switch off



Back



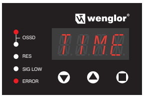
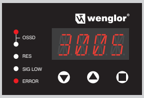
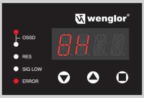
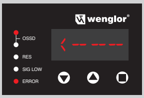
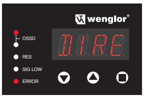
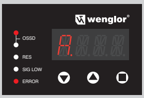
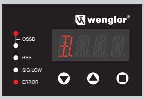
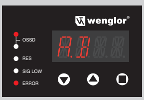
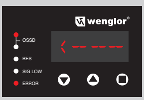
- The “override” function enables a stopped object to be removed from the muting area.
- This can be necessary if a valid muting sequence is interrupted (due to a conveyor belt stop, for example).
  - ON: Override activated.
  - OFF: Override deactivated.
- For more information on the “override” function, see section 5.2.4.7.10, page 77.

NOTE!

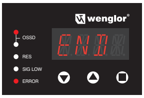
- Activating the two sensor linear muting function deactivates:
  - Cross muting,
  - Four sensor linear muting,
  - Direction setting,
  - Muting end through ESPE.
- Activating belt stop deactivates Full Muting Enable.

9.4.8.3 Parametrization Four Sensor Linear Muting with Sequence (LSEQ) or Time Monitoring (LTME)

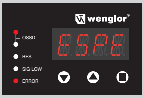
- For general information on four sensor linear muting with sequence monitoring, see section 5.2.4.5, page 65 , or section 5.2.4.6, page 68 for four sensor linear muting with time monitoring.
- All settings under the muting function must be carried out in one go. If the four sensor linear muting menu item is called up again, the parameter configurations must be set again for the desired options.
- The following selection options are available for four sensor linear muting:

a) Timeout / muting duration		
	300 sec:  8 hours  Back 	• There is a time limit on the maximum duration of an active muting sequence. There are two values to choose from. – 300S: Muting duration max. 300 s – 8H: Muting duration max. 8 h • For more information on the “muting duration” function, see section 5.2.4.7.2, page 71.
b) Direction setting		
	Direction A  Direction B  Direction AB  Back 	• The “direction setting” function specifies and checks the permissible activation sequence of the muting signals. • If an object passes through the safety field in a direction other than the one defined, the muting cycle is not initiated. – A: unidirectional – only direction A is permitted (MS1 / MS2 before MS3 / MS4) – B: unidirectional – only direction B is permitted (MS4 / MS3 before MS2 / MS1) – AB: bidirectional – both directions are permitted • For more information on the “direction setting” function, see section 5.2.4.7.5, page 74.

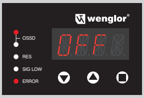
c) Muting end through clearing of the ESPE



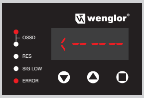
Activate



Switch off

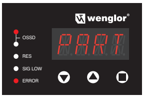


Back

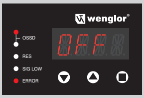


- The “Muting end through clearing of the ESPE” function determines which signal initiates the end of the muting process.
  – ESPE: Muting is ended immediately after the safety field is freed.
  – OFF: Muting is ended once the valid sequence (MS or set time) is complete.
- For more information on the “Muting end through clearing of the ESPE” function, see section 5.2.4.7.6, page 74.

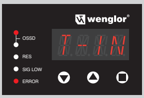
d) Partial muting



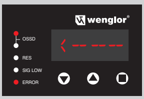
Switch off



Teach-in

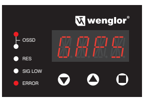


Back

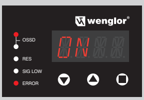


- The “partial muting” function limits the impact of muting to a partial area of the safety field.
  – OFF: No partial muting.
  – T-IN: Teach-in the relevant muting area.
    - To do this, move an object of the desired size into the safety field
.
    - The display T000 shows the number of beams currently blocked (e.g. T004 → 4 beams)
    - 1 beam is automatically added to the actual object size at the ends of the area to increase the availability through potential tolerances.
    - If no beam was blocked during the teach process, the parameter configuration is not applied.
- For more information on the “partial muting” function, see section 5.2.4.7.7, page 75.

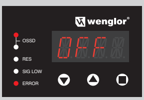
e) Gap suppression



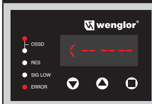
Switch on



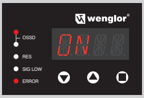
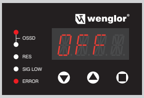
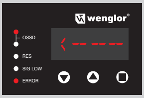
Switch off



Back



- For transport items with gaps, brief interruptions in the muting signal are to be expected. The “gap suppression” function prevents this from ending the muting function.
  – ON: The muting signals (MS1...MS4) are delayed by 250 ms.
  – OFF: No delay of the muting signals.
- For more information on the “gap suppression” function, see section 5.2.4.7.9, page 77.

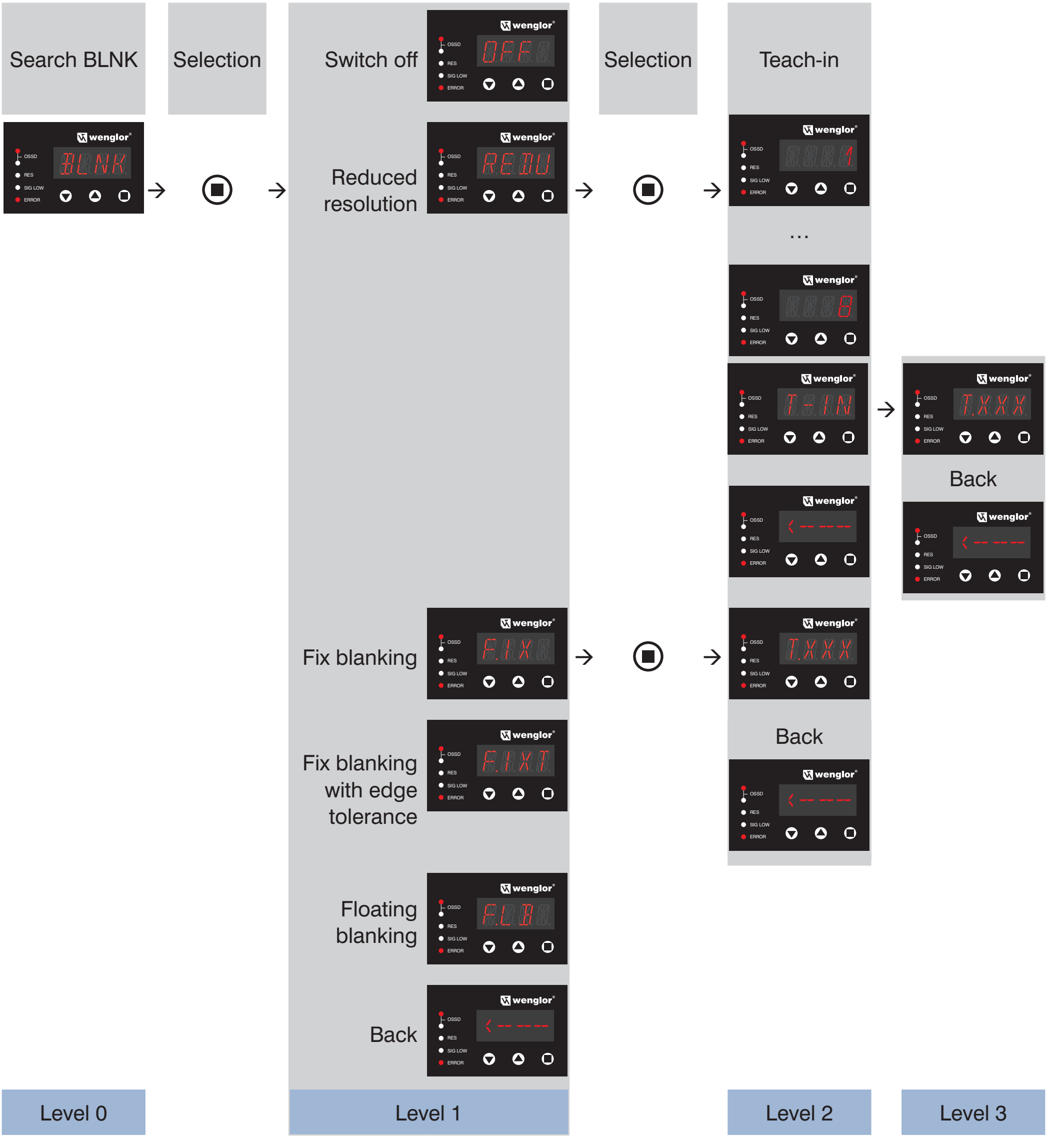
f) Override		
	Switch on 	• The “override” function enables a stopped object to be removed from the muting area. • This can be necessary if a valid muting sequence is interrupted (due to a conveyor belt stop, for example). – ON: Override activated. – OFF: Override deactivated. • For more information on the “override” function, see section 5.2.4.7.10, page 77.
	Switch off 	
	Back 	

NOTE!

- Activating the four sensor linear muting function deactivates:
  – Cross muting,
  – two sensor linear muting,
  – Muting enable
  – Belt stop
  – Full Muting Enable.

9.4.9 Parametrization Blanking (BLNK)

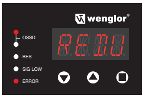
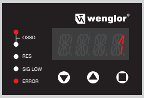
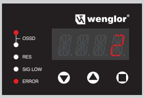
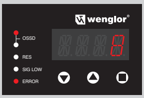
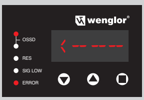
- For general information on the blanking function, see section 5.2.5, page 79.
- The following steps are used for activation or deactivation:



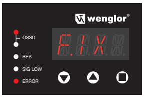
1. Acknowledge the BLNK mode by pressing the ⏹ key
2. Choose from “OFF”, “REDU”, “FIX”, “FIXT”, “FLB” and “<---” using the ▽ or △ key. The parameters to be selected are shown flashing.
3. Acknowledge the selection by pressing the ⏹ key.
4. A selected parameter is displayed for approx. 2 s, before the display switches to the next level (level 2).
   Exception: If blanking is deactivated (OFF), the display switched back to level 0.
5. In the following level (level 2), the object(s) are taught-in or the display switches back.

NOTE!
The blanking function is only available on the devices SEFG411-SEFG442.

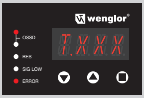
The parameter configuration of the different blanking functions is described in more detail in the following table:

a) Reduced resolution		
	Teach-in …  Back 	• The reduced resolution can be parameterized in two ways: – Teach-in – Direct selection of the beams to be reduced • When the T-IN function is selected, parametrization is performed by teaching in potential obstructions. These obstructions must be brought into the safety field during the teach-in process. • Pressing the ⏹-key teaches in the highest value recorded during the teach-in process. • The values “T999” and “T000” are invalid (e.g.: synchronization beams blocked). • The teach value (display T0xx) corresponds to the maximum object size blocked (e.g. T002 → 2 beams blocked) • This value must be used for calculating the effective resolution and the safety clearance. • Activating reduced resolution deactivates partial muting and Full Muting Enable. • For more information on the “reduced resolution” function, see section 5.2.5.5, page 96.

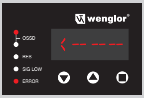
b) Fix blanking



Teach-in

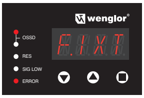


Back



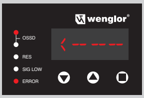
- The parameter configuration takes place by teaching in the blanking objects. These obstructions must be brought into the safety field during the teach-in process.
- The current value is taught-in by pressing the ■-key.
- The values “T999” and “T000” are invalid (e.g.: synchronization beams blocked).
- Here, the teach value (display Txxx) corresponds to the number of blocked beams (e.g. T002 → 2 beams blocked)
- This value must be used for calculating the effective resolution and the safety clearance.
- For more information on the “fix blanking” function, see section 5.2.5.2, page 81.

c) Fix blanking with edge tolerance



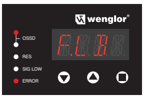
Teach-in

Back



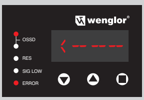
- The parameter configuration takes place by teaching in the blanking objects. These obstructions must be brought into the safety field during the teach-in process.
- The current value is taught-in by pressing the ■-key.
- The values “T999” and “T000” are invalid (e.g.: synchronization beams blocked).
- Here, the teach value (display Txxx) corresponds to the number of blocked beams (e.g. T002 → 2 beams blocked)
- This value must be used for calculating the effective resolution and the safety clearance.
- For more information on the “fix blanking with edge tolerance” function, see section 5.2.5.3, page 84.

d) Floating blanking



Teach-in

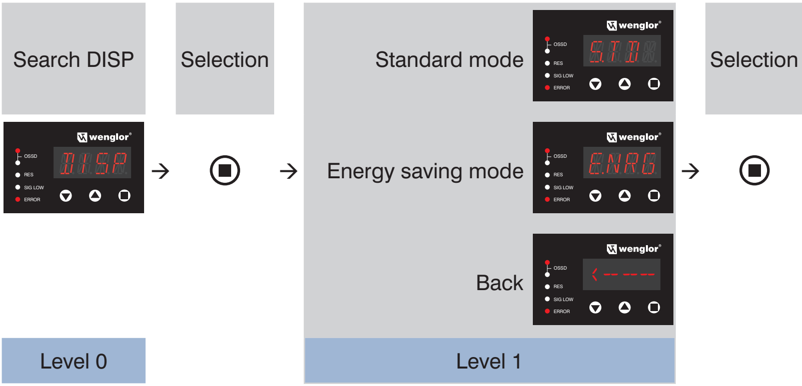
Back



- The parameter configuration takes place by teaching in the blanking objects. These obstructions must be brought into the safety field during the teach-in process.
- Pressing the ■-key teaches in the highest value recorded during the teach-in process.
- The values “T999” and “T000” are invalid (e.g.: synchronization beams blocked).
- The teach value (display TXYY) shows:
  - x: number of blocked objects
  - yy: the maximum tolerance
  - e.g. T102 → 1 object, 2 beam tolerance.
- The value for the tolerance must be used for calculating the effective resolution and the safety clearance.
- For more information on the “floating blanking” function, see section 5.2.5.4, page 89.

9.4.10 Setting the Display (DISP)

- The display can be operated in either standard mode or energy saving mode.
- The setting is carried out in the following steps:

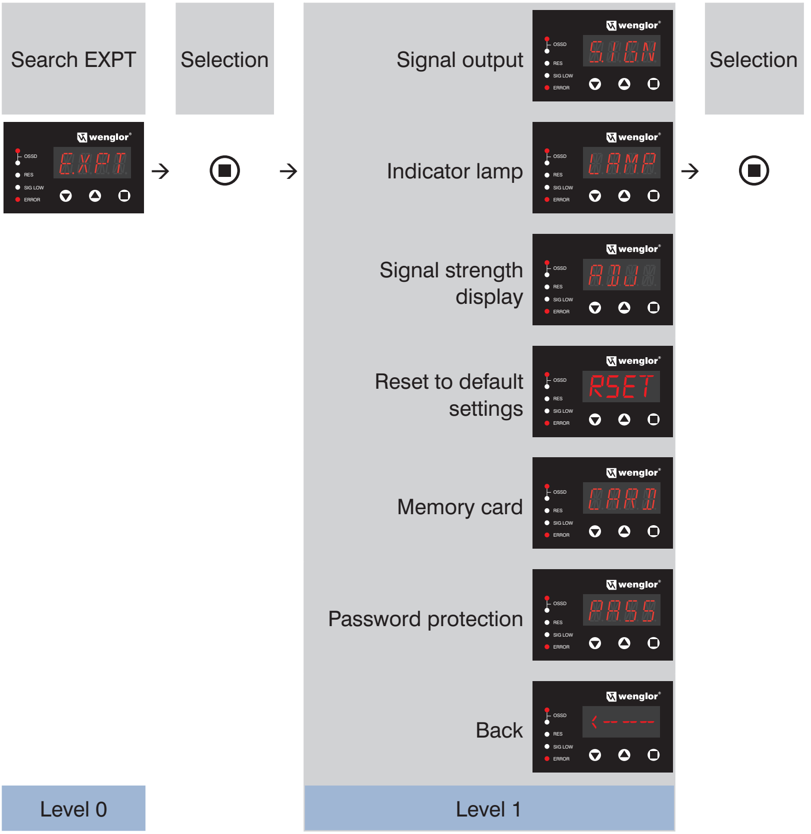


1. Acknowledge the DISP mode by pressing the (■) key
2. Choose from “STD”, “ENRG” and “<---” using the (▼) or (▲) key.
   The parameters to be selected are shown flashing.
3. Acknowledge the selection by pressing the (■) key.
4. A selected parameter is displayed for approx. 2 s, before the display switches to the next level (level 2).

For more information on the “Setting the Display” function, see section “5.2.6.2 Display Settings” on page 101.

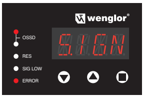
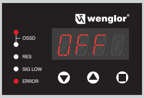
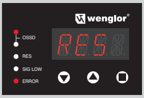
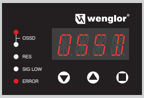
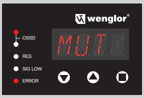
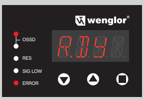
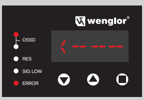
9.4.11 Expert Menu (EXPT)

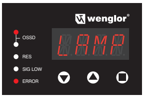
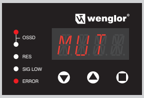
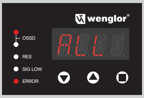
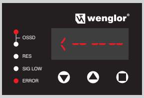
- Advanced settings can be made in the expert menu.
- The setting is carried out in the following steps:

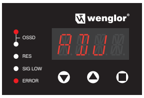
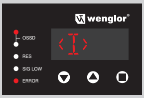
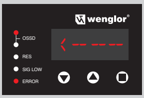


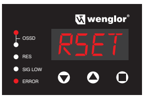
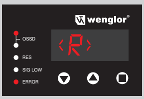
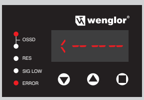
1. Acknowledge the EXPT mode by pressing the key
2. Choose from “SIGN”, “LAMP”, “ADJ”, “RSET”, “CARD”, “PASS” and “<---” using the or key.
   The parameters to be selected are shown flashing.
3. Acknowledge the selection by pressing the key.
4. A selected parameter is displayed for approx. 2 s, before the display switches to the next level (level 2).

The parameter configuration of the different expert settings is described in the following table:

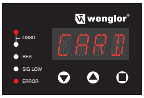
a) Signal output		
	**Deactivate** 	• Pin 6 of the IO-Link output is on the system connection of the receiver. If IO-Link communication is not active, this output can alternatively be used as a signal output. – OFF: Output deactivated – RES: Acknowledgment prompt – OSSD: OSSD switching states – MUT: Muting status – CONT: Contamination warning – SYNC: Synchronous run – RDY: Signals that the ESPE is ready for operation. • For more information on the signal output, see section 5.2.6.3, page 101.
	Acknowledgment prompt 	
	OSSD 	
	Muting 	
	Weak signal/ contamination 	
	Synchronous run 	
	Ready for operation 	
	Back 	

b) Indicator lamp		
	Muting 	• The parameters for the integrated indicator lamp function can be configured by selecting LAMP. – MUT: Muting state display. – ALL: Muting and OSSD state display. • For more information on the indicator lamp, see section 5.2.6.4, page 102.
	Muting+OSSD 	
	Back 	

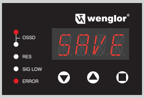
c) Signal strength display		
	Beam intensity 	– <I> stands for signal strength intensity. – The setting can be canceled via "<– – –". After the ESPE is switched on, the signal strength is displayed for 30 s as standard. • For more information on the signal strength, see section 5.2.6.5, page 102.
	Back 	

d) Reset to default setting / reset		
	Reset 	• Selecting "RSET" takes the user to the reset menu. – <R>: Reset to default setting – The reset process can be canceled via "<– – –". • For more information on the default setting, see section 9.4.1, page 120.
	Cancel 	

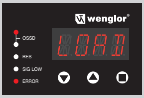
e) Memory card



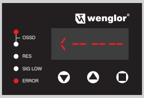
Save



Load



Back

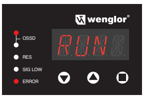
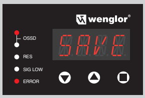


- If a memory card is inserted, the following options are available:
  - SAVE: Saves the parameter configuration most recently saved in the sensor memory to the memory card (see section 9.4.12, page 148).
    → **ATTENTION:** It is not the current set parameter configuration that is saved!
  - LOAD: The parameter configuration for the memory card is written to the sensor memory.
    → **ATTENTION:** A loaded parameter configuration must first be saved in the device memory (see section 9.4.12, page 148).
- The correct procedure for using the memory card is outlined below.
- Warning messages may appear when accessing the SD card (see section 13.3.4, page 172).
- For more information on the memory card, see section 5.2.6.6, page 103.

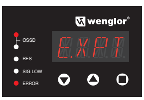
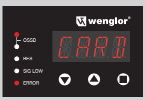
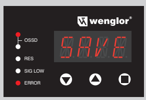
Save

- The most recent parameter configurations saved in the sensor memory are saved to the memory card using the following steps:

1. Save the desired parameter configuration in the sensor memory:

Run		Selection		Save parameter configuration		Selection
	→	⏹	→		→	⏹
Level 0				Level 1		

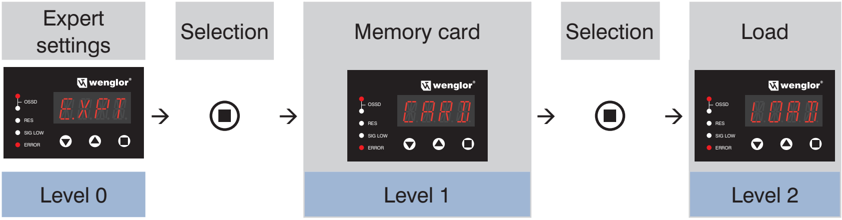
2. ESPE carries out a restart.
3. Select the menu again.
4. Transfer the sensor parameter configuration to the memory card:

Expert settings		Selection		Memory card		Selection		Memory
	→	⏹	→		→	⏹	→	
Level 0				Level 1				Level 2

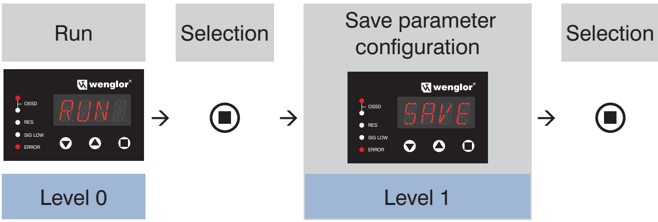
Load

- The parameter configuration saved on the memory card is loaded using the following steps:

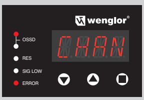
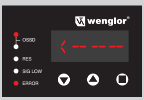
1. Load the parameter configuration from the memory card:



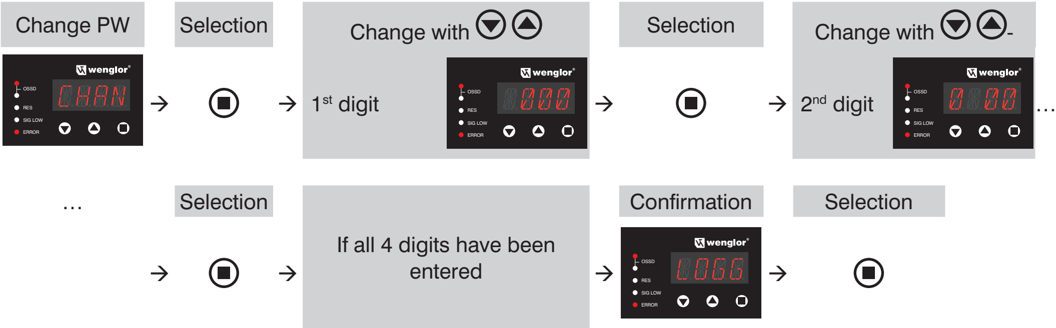
2. Save the loaded parameter configuration to the sensor memory:



3. ESPE carries out a restart.

f) Password protection		
	Change PW  Back 	• This setting can be used to change the current valid password. • The correct procedure for changing the password is outlined below. • For more information on password protection, see section 5.2.6.7, page 105.

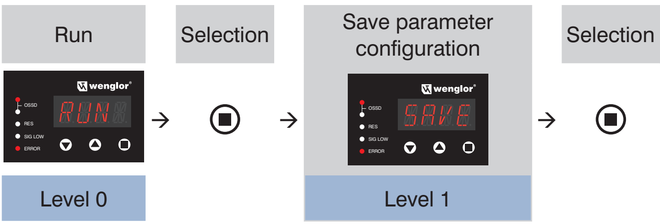
To change the password, proceed as follows:



9.4.12 Saving the Configuration and Restart (RUN)

NOTE!
Changes to the sensor parameter configuration are only saved if the selected parameter configuration was saved via the menu selection “Run” → “Save”. Otherwise, the changes will be lost when the sensor is restarted.

To save the parameter configuration, proceed as follows:



1. Acknowledge the RUN mode by pressing the (■) key
2. Choose from “SAVE”, “CANC” and “<---” using the (▼) or (▲) key.
3. Acknowledge the selection by pressing the (■) key.
4. “SAVE” writes the current parameter configuration to the sensor memory.
   ”CANC” cancels the saving process.
5. The ESPE carries out a restart after both a save and cancel action.
   The restart is indicated by a moving segment in the 4th digit.

9.5 Parametrization via the IO-Link Interface

9.5.1 Requirements and Framework Conditions

The following requirements must be met to parametrize the ESPE via IO-Link:
- The system connection of the ESPE is connected to the IO-Link master via the T-plug (ZC7G001).
- The IO-Link master is equipped with the latest software version.
- The current IODD (device description file) for the ESPE used is present and available in the master.
- Master and ESPE are connected with each other (online).

NOTE!
The latest versions of the software, IODD and the interface protocol are available on the wenglor homepage in the download area for the product.

If the connection is successful, the following operating displays are shown during the parameter configuration via IO-Link (see section 11.1.1, page 157 and section 11.1.2, page 158):

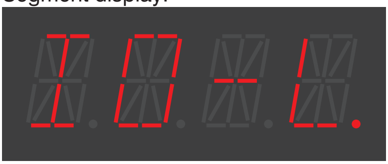
Emitter

Display		External parametrization
1	POWER	LED lit
2	CODE	LED off
3	HI RAN	LED off
4	ERROR	LED blinks

Receiver

Display		External parametrization
1	OSSD 1 (LED 1, red)	LED lit
	OSSD 2 (LED 2, green)	LED off
2	RES	LED off
3	SIG LOW	LED off
4	ERROR	LED flashes

Segment display:



Digit 1 Digit 2 Digit 3 Digit 4

NOTE!
The parameter configuration on the control panel (see section 9.3, page 117, section 9.4, page 120) always has priority over setting via IO-Link.

9.5.2 Process Data

The following process data is output cyclically by the ESPE:

Process data	Description	
OutputState	Output status of the ESPE 8 bit encrypted	
InputState	Status of the inputs (RES, EDM, MS1- MS4, cascading) 8 bit encrypted	
	Parameter set A **Measuring function** (see section 5.2.6.1, page 99)	**Parameter set B** **Muting** (see section 5.2.4, page 57)
A:LBB / B:SensorTime S1-S2	Last blocked beam LBB 0 – no beam blocked 1…x – beam number (from the control panel) 255 – receiver not in synchronous run	Time for status change between MS1-MS2 0…250 in 0.1 s
A:FBB / B:SensorTime S3-S4	First blocked beam FBB 0 – no beam blocked 1…x – beam number (from the control panel) 255 – receiver not in synchronous run	Time for status change between MS3-MS4 0…250 in 0.1 s
A:NBB / B:MutingTime HighByte	Number of blocked beams NBB 0 – no beam blocked 255 – receiver not in synchronous run	Muting duration 0…28800 in s 65535 – muting is not active
A:NCBB / B:MutingTime LowByte	Number of cumulated blocked beams (biggest group) NCBB 0 – no beam blocked 255 – receiver not in synchronous run	
A:NOBJ / B:MutingState	Number of objects NOBJ 255 – receiver not in synchronous run	0 – no status message / not active 1...n – numerical value of the muting codes (see section 13.3.3, page 171)
Device State	ESPE status 0 – no errors 1 – parametrization on the device 2 – parametrization via IO-Link 10…255 – error codes (see section 13.3.2, page 168)	

9.5.3 Parameter Data

NOTE!
- To prevent impermissible or unintentional changes to the ESPE, a password must be entered to carry out a parameter configuration (see section 5.2.6.7, page 105).
- Setting parameter data requires user level "Admin".
- There is only one password for the ESPE, regardless of whether the setting takes place on the control panel or via IO-Link.

The following parameters can be set and/or read:

Device settings	
Block device access	Block parameter settings via IO-Link (regardless of the password)
PasswordParamEntry	4-digit password must be entered to start the parameter configuration
ParamEnd	This parameter must be set and saved to apply the parameter in the memory of the ESPE
PasswordChange	Change the password
Ident	Information on the parameter set of the ESPE
Basic settings	
Operation Mode	Full resolution, reduced resolution, fix blanking (with/without tolerance), floating blanking
Function Mode	Beam coding, RES, EDM, cascading
Muting Settings	Selection of the muting type and setting of the muting parameters
Display settings	
Display.Mode	Standard or energy saving mode
Display-Advanced-Screen	The current display on the 4-digit segment display on the receiver is shown
Expert settings	
SignalOutput	Parameter configuration of the signal output function with inactive IO-Link communication
Lamp	Parameter configuration of the indicator lamp function
AdjustSignal	Display the signal strength 0 – no synchronization 1…4 – signal strength level
FactoryReset	Reset to default settings
SD-Card	Save or load from the microSD card
IO-Link process data	Choose from parameter set A or B (process data)
Beam settings	
Beam.Mode	Parametrized safety field status (saved in ESPE)
Beam.State	Current safety field status
Diagnosis	
ErrorCode	Display of the relevant error code (see section 13.3.2, page 168)

NOTE!

- Due to the different dependencies between the functions, it is not possible to make block changes to parameters. **This means that each parameter must be written individually to the ESPE.**
- When changing a parameter, the data should be loaded again so that all changes are visible for any other parameters (marked in color depending on the master).
- For examples of parameter configuration, see section 9.5.4, page 152.

9.5.4 Examples for Setting the Parameter Data

Example 1: Cross muting is to be parametrized

Starting point:

- ESPE parameter configuration as per delivery state
- ESPE is positioned and installed correctly with the correct electrical connection
- Cross muting with muting end through ESPE is to be parametrized

1. Password entry

- PasswordParamEntry: “0000” (current password) → “write”
- ESPE enters parametrization mode (see above for operating display)
- Parameters can be changed and saved

2. Set muting type

- Change muting mode from “No” to “X” → write
- Right-click → reload or update by other means
- Dependencies are shown (e.g. Restart Inhibit changes from “False” to “True”)

3. Carry out other muting settings

- Set “End” (muting end through clearing of the ESPE) to “true” → write

4. Write parameters to ESPE

- Set ParamEnd to “Save and Restart” → write

5. Restart ESPE

- ESPE restarts automatically and the parameter configuration is applied
- The ESPE then switches to normal operation (due to the set RES, the RES-LED flashes on the receiver and the OSSDs are switched.

The following procedure must be followed for changing the parameter configuration via IO-Link

1. Reset memory parameters, as block writing is not possible

- ParamEnd “Save + Restart” → delete or update

2. Password entry

- PasswordParamEntry: “0000” (current password) → “write”.
- ESPE enters parametrization mode (see above for operating display).
- Parameters can now be changed and saved.

3. Carry out changes and save as outlined above.

Example 2: Fix blanking is to be parametrized (Teach-in)

Starting point:
- ESPE parameter configuration as per delivery state.
- ESPE is positioned and installed correctly with the correct electrical connection.
- Fix blanking is to be parametrized.

1. Password entry
- PasswordParamEntry: “0000” (current password) → “write”
- ESPE enters parametrization mode (see above for operating display).
- Parameters can be changed and saved.

2. Set the operating mode
- Set Operation Mode to “Fix Blanking” → “write”.

3. Teach-in the blocked area
- Set Param.TeachIn to “Start” → write.
  - Bring the desired object into the safety field.
  - The number of beams currently blocked is shown in Param.TeachIn.Value (update display if necessary).
  - Move the object until the position, size and number of taught-in beams correspond to the final set-up.
  - The position of the taught-in beams can also be read off from the process data via parameter set A.
- Set Paramt.Teach In to “Ok” → write

4. Write parameters to ESPE
- Set ParamEnd to “Save and Restart” → write

5. Restart ESPE
- ESPE restarts automatically and the parameter configuration is applied.
- The ESPE then enters normal operation.

9.5.5 Data Storage

- For functional safety reasons, the devices have no data storage function.
- All parameters are saved in the ESPE or can be saved on the microSD card.

10. Initial Start-Up

DANGER!
Hazardous machine state

- No hazardous motions must be possible on the machine during installation, electrical connection and initial start-up.
- It is important to ensure that the OSSDs of the ESPE have no impact on the machine during installation, electrical connection and initial start-up.

DANGER!
Risk of safety device failure

- Before the initial start-up of the machine, ensure that it has been checked and approved by a qualified person.
- The machine may only be commissioned with functioning ESPE.

10.1 Overview

The following requirements must be met to start the initial start-up:

- The project engineering has been completed successfully (see section 5, page 36)
- The installation has been completed successfully (see section 7, page 108)
- The electrical connection has been completed successfully (see section 8, page 114)
- The parameter configuration has been completed successfully (see section 9, page 117)
- For operating modes and functions involving teach-in processes, the parameter configuration can only take place following switch-on and alignment.

The initial start-up is divided into the following steps:

- Switch on the ESPE,
- Align the ESPE,
- Check the parameter configuration,
- Check for initial start-up.

10.2 Switching On

Procedure:

- Switch on the power supply.
- The emitter and receiver are initialized automatically.
- All LEDs (for emitter and receiver) light up briefly at the same time.
- Following the initialization, the following operating displays can be read off:

Emitter

- Current parameter configuration (see section 11.1.1, page 157)

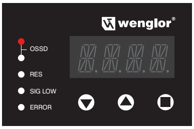
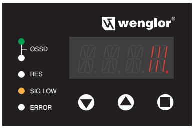
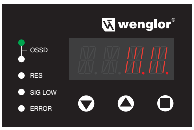
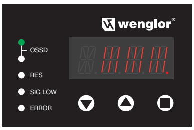
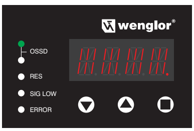
Receiver

- LEDs: Status indicators (see section 11.1.2, page 158)
- Segment display:
  - Signal strength for 30 s after switch-on (see section 5.2.6.5, page 102)
  - SYNC item following successful synchronization
  - Warning messages where applicable (see section 13.3.1, page 167)

10.3 Aligning the Emitter and Receiver

The signal strength is shown on the segment display for easy alignment of the emitter and receiver. This feature is active automatically for 30 s after switch-on.
During parameters configuration, the display can be shown for a lengthy period of time (up through timeout) (see section 9.4.11, page 143). The signal strength should be as high as possible to ensure safe operation and avoid unnecessary process interruptions.

The signal strength display is divided into five levels:

Display	Meaning	Explanation
	Too weak	• Receiver not detecting any emitter beams • No synchronization possible • OSSDs are not activated → Alignment must be improved to commission the ESPE.
	Weak	• Signal strength is weak. • Synchronization takes place (SYNC point) • LED SIG LOW lights up • OSSDs can be activated → Improve the alignment to avoid unintentional switching due to contamination, for example.
	Medium	• Signal strength is adequate with a small reserve for changes (e.g. contamination, alignment) • Synchronization takes place (SYNC point) • OSSDs can be activated → If possible, improve the alignment further to achieve higher process reliability.
	Good	• Signal strength is good with a medium reserve for changes (e.g. contamination, alignment) • Synchronization takes place (SYNC point) • OSSDs can be activated → If possible, improve the alignment further to achieve higher process reliability.
	Very good	• Signal strength is very good • Synchronization takes place (SYNC point) • OSSDs can be activated The optimal alignment for high process reliability has been achieved.

Procedure

1. Installation has been carried out correctly (see section 7, page 108).
2. Alignment takes place with a free safety field while monitoring the LEDs and segment display.
3. Loosen the mounting so that the ESPE can only just be moved.
4. Align the emitter and receiver until the highest possible signal strength is shown.
5. Tighten the mounting so that the ESPE can no longer be adjusted. The tightening torques for the different mounting components must be observed.

NOTE!
wenglor offers a suitable laser alignment tool Z98G001 to make a reliable alignment easier even with large distances (see section 4.9.11, page 35).

10.4 Checking for Initial Start-up

- The described tests are intended to confirm compliance with national / international safety regulations.

NOTE!
- Regulations governing operator induction by specialist personnel must be observed before work is commenced.
- The company which operates the machine is responsible for training.
- A test body with 14 or 30 mm depending on the resolution of the ESPE must be used for initial start-up. For applications with reduced resolution, test bodies with 24 or 34 mm can also be used for initial start-up. (see EN 61496-1, Para. 7f)

- First of all, a check must be carried out to determine whether the ESPE has been chosen correctly according to the local regulations and whether it offers the necessary protection when used as intended.
- The effectiveness of the ESPE in all operating modes available on the machine must then be checked.
- The check takes place according to the checklist for initial start-up (see section 16.1.1, page 173)

The check must be carried out in the following cases:
- Before the initial start-up,
- After changes have been made on the machine,
- After extended machine downtimes,
- Following modifications or repairs on the machine.

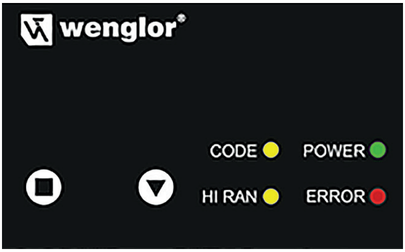
DANGER!
- It is important to ensure that no one is endangered during initial start-up of the machine. There must be no persons located in the danger zone.
- Work on the machine must be immediately stopped if any impairment of the safety function is detected. Once the situation has been resolved, the effectiveness of the ESPE must be checked again according to the checklist (see section 16.1.1, page 173).

11. Operation

11.1 Operating Display

Information on the status of the ESPE is output via the operating displays.
For diagnostic information for the ESPE, see section 13, page 166.
Status and diagnostic information can also be read out for IO-Link. Relevant information can be found in the interface protocol of the ESPE.

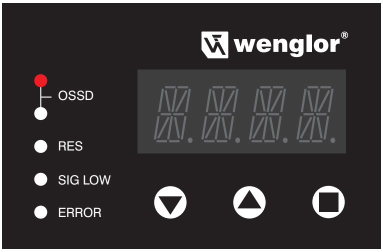
11.1.1 Operating Displays Emitter



The following status displays can be read off in normal operation:

Display				Explanation
1	POWER	LED off	POWER	Sensor is off
		LED lit	POWER	Sensor is on
2	CODE	LED off	CODE	Coding OFF
		LED lit	CODE	Coding ON
3	HI RAN (High Range)	LED off	HI RAN	Low range
		LED lit	HI RAN	High range
4	ERROR	LED off	ERROR	No errors
		LED lit	ERROR	Active error(s)

11.1.2 Operating Displays Receiver



The following status displays can be read off in normal operation:

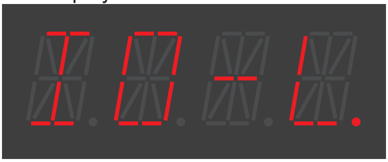
Display				Explanation
1	OSSD	LED 1 lit, LED 2 off	OSSD	The OSSDs are in OFF state
		LED 1 off, LED 2 lit	OSSD	The OSSDs are in ON state
2	RES	LED off	RES	No acknowledgment required
		LED blinks	RES	Restart inhibit set, OSSDs off, no penetration detected, no acknowledgment signal detected.
3	SIG LOW	LED off	SIG LOW	All beams are detected according to the selected operating mode, no beam has a weak signal. With OSSDs OFF, SIG LOW is also always OFF.
		LED lit	SIG LOW	All beams are detected according to the selected operating mode, but at least one beam has a weak signal.
4	ERROR	LED off	ERROR	No active errors
		LED lit	ERROR	Active error(s)

Segment display

The following information is shown in the segment display:

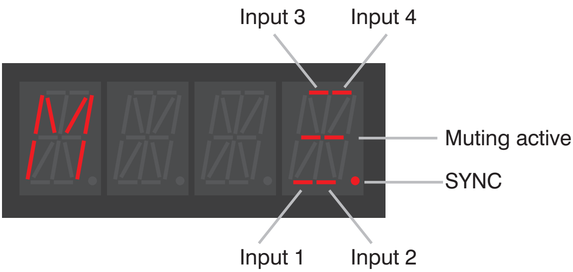
- Signal strength for 30 s after switch-on (see section 5.2.6.5, page 102),
- SYNC item following successful synchronization,
- Display of the active inputs during muting,
- Display of muting messages (see section 13.3.3, page 171),
- Warning messages where applicable (see section 13.3.1, page 167).

The display is laid out as follows:

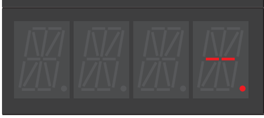


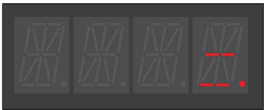
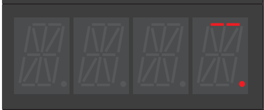
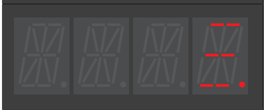
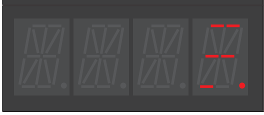
Status displays during muting

If muting is parametrized, information on the current muting sequence and diagnostic information can be read off the segment display.
This information is shown as follows:



The following rules apply:
- M in the first digit indicates that a muting error is present. The meaning of the error is indicated by a code in the following digits.
- The fourth digit shows the current muting status.
- For explanations of the diagnostic codes, see section 13.3.3, page 171.

Meaning of the displays in the fourth digit			
	E1 (MS3 / belt stop / Full Muting Enable)		E2 (MS4 / Muting Enable)
	E3 (MS1)		E4 (MS2)
	Muting active		

Examples:	
	Signal is applied on E1 and E2, muting is active. E.g.: Active four sensor muting, where the object is activating two MS
	Signal is applied on E3 and E4. e.g.: Cross muting was deactivated due to clearing of the ESPE (parametrized in ESPE), even though the object is still activating two MS.
	Signal is applied on E1, E2, E3 and E4, muting is active. E.g.: active four sensor muting, where the object is activating all four MS
	Signal is applied on E1 and E4, muting is active. e.g.: two sensor muting is active and a belt stop signal is applied. The object activates MS2.

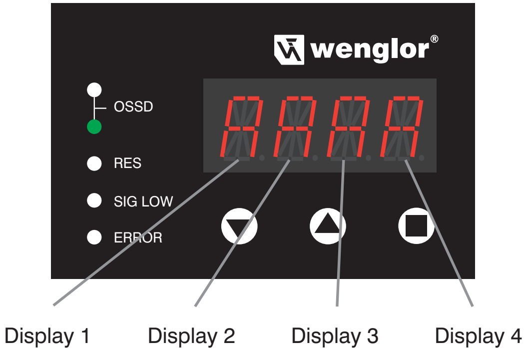
11.2 Calling Up the Current Parametrization ("Worker" User Level)

The operator can query the current parameter configuration of the ESPE during operation without entering a password.
The following procedure must be followed here:

Emitter
- The current parameter configuration can be read off via the LED displays.
- For more information on the operating displays, see section 11.1.1, page 157.

Receiver
- The current parameter configuration can be called up from the RUN mode, as well as from error mode.

The settings are called up as follows:
- Press and hold the "apply" key (■) for approx. 2 s.
- The SIG LOW-LED provides visual feedback. When the apply key is pressed, it will light up for approx. 2 seconds. The button can be released after the light goes out.
- Release the key.
- The current setting in the main menu is shown (for details of the structure, see section 9.4.3, page 122).
- The push buttons (menu down, menu up) can be used to navigate within the main menu.
- Use the apply key (■) to make the desired menu selection and switch to the subordinate menu level (for details on the navigation, see section 9.4, page 120).
- For more information on the control panel, see section 11.1.2, page 158.



Display 1 Operating functions	Restart inhibit	Contactor monitoring	Cascading	Beam coding
As displayed in the menu tree	**RES**	**EDM**	**CASC**	**CODE**
A	✗	✗	✗	✗
B	✓	✗	✗	✗
C	✗	✓	✗	✗
D	✓	✓	✗	✗
E	✗	✗	✓	✗
F	✓	✗	✓	✗
G	✗	✓	✓	✗
H	✓	✓	✓	✗
J	✗	✗	✗	✓
K	✓	✗	✗	✓
L	✗	✓	✗	✓
N	✓	✓	✗	✓
P	✗	✗	✓	✓
R	✓	✗	✓	✓
S	✗	✓	✓	✓
T	✓	✓	✓	✓

Display 2 Operating mode	Full resolution	Fix blanking	Fix blanking with edge tolerance	Reduced resolution The resolution is reduced by …	Float blanking The tolerance between the minimum and maximum object size is …
As displayed in the menu tree under BLNK	**BLNK OFF**	**FIX**	**FIXT**	**REDU**	**FLB**
A	✓	×	×	×	×
B	×	✓	×	×	×
C	×	×	✓	×	×
D	×	×	×	✓ - 1 beam	×
E	×	×	×	✓ - 2 beams	×
F	×	×	×	✓ - 3 beams	×
G	×	×	×	✓ - 4 beams	×
H	×	×	×	✓ - 5 beams	×
J	×	×	×	✓ - 6 beams	×
K	×	×	×	✓ - 7 beams	×
L	×	×	×	✓ - 8 beams	×
N	×	×	×	×	✓ - 0 beams
P	×	×	×	×	✓ - 1 beam
R	×	×	×	×	✓ - 2 beams
S	×	×	×	×	✓ - 3 beams
T	×	×	×	×	✓ - 4 beams
U	×	×	×	×	✓ - 5 beams
V	×	×	×	×	✓ - 6 beams
X	×	×	×	×	✓ - 7 beams
Y	×	×	×	×	✓ - 8 beams

Display 3	Muting mode function				Muting options		
Muting mode function	**Cross muting**	**2-sensor linear muting**	**4-sensor linear muting with sequence monitoring**	**4-sensor linear muting with time monitoring**	**Maximum long muting duration (8 hours)**	**Muting enable function**	**Belt stop function**
As displayed in the menu tree under MUTG	**X**	**2L**	**LSEQ**	**LTME**	**TIME**	**ENAB**	**STOP**
A	×	×	×	×	×	×	×
B	✓	×	×	×	×	×	×
C	✓	×	×	×	✓	×	×
D	✓	×	×	×	×	✓	×
E	✓	×	×	×	✓	✓	×
F	✓	×	×	×	×	×	✓
G	✓	×	×	×	✓	×	✓
H	✓	×	×	×	×	✓	✓
J	✓	×	×	×	×	✓	✓
K	×	✓	×	×	×	×	×
L	×	✓	×	×	✓	×	×
N	×	✓	×	×	×	✓	×
P	×	✓	×	×	✓	✓	×
R	×	✓	×	×	×	×	✓
S	×	✓	×	×	✓	×	✓
T	×	✓	×	×	×	✓	✓
U	×	✓	×	×	✓	✓	✓
V	×	×	✓	×	×	×	×
X	×	×	✓	×	✓	×	✓
Y	×	×	×	✓	×	×	×
Z	×	×	×	✓	✓	×	✓

Display 4 – Further muting options	Partial muting	Gap suppression	Muting end through clearing of the ESPE	Override function
As displayed in the menu tree under MUTG	**PART**	**GAPS**	**END**	**OVRR**
A	×	×	×	×
B	✓	×	×	×
C	×	✓	×	×
D	✓	✓	×	×
E	×	×	✓	×
F	✓	×	✓	×
G	×	✓	✓	×
H	✓	✓	✓	×
J	×	×	×	✓
K	✓	×	×	✓
L	×	✓	×	✓
N	✓	✓	×	✓
P	×	×	✓	✓
R	✓	×	✓	✓
S	×	✓	✓	✓
T	✓	✓	✓	✓

12. Servicing

DANGER!
Risk of safety device failure!
- No repairs may be carried out on the ESPE.
- No changes or manipulations may be carried out on the ESPE.

12.1 Maintenance

NOTE!
- This wenglor sensor is maintenance-free.
- The instructions for the annual (see section 12.4, page 165) and regular inspection (see section 12.3, page 167), as well as cleaning (see section 12.2, page 164) must be observed.

12.2 Cleaning

NOTE!
- The panes of the ESPE must be clean at all times. They must be free from contamination, scratches or roughening.
- Contamination of any kind has a direct impact on the signal strength of the ESPE and may result in malfunctions.

The panes may only be cleaned with the supply voltage disconnected.
It is advisable to clean the panes regularly. The frequency of the cleaning depends on the level of contamination on the system.
Cleaning takes place with a clean, soft and damp (to prevent electrostatic charge) cloth, without putting any pressure on the pane.
Do not clean the ESPE with solvents or cleaning agents which could damage the device (aggressive, abrasive, scratching).
To guarantee good and lasting legibility of the segment display, the same cleaning measures are recommended as for the panes.
After cleaning, check the function of the safety device (see section 12.3, page 167).

12.3 Regular Inspections

The described checks are intended to confirm compliance with national / international safety regulations.

NOTE!
- Regulations governing operator induction by specialist personnel must be observed before work is commenced.
- The company which operates the machine is responsible for training.

Regular inspections must be conducted by a person who has been authorized and engaged to do so by the company which operates the machine. The frequency (e.g. daily, at shift changes, etc.) must be determined based on the risk assessment for the application.
The inspection must follow the regular inspection checklist (see section 16.1.3, page 176).

DANGER!
- Work on the machine must be immediately stopped if any impairment of the safety function is detected.
- Once the situation has been resolved, the effectiveness of the ESPE must be checked again according to the checklist for initial start-up (see section 16.1.1, page 173).

NOTE!
- The supplied sticker "Instructions for regular inspections" must be mounted in a clearly visible location close to the relevant ESPE.
- Do not clean the ESPE with solvents or cleaning agents which could damage the device (aggressive, abrasive, scratching) (see section 12.2, page 164).

12.4 Annual Inspection

The described tests are intended to confirm compliance with national / international safety regulations.

NOTE!
- Regulations governing operator induction by specialist personnel must be observed before work is commenced.
- The company which operates the machine is responsible for training.

The inspection must be carried out annually or within the required deadlines according to the valid national regulations.
The check takes place according to the annual inspection checklist (see section 16.1.2, page 175)

DANGER!
- Work on the machine must be immediately stopped if any impairment of the safety function is detected.
- Once the situation has been resolved, the effectiveness of the ESPE must be checked again according to the checklist for initial start-up (see section 16.1.1, page 173).

13. Diagnosis

13.1 Performance in Case of Fault

NOTE!

- Shut down the machine.
- Analyze and remedy the cause of the error based on the diagnosis information (see section 13.2, page 166).
- If the error cannot be eliminated, contact wenglor's support department (see the wenglor homepage for contact details).

DANGER!

Risk of personal injury or property damage in case of non-compliance!

The system's safety function is disabled. Personal injury and damage to equipment may occur.

- Do not operate in case of indeterminate malfunction.
- The machine must be shut down if the error cannot be definitively explained or properly eliminated.
- Required action as specified in case of fault.

13.2 Error Indicators

13.2.1 Error Indicator on the Emitter

Display		Error					
		Parametrization not complete (timeout)		Internal error		Over/undervoltage	
1	POWER	POWER	LED off	POWER	LED off	POWER	LED lit
2	CODE	CODE	LED lit	CODE	LED off	CODE	LED off
3	HI RAN	HI RAN	LED lit	HI RAN	LED off	HI RAN	LED off
4	ERROR	ERROR	LED lit	ERROR	LED lit	ERROR	LED lit

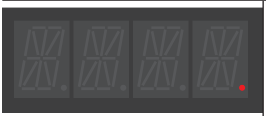
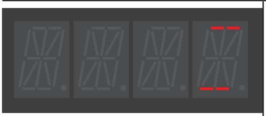
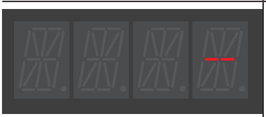
13.2.2 Error Indicator on the Receiver

Display		Error	
		According to the diagnosis code in the segment display (see section 13.3, page 167)	
1	OSSD 1 (red) OSSD2 (green)	OSSD	LED lit LED off
2	RES	RES	LED off
3	SIG LOW	SIG LOW	LED off
4	ERROR	ERROR	LED lit
Action		According to the relevant diagnosis code (section 13.3, page 167)	

13.3 Diagnosis Codes

A precise analysis of the current status of the ESPE is possible via the code on the 4-digit segment display on the receiver.
The following overviews describe the codes and measures for removing errors.

13.3.1 Codes for Information and Warnings

Code	Status	Description/cause	Measures
WED	Only initially	Contactor monitoring signal present, but EDM function is not active.	Parametrize contactor monitoring
	Always	Synchronous run (parallel to other displays)	Not required
	Always	Status display of the inputs	Not required
	Always	Status display muting	Not required

13.3.2 Codes for General Errors

Code	Affected components	Status	Description/cause	Measures
002	Emitter / receiver	Temporary, restarts after 2 s	Parameter configuration request from normal operation and error mode	
003	Emitter / receiver	Temporary, restarts after 2 s	Parameter configuration request from normal operation and error mode	
Application errors				
E010	Emitter / receiver	Temporary, restarts after 12 s	Supply voltage too low	Make supply voltage available within the specified limits
E011	Emitter / receiver	Temporary, restarts after 12 s	Supply voltage too low	Make supply voltage available within the specified limits
E012	Emitter / receiver	Permanent	Supply voltage too high	Make supply voltage available within the specified limits
E013	Emitter / receiver	Permanent	Supply voltage too high	Make supply voltage available within the specified limits
E020	Receiver	Permanent	OSSD A: Short to positive/ capacity too high	Resolve short to positive
E021	Receiver	Permanent	OSSD A: Short to positive/ capacity too high	Resolve short to positive
E022	Receiver	Permanent	OSSD A: Short to ground/ overload	Resolve short to ground
E023	Receiver	Permanent	OSSD A: Short to ground/ overload	Resolve short to ground
E024	Receiver	Permanent	OSSD B: Short to positive/ capacity too high	Resolve short to positive
E025	Receiver	Permanent	OSSD B: Short to positive/ capacity too high	Resolve short to positive
E026	Receiver	Permanent	OSSD B: Short to ground/ overload	Resolve short to ground
E027	Receiver	Permanent	OSSD B: Short to ground/ overload	Resolve short to ground
E028	Receiver	Permanent	Slave inputs: Different switch-ing status	Check slave connection, inconsistent signals
E029	Receiver	Permanent	Slave inputs: Different switch-ing status	Check slave connection, inconsistent signals

E030	Receiver	Permanent	• Contactor short to positive • Contactor does not drop • Incorrect parameter configuration	• Check the contactor function • Configure the EDM parameters correctly
E031	Receiver	Permanent	• Contactor short to positive • Contactor does not deactivate • Incorrect parameter configuration	• Check the contactor function • Configure the EDM parameters correctly
E032	Receiver	Permanent	• Contactor short to ground • Contactor does not activate • Incorrect parameter configuration	• Check the contactor function • Configure the EDM parameters correctly
E033	Receiver	Permanent	• Contactor short to ground • Contactor does not activate • Incorrect parameter configuration	• Check the contactor function • Configure the EDM parameters correctly
E040	Receiver	Permanent	Ambient light: Emitter of the same type detected	Remove the interfering emitter
E041	Receiver	Permanent	Ambient light: Emitter of the same type detected	Remove the interfering emitter
E042	Receiver	Permanent	Ambient light: Potential other cause	Check for and remove any other extraneous light sources
E043	Receiver	Permanent	Ambient light: Potential other cause	Check for and remove any other extraneous light sources
E050	Emitter / receiver	Permanent	Parametrization not complete	Repeat parametrization
E051	Emitter / receiver	Permanent	Parametrization not complete	Repeat parametrization
E052	Receiver	Permanent	Safety field: • Monitored blanking • Object too small • Incorrect parameter configuration	• Check blanking objects • Repeat parametrization
E053	Receiver	Permanent	Safety field: • Monitored blanking • Object too small • Incorrect parameter configuration	• Check blanking objects • Repeat parametrization
E054	Receiver	Permanent	Safety field: • Monitored blanking • Object too small	• Check blanking objects • Repeat parametrization
E055	Receiver	Permanent	Safety field: • Monitored blanking • Object too small	• Check blanking objects • Repeat parametrization

Internal errors				
E 1xx E 2xx	Emitter / receiver	Permanent	• Internal error	• Disconnect the power supply and restart the ESPE. • If this error occurs repeatedly, contact the wenglor support department.
E126	Receiver	Permanent	• SD card present but file is damaged	• Write SD card again and insert and load in ESPE
E127	Receiver	Permanent	• SD card present but file is damaged	• Write SD card again and insert and load in ESPE

13.3.3 Codes for Muting Errors

- The following codes are displayed until a muting cycle is initiated
- The first message to occur is always shown

Code	Description/cause	Measures
M50	Runtime error muting	Restart muting and check the sequence.
M53	Time exceeded when initiating muting	
M54	Time exceeded when initiating the second sensor pair muting	Restart muting and check the sequence. Adjust muting (type, positioning MS, muting signals) if necessary.
M55	1. Signal was present, but was withdrawn without a follow-up signal.	
M56	Signal sequence for initiating muting incorrect (for linear muting with sequence monitoring)	
M57	Incorrect order when activating the muting signals (1st/2nd signal switched)	
M58	Incorrect order when activating the muting signals (2nd/3rd signal switched)	
M59	Incorrect order when activating the muting signals (3rd/4th signal switched)	
M60	Incorrect order during deactivation 1st signal	
M61	Incorrect order during deactivation 2nd signal	
M62	Incorrect signal sequence when ending muting (signal switches incorrectly from 0 -> 1)	
M63	MUTING_ENABLE timeout	Apply Muting Enable signal for less than 300 s.
M64	MUTING_ENABLE was on 0 before the muting condition was valid.	Apply the Muting Enable signal until the muting conditions are fulfilled.
M65	Muting timeout	• Check the muting setup. • If necessary, adjust the muting properties (type, positioning MS, muting signals).
M66	The safety field was occupied when muting was deactivated.	• Check the muting setup. • If necessary, adjust the muting properties (type, positioning MS, muting signals).
M67	Penetration of the safety field before muting was activated.	• Check the muting setup. • Adjust the muting properties (type, positioning MS, muting signals) if necessary.
M75	Change to the safety field status while belt stop active.	Check the “belt stop” function and rule out manipulation.
M76	Muting sensor signals changed while belt stop active.	Check the “belt stop” function and rule out manipulation.
M77	Belt stop timeout	Apply belt stop signal for less than 8 h.
M80	Penetration into non-blocked beam during active partial muting.	Check the parameter configuration for partial muting and adjust if necessary.

M81	OSSDs are off as a result of a slave device switching off.	If the OSSDs of the slave device are switched off, the muting process is canceled on the master device.
M90	Override timeout: Max. time for static override request exceeded (is shown for as long as the override request is applied, i.e. the key is pressed).	End override requests. Generate new override request if necessary.

13.3.4 Codes when Accessing the Memory Card

Code	Description/cause	Measures
WSD0	No microSD card present.	Insert a MicroSD card in the designated memory card slot.
WSD1	No file corresponding to the ESPE present on the microSD card. Read/write access error on the microSD card.	Check the contents of the microSD card and save a new file if necessary.

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14. Decommissioning

- The sensor must be disconnected from supply power for decommissioning.
- The ESPE neither contains nor gives off any environmentally harmful substances. It consumes minimum amounts of energy and resources.

15. Proper Disposal

- wenglor sensoric GmbH does not accept the return of unusable or irreparable devices.
- Respectively valid national waste disposal regulations apply to product disposal.

16. Appendix

16.1 Checklists

16.1.1 Checklist Initial Start-up

NOTE!
- This checklist is intended to provide assistance during initial start-up.
- This checklist does not replace the checks before initial start-up, nor the regular checks on the part of specialized personnel.

Standards and guidelines; selecting the ESPE	Yes	No
Are the safety rules for the machine based on applicable standards and guidelines?		
Are the standards and directives used included in the EU declaration of conformity for the machine?		
Does the safety device correspond to the required PL (EN ISO 13849-1) / SILcl (EN 62061) from the risk assessment?		
Safety clearance	**Yes**	**No**
Was the safety clearance calculated according to applicable standards?		
Was the response time of the ESPE, the response time of any safety evaluation unit used and the over-travel time of the machine taken into account in the calculation?		
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.		
Has the safety clearance between the point of danger and the safety field been adhered to?		
Access to the point of danger	**Yes**	**No**
Is it only possible to access the point of danger via the ESPE's safety field?		
Is it assured that persons are unable to remain within the danger zone unprotected (e.g. by means of mechanical protection against side-stepping), and are the implemented measures protected against manipulation?		

Have additional mechanical protective measures been installed which prevent reaching under, over or around the safety field, and are they protected against manipulation?		
Installation	**Yes**	**No**
Have the components of the ESPE been correctly attached and secured against loosening, shifting and rotation after adjustment?		
Is the external condition of the ESPE and all associated system components flawless?		
Has the acknowledgment key for resetting the ESPE been correctly installed outside of the danger zone, and is it functional?		
Incorporation into the machine	**Yes**	**No**
Are both OSSDs incorporated in the downstream machine control?		
Does the incorporation match the circuit diagrams?		
Are the switching elements which are controlled by the ESPE (e.g. contactors, valves) monitored by EDM?		
Have the required safety measures to protect against electric shock been implemented effectively?		
Functionality	**Yes**	**No**
Is the ESPE effective during the entire duration of the machine's hazardous motion?		
When the ESPE is disconnected from the supply voltage, is the hazardous motion stopped and does the acknowledgment key need to be pressed to reset the machine after the supply voltage is restored?		
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?		
Are the specified safety functions functional in every operating mode of the machine?		
Has the safety function been tested in accordance with the inspection instructions in the operating instructions?		
Are the instructions for the regular inspection of the ESPE legible and mounted in a clearly visible position?		

DANGER!

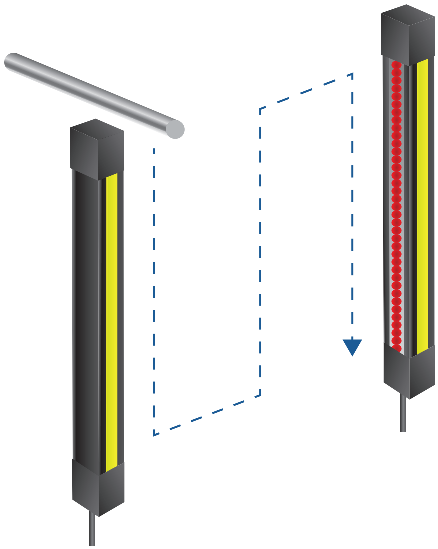
- Work on the machine must be immediately stopped if any impairment of the safety function is detected.
- Once the situation has been resolved, the effectiveness of the ESPE must be checked again according to the checklist for initial start-up (see section 16.1.1, page 173).

16.1.2 Checklist Annual Inspection

	Yes	No
Have any changes or manipulations been carried out on the machine, which could have an impact on the safety system?		
Have any changes or manipulations been carried out on the ESPE, which could have an impact on the safety system?		
The ESPE is connected correctly to the machine.		
Has the response time of the machine (incl. ESPE) increased compared with the initial start-up?		
Cables, plugs and mounting are in flawless condition.		

DANGER!
- Work on the machine must be immediately stopped if any impairment of the safety function is detected.
- Once the situation has been resolved, the effectiveness of the ESPE must be checked again according to the checklist for initial start-up (see section 16.1.1, page 173).

16.1.3 Regular Inspection Checklist

	Yes	No
The ESPE is free from visible damage.		
The lens cover is not scratched or contaminated.		
The danger zone is only be accessible via the ESPE's safety field.		
Cables, plugs and mounting are in flawless condition.		
Checking the effectiveness of the ESPE: • The check may only be conducted if the hazardous motion has been switched off. • Testing must be conducted with a test rod, and not by reaching in with the hand. • Test rod diameter: in accordance with ESPE resolution		
Checking the "safety operating mode (automatic start-up)" function: • The OSSD ON display must light up before testing is started. • Pass the test rod through the entire safety field as shown in the figure. • The OSSD OFF display must be lit up as long as the test rod is in the safety field.		
Testing the "restart inhibit" function: • The RES display must flash before testing is started. • Pass the test rod through the safety field as shown in the figure. • The OSSD OFF display must be lit up as long as the test rod is in the safety field. • The RES display may not light up as long as the test rod is in the safety field. 		

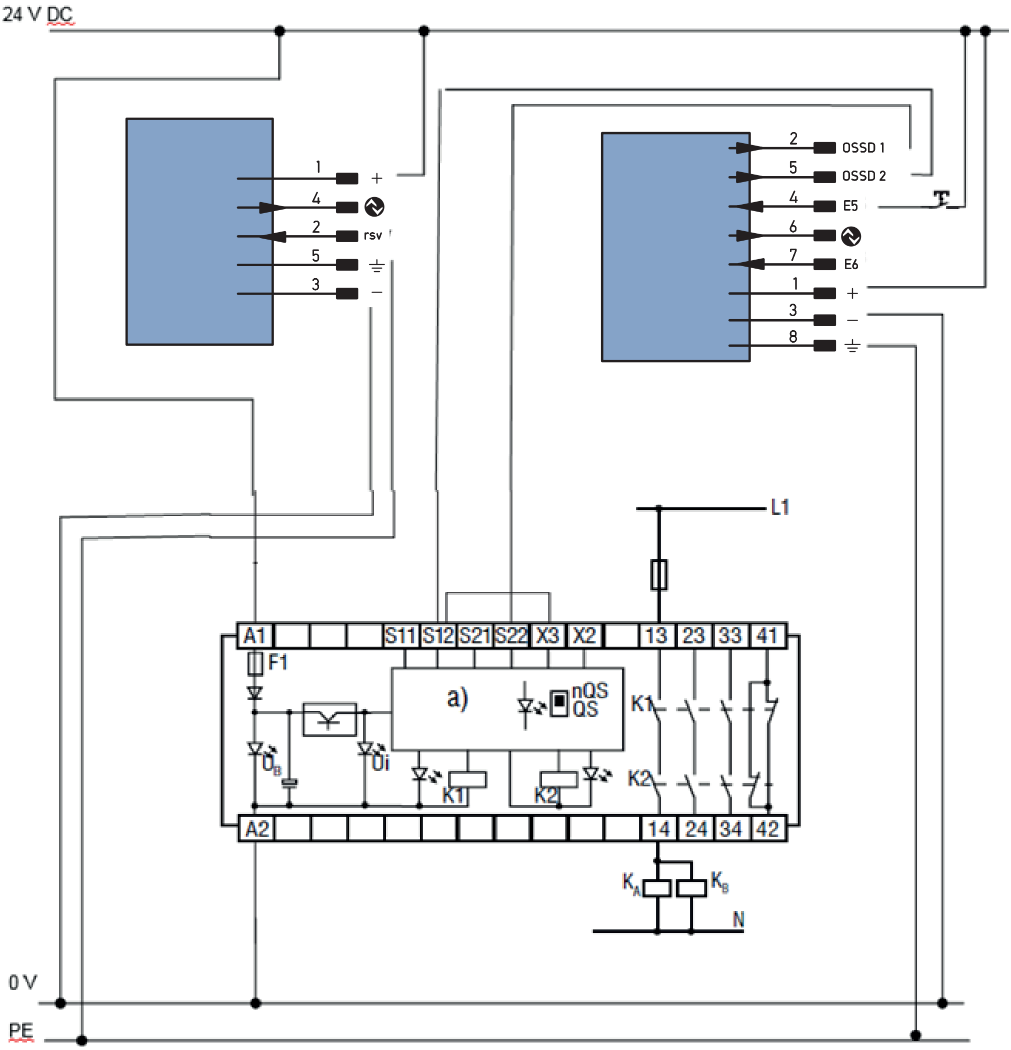
DANGER!

- Work on the machine must be immediately stopped if any impairment of the safety function is detected.
- Once the situation has been resolved, the effectiveness of the ESPE must be checked again according to the checklist for initial start-up (see section 16.1.1, page 173).

16.2 Connection Examples

16.2.1 Connection Example Start-Up Disabling and Restart Inhibit

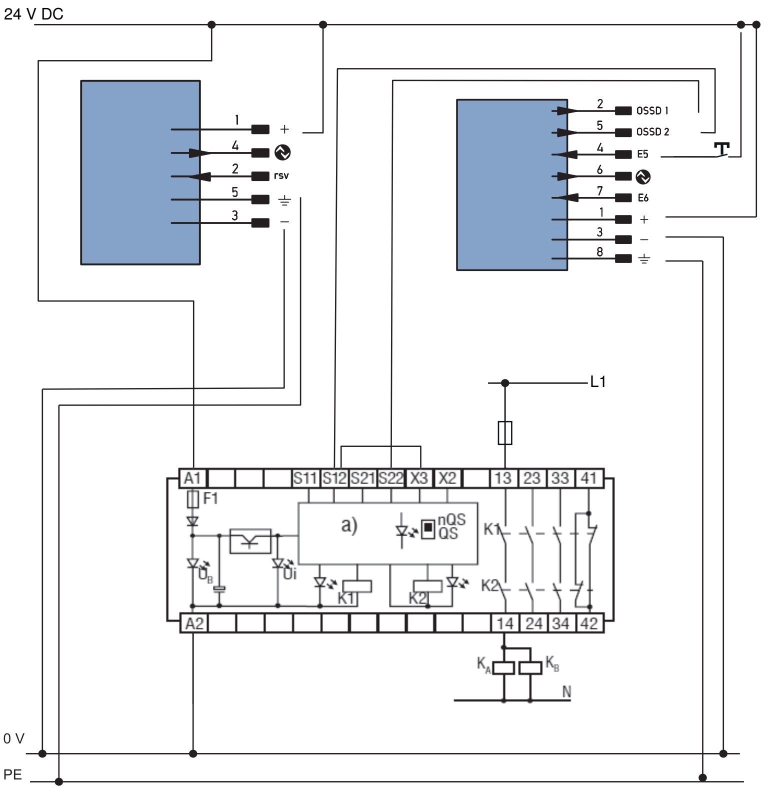
- Start-up disabling and restart inhibit RES via ESPE
- No contactor monitoring EDM
- Connection to safety relay SR4B3B01S

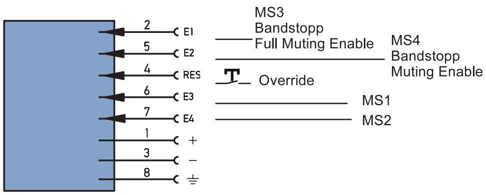


16.2.2 Connection Examples Muting

- Start-up disabling and restart inhibit RES via ESPE
- Connection to safety relay SR4B3B01S
- Connection of the necessary muting components via the extension connection

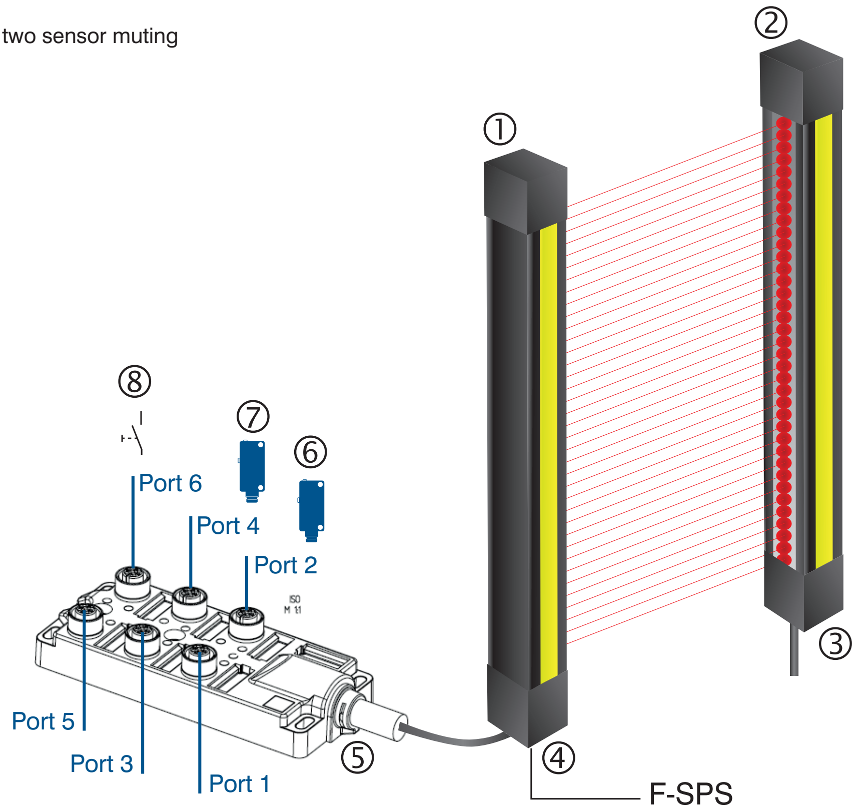
NOTE!
Quick electrical connection of the muting components is possible via the muting sets (incl. connection box ZFBB001).





Muting with connection box ZFBB001

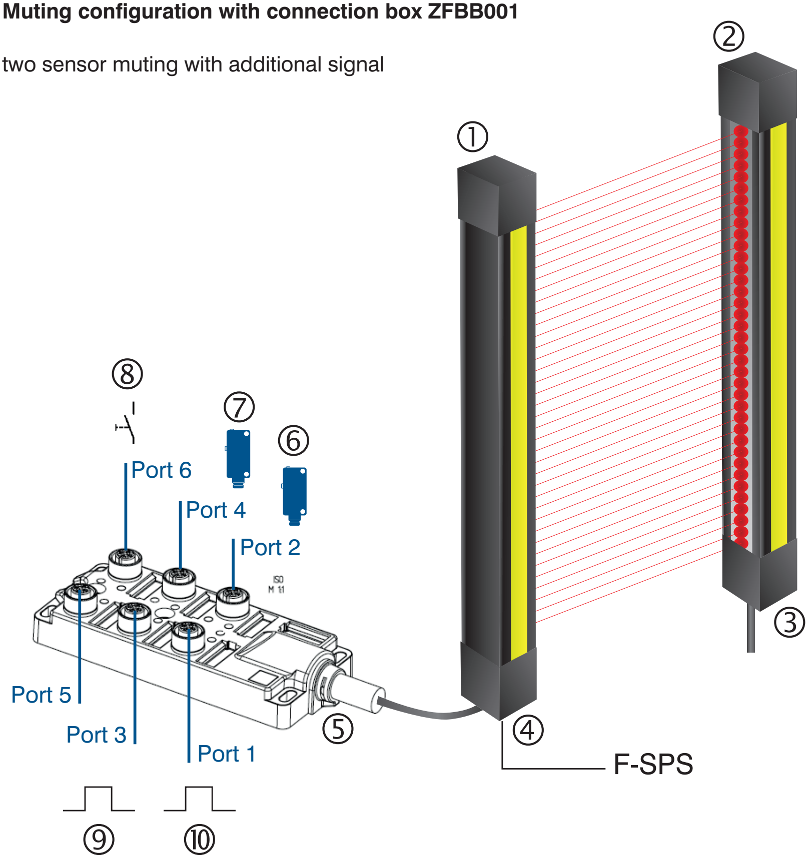
two sensor muting



1	Receiver SEFGxxx
2	Emitter SEFGxxx
3	Connection line M12×1; 4/5-pin
4	Connection line M12×1; 8-pin
5	Connection box ZFBB001
6	MS with connection cable on M12×1; 4/5-pin
7	MS with connection cable on M12×1; 4/5-pin
8	Override key with connection cable on M12×1; 4/5-pin

Muting configuration with connection box ZFBB001

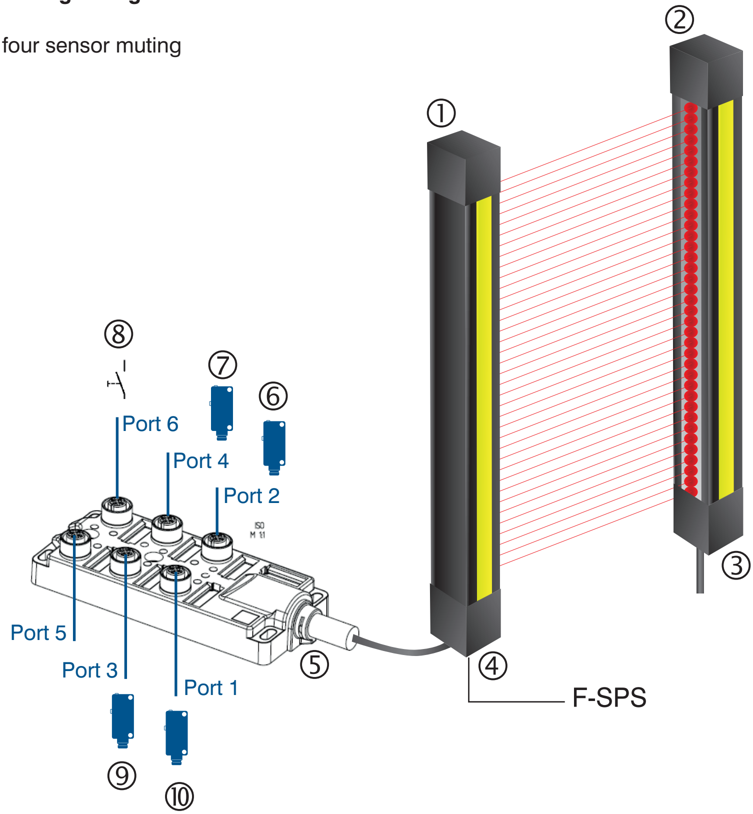
two sensor muting with additional signal



1	Receiver SEFGxxx
2	Emitter SEFGxxx
3	Connection line M12×1; 4/5-pin
4	Connection line M12×1; 8-pin
5	Connection box ZFBB001
6	MS with connection cable on M12×1; 4/5-pin
7	MS with connection cable on M12×1; 4/5-pin
8	Override key with connection cable on M12×1; 4/5-pin
9	Muting enable signal with connection cable on M12×1; 4/5-pin
10	Belt stop signal connection cable on M12×1; 4/5-pin

Muting configuration with connection box ZFBB001

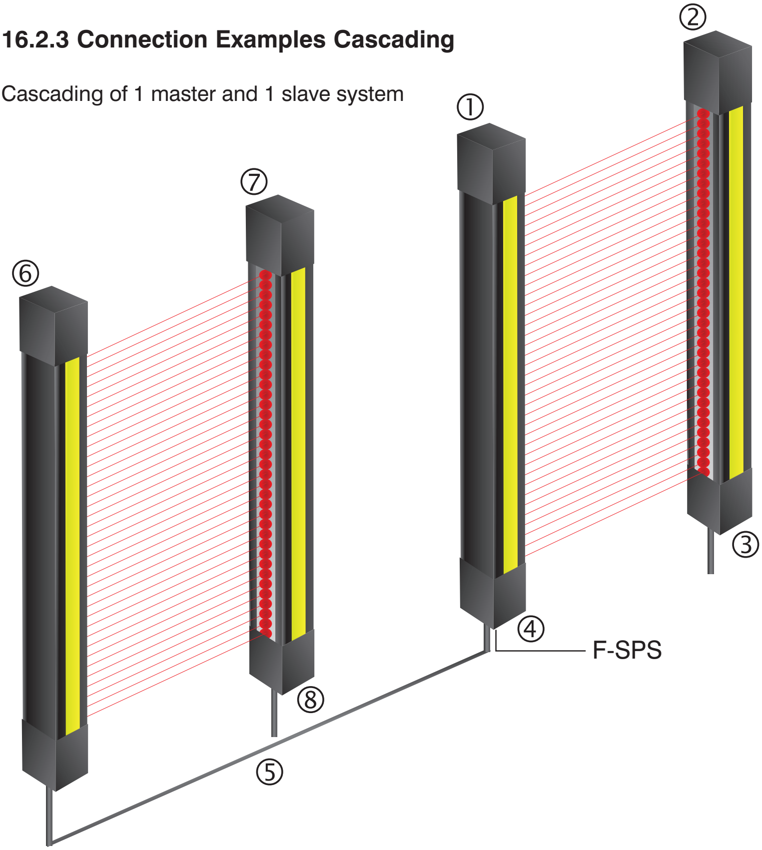
four sensor muting



1	Receiver SEFGxxx
2	Emitter SEFGxxx
3	Connection line M12×1; 4/5-pin
4	Connection line M12×1; 8-pin
5	ZFBB001 Connection Box
6	MS with connection cable on M12×1; 4/5-pin
7	MS with connection cable on M12×1; 4/5-pin
8	Override key with connection cable on M12×1; 4/5-pin
9	MS with connection cable on M12×1; 4/5-pin
10	MS with connection cable on M12×1; 4/5-pin

16.2.3 Connection Examples Cascading

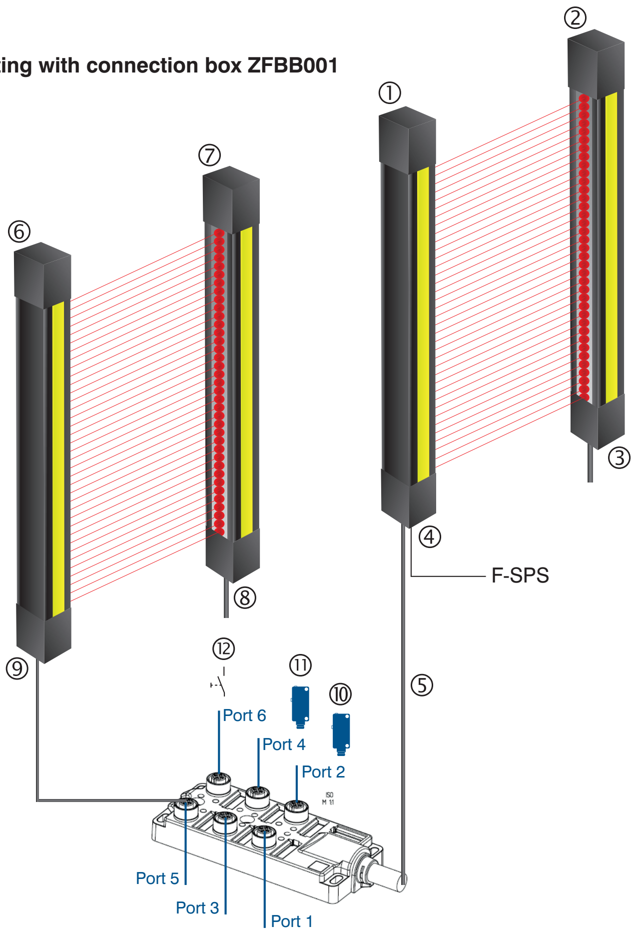
Cascading of 1 master and 1 slave system



1	Receiver SEFGxxx MASTER
2	Emitter SEFGxxx MASTER
3	Connection line M12×1; 4/5-pin
4	Connection line M12×1; 8-pin
5	Connection cable BG88SG88V2-2M
6	Receiver SEFGxxx SLAVE
7	Emitter SEFGxxx SLAVE
8	Connection line M12×1; 4/5-pin

NOTE!
The cascading function can be used in conjunction with muting via connection box ZFBB001.

Cascading and muting with connection box ZFBB001



1	Receiver SEFGxxx MASTER
2	Emitter SEFGxxx MASTER
3	Connection line M12×1; 4/5-pin
4	Connection line M12×1; 8-pin
5	ZFBB001 Connection Box
6	Receiver SEFGxxx SLAVE
7	Emitter SEFGxxx SLAVE
8	Connection line M12×1; 4/5-pin
9	Connection cable BG88SG88V2-2M
10	MS with connection cable on M12×1; 4/5-pin
11	MS with connection cable on M12×1; 4/5-pin
12	Override key with connection cable on M12×1; 4/5-pin

16.3 Order Notes

The operating instructions apply for the following sensors.

SEFG muting

Finger protection			
SFH [mm]	**Set**	**Emitter**	**Receiver**
159	SEFG471	SEFG531	SEFG671
309	SEFG472	SEFG532	SEFG672
460	SEFG473	SEFG533	SEFG673
610	SEFG474	SEFG534	SEFG674
760	SEFG475	SEFG535	SEFG675
910	SEFG476	SEFG536	SEFG676
1061	SEFG477	SEFG537	SEFG677
1211	SEFG478	SEFG538	SEFG678
1361	SEFG479	SEFG539	SEFG679
1511	SEFG480	SEFG540	SEFG680
1662	SEFG481	SEFG541	SEFG681
1812	SEFG482	SEFG542	SEFG682
Hand protection			
SFH [mm]	**Set**	**Emitter**	**Receiver**
159	SEFG451	SEFG511	SEFG651
309	SEFG452	SEFG512	SEFG652
460	SEFG453	SEFG513	SEFG653
610	SEFG454	SEFG514	SEFG654
760	SEFG455	SEFG515	SEFG655
910	SEFG456	SEFG516	SEFG656
1061	SEFG457	SEFG517	SEFG657
1211	SEFG458	SEFG518	SEFG658
1361	SEFG459	SEFG519	SEFG659
1511	SEFG460	SEFG520	SEFG660
1662	SEFG461	SEFG521	SEFG661
1812	SEFG462	SEFG522	SEFG662

SEFG muting / blanking

Finger protection			
SFH [mm]	**Set**	**Emitter**	**Receiver**
159	SEFG431	SEFG531	SEFG631
309	SEFG432	SEFG532	SEFG632
460	SEFG433	SEFG533	SEFG633
610	SEFG434	SEFG534	SEFG634
760	SEFG435	SEFG535	SEFG635
910	SEFG436	SEFG536	SEFG636
1061	SEFG437	SEFG537	SEFG637
1211	SEFG438	SEFG538	SEFG638
1361	SEFG439	SEFG539	SEFG639
1511	SEFG440	SEFG540	SEFG640
1662	SEFG441	SEFG541	SEFG641
1812	SEFG442	SEFG542	SEFG642
Hand protection			
SFH [mm]	**Set**	**Emitter**	**Receiver**
159	SEFG411	SEFG511	SEFG611
309	SEFG412	SEFG512	SEFG612
460	SEFG413	SEFG513	SEFG613
610	SEFG414	SEFG514	SEFG614
760	SEFG415	SEFG515	SEFG615
910	SEFG416	SEFG516	SEFG616
1061	SEFG417	SEFG517	SEFG617
1211	SEFG418	SEFG518	SEFG618
1361	SEFG419	SEFG519	SEFG619
1511	SEFG420	SEFG520	SEFG620
1662	SEFG421	SEFG521	SEFG621
1812	SEFG422	SEFG522	SEFG622

16.4 EU Declaration of Conformity

The EU declaration of conformity can be found on our website at www.wenglor.com in the product’s separate download area.

16.5 Index of Changes

Version	Date	Description / change
1.0.1	07/08/2019	First version
1.0.2	05/11/2019	Revision
1.1.0	09.06.2021	Additions to chapters “4.1 General Technical Data” on page 15, “9.4.3 Menu Structure” on page 122, “9.4.9 Parametrization Blanking (BLNK)” on page 139 “11.2 Calling Up the Current Parametrization (“Worker” User Level)” on page 160

16.6 Index of Abbreviations

Version	Description / change
a	Height of the danger zone
b	Height of the top edge of the safety field
ESPE	Electro-sensitive protective equipment
C	Margin for the safety clearance
C_{RO}	Margin for the safety clearance for access over the safety field
C_{RT}	Margin for the safety clearance for access through the safety field
d	Resolution of the ESPE or minimum distance for muting structures
EDM	External Device Monitoring (contactor monitoring)
FBB	First Beam Blocked
H	Height of the safety field above the floor
H_{min}	Minimum permissible mounting height
IODD	IO-Link device description file
K	approach speed
LBB	Last Beam Blocked
m	Minimum clearance to reflective surfaces
MS	Muting Sensor
MS1	Muting Sensor 1 (same for MS2, MS3, MS4)
MMD	Muting Duration
NBB	Numbers of beams Blocked
NCBB	Numbers of Cumulated beams Blocked
NC	Normally Closed (NC contact)
NO	Normally Open (NO contact)
NOBJ	Number of Objects
OSSD	Output Signal Switching Device Safe switching output of the ESPE
PL	Performance Level
RES	Restart Inhibit
S	Safety clearance
S_{RO}	Safety clearance for access over the safety field
S_{RT}	Safety clearance for access through the safety field
Sfb	Safety Field Width
SFH	Safety Field Height
SIL	Safety Integrity Level

SIL CL	Safety Integrity Level Claim Level
F-PLC	Failsafe control
T	Total response time
t_1	Response time of the ESPE
t_2	Response time of the safety switching device
t_3	Response time of the machine
t_{ESPE}	ESPE processing time for all muting signals
t_{MS}	Response time of the muting sensors

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