Leuze electronic

the sensor people

COMPACT*plus*-i

Safety Light Curtains
Function Package "Initiation"

607016 - 2009/12
Subject to change without prior notice

CONNECTING AND OPERATING INSTRUCTIONS
Original Instructions

Notes on Connecting and Operating Instructions

These instructions contain information on th efficiency in the use of COMPACT*plus*-i Safety Light Curtains in accordance with their intended applications. These instructions constitute a part of the scope of delivery.

All the information contained herein, in particular the safety notes, need to be carefully observed.

Notes regarding safety and warnings are marked by this symbol ⚠ .

This connecting and operating instructions must be stored carefully. It must be available for the entire operating time of the COMPACT*plus*-i.

Notes regarding important pieces of information are marked by the symbol ⓘ .

The Leuze electronic GmbH + Co. KG is not liable for damages caused by improper use. Acquaintance with these instructions is an element of the knowledge required for proper use.

Leuze electronic GmbH + Co. KG
In der Braike 1
D-73277 Owen - Teck / Germany
Phone +49 (0) 7021 / 573-0
Fax +49 (0) 7021 / 573-199
info@leuze.de
www.leuze.com

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1 General

COMPACT*plus* Safety Light Curtains and Multiple Light Beam Protective Devices and Transceiver are type 4 **A**ctive **O**pto-electronic **P**rotective **D**evices (AOPD) in accordance with IEC/EN 61496-1 and IEC/prEN 61496-2.

COMPACT*plus* represents an extension of the tried, tested and proven COMPACT series and is optically and mechanically, with the exception of the connection cap, compatible with this series. All versions have start/restart interlock that can be selected and deselected, plus the contactor monitoring function and a number of additional functions. They also have a variety of inputs, signal outputs, LEDs and 7-segment displays.

The devices are delivered as standard with safety-related transistor outputs and cable screws. The receiver is optionally available with relay outputs or with connection to a safety bus, for example.

In order to offer an optimal solution for each specific application, the devices of the COMPACT*plus* series are available in various versions with different ranges of functionality.

Overview of function packages:

COMPACT*plus*-m

Safety light curtains and multiple light beam protective devices and transceivers with the "Muting" function package for bridging the protective device for a limited period, with, for example, proper material transport through the protective field.

COMPACT*plus*-b

Safety light curtains with the "Blanking" function package with additional functions such as fixed and/or floating blanking of beams and „reduced resolution“ of the protective field.

COMPACT*plus*-i

Safety light curtains with the "Initiation" function package to not only protect with the protective device, but rather to also provide safety-related control of the production machine.

1.1 Certifications

Company

Leuze electronic GmbH & Co. KG in D-73277 Owen - Teck, Germany has a certified quality assurance system in accordance with ISO 9001.

Products

COMPACT*plus* Safety Light Curtains and Multiple Light Beam Protective Devices and Transceivers are developed and produced in compliance with applicable European directives and standards.

EC prototype test in accordance with
IEC/EN 61496 Part 1 and Part 2
TÜV PRODUCT SERVICE GmbH, IQSE
Certification Office
Ridlerstraße 65
D-80339 Munich, Germany

1.2 Symbols and terms

Symbols used:

⚠	Warning sign – This symbol indicates possible dangers. Please pay especially close attention to these instructions!
i	Notes on important information.
➢	A note, which also refers to a course of action, provides information about special attributes or describes set-up procedures.

Table 1.2-1: Symbols

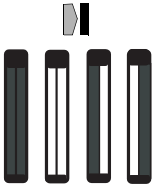
	Symbols of the COMPACT*plus* CPT Transmitter General transmitter symbol Transmitter not active Transmitter active
	Symbols of the COMPACT*plus* CPR Receiver Above: General receiver symbol Below from left to right: • The receiver's active protective field is not free, outputs in OFF state • Receiver's active protective field free, outputs in ON state • The receiver's active protective field is not free, outputs still in ON state (can be parameterized, for example, with PC and SafetyLab during MultiScan) • Receiver's active protective field free, outputs in OFF state
	Signal output Signal input Signal input and/or signal output

Table 1.2-1: Symbols

Terms used:

AOPD	Active opto-electronic protective device (**A**ctive **O**pto-electronic **P**rotective **D**evice)
AOPD response time	Time between intrusion into the active protective field of the AOPD and the actual switching off of the OSSDs.
AutoReset	When an error indication occurs, caused, for example, by faulty external wiring, the AOPD attempts to start again. If the error no longer exists, the AOPD returns to the normal state.
Bypass	Regulations-correct, time-limited suppression of the protective field safety function during a "not dangerous" part of the machine's working cycle.
Clear	Cycle clearing; clearing after completion of an introduced cycle by a machine signal
Contactor monitoring (EDM)	The EDM function monitors the normally closed contacts of downstream positive-guided contactors and relays or valves
CP-i	COMPACT*plus* with "Initiation" function package
CPR-i	COMPACT*plus* Receiver with "Initiation" function package
CPT	COMPACT*plus* Transmitter

Table 1.2-2: Terms

CSC	**C**ycle **S**tart **C**ontrol, optional cycle release signal (release only after valid positioning of the workpiece, for example)
EDM	see „Contactor monitoring“ (**E**xternal **D**evice **M**onitoring)
FS	Factory setting (parameter value with ex-factory delivery, which can be changed with switches or SafetyLab)
MultiScan	MultiScan: Beams must be interrupted in several consecutive scans, before the receiver switches OFF. MultiScan has a direct effect on the response time of the AOPD!
Operating mode	Guard-only mode, single-break or double-break operation
OSSD1, OSSD2	Safety related switching output, **O**utput **S**ignal **S**witching **D**evice
P0	7-Segment display receiver, operating mode "guard-only mode"
P1	Receiver 7-segment display, operating mode "single-break operation"
P2	Receiver 7-segment display, operating mode "double-break operation"
RES	Start/restart interlock
SafetyKey	Additional component for instructing procedures (only for Light Curtains)
SafetyLab	Diagnostics and Parameterization Software (optional)
Scan	All beams, beginning with the synchronization beam, are pulsed by the transmitter in cycles one after the other.
Start/restart interlock	Prevents automatic start after supply voltage is switched on, after the protective field has been entered or the external safety circuit has been activated

Table 1.2-2: Terms

1.3 COMPACT*plus*-i Selection

1.3.1 Selecting Safety Light Curtains – Basic Design/Host

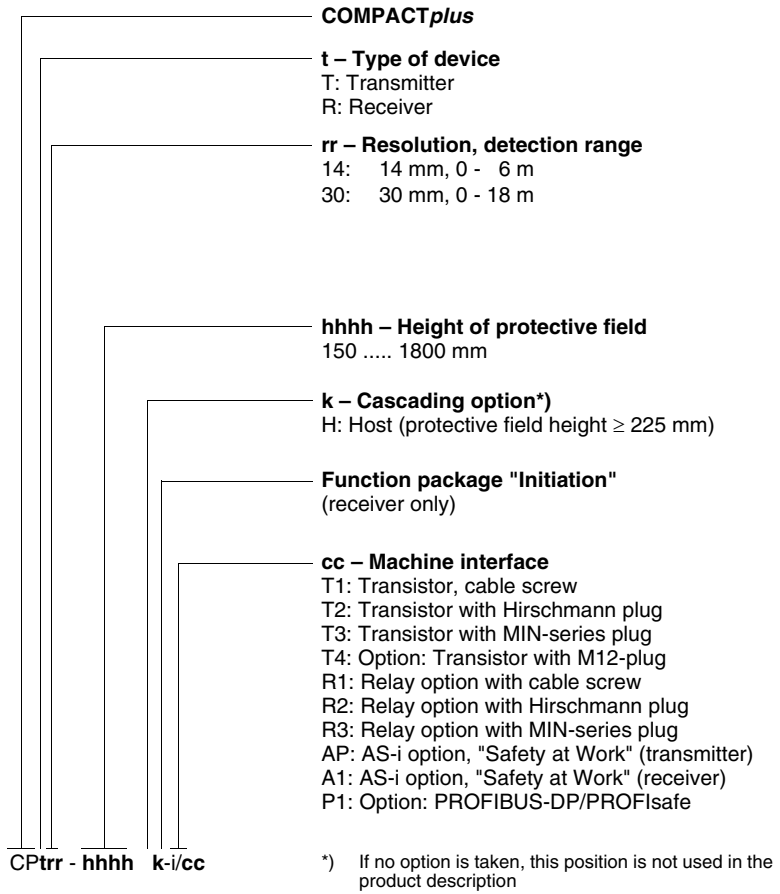


Fig. 1.3-1: Selecting COMPACT*plus*-i Safety Light Curtains

1.3.2 Selecting Safety Light Curtains – Guests

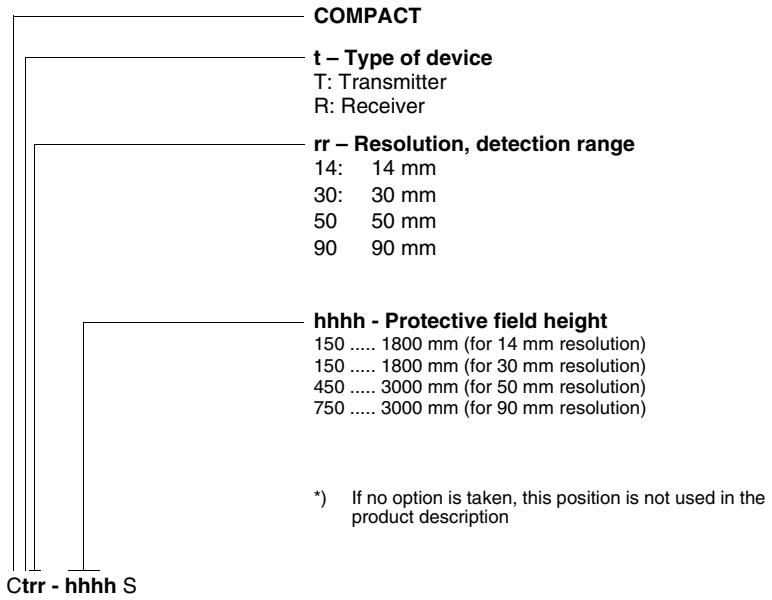


Fig. 1.3-2: Selecting COMPACT Guests

1.3.3 Examples for selection

COMPACT*plus*-i Safety Light Curtain without options

CPT14-900/T1		CPR14-900-i/T1	
COMPACT*plus*	Safety Light Curtain	COMPACT*plus*-i	Safety Light Curtain
Device type:	Transmitter	Device type:	Receiver
Physical resolution:	14 mm	Physical resolution:	14 mm
Detection range:	0 - 6 m	Detection range:	0 – 6 m
Height of protective field:	900 mm	Height of protective field:	900 mm
		Function package:	Initiation
		Safety output:	2 OSSD transistor outputs
Transmitter interface connection system:	Cable screw	Machine interface connection system:	Cable screw

Table 1.3-1: Example 1, selecting CP-i Safety Light Curtain

COMPACT*plus*-i Safety Light Curtain with AS-i interface options

CPT30-1050/AP		CPR30-1050-i/A1	
COMPACT*plus*	Safety Light Curtain	COMPACT*plus*-i	Safety Light Curtain
Device type:	Transmitter	Device type:	Receiver
Physical resolution:	30 mm	Physical resolution:	30 mm
Detection range:	0 – 18 m	Detection range:	0 – 18 m
Height of protective field:	1050 mm	Height of protective field:	1050 mm
		Function package:	Initiation
		Safety output option:	AS-i "Safety at Work"
Transmitter interface connection system:	M12, 5-pin	Machine interface connection system:	M12, 5-pin

Table 1.3-2: Example 2, selecting CP-i Safety Light Curtain

COMPACTplus-i Safety Light Curtain in host/guest combination with relay output option.

CPT14-1200H/T1		**CPR14-1200H-i/R1**	
COMPACT*plus*	Safety Light Curtain	COMPACT*plus*-i	Safety Light Curtain
Device type:	Transmitter	Device type:	Receiver
Physical resolution:	14 mm	Physical resolution:	14 mm
Detection range:	0 – 6 m	Detection range:	0 – 6 m
Height of protective field:	1200 mm	Height of protective field:	1200 mm
Design type:	Transmitter, Host	Design type:	Receiver, Host
		Function package:	Initiation
		Safety output:	2 OSSD transistor outputs
Connection system Transmitter interface:	Cable screw	Connection system Machine interface:	Cable screw
Connection system for guest transmitter:	Connection socket M12, 8-pin	Connection system for guest receiver:	Connection socket M12, 8-pin
CT50-450S		**CR50-450S**	
COMPACT	Safety Light Curtain	COMPACT	Safety Light Curtain
Device type:	Transmitter	Device type:	Receiver
Physical resolution:	50 mm	Physical resolution:	50 mm
Detection range:	0 - 18 m*)	Detection range:	0 - 18 m*)
Height of protective field:	450 mm	Height of protective field:	450 mm
Design type:	Transmitter, Guest	Design type:	Receiver, Guest
Connection system for host transmitter:	250 mm connection cable with M12, 8-pin plug	Connection system for host receiver:	250 mm connection cable with M12, 8-pin plug

*) Detection range possibly limited by host detection range

Table 1.3-3: Example 3, selecting CP-i Safety Light Curtain

2 Safety

Before using the safety sensor, a risk evaluation must be performed according to valid standards (e.g. EN ISO 1411, EN ISO 12100-1, ISO 13849-1, IEC 61508, EN 62061). The result of the risk assessment determines the required safety level of the safety sensor (see Table 2.1-1). For mounting, operating and testing, document "COMPACT*plus*-i Safety Light Curtains, cycle control function package" as well as all applicable national and international standards, regulations, rules and directives must be observed. Relevant and supplied documents must be observed, printed out and handed to the affected personnel.

Before working with the safety sensor, completely read and understand the documents applicable to your task.

In particular, the following national and international legal regulations apply for the start-up, technical inspections and work with safety sensors:

- Machinery directive 2006/42/EC
- Low voltage directive 2006/95/EC
- Electromagnetic compatibility directive 2004/108/EC
- Use of Work Equipment Directive 89/655/EEC supplemented by Directive 95/63 EC
- OSHA 1910 Subpart 0
- Safety regulations
- Accident-prevention regulations and safety rules
- Ordinance on Industrial Safety and Health and Labor Protection Act
- Device Safety Act

Notice!

For safety-related information you may also contact the local authorities (e.g., industrial inspectorate, employer's liability insurance association, labor inspectorate, occupational safety and health authority).

2.1 Approved purpose and foreseeable improper operation

Warning!

A running machine can cause severe injuries!
Make certain that, during all conversions, maintenance work and inspections, the system is securely shut down and protected against being restarted again.

2.1.1 Proper use

The safety sensor must only be used after it has been selected in accordance with the respectively applicable instructions and relevant standards, rules and regulations regarding labor protection and occupational safety, and after it has been installed on the machine, connected, commissioned, and checked by a competent person.

When selecting the safety sensor it must be ensured that its safety-related capability meets or exceeds the required performance level PL_r ascertained in the risk assessment.

The following table shows the safety-related characteristic parameters of the COMPACT*plus*-i Safety Light Curtain.

Type in accordance with IEC/EN 61496	Type 4
SIL in accordance with IEC 61508	SIL 3
SILCL in accordance with IEC/EN 62061	SILCL 3
Performance Level (PL) in accordance with EN ISO 13849-1: 2008	PL e
Category in accordance with ISO 13849	Cat. 4
Average probability of a failure to danger per hour (PFH_d) For protective field heights up to 900 mm, all resolutions For protective field heights up to 1800 mm, all resolutions For protective field heights up to 3000 mm, all resolutions	 $2.26 \times 10^{-8}\ 1/h$ $2.67 \times 10^{-8}\ 1/h$ On request
Service life (T_M)	20 years
Number of cycles until 10 % of the components have a failure to danger (B_{10d}) Version /R with relay output, DC13 (5 A, 24 V, inductive load) Version /R with relay output, AC15 (3 A, 230 V, inductive load)	 630,000 1,480,000

Table 2.1-1: Safety-related characteristic parameters of the COMPACT*plus*-i Safety Light Curtain

- The safety sensor protects persons at access points or at points of operation of machines and plants.
- The safety sensor with vertical mounting detects the penetration by fingers and hands at points of operation or by the body at access points.
- The safety sensor only detects persons upon entry to the danger zone; it does not detect persons who are located within the danger zone. For this reason, a start/restart interlock is mandatory.
- The safety sensor with horizontal mounting detects persons who are located within the danger zone (presence detection).
- The construction of the safety sensor must not be altered. When manipulating the safety sensor, the protective function is no longer guaranteed. Manipulating the safety sensor also voids all warranty claims against the manufacturer of the safety sensor.
- The safety sensor must be tested regularly by competent personnel.
- The safety sensor must be exchanged after a maximum of 20 years. Repairs or the exchange of parts subject to wear and tear do not extend the service life.

2.1.2 Foreseeable misuse

In principle, the safety sensor is not suitable as a protective device in case of:

- danger of objects being expelled or hot or dangerous liquids spurting from the danger zone
- applications in explosive or easily flammable atmospheres

2.2 Competent personnel

Prerequisites for competent personnel:

- he has a suitable technical education
- he knows the rules and regulations for occupational safety, safety at work and safety technology and can assess the safety of the machine
- he knows the instructions for the safety sensor and the machine
- he has been instructed by the responsible person on the mounting and operation of the machine and of the safety sensor

2.3 Responsibility for safety

Manufacturer and operating company must ensure that the machine and implemented safety sensor function properly and that all affected persons are adequately informed and trained.

The type and content of all imparted information must not lead to unsafe actions by users.

The manufacturer of the machine is responsible for:

- safe machine construction
- safe implementation of the safety sensor
- imparting all relevant information to the operating company
- adhering to all regulations and directives for the safe starting-up of the machine

The operator of the machine is responsible for:

- instructing the operating personnel
- maintaining the safe operation of the machine
- adhering to all regulations and directives for occupational safety and safety at work
- regular testing by competent personnel

2.4 Exemption of liability

Leuze electronic GmbH + Co. KG is not liable in the following cases:

- safety sensor is not used as intended
- safety notices are not adhered to
- reasonably foreseeable misuse is not taken into account
- mounting and electrical connection are not properly performed
- Proper function is not tested (see Chapter 10)
- changes (e.g., constructional) are made to the safety sensor

2.5 Safety notes for the "Initiation" function package

Special precautionary measures apply with controlling protective devices. It must consequently not be possible to step behind the protective device on the danger point facing side. The consequence here would be an automatic activation of the dangerous movement with crossing the protective field. Only window openings may therefore be secured in such a way that a person could never entirely pass through the protective field. All other accesses to the danger point must be fitted with hard guards or additional protective devices.

More detailed regulations are described in the standard EN ISO 12100-2 under item 5.2.5.3, controlling active opto-electronic protective devices. The European standards for mechanical presses, EN 692, and hydraulic presses, EN 693, necessitate the following requirements for controlling active opto-electronic protective devices:

- The resolution capacity of the AOPD may not exceed 30 mm.
- The maximum safety category in accordance with ISO 13849 is required.

In order to prevent stepping behind the protective field, the following are also required:

- Minimum height of work table – 750 mm
- Maximum stroke length – 600 mm
- Maximum press table depth – 1000 mm

If these values are not attained, additional measures must be implemented, e.g. monitoring of the inner press space.

The standards also require observation of a

- maximum distance between the protective field and press table of 75 mm.

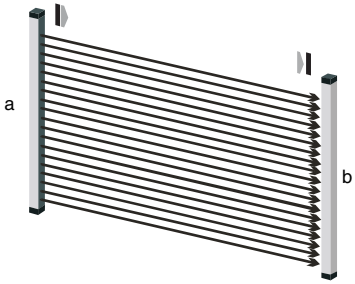
If the safety distance calculated in accordance with Chapter 6.1 results in a greater distance, an additional stepping behind protection is required, e.g. with a host/guest combination or with mechanical barriers. If mechanical barriers are designed as removable, they must be electrically integrated into the safety circuit.

3 System design and application examples

3.1 The opto-electronic protective device

Mode of operation

COMPACT*plus*-i consists of a transmitter and a receiver. Beginning with the first beam (synchronization beam) directly after the display panel, the transmitter pulses beam for beam in rapid succession and consequently forms a protective field. The synchronization between transmitter and receiver is performed optically.



a = Transmitter
b = Receiver

Fig. 3.1-1: Principle of the opto-electronic protective device

The receiver recognizes the specially formed pulse bundles of the transmitter beams and opens the corresponding receiver elements in sequence in the same rhythm. A protective field is consequently formed in the area between the transmitter and receiver, the height of which depends on the geometrical dimensions of the optical protective device, the width of which depends on the distance selected between the transmitter and receiver within the permissible detection range.

To improve the availability under difficult environmental conditions, it can be useful to wait after a beam interruption has been detected to see if this interruption is still present in the next scan(s), before the receiver switches the OSSDs off. This type of evaluation is called "MultiScan Mode" and it influences the receiver response time.

If MultiScan is active, it works scan-related, i.e. the receiver switches to the OFF state regardless of which of the beams is affected, as soon as a defined number of consecutive scans (Hx) have been interrupted (scan-related).

This MultiScan factor used is briefly displayed on the 7-segment display of the receiver (Hx) with start after power-on. The resulting response time is subsequently displayed with tx xx, whereby the response time x xx is displayed in milliseconds.

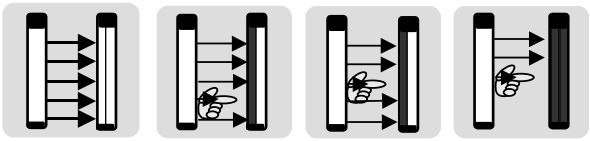


Fig. 3.1-2: Example: MultiScan, scan-related, MultiScan factor H = 3

In the factory setting, scan-related MultiScan applies with the following MultiScan factor (AutoScan mode):

- Safety Light Curtains (8..240 beams): H = 1

The values for the MultiScan factor can be selected within limits with SafetyLab (Chapter 13.2).

Warning!

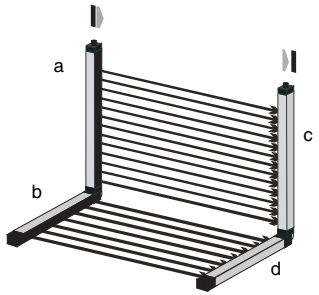
An increase in the MultiScan factor causes an extension of the response time and makes a recalculation of the safety distance necessary in accordance with Chapter 6.1!

Basic functions such as start/restart interlock or contactor monitoring (EDM) and a series of additional functions can be optionally assigned to the receiver so that there is generally no need for a downstream safety interface.

The "Initiation" function package provides the option of selecting the operating modes, "guard-only mode", "single-break operation" and "double-break operation". In the cycle control mode, with the release of the protective field, e.g. after insertion of a workpiece, the machine cycle can be controlled and therefore optimally adjusted to the working rhythm of the operator.

3.2 Cascading option

To implement multiple linked protective fields, COMPACT*plus* Safety Light Curtains can be cascaded one after the other via plug-in cable connections. This allows devices with different physical resolutions to be combined with each other.



a = CPT Transmitter, Host
b = CT Transmitter, Guest
c = CPR Receiver, Host
d = CR Receiver, Guest

Fig. 3.2-1: Structure of a cascaded system

Cascading devices make it possible to implement adjacent protective fields, for stepping behind protection without any additional expense for control and connection, for example. The host system is responsible here for all processor tasks, displays and the interfaces to the machine and control devices.

The following limits must be observed:

- The height of the protective field for the first light curtain (host) must be at least 225 mm.
- Ensure that the required detection range of the cascaded system falls within the maximum detection range of all individual components.
- The number of beams of all components must not exceed 240. For the number of beams n, for the individual components, please refer to the tables 12.2-1 and 12.2-2.
- The cables between the individual components are part of the guest. Their standard length is 250 mm. The connection to the host is made with an M12 plug.

3.3 Application examples

3.3.1 Hydraulic press

The setup shows a COMPACT*plus*-i safety light curtain in the host/guest combination for safeguarding danger points with protection against stepping behind. Optimal access is consequently enabled with the safety distance provided, e.g. for a tool change. The height of the top light beam is set in accordance with EN 294, if no further protection against reaching over is planned.

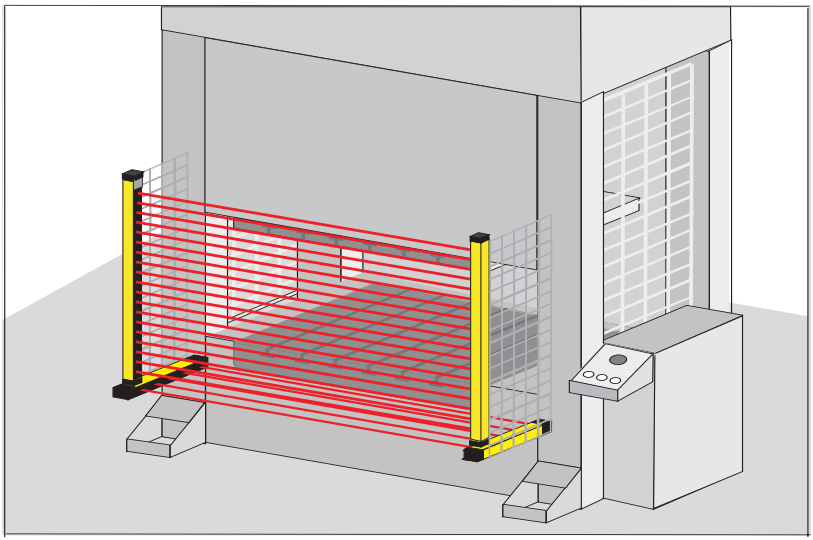


Fig. 3.3-1: Hydraulic press in guard-only mode, single-break or double-break operation

3.3.2 Circular cycle table

COMPACT*plus*-i is especially suitable for controlling machines in cycle control mode, as with normal sequence, no additional handling is required for starting the cycle. The machine adjusts itself without any time loss to the working rhythm of the operator.

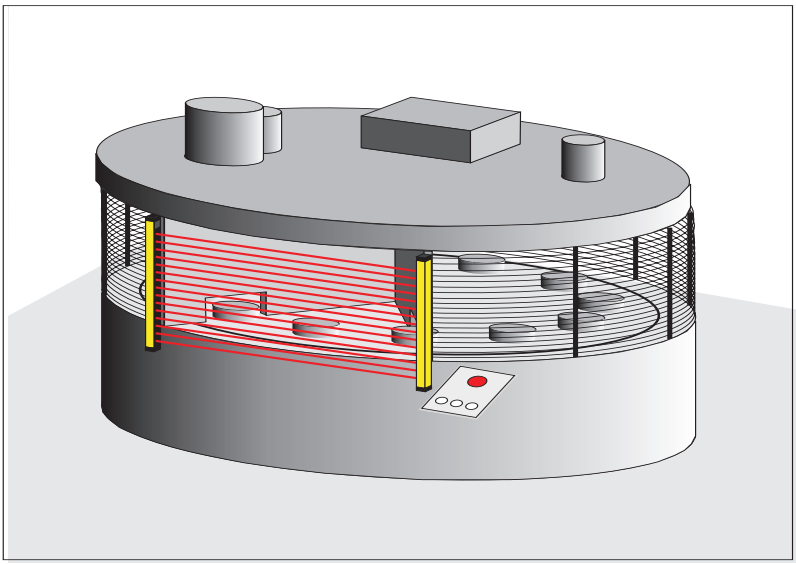


Fig. 3.3-2: Circular cycle table with manual insertion and removal

4 Function package "Initiation"

4.1 Parameterizable functions of the transmitter

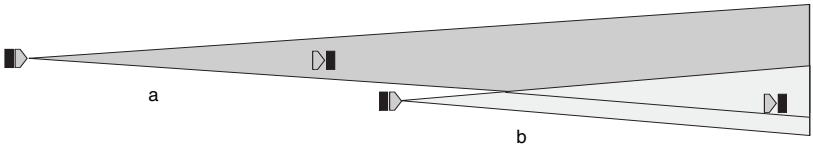
4.1.1 Transmission channel

The infrared beams are modulated with specially shaped pulse bundles so that they are distinct from ambient light and undisturbed operation is therefore ensured. Sparks from welding or warning lights from passing forklifts etc. do not have any effect on the protective field.

If two protective fields are located directly next to each other for two adjacent machines, measures must, however, be implemented so that the optical protective devices do not affect each other.

Both transmitters should first be assembled "back to back" so that the beams radiate in opposite directions. It is consequently impossible for them to affect each other.

Another possible way to suppress mutual influences is to switch one of the two protective devices from transmission channel 1 to 2, thereby switching them to differently formed pulse bundles. This option can then be selected when more than two optical protective devices are arranged next to each other.



a = AOPD "A" transmission channel 1
b = AOPD "B" transmission channel 2, not affected by AOPD "A"

Fig. 4.1-1: Transmission channel selection

The change from transmission channel 1 (FS) to 2 must be made both on the transmitter and the receiver of the optical protective device in question. You will find more detailed information in Chapter 8.

4.2 Functions of the receiver, parameterizable with switches or SafetyLab

You will find setting notes for parameterization using switches on the display and parameter module in the connecting and operating instructions. Further settings are also available with SafetyLab and PC. See the separate user manual for SafetyLab.

Note!

If required, information on further setting options with switches or on customer-specific presettings can be found on an attached data sheet or in additional connecting and operating instructions.

Warning!

After parameters are changed, be it with switch or with PC with SafetyLab, the functioning of the optical protective device must be carefully tested. You will find more information on this in Chapters 10 and 13.

4.2.1 Transmission channel

Transmitters and receivers/transceivers are set to transmission channel 1 (C1) in the factory settings status. If the corresponding transmitter is switched to transmission channel 2, the receiver must also be set to transmission channel 2 (C2). See Chapter 8 for more information.

4.2.2 Start/restart interlock

Warning!

*When delivered, the internal start/restart interlock of the COMPACTplus is **not** activated!*

The start/restart interlock function prevents the safety circuits from being released automatically when the machine is turned on or the power supply is restored after a power outage. The receiver only switches to the ON state by pressing and releasing the start-/restart button within a time window.

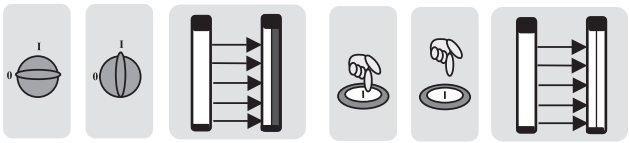


Fig. 4.2-1: Start/restart interlock function with supply voltage power-on

If the protective field is penetrated or an optional safety circuit is activated, the start/restart interlock function ensures that the receiver also remains in the OFF state after the protective field has been freed. The receiver will then not be switched back to the ON state until the start-/restart button is pressed and released again within a time window of 0.1 to 4 seconds (FS).

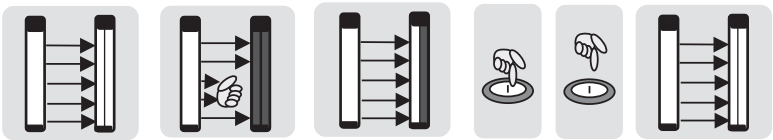


Fig. 4.2-2: Start/restart interlock function after interrupting the protective field

Without the start/restart interlock, the receiver outputs immediately switch to the ON state after the machine has been turned on or the power supply has been restored and after the protective field has been freed! Operation of the protective device without the start/restart interlock is only permitted in a very few exceptions and under the conditions of controlling protective devices in accordance with EN ISO 12100-1 and EN ISO 12100-2. It must also be ensured that it is impossible to walk or slip through the protective field.

How to activate the start/restart interlock:

➢ Internally in the COMPACT*plus* receiver (see Chapter 8.3.3)
➢ or in the downstream safety interface (e.g. MSI from Leuze)
➢ or in the downstream machine control unit
➢ or in the downstream Safety PLC

If the internal start/restart interlock is activated as described in Chapter 8.3.3, the interlock functions are monitored dynamically. The receiver is only switched back to the ON state after the start-/restart button has been pressed and released again. Additional requirements are, of course, that the protective field be free and that any connected additional safety circuits be in the ON state.

If both the internal and a subsequent start/restart interlock are activated, the receiver will only perform a reset function with its assigned start-/restart button.

4.2.3 Contactor monitoring (EDM)

Warning!

The contactor monitoring function is not activated at the factory!

The "Contactor monitoring" function dynamically monitors contactors, relays or valves downstream from the COMPACT*plus*. Precondition here are switching elements with positive-guided feedback contacts (normally closed).

Fig. 4.2-3: Contactor monitoring function, combined in this example with start/restart interlock

Activate the contactor monitoring function via:

➢ The internal dynamic contactor monitoring in the receiver
➢ or the external contactor monitoring of the downstream safety interface (e.g. MSI from Leuze)
➢ or via a possible downstream Safety PLC
(optional, connected via a safety bus)

If the contactor monitoring is activated via a switch it works dynamically, which means, in addition to the closed feedback circuit being checked before each switching-on of the OSSDs, it is checked to see if the feedback circuit has opened within 300 ms (FS) after release of the safety circuit, and if it has closed again within 300 ms (FS) after the OSSDs have been switched off. If this is not the case, the OSSDs return to the OFF state again after being briefly switched on. An error signal appears on the 7 segment display and the receiver goes to the error locking status, from which it can only return to normal operation by switching the supply voltage off and back on again.

4.2.4 Single-break operation

Particular precautionary measures must be taken if the protective device is used for controlling. These are described in the safety notes, Chapter 2.5.

This operating mode is always linked with the internal start/restart interlock function, regardless of the setting of the start/restart interlock via switch S3 or PC and SafetyLab The start interlock ensures that the OSSDs remain in the OFF state after the supply voltage is switched on. The "start/restart interlock locked" display, the yellow LED3 (symbol: Lock, see Chapter 5.2) lights constantly.

The standby status for the single-break operation is attained with pressing and releasing of the start/restart button, the LED3 blinks once per short time interval. COMPACT*plus*-i waits in this status for an intrusion of at least 100 ms (FS) into the protective field by the operator. After the protective field has been released, the OSSDs switch to the ON state. The machine cycle is released.

After completion of a machine cycle the machine sends a CLEAR signal pulse to the receiver's control input that is responsible for this. The OSSDs consequently switch off and the machine stops. The next cycle can be activated by intervening and releasing the protective field. If the protective field is penetrated during the running machine cycle, the OSSDs switch off immediately. The start/restart interlock must be reset with the start/restart button before activating the next machine cycle.

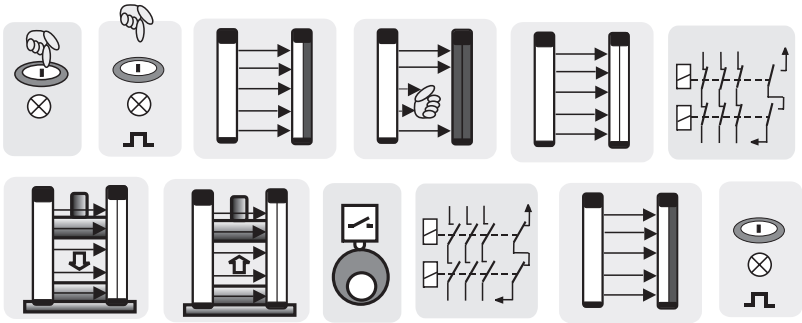


Fig. 4.2-4: Single-break operation functioning sequence

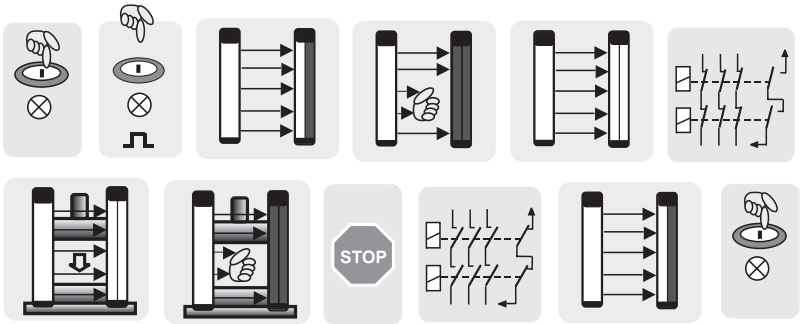
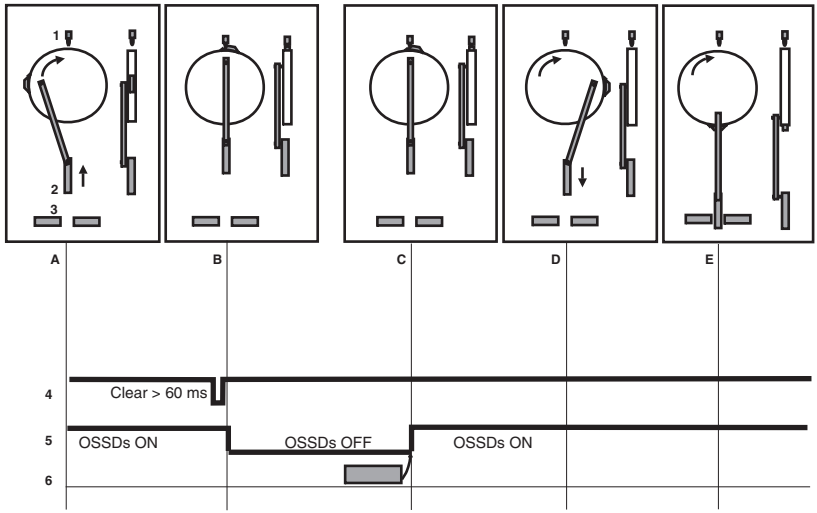


Fig. 4.2-5: Single-break operation, further intervention during the machine movement



A = Machine cycle, upward movement
B = Machine cycle, top end position, clear signal ≥ 60 ms (FS)
The normally closed contact must be overridden until it has closed again. Waiting on **one** intrusion of greater than 100 ms (FS) into the protective field
C = The new machine cycle begins with exit from the protective field.
The release of the OSSDs can be optionally linked with the cycle release signal.
D = Machine cycle, downward movement
A further intrusion would switch off the OSSDs after the response time t_{AOPD}.
E = Without further intrusion into the protective field, the stamp runs to the top end position (cycle release signal).
1 = Limit switch, cycle clearing (clear)
2 = Stamp
3 = Lower die
4 = Clear signal of the limit switch
5 = OSSDs, status
6 = Intrusion into the protective field

Fig. 4.2-6: Example of single-break operation with protective function, schematic illustration

4.2.5 Double-break operation

Particular precautionary measures must be taken if the protective device is used for controlling. These are described in the safety notes, Chapter 2.5.

This operating mode is always linked with the internal start/restart interlock function, regardless of the setting of the start/restart interlock via switch S3 or PC and SafetyLab The start interlock ensures that the OSSDs remain in the OFF state after the supply voltage is switched on. The "start/restart interlock locked" display, the yellow LED3 (symbol: Lock) lights constantly.

The standby status for the double-break operation is attained with pressing and releasing of the start/restart button, the LED3 blinks twice per short time interval. After a first intrusion of at least 100 ms (FS) into the protective field, the LED blinks once per short time interval. COMPACT*plus*-i waits in this status for a second controlling intrusion of at least 100 ms (FS) into the protective field. With the second release of the protective field, the OSSDs switch to the ON state. The machine cycle is released. The rest of the sequence is identical to the single-cycle operation.

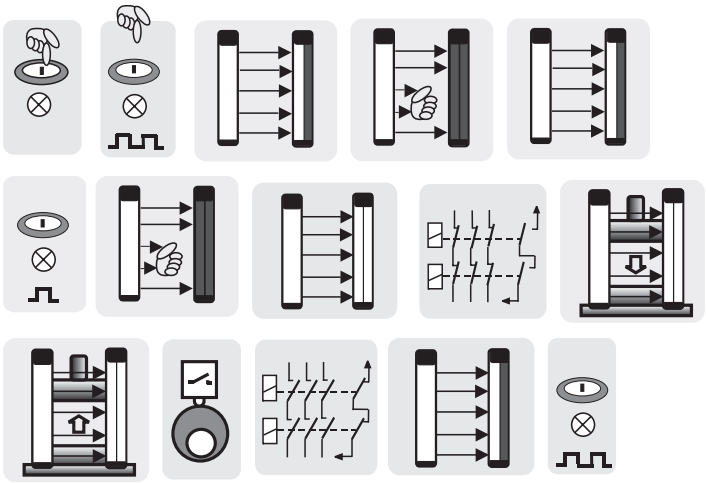
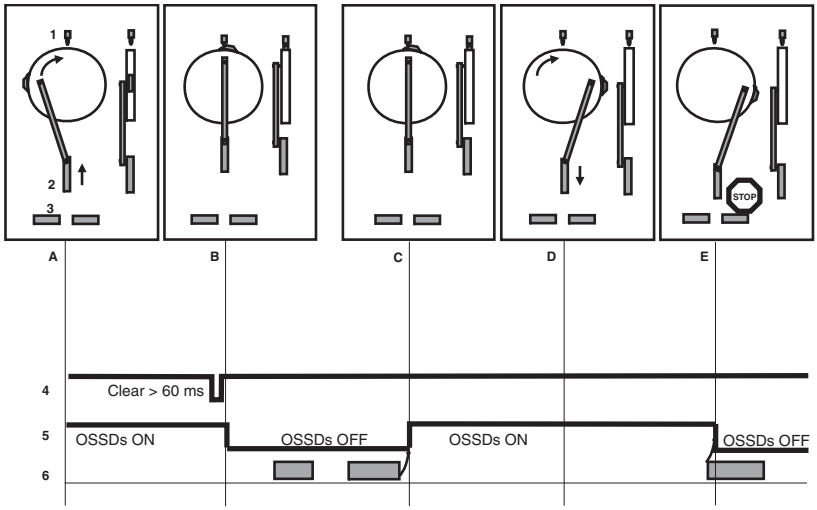


Fig. 4.2-7: Double-break operation functioning sequence



A = Machine cycle, upward movement
B = Machine cycle, top end position, clear signal ≥ 60 ms (FS)
The normally closed contact must be overridden until it has closed again. Waiting on **two** intrusions of greater than 100 ms (FS) into the protective field
C = The new machine cycle starts with the second exit from the protective field.
The release of the OSSDs can be optionally linked with the cycle release signal.
D = Machine cycle, downward movement
E = The example shows a further intrusion into the protective field following the two controlling intrusions. The OSSDs switch to the OFF state after the response time, t_{AOPD}.
1 = Limit switch, cycle clearing (clear)
2 = Stamp
3 = Lower die
4 = Clear signal of the limit switch
5 = OSSDs, status
6 = Intrusions into the protective field

Fig. 4.2-8: Example of double-break operation with protective function, schematic illustration

4.2.6 External selection of operating modes

Changing to external operating mode selection can also be made by switch or PC with SafetyLab. It is consequently possible to select the operating modes, "guard-only mode", "single-break operation" or "double-break operation" external via a operating modes selection switch (keyed switch) or with jumpers (see Chapter 7.1).

4.2.7 Cycle Start Control (CSC)

COMPACT*plus*-i provides the option of making the release of the last cycle dependent on an additional cycle release signal. This signal can, for example, come from a sensor that monitors the correct position of the manually inserted workpiece. Tool and workpiece can therefore be protected from damaging. This function is not effective in the factory setting. It can be selected via switch or SafetyLab.

4.3 Functions of the receiver, parameterizable with SafetyLab

4.3.1 Time monitoring for cycle control

A time monitoring prevents further controlling intrusions from being possible 30 s (FS) after "standby status" or the last controlling intrusion into the protective field. The start/restart interlock locks after expiry of this time, the yellow LED3 lights constantly. With the start/restart button, the standby status can be restored.

The time monitoring provides protection against unintentional activation of a work cycle after a significant idle period. The time until interlocking can be reduced with PC and SafetyLab.

4.3.2 Combination of cycle control and bypass function

With proper installation, COMPACT*plus*-i protects during the entire working cycle. If it is important that the work process may not be interrupted during certain phases for safety or operational process reasons, e.g. with the passing of a stamp through the material, the additional operating mode "cycle control with bypass function" is available with the use of PC and SafetyLab.

With the additional bypass function, the protective effect for the "not dangerous" part of the work movement can be removed. Bypass can, for example, initiate when the stamp reaches 6 mm from the material and no dangers exist with passing through and return of the tool. Further details on "cycle control with bypass function" can be found in the SafetyLab user manual.

4.4 Additional functions to be set with SafetyLab

In addition to diagnostics of the protective field, the Diagnostics and Parameterization Software SafetyLab enables:

- Graphic representation of the beam state and the beam parameterization
- Display of internal and external signals, e.g. from muting sensors.
- Position of switches S1 to S6
- Internal voltage and current values
- Reading out event recorder
- Data recorder for logging the sequence of selected signals

As the settings with SafetyLab could contradict the per switch settings, a priority rule becomes inevitable. In order, therefore, to allow the values set with SafetyLab to become effective, all switches must be set to the ex-factory setting L. Only then can the values marked with SW: in table 8.3-1 be overwritten by the values sent by SafetyLab. If one of the switches is not in position L after the parameterization by SafetyLab, then the receiver is in an error state, which can be resolved as follows:

➢ Either all switches are switched back to position L → the SafetyLab settings become effective again.

➢ Or the receiver is reset with SafetyLab and the password (with setting of all switches to position L) to the basic setting →, now the switches can be used again as described in Chapter 8.

Here is an overview of the functions that can be set with SafetyLab.

- Definition of the optics
- Protective field parameterization
- Transmission channel
- MultiScan mode
- Display
- Start/restart interlock
- Contactor monitoring
- Optional safety circuit
- Indicating signal output
- MultiScan factor change
- Initiation: Operating mode, cycle clearing, cycle release
- Parameters for the bypass function
- Protective fields parametering, alternative to cycle control:
  Fixed and floating blanking, reduced resolution

Further details on diagnostics and parameterization can be found in the SafetyLab user manual.

5 Display elements

5.1 Status displays of the CPT transmitter

If the 7-segment transmitter display is lit, this indicates that the power supply is connected.

Fig. 5.1-1: Transmitter status displays

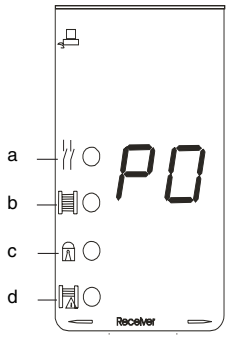
Current status of the transmitter:

7-Segment display	Meaning
8.	Hardware reset when turned on
S	Self test running (for approx. 1 s)
1	Normal operation, set to channel 1
2	Normal operation, set to channel 2
.	Dot next to the number: Test on – the transmitter does not supply any valid pulses (jumper 3 – 4 not closed)
F / **x**	F = Device fault x = Fault number, alternating with "F" (see Chapter 11)

Table 5.1-1: Transmitter 7-segment display

5.2 Status displays of the receiver

Four LEDs and two 7-segment displays report the receiver operating status.



a = LED1, red/green
b = LED2, orange
c = LED3, yellow
d = LED4, blue

Fig. 5.2-1: Status displays of the receiver

5.2.1 7-segment displays

After the supply voltage is switched on, the following data appear on both 7-segment displays of the receiver:

7-Segment displays	Meaning
88	Hardware reset and self test after power-on or reset
	Sequence of parameter displays during startup for 1 s each
4y **xx**	Function package display (4 = initiation, cycle control) x xx = Firmware version
Hx	MultiScan factor display x = Number of scans per evaluation cycle
tx **xx**	Response time of the AOPD after interruption of the active protective field x xx = Response time in ms
Cx	Transmission channel display x = Transmission channel set (1 or 2, FS = 1)
	Permanent parameter display after startup
Px	Operating mode display x = Operating mode set: 0 = Guard-only mode, 1 = Single-break operation, 2 = Double-break operation

Table 5.2-1: 7-segment displays for receiver

	Temporary event displays in alignment mode
1 a b  n	Alignment display: One horizontal bar represents one beam: 1a: First beam of the basic device/host (synchronization beam) an: Last beam of the basic device/host 1b: First beam of the guest device bn: Last beam of the guest device This procedure is described in more detail in Chapter 9.2.
	Temporary event displays alternating with the permanent parameters display, 1 second per display
Ux	Display of interlocking of external safety circuit (parameterizable with SafetyLab) x = Index of the additional safety circuit
Ex **xx**	Display of locking status "Malfunction", which can be released by the user x xx Fault number (e.g. no signal from contactor monitoring, see Chapter 11)
Fx **xx**	Locking status display of device faults, receivers must be replaced

Table 5.2-1: 7-segment displays for receiver

5.2.2 LED displays

LED	Color	Meaning		
LED1	Red/ green	Red	=	Safety outputs in the OFF state
		Green	=	Safety outputs in the ON state
		No display	=	Device without supply voltage
LED2	Orange	**Operating mode with internal RES in OFF state (LED1 red):**		
		ON	=	Protective field free
		Operating mode with/without internal RES in ON state (LED1 green):		
		ON	=	Weak beam indication with free protective field
LED3	Yellow	ON	=	Internal restart interlock locked
		Blinks 2 x	=	Two intrusions into the protective field expected
		Blinks 1 x	=	One intrusion into the protective field expected
		OFF	=	Restart interlock unlocked/not active
LED4	Blue	OFF	=	No special function
		ON	=	Bypass (e.g. during return), parameterizable via SafetyLab

Table 5.2-2: LED displays for receiver

6 Installation

In this Chapter you will find important information on installing the COMPACT*plus*, the effective protection of which is only guaranteed if the following installation specifications are complied with. These installation specifications are based on the respective applicable versions of European standards such as EN 999 and EN 294. It must also be ensured that the specifications applicable when using COMPACT*plus* in non-European countries are observed.

6.1 Minimum distances and component positions

Optical protective devices can only fulfill their protective requirements if they are installed with a sufficient safety distance.

The calculation formulas for safety distance are dependent on the type of protection. In the harmonized European standard EN 999, “Positioning of protective devices with regard to approach speeds of parts of the human body”, the installation situations and calculation formulas for safety distance are described for the following protection types.

The formulas for the necessary distance from reflective surfaces are determined in accordance with the European standard for "Active opto-electronic Protective Devices“, IEC/prEN 61496-2.

6.1.1 Safety distance with normal approach to the protective field

Safety distance calculation for a safety light curtain for safeguarding danger points with an effective resolution of 14 to 40 mm:

The safety distance "S" for safeguarding danger points can be calculated in accordance with EN 999 using the formula:

$$S\ [mm] = K\ [mm/s] \times T\ [s] + C\ [mm]$$

S = Safety distance in mm

If the result is less than 100 mm, a min. distance of 100 mm must be used.*

K = Approach speed in mm/s

In the close range of 500 mm, 2000 mm/s is used for the calculation. If a distance greater than 500 mm is calculated, K = 1600 mm/s may be used. However, in this case a minimum safety distance of 500 mm is applied.

T = Total time delay in seconds;

Sum of:

protective device response time	t_{AOPD},	see Chapter 12.2
Safety interface, if any,	$t_{Interface}$,	interface technical data
and the machine's stopping time	$t_{Machine}$.	Technical data of the machine or stopping time measurement

C = 8 x (d-14) in mm
Additional distance, based on intrusion towards the danger zone prior to actuation *)

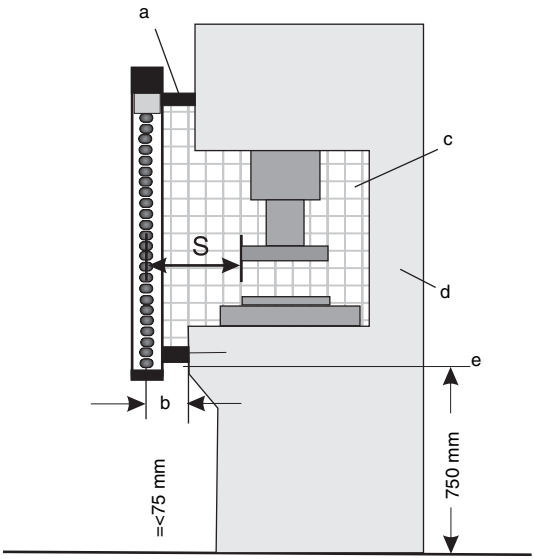
d = Resolution of the AOPD

*) AOPDs with additional cycling control function must have a resolution of ≤ 30 mm and a minimum distance S ≥ 150 mm.

**) Observe deviation in the C standards EN 692 and EN 693 for mechanical and hydraulic presses:

Additional distance C with resolution of

14 mm	=	0 mm	
> 14 to 20 mm	=	80 mm	
> 20 to 30 mm	=	130 mm	
> 30 to 40 mm	=	240 mm	No cycle control allowed



a = Measures to prevent access from above
b = Maximum distance to prevent stepping behind. If a distance greater than 75 mm results because of the safety distance S, other measures must be taken against stepping behind.
c = Measures to prevent access from the sides
d = Measures to prevent access from the rear
e = Measures to prevent access from below

Fig. 6.1-1: Safety distance "S" for safeguarding danger points

$$S\ [mm] = k\ [mm/s] \times (t_{AOPD} + t_{Interface} + t_{Machine})\ [s] + 8 \times (d-14)\ [mm]$$

Calculation example for safeguarding danger points:

A CP14-1500 safety light curtain with transistor output is in direct use on a press with a 150 ms stopping time. MultiScan factor H = 1 (FS).

Approaching speed k in close area = 2000 mm/s

Machine's stopping time $t_{Machine}$ = 150 ms

Response time t_{AOPD} (H = 1) = 35 ms

Response time $t_{Interface}$ = 20 ms

Resolution d, of AOPD = 14 mm

T = 0.150 + 0.035 + 0.020 = 0.205 s

S = 2000 x 0.205 + 0 = 410 mm

Ensure with the installation that the possibility of reaching over, under or around or of steppng behind the safety light curtain has been definitively ruled out.

To prevent someone from stepping behind the protective device, the distance between the machining table and the light curtain may only be a max. 75 mm. Stepping undetected behind can be prevented, for example, by mechanical barriers or with a host/guest arrangement of the safety light curtain. If removable mechanical barriers are selected, these must be electrically integrated into the safety-related safety circuit.

Calculation example for host/guest application

ⓘ See figure 6.1-2

Assuming a calculated safety distance of 410 mm from the calculation example given above, the distance between the protective field and the machining table may not be less than 75 mm and a host/guest application comprising CP14-1500H (Host) and C30-300S (Guest) is therefore selected, the safety distance between the protective field of the host and the danger point, S_H, is therefore calculated as follows:

Machine's stopping time $t_{Machine}$ = 150 ms

Response time t_{AOPD} (H = 1) = 35 ms + 4 ms (host + guest)

Response time $t_{Interface}$ = 20 ms

Host resolution, d_H = 14 mm

T = 0.150 + 0.039 + 0.020 = 0.209 s

S_H = 2000 x 0.209 + 0 = 418 mm

Host safety distance, S_H = 418 mm

On the basis of the resolution of the Guest d_G of 30 mm, the safety distance between the horizontally positioned Guest and the danger point is:

Resolution of the Guest d_G = 30 mm

S_G = 2000 x 0.209 + 138 = 546 mm

As a distance of over 500 mm is calculated for the guest, with an access speed of K = 1600 mm/s, recalculation may be made. If, however, the new result is under 500 mm, at least 500 mm must be observed:

S_G = 1600 x 0.209 + 8 x (30 -14) = 463 mm

As the result is under 500 mm, the minimum distance of 500 mm is used:

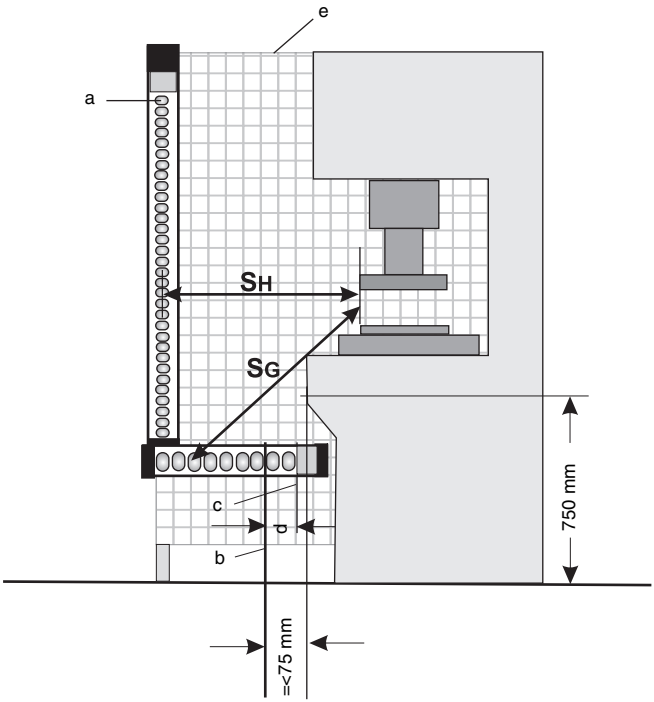
Safety distance Guest S_G = 500 mm

6.1.2 Switching position at the end of the protective field

While the switching position of the first beam (synchronization beam) is positioned just next to the display panel, the switching position at the end of the protective field depends on the resolution of the light curtain.

Warning!

The determination of the position of the switching point is important in all cases of rear area protection, e.g. in host/guest applications and/or with danger point protection with parallel approach to the protective field.



a = Synchronization beam, height in accordance with EN 294 or measures against reaching over
b = Switching position, from which the minimum distance must be measured
c = End of the protective field
d = Effective resolution of the protective device
e = Measures to prevent access from the sides

Fig. 6.1-2: Example: Safety distances S_H and S_G in host/guest application

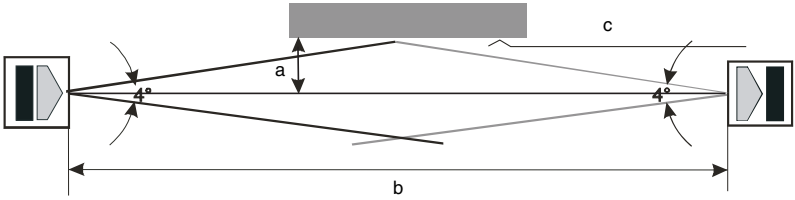
The presence of a person between the protective device and the machining table must be definitely detected. Therefore the distance between the switching position of the protective device and the machining table (at a height of 750 mm) must not exceed 75 mm.

The same applies if a danger point is protected with a light curtain that is mounted inclined and the end of the protective field points toward the machine.

6.1.3 Minimum distance from reflective surfaces

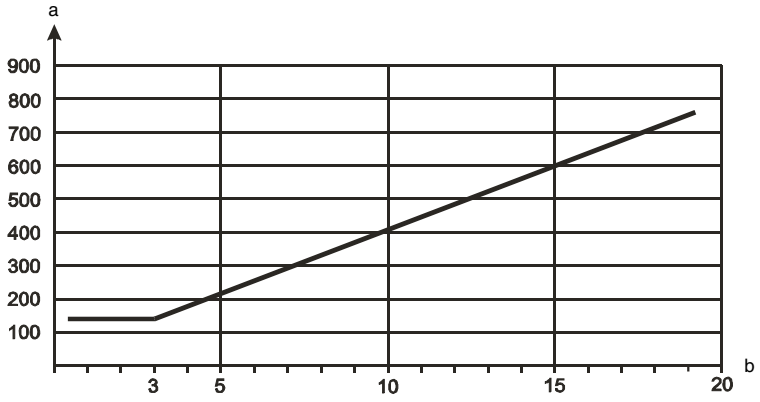
Warning!

Reflective surfaces near optical protective devices can indirectly deflect the transmitter's beams into the receiver. This can cause non-recognition of an object in the protective field! Therefore, all reflecting surfaces and objects (material containers, cans, etc.) must be kept at a minimum distance from the protective field. The minimum distance "a" is dependent on the distance "b" between the transmitter and the receiver.



a = Minimum distance to reflective surfaces
b = Protective field width
c = Reflecting surface

Fig. 6.1-3: Minimum distances to reflective surfaces



a = Required minimum distance to be maintained from reflecting surfaces [mm]
b = Protective field width [m]

Fig. 6.1-4: Minimum distance from reflective surfaces depending on protective field width

6.2 Mounting notes

Special notes on mounting of controlling Safety Light Curtains

- ➢ Calculate the safety distance according to the formula in Chapter 6.1.1.
- ➢ Please observe the special safety instructions on "controlling safety light curtains" in Chapter 2.5.
- ➢ Observe the safety distance between protective field and danger point(s) calculated in accordance with Chapter 6.1.
- ➢ Ensure that it is impossible to reach under, over, around or step behind the safety light curtain.
- ➢ If no mechanical protection against reaching over is planned: Ensure that the position of the highest light beam and therefore the protective field height complies with requirements in accordance with EN 294.
- ➢ Ensure that the transmitter and receiver are not set on the machining table, as with a smooth table, the danger of reflection exists for the lower beams. Transmitter and receiver must be mounted in front of the machining table.
- ➢ Observe the maximum distance between machining table and protective field, which may not be more than 75 mm. If the calculation of the safety distance calls for a greater distance, additional measures must be implemented against stepping behind, e.g. barriers or the use of a host/guest combination.
- ➢ If cycle control is used without additional monitoring of inner machine space, then further conditions must be observed: Machining table height ≥ 750 mm; machining table depth ≤ 1000 mm; stroke length of the tool ≤ 600 mm, so that a person cannot walk through the protective field.

6.3 Mechanical mounting

ⓘ With settings of functions using switches, it is best to do so before installation, as the transmitter and/or receiver should be opened in as clean a room as feasibly possible. It is therefore recommended that the necessary settings be made before starting installation (chap. 4 and 8).

What should generally be taken into consideration with mechanical mounting?

- ➢ With machines with which the optical components are set for shock loads, use the option of: Swivelling mounting brackets with shock absorber.
- ➢ Ensure that transmitter and receiver are mounted on an even surface.
- ➢ Transmitter and receiver must be mounted at the same height. Their connections must point in the same direction.
- ➢ When mounting, use screws that can only be loosened by a tool.
- ➢ Fix and secure the transmitter and receiver after alignment so that they cannot be turned or shifted. Fixing against turning is particularly important in the close range of less than 0.8m protective field width for safety reasons.

6.3.1 Standard mounting

Four standard mounting brackets (with sliding nuts and screws) are included in the delivery. If the shock and vibration load mentioned in the technical data is exceeded, swiveling brackets with shock absorbers must be used.

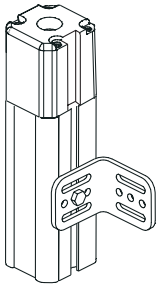


Fig. 6.3-1: Standard mounting bracket

6.3.2 Option: Mounting with swivelling brackets

Four swivelling brackets with shock absorbers can be ordered optionally. They are not included in the delivery. The swivel angle is ± 8°.

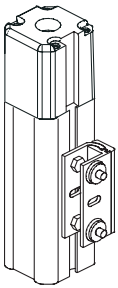


Fig. 6.3-2: Swivelling mounting bracket with shock absorber

7 Electrical connection

- The electrical connection must be performed by experienced personnel. Knowledge of all safety notes contained in these operating instructions is part of this competence.
- The external supply voltage of 24 V DC ± 20 % must guarantee safe isolation from the mains voltage and be able to bridge a power outage period of at least 20 ms for devices with transistor outputs. Leuze offers suitable power supplies (see list of accessories in the Appendix). It must supply load current reserve of at least 2 A. Transmitters and receivers must be fused against overcurrent.
- Basically both safety switch outputs OSSD1 and OSSD2 must be looped into the work circuit of the machine. Relay contacts must be externally protected by fuses (technical data, Chapter 12.1.6), in order to prevent the contacts from welding.
- Signal outputs may not be used for switching downstream safety circuits.
- The start-/restart button for unlocking the start-/restart interlock must be mounted in such a way that it cannot be reached from the danger zone and the entire danger zone is fully visible from its installation position.
- It is vital during the electrical installation that the power of the machine or system to be secured is switched off and locked, so that the dangerous movements cannot be started up again unintentionally.
- It must additionally be ensured with devices with safety-related relay outputs that the voltage feed to the relay contacts is also interrupted and secured against restarting. If this is not observed, the **danger of electric shock** from the adjacent voltages arises when opening devices!

All COMPACT*plus* receivers have a local interface and a machine interface. Optional local control elements and/or sensors can be connected to the local interface via an M12 connection. The cables required for this are listed as accessories in Chapter 13.2 and are not included in the delivery of the optical protective device.

The interface to the machine is available in the following design types:

Design type	Transmitter interface	Machine Interface Receiver	
	Connection system	Safety outputs:	Connection system
/T1	MG cable screw, M20x1.5 (standard)	Transistor	MG cable screw, M20x1.5
/T2	Hirschmann plug, 11-pin+FE	Transistor	Hirschmann plug, 11-pin+FE
/T3	MIN-series plug, 3-pin	Transistor	MIN-series plug, 7-pin
/T4	M12-plug 5-pin	Transistor	M12-plug, 8-pin
/R1	With transmitter /T1	Relay	MG cable screw, M25x1.5
/R2	With transmitter /T2	Relay	Hirschmann plug, 11-pin+FE
/R3	With transmitter /T3	Relay	MIN-series plug, 12-pin
/A1	M12 plug, 3-pin /AP	AS Interface Safety at Work	M12 plug, 5-pin
/P1	With transmitter /AP or /T4	PROFIBUS DP PROFIsafe	3 cable tails with M12-plug and socket 5-pin

Table 7.0-1: Machine interface selection table

Note!

Information on connecting further interface versions can be found, if required, on an attached data sheet or in additional connecting and operating instructions.

7.1 Receiver – Local Interface

One characteristic of all COMPACT*plus* receivers is the 8-pin M12 local connection socket in the connection cap. This makes it possible to have short cables leading to components in the immediate vicinity of the optical protective device. Included in the COMPACT*plus*-i version are the start/restart button, the machine control signal for cycle clearing (clear), the optional cycle release signal (CSC) and the external machine mode keyed switch.

7.1.1 Local connection socket

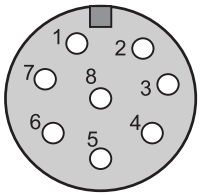
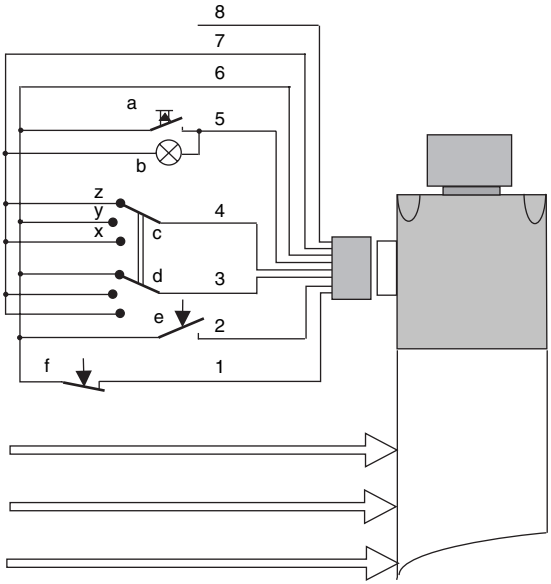


Fig. 7.1-1: Receiver local connection socket, M12 8-pin

Pin	Cable color*)	Assignment		Inputs/outputs (FS), can be differently arranged via SafetyLab
1	White	⇐	L1, local input	CLEAR: Machine control signal for cycle clearing Interruption ≥ 60 ms required
2	Brown	⇔	L2, local input/output	Optional cycle release signal, CSC (Cycle Start Control), if switch S6 = R or parameterized via SafetyLab. The circuit must be closed to release the machine movement.
3	Green	⇐	L3, local input	External operating mode selection switch, level I, if S4/S5 = R/R or parameterized via SafetyLab.
4	Yellow	⇐	L4, local input	External operating mode selection switch, level II, if S4/S5 = R/R or parameterized via SafetyLab.
5	Gray	⇔	L5, local input/output	RES_L: Start/restart button, local Output: Number of intrusions to be expected, blinks briefly, like LED3 (yellow).
6	Pink	⇒	Local output	+24 V DC
7	Blue	⇒	Local output	0 V
8	Red	⇒	Local output	FE, functional earth

*) Cables are not included in the delivery, see table 13.2-1 for accessories

Table 7.1-1: Local connection socket, 8-pin cable connector assignment



1 to 8 =PIN number of the local connection socket
a = Start/restart button
b = Lamp, e.g. for start/restart button
c = Operating mode selection switch (keyed switch), level I
d = Operating mode selection switch (keyed switch), level II
e = Optional cycle release signal (Cycle Start Control)
f = Machine signal cycle clearing (Clear)
x = P0, guard-only mode setting
y = P1, single-break operation setting
z = P2, double-break operation setting

Fig. 7.1-2: Example connection, local connection socket

7.2 Standard: Machine interface/T1, MG cable screw M20x1.5

7.2.1 Transmitter interface /T1

The terminal field for the transmitter connection cable is located inside the connection cap.

➢ After you have loosened the 4 fastening screws, pull the connection cap out in a straight direction. Use insulated conductor sleeves.

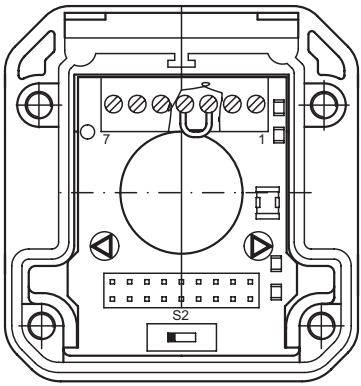


Fig. 7.2-1: Transmitter connection cap /T1 removed, inside view/terminal field

Terminal	Assignment		Inputs/outputs	
1	⇐	Power supply	+24 V DC	
2	⇐	Power supply	0 V	
3	⇒	Test out	Jumper to 4	Jumper set in factory
4	⇐	Test in	Jumper to 3	
5		Reserved		
6		Reserved		
7	⇐	Functional earth, shield	FE	

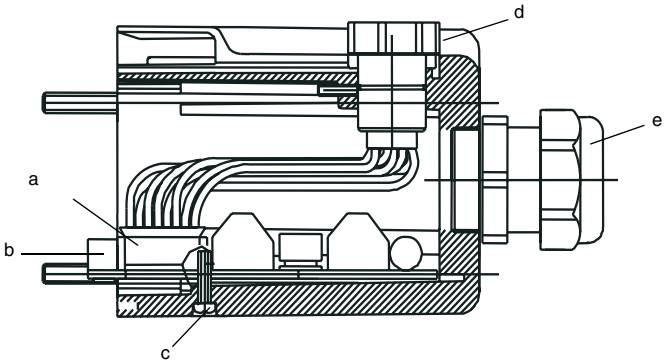
Table 7.2-1: Transmitter interface /T1 – terminal field connection assignment

7.2.2 Receiver machine interface /T1

The connecting circuit board with the terminal field for the machine interface connection cable fixed with the M20x1.5 cable screw is located inside the connection cap.

➢ After you have loosened the 4 fastening screws, pull the connection cap out in a straight direction.

➢ Loosen the fixing screw on the rear side of the connection cap and slightly pull out the connecting circuit board.



a = Plug connection for the cable to the local connection socket
b = Connecting circuit board
c = Fixing screw
d = Local connection socket
e = Cable screw M20x1.5

Fig. 7.2-2: Receiver cap /T1, removed

➢ If required, loosen the plug connection for the cable to the local connection socket.

➢ Pull the circuit board out completely, the connecting terminals are now free.

➢ Use insulated conductor sleeves.

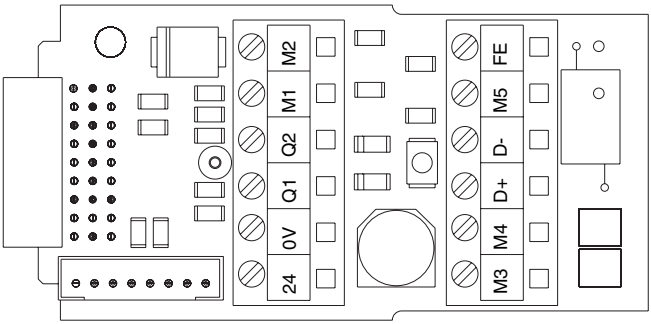
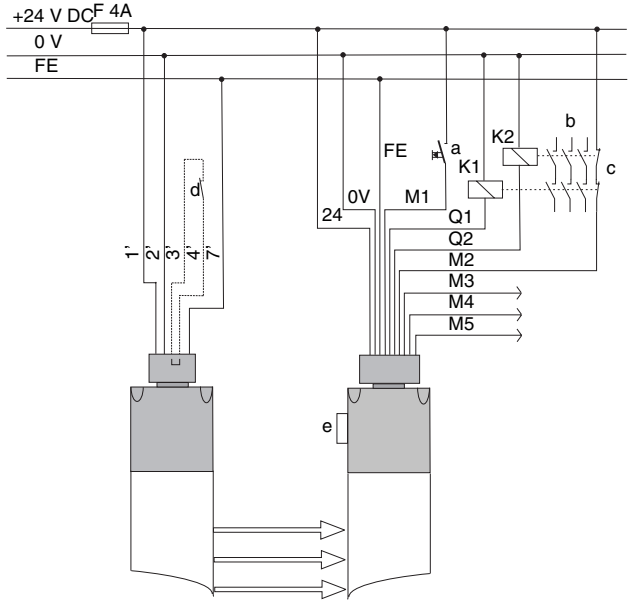


Fig. 7.2-3: Receiver machine interface /T1, terminal field

Terminal	Assignment		Inputs/outputs M1 .. M5 (FS) can be differently arranged via SafetyLab
24	⇐	Supply voltage	+24 V DC
0V	⇐	Supply voltage	0 V
Q1	⇒	OSSD1 Output	Transistor output
Q2	⇒	OSSD2 Output	Transistor output
M1	⇐	M1 input	RES_M, machine interface start button*)
M2	⇐	M2 input	EDM, contactor monitoring against +24 V DC
M3	⇔	M3 input/output	Active protective field free, number of expected intrusions (blinks briefly like yellow LED3)
M4	⇔	M4 input/output	Collective malfunction/dirt signal
D+		Reserved	
D-		Reserved	
M5	⇔	M5 input/output	Free
FE	⇐	Functional earth, shield	FE

*) Alternative to L5 of the local interface: Start/restart button on the machine interface (M1), in FS same effect as via L5

Table 7.2-2: Receiver machine interface /T1, connection assignment, terminal field



a = Start/restart button, alternative to L5
b = Release circuits
c = EDM, feedback contacts contactor monitoring
d = Optional: External test, if factory-set jumper is removed
e = Local connection socket
1' to 4', 7' = Transmitter terminal field numbers

ⓘ Shielded connection cables are recommended for extreme electromagnetic interferences. The shield should be connected with FE on a large surface.
The safety-related transistor outputs carry out the spark extinction. With devices with transistor outputs, it is therefore not necessary to use the spark extinction elements recommended by contactor/valve manufacturers etc. (RC modules, varistors or recovery diodes). These extend the delay times of inductive switching elements.

Fig. 7.2-4: Connection example, machine interface /T1 – MG cable screw M20x1.5

7.3 Option: Machine interface /T2, Hirschmann plug, M26 11-pin+FE

The COMPACT*plus*/T2 device design is equipped to connect both the transmitter interface and receiver machine interface with a 12-pin Hirschmann plug. This has no effect on the option of connecting local control elements or additional sensor equipment to the local interface, as described in Chapter 7.1. The corresponding cable sockets in straight or angled version incl. crimp contacts and complete connection cable in varying lengths are available as accessories.

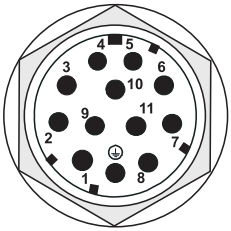


Fig. 7.3-1: Transmitter and receiver machine interface /T2 (view of the pins)

7.3.1 Transmitter interface /T2

Pin	Wire colors CB-8N-xxxxx-12GF	Assignment		Inputs/outputs	
1	Brown	⇐	Power supply	+24 V DC	
2	Pink	⇐	Power supply	0 V	
3	Blue	⇒	Test out	External Jumper to 4	Factory setting: **No** internal jumper set
4	Gray	⇐	Test in	External Jumper to 3	
5	Black		Reserved		
6	Orange		Reserved		
7	Red		Reserved		
8	Purple		Reserved		
9	White		Reserved		
10	Beige		Reserved		
11	Clear		Reserved		
⏚	Green/yellow	⇐	Functional earth, shield	FE	

Table 7.3-1: Transmitter interface /T2, Hirschmann cable socket connection assignment

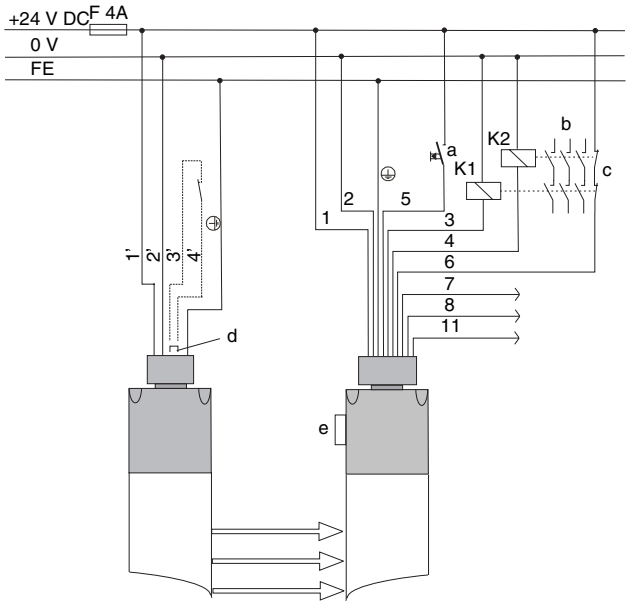
7.3.2 Receiver machine interface /T2

The receiver has safety-related transistor outputs.

Pin	Wire colors CB-8N-xxxxx-12GF	Assignment		Inputs/outputs M1 ... M5 (FS), can be differently arranged via SafetyLab
1	Brown	⇐	Supply voltage	+24 V DC
2	Pink	⇐	Supply voltage	0 V
3	Blue	⇒	OSSD1 Output	Transistor output
4	Gray	⇒	OSSD2 Output	Transistor output
5	Black	⇐	M1 input	RES_M, start/restart button, machine interface*)
6	Orange	⇐	M2 input	EDM, contactor monitoring against +24 V DC
7	Red	⇔	M3 input/output	Active protective field free, number of expected intrusions (blinks briefly like yellow LED3)
8	Purple	⇔	M4 input/output	Collective malfunction/dirt signal
9	White		Reserved	
10	Beige		Reserved	
11	Clear	⇔	M5 input/output	free
⏚	Green/yellow	⇐	Functional earth, shield	FE

*) Alternative to L5 of the local interface: Start/restart button, machine interface M1, in FS same effect as via L5

Table 7.3-2: Receiver machine interface /T2, Hirschmann cable socket connection assignment



a = Start/restart button, alternative to L5
b = Release circuits
c = EDM, feedback contacts contactor monitoring
d = Optional: External test, if factory-set jumper is removed
e = Local connection socket (see Chapter 7.1)
1' to 4', ⏚
= Pin numbers, Hirschmann plug, transmitter
1 to 8, 11 ⏚
= Pin numbers, Hirschmann plug, receiver

ⓘ Shielded connection cables are recommended for extreme electromagnetic interferences. The shield should be connected with FE on a large surface.
The safety-related transistor outputs carry out the spark extinction. With devices with transistor outputs, it is therefore not necessary to use the spark extinction elements recommended by contactor/valve manufacturers etc. (RC modules, varistors or recovery diodes). These extend the delay times of inductive switching elements.

Fig. 7.3-2: Connection example, machine interface /T2, Hirschmann plug

7.4 Option: Machine interface /T3, MIN-series plug

The COMPACT*plus*/T3 design type is equipped to connect the transmitter with a 3-pin and the receiver machine interface with a 7-pin MIN-series plug. This has no effect on the option of connecting local control elements or additional sensor equipment to the local interface, as described in Chapter 7.1. Connection cables are not included in the delivery.

7.4.1 Transmitter interface /T3

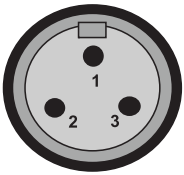


Fig. 7.4-1: Transmitter interface /T3, MIN-series (view of the pins)

Pin	Wire Color	Assignment		Inputs
1	Green	⇐	Functional earth, shield	FE
2	Black	⇐	Supply voltage	0 V
3	White	⇐	Supply voltage	+24 V DC

Table 7.4-1: Transmitter interface /T3, connection assignment, MIN-series cable socket, 3-pin

7.4.2 Receiver machine interface /T3

The receiver has safety related transistor outputs.

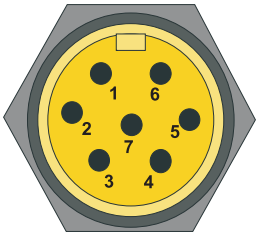
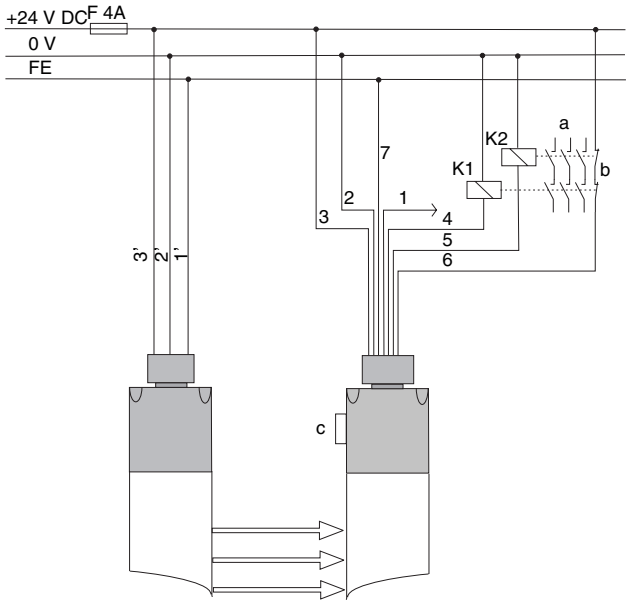


Fig. 7.4-2: Machine interface /T3, MIN-series (view of the pins)

Pin	Wire Color	Assignment		**Inputs/outputs** M2, M3 (FS), can be differently arranged via SafetyLab
1	White/black	⇔	M3 input/output	Active protective field free
2	Black	⇐	Power supply	0 V
3	White	⇐	Power supply	+24 V DC
4	Red	⇒	OSSD1 Output	Transistor output
5	Orange	⇒	OSSD2 Output	Transistor output
6	Blue	⇐	M2 input	EDM, contactor monitoring against +24 V DC
7	Green	⇐	Functional earth, shield	FE

Table 7.4-2: Receiver machine interface /T3, connection assignment, MIN-series cable socket, 7-pin



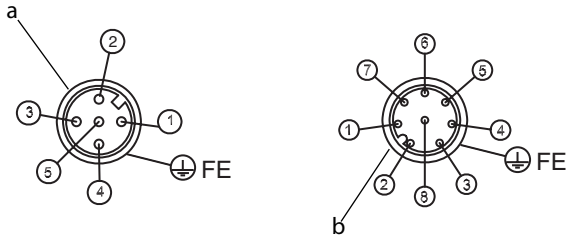
a = Release circuit
b = EDM, feedback contacts contactor monitoring
c = Local connection socket
1‘ to 3‘
= Pin numbers, MIN-series plug, 3-pin, transmitter
1 to 7
= Pin numbers, MIN-series plug, 7-pin, receiver

ⓘ Shielded connection cables are recommended for extreme electromagnetic interferences. The shield should be connected with FE on a large surface.
The safety-related transistor outputs carry out the spark extinction. With devices with transistor outputs, it is therefore not necessary to use the spark extinction elements recommended by contactor/valve manufacturers etc. (RC modules, varistors or recovery diodes). These extend the delay times of inductive switching elements.

Fig. 7.4-3: Connection example, machine interface /T3, MIN-series plug

7.5 Option: Machine interface /T4, M12 plug

The COMPACTplus/T4 design type is equipped to connect the transmitter interface with an 5-pin M12 plug and the receiver machine interface with an 8-pin M12 plug. Connection cables in different lengths are available.



a = Transmitter encoding
b = Receiver encoding

Fig. 7.5-1: Transmitter and receiver machine interface /T4 (view of the pins)

7.5.1 Transmitter interface /T4

Pin	Wire colors CB-M12-xxxxS-5GF	Assignment		Inputs/outputs
1	brown	⇐	Supply voltage	24 V DC
2	white	⇒	Test out	ext. jumper to 4
3	blue	⇐	Supply voltage	0 V
4	black	⇐	Test in	ext. jumper to 2
5	Shield		Functional earth, shield	FE

Table 7.5-1: Transmitter interface /T4 connection assignment M12 plug

7.5.2 Receiver machine interface /T4

The receiver has safety-related transistor outputs.

Pin	Wire colors CB-M12-xxxxxS-8GF	Assignment		Inputs/outputs M2, M4, M5 (WE), adjustable by Safetylab
1	White	⇐ ⇒	M4 input/output	Collective malfunction/dirt signal
2	Brown	⇐	Supply voltage	24 V DC
3	Green	⇐	M2 input	EDM, contactor monitoring against 24 V DC
4	Yellow		M5 input/output	free
5	Gray	⇒	OSSD1 output	Transistor output
6	Pink	⇒	OSSD2 output	Transistor output
7	Blue	⇐	Supply voltage	0 V
8	Shield	⇐	Functional earth, shield	FE

Table 7.5-2: Receiver machine interface /T4 connection assignment M12 plug

7.6 Option: Machine interface /R1, MG cable screw M25x1.5

This version of the machine interface is characterized by relay outputs and cable screws on the connection caps in the transmitter and receiver. This has no effect on the option of connecting local control elements or additional sensor equipment to the local interface, as described in Chapter 7.1.

Warning!

It applies with relay outputs that: The cable or cables for machine control must generally be laid with protected installation in a cable duct or with armor in such a way that cross-connections between the cable wires can be safely ruled out.

7.6.1 Transmitter interface /T1

A separate transmitter for devices with relay outputs is not available. The corresponding transmitter /T1 also equipped with cable screw is used (see Chapter 7.2.1).

7.6.2 Receiver machine interface /R1

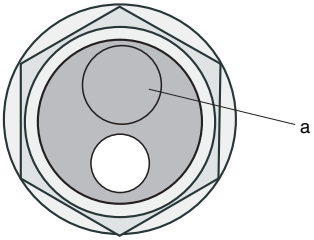
The design type COMPACT*plus*/R1 has 2 relay outputs (2 potential-free N/O contacts) and is equipped with a cable screw connection for connecting to the machine interface. The seal in the cable screw has an ex-factory lead-in opening. If protective extra low voltages of up to 42 V are switched, then **one** cable with up to 12 wires can be pulled through here.

Warning!

The current path via the relay contacts of the AOPD must be compulsorily protected to prevent the contacts welding in the event of an overcurrent. The fuse sizes depend on the load. They are provided in Tab. 12.1-7, Technical data.

Warning!

For higher voltages of up to 250 V AC, the load circuit must be separated from the voltage supply and the status signals. In this case ***two*** *cables must be routed through the cable screw; the second lead-in opening has already been prepared and must now only be pushed through.*

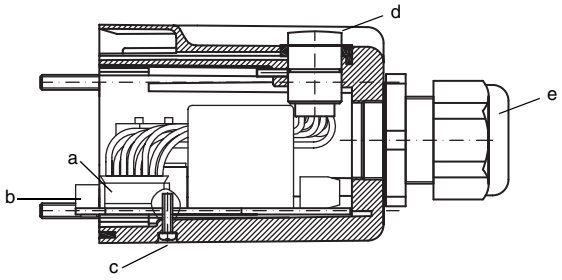


a = Just push opening through when a separate connection cable for the load circuit is to be connected.

Fig. 7.6-1: Cable screw M25x1.5, application prepared for connecting 2 cables

To connect:

- ➢ After you have loosened the 4 fastening screws, pull the connection cap out in a straight direction.
- ➢ Loosen the fixing screw on the rear side of the connection cap and slightly pull out the connecting circuit board.
- ➢ If required, loosen the plug connection for the cable to the 8-pin M12 local connection socket.
- ➢ Pull the circuit board out completely, the connecting terminals are now free.
- ➢ Use insulated conductor sleeves.



a = Plug connection for the cable to the local connection socket
b = Relay circuit board connection
c = Fixing screw
d = Local connection socket
e = Cable screw M25x1.5

Fig. 7.6-2: Receiver cap /R1, removed

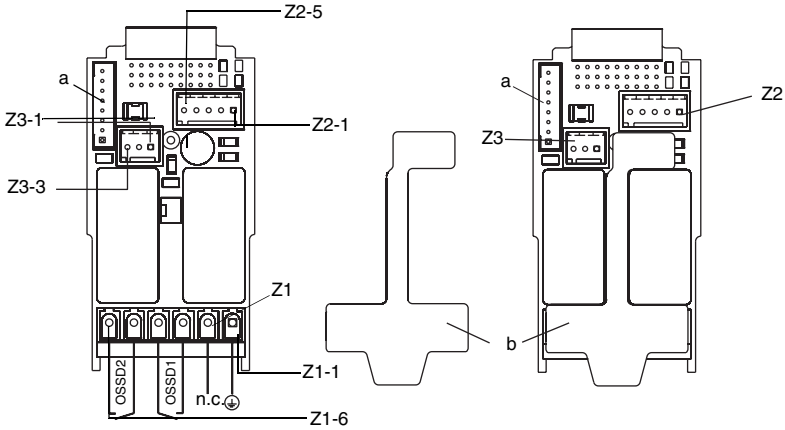
A relay circuit board, to which the load lines (Z1-1 to 6), signal lines (Z2-1 to 5) and power supply lines (Z3-1 to 3) must be connected, is located in the connection cap.

➢ If required, pull plug a, cable to local connection socket.
Remove insulating plate b, connect load lines to Z1.
With switching voltages over 42V, use lead-in with two openings and separate cable for the load line. Connect PE to Z1-1.

➢ Insert insulting plate so that an insulation is provided between load line and the other lines.

➢ Connect signal and power supply line to Z2 and Z3. If PE has to be connected, the FE must not be connected to Z3-1.

➢ If required, re-connect plug for cable to local connection socket again.



a = Plug connection for cable to local connection socket.
b = Insulating plate
Z1= Load circuit connection
Z2= Signal connection
Z3= Supply voltage connection

Fig. 7.6-3: Receiver machine interface /R1, terminal field (terminal 1 marked accordingly)

The cable(s) is/are connected to the three terminal blocks as follows:

Z1: Load circuit connection

Warning!

*If voltages U > 42V AC/DC are to be switched, a **separate cable** must be routed through the second opening of the MG screw intended for this purpose! Instead of the FE connection at Z3-1, PE connection at Z1-1 is required.*

Terminal	Assignment		
Z1-1	⇐	PE, protective earth, shield, to be connected with switching voltages >42V AC/DC (in this case FE, functional earth connection to Z3-1 must not be connected)	
Z1-2		Free	
Z1-3	⇐	OSSD1A, relay 1, terminal A	Potential-free N/O contact Technical data, see Chapter 12.1.7
Z1-4	⇒	OSSD1B, relay 1, terminal B	
Z1-5	⇐	OSSD2A, relay 2, terminal A,	Potential-free N/O contact Technical data, see Chapter 12.1.7
Z1-6	⇒	OSSD2B, relay 2, terminal B	

Z2: Signal connection

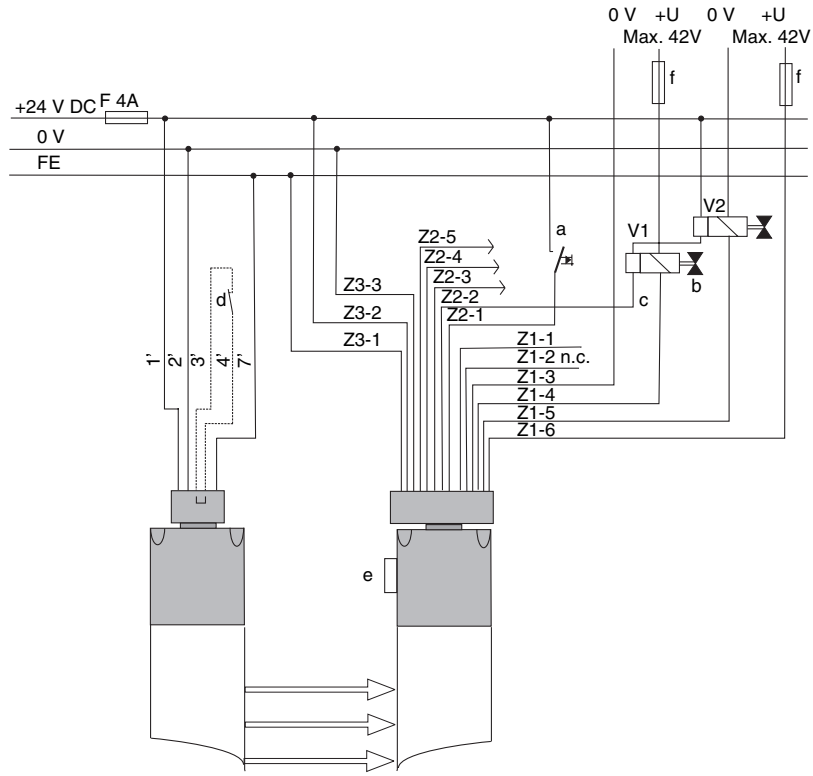
Pin	Assignment		**Inputs/outputs** M1 to M5 (FS), can be differently arranged via SafetyLab
Z2-1	⇐	M1 input	RES_M, start/restart button, machine interface*)
Z2-2	⇐	M2 input	EDM, contactor monitoring against +24 V DC
Z2-3	⇔	M3 input/output	Active protective field free/ready for unlocking
Z2-4	⇔	M4 input/output	Collective malfunction/dirt signal
Z2-5	⇔	M5 input/output	Free

*) Alternative to L5 of the local interface: Start/restart button, machine interface M1, same effect in FS as via L5

Z3: Supply voltage connection

Pin	Assignment	
Z3-1	⇐	FE, functional earth, shield, to be connected with switching voltages of up to 42VAC/DC (in this case PE, protective earth connection to Z1-1 must not be connected)
Z3-2	⇐	Power supply +24 V DC
Z3-3	⇐	Power supply 0 V

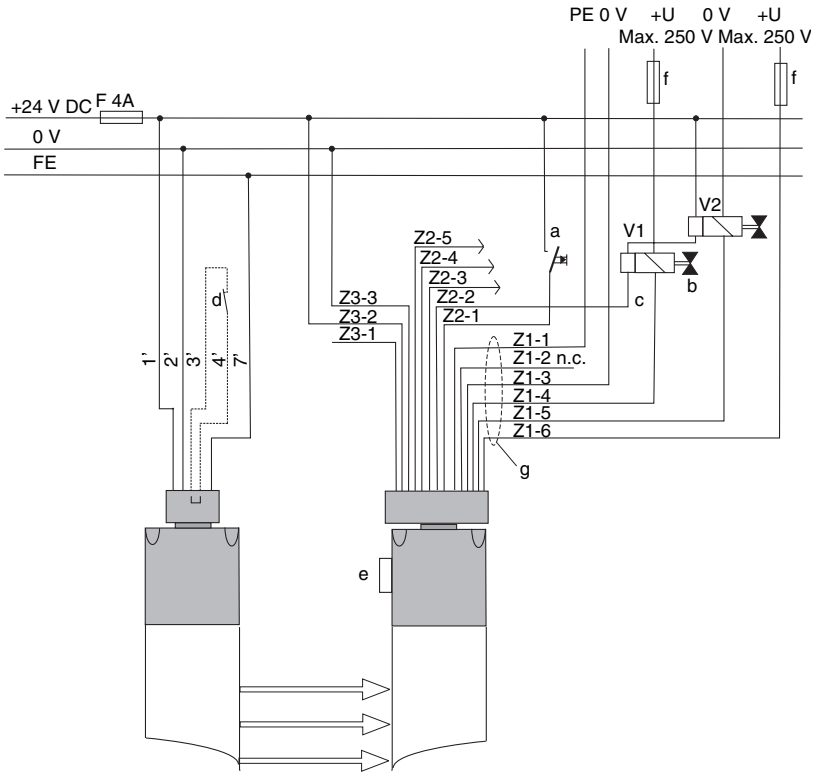
Table 7.6-1: Receiver machine interface /R1, terminal fields connection assignment Z1 to Z3



a = Start/restart button, alternative to L5
b = Release circuits, safety valves V1 and V2 must be selected in such a way that at ½ Umax they are sure not to pull, and should they be pulled, they are sure to release! Suitable spark extinction elements must be planned parallel to the spooling of V1 and V2.
c = EDM, feedback contacts, valve monitoring
d = Optional: External test, if factory-set jumper is removed
e = Local connection socket
f = Fuse for protecting the normally open contacts, for sizes see technical data Chapter 12.1.7
Z1-, Z2- and Z3-
= Terminal numbers of the blocks Z1, Z2 and Z3
1‘ to 4‘, 7‘
= Transmitter terminal numbers

ⓘ The connection cables must be routed in a strong conduit so that mechanical damage is prevented. Shielded connection cables are recommended for extreme electromagnetic interferences. The shield should be connected with FE on a large surface.

Fig. 7.6-4: Connection example, machine interface /R1, MG25 x 1.5 switching voltages up to 42V AC/DC



a = Start/restart button, alternative to L5
b = Release circuits, safety valves V1 and V2 must be selected in such a way that at ½ Umax they are sure not to pull, and should they be pulled, they are sure to release! Suitable spark extinction elements must be planned parallel to the spooling of V1 and V2.
c = EDM, feedback contacts, valve monitoring
d = Optional: External test, if factory-set jumper is removed
e = Local connection socket
f = Fuse for protecting the normally open contacts, for sizes see technical data, Chapter 12.1.6
g = Separate cable, required with switching voltages > 42V AC/DC
Z1-, Z2- and Z3-
= Terminal numbers of the blocks Z1, Z2 and Z3
1' to 4', 7'
= Transmitter terminal numbers

ⓘ The connection cables must be routed in a strong conduit so that mechanical damage is prevented. Shielded connection cables are recommended for extreme electromagnetic interferences. The shield should be connected with FE on a large surface.

Fig. 7.6-5: Connection example, machine interface /R1, MG25 x 1.5 switching voltage over 42V AC/DC

7.7 Option: Machine interface /R2, Hirschmann plug, M26 11-pin+FE

The design type COMPACT*plus*/R2 has 2 relay outputs and is equipped with a Hirschmann plug, M26 11-pin+FE in the connection cap for the connection to the machine interface. This has no effect on the option of connecting local control elements or additional sensor equipment to the local interface, as described in Chapter 7.1. The corresponding cable socket in straight or angled version incl. crimp contacts and ready prepared connection cable in varying lengths are available as accessories.

Warning!

It applies with safety-related outputs that: The cable for machine control must generally be laid with protected installation in a cable duct or with armor in such a way that cross-connections between the cable wires can be safely ruled out.

7.7.1 Transmitter interface /T2

A separate transmitter for devices with safety-related outputs is not available. The corresponding transmitter /T2 also equipped with Hirschmann plug, M26 11-pin+FE is used (see Chapter 7.3.1)

7.7.2 Receiver machine interface /R2

The receiver has safety-related relay outputs.

Warning!

The machine interface /R2 is suitable for switching U max. = 42V. Only version /R1 with MG cable screw and separate connection cable is suitable for higher switching voltages. The current path via the relay contacts of the AOPD must be compulsorily protected to prevent the contacts from welding together. The respective fuse size depends on the load. This can be found in the technical data, Chapter 12.1.7.

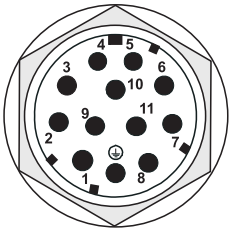


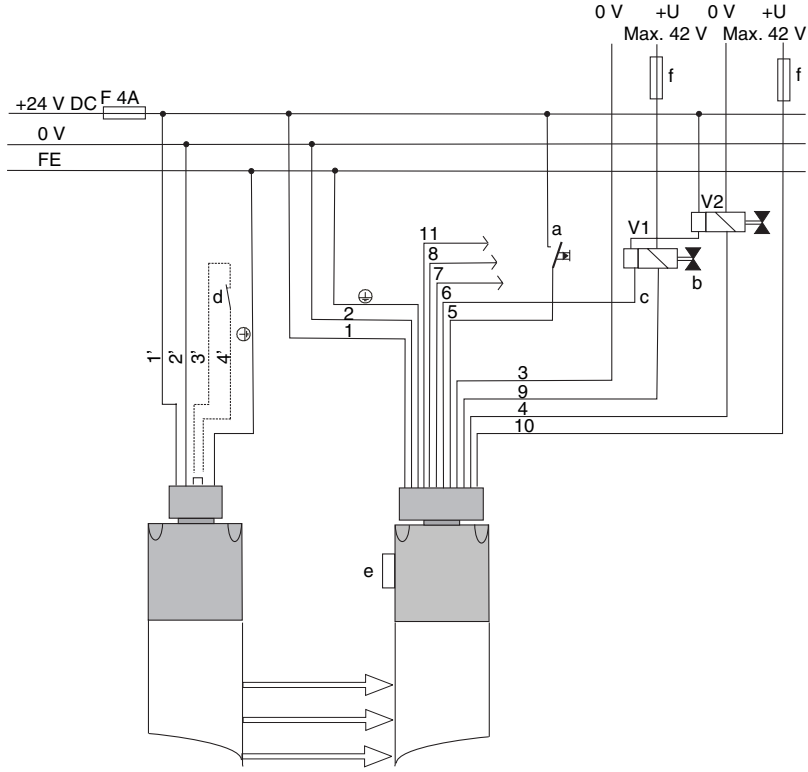
Fig. 7.7-1: Receiver machine interface /R2, Hirschmann plug (view of the pins)

The plug is assigned as follows:

Pin	Wire colors CB-8N-xxxxx-12GF	Assignment		Inputs/outputs M1...M5 (FS), can be differently arranged via Safety-Lab
1	Brown	⇐	Supply voltage	+24 V DC
2	Pink	⇐	Supply voltage	0 V
3	Blue	⇐	Relay 1, terminal A Max. switching voltage 42V Potential-free normally open contact	OSSD1A
4	Gray	⇐	Relay 2, terminal A Max. switching voltage 42V Potential-free normally open contact	OSSD2A
5	Black	⇐	M1 input	RES_M, machine interface start button*)
6	Orange	⇐	M2 input	EDM, contactor monitoring against +24 V DC
7	Red	⇔	M3 input/output	Active protective field free/ ready for unlocking
8	Purple	⇔	M4 input/output	Collective malfunction/dirt signal
9	White	⇒	Relay 1, terminal B	OSSD1B
10	Beige	⇒	Relay 2, terminal B	OSSD2B
11	Clear	⇔	M5 input/output	Free
⏚	Green/yellow	⇐	Functional earth, shield	FE

*) Alternative to L5 of the local interface: Start/restart button, machine interface M1, same effect in FS as via L5

Table 7.7-1: Receiver machine interface /R2, Hirschmann cable socket connection assignment



a = Start/restart button, alternative to L5
b = Release circuits, safety valves V1 and V2 must be selected in such a way that at ½ Umax they are sure not to pull, and should they be pulled, they are sure to release! Suitable spark extinction elements must be planned parallel to the spooling of V1 and V2.
c = EDM, feedback contacts, valve monitoring
d = Optional: External test, if factory-set jumper is removed
e = Local connection socket
f = Fuse for protecting the normally open contacts, for sizes see technical data, Chapter 12.1.6
1‘ to 4‘, ⏚
= Pin numbers, Hirschmann plug, transmitter
1 to 11, ⏚
= Pin numbers, Hirschmann plug, receiver

ⓘ The connection cables must be routed in a strong conduit so that mechanical damage is prevented. Shielded connection cables are recommended for extreme electromagnetic interferences. The shield should be connected with FE on a large surface.

Fig. 7.7-2: Example connection machine interface /R2, Hirschmann plug

7.8 Option: Machine interface /R3, MIN-series plug

The design type COMPACT*plus*/R3 has 2 relay outputs and is equipped with MIN-series plug in the connection cap for the connection to the machine interface. This has no effect on the option of connecting local control elements or additional sensor equipment to the local interface, as described in Chapter 7.1.

Warning!

It applies with relay outputs that: The cable for machine control must generally be laid with protected installation in a cable duct or with armor in such a way that cross-connections of the cable wires can be safely ruled out.

7.8.1 Transmitter interface /T3

A separate transmitter for devices with safety-related outputs is not available. The corresponding transmitter /T3 with 3-pin MIN-series plug is used (see 7.4.1)

7.8.2 Receiver machine interface /R3

The receiver has safety-related relay outputs.

Warning!

The machine interface /R3 is suitable for switching U max. = 42V. Only version /R1 with MG cable screw and separate connection cable is suitable for higher switching voltages. The current path via the relay contacts of the AOPD must be compulsorily protected to prevent the contacts from welding together. The respective fuse size depends on the load. This can be found in the technical data, Tab. 12.1.7.

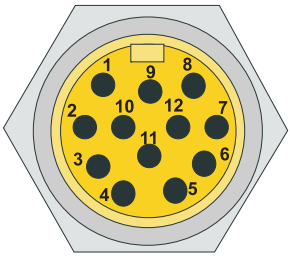


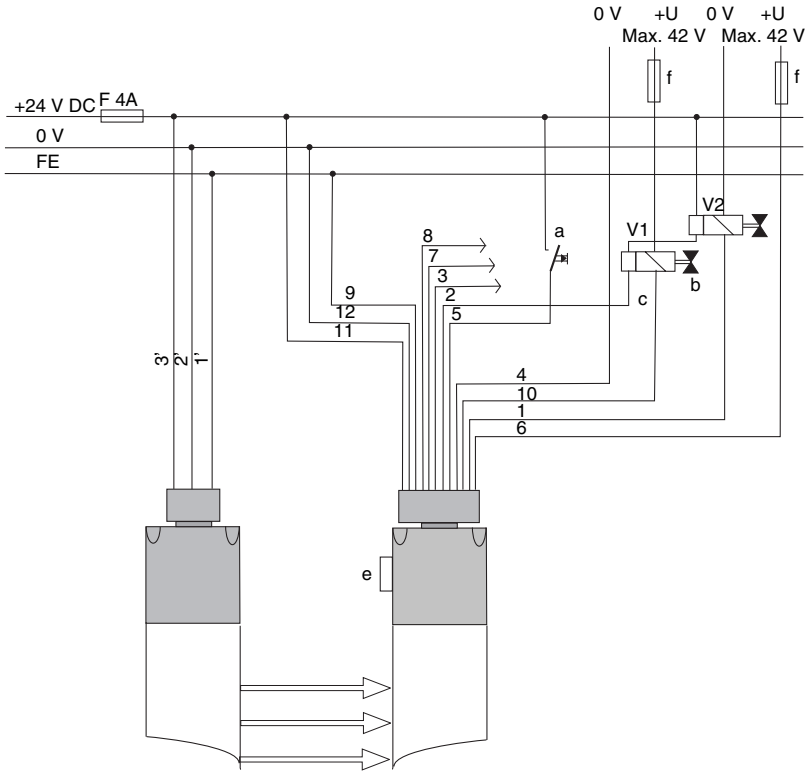
Fig. 7.8-1: Receiver machine interface /R3, MIN-series device plug (view of the pins)

The plug is assigned as follows:

Pin	Wire colors	Assignment		Inputs/outputs M1...M5 (FS), can be differently arranged via Safety-Lab
1	Orange	⇐	Relay 2, terminal A Max. switching voltage 42V	OSSD2A
2	Blue	⇐	M2 input	EDM, contactor monitoring against +24 V DC
3	White/black	⇔	M3 input/output	Active protective field free/ ready for unlocking
4	Red/black	⇒	Relay 1, terminal B Max. switching voltage 42V	OSSD1B
5	Green/black	⇐	M1 input	RES_M, start/restart button, machine interface*)
6	Orange/black	⇒	Relay 2, terminal B	OSSD2B
7	Blue/black	⇔	M4 input/output	Collective malfunction/dirt signal
8	Black/white	⇔	M5 input/output	Free
9	Green/yellow	⇐	Functional earth, shield	FE
10	Red	⇐	Relay 1, terminal A	OSSD1A
11	White	⇐	Supply voltage	+24 V DC
12	Black	⇐	Supply voltage	0 V

*) Alternative to L5 of the local interface: Start/restart button, machine interface M1, same effect in FS as via L5

Table 7.8-1: Receiver machine interface /R3, 12-pin MIN-series cable socket connection assignment



a = Start/restart button
b = Release circuits, safety valves V1 and V2 must be selected in such a way that at ½ Umax they are sure not to pull, and should they be pulled, they are sure to release!
c = EDM, feedback contacts, valve monitoring
e = Local connection socket
f = Fuse for protecting the normally open contacts, for sizes see technical data, Chapter 12.1.6
1‘ to 3‘
= Pin numbers, 3-pin MIN-series plug, transmitter
1 to 12
= Pin numbers, 12-pin MIN-series plug, receiver

ⓘ Shielded connection cables are recommended for extreme electromagnetic interferences. The shield should be connected with FE on a large surface.

Fig. 7.8-2: Connection example, machine interface /R3, MIN-series plug

7.9 Option: Machine interface /A1, AS-i Safety at Work

The COMPACT*plus-s*/A1 design type is equipped to connect the transmitter and the receiver/transceiver machine interface on the AS-I bus system with a 5-pin M12 plug in the connection cap.

7.9.1 Transmitter interface /AP

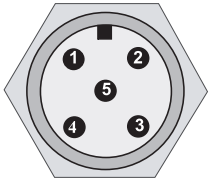
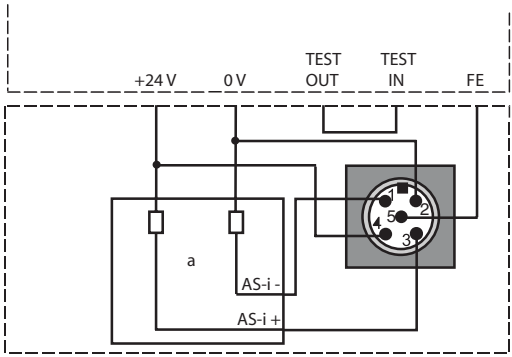


Fig. 7.9-1: Transmitter interface /AP, device plug M12 5-pin (view of the pins)

Pin	Assignment
1	AS-i +
2	0 V auxiliary supply
3	AS-i –
4	+24 V DC auxiliary supply
5	FE

Table 7.9-1: Transmitter interface /AP, 5-pin M12 plug signal assignment



a = Decoupling electronics

Fig. 7.9-2: Transmitter interface /AP, schematic structure

Note!

The transmitter can be supplied either from the yellow AS-i cable or by a separate 24V power supply line. Concurrent connection of all lines is not allowed. If power supply from the AS-i cable is used, grounding has to be done over a sliding nut and the housing. If power supply via pin 2 and 4 is used, use pin 5 for grounding.

7.9.2 Receiver machine interface /A1

It must be ensured that the supply voltage for the receiver cannot be taken from the standard AS-i line. 24 V DC must be fed via pins 2 and 4 for the receiver. A suitable AS-i adapter for bus connection and 24V voltage supply, AC-PDA1/A, is available as an accessory, which feeds the separately laid AS-i data and power supply line to an M12 connection socket so that the receiver can be connected via a standard M12 extension cable with 1:1 connection.

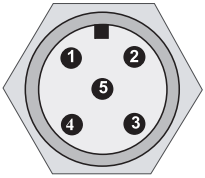


Fig. 7.9-3: Machine interface /A1, 5-pin M12 plug signal assignment (view of the pins)

Pin	Assignment
1	AS-i +
2	0 V auxiliary supply
3	AS-i –
4	+24 V DC auxiliary supply
5	FE

Table 7.9-2: Machine interface /A1, 5-pin cable socket connection assignment

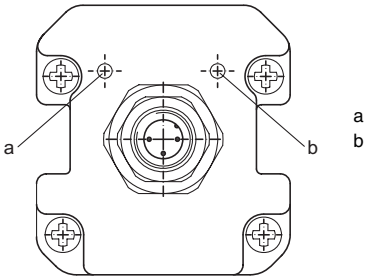


Fig. 7.9-4: Receiver connection cap, switch positions

LED green „PWR“	LED red „Fault“	Meaning	Activity
On	Off	AS-i communication without faults	None
Flashing	On	Receiver has AS-i address 0	Assign valid address
On	On	No communication with AS-i master, because: - Master not connected with AS-i - Device has wrong AS-i address - Wrong slave profile expected in the AS-i master	- Ensure AS-i master connection with AS-i - Correct device's AS-i address - Set AS-i profile in the master again
On	Flashing	Device fault, AS-i connection defective	Replace device
Off	*	No AS-i power on yellow AS-i cable	Ensure connection of the AS-i power supply and the device to the AS-i cable

Table 7.9-3: Maschine interface /A1, meaning of LEDs

The machine interface /A1 delivers the AS-i Safety at Work-specific code sequence, which the AS-i safety monitor learns and permanently monitors. Additionally, the bus master has the option via the parameter port of reading the outputs M3 and M4 diagnostic data and of writing control data via the cyclic output data to the inputs M1, M2 and M5. The meaning of the signals can be changed via the Diagnostics and Parameterization Software, SafetyLab. Set ex-factory is:

Assignment		Bit	Factory setting of the signal assignment
⇐	M1 input	D0	"Start button" input in all function packages, however may not be used via AS-i for safety reasons, and therefore is ignored in this function by the device. This signal input can otherwise be assigned by SafetyLab.
⇐	M2 input	D1	"Contactor monitoring" input in all function packages. This function is usually implemented in the safety monitor. This signal input can otherwise be assigned by SafetyLab.
⇐	M5 input	D2	SafetyLab must not make any assignment.
⇒	M3 output	P0	Active protective field free / ready for unlocking
⇒	M4 output	P1	Fault, dirt or failure

Table 7.9-4: Machine interface /A1, status signal assignment factory setting

The machine interface /A1 has the following internal schematic structure. The data port and the parameter port of the AS-i IC are both shown.

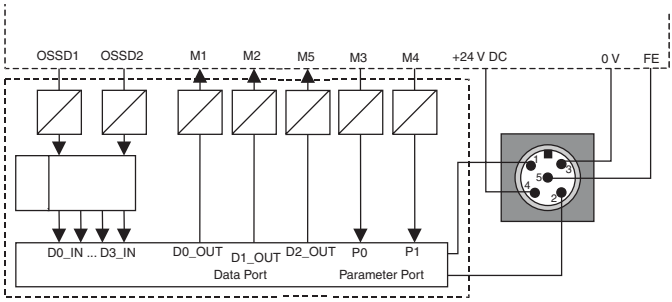


Fig. 7.9-5: Machine interface /A1, schematic structure

The potential separated OSSD outputs control the generator for the code sequence, which supplies the cyclically changing 4 output data bits as long as both OSSD = 1. These input data bits are evaluated by the safety monitor, generally, however, not by the bus master. The output data bits D0, D1 and D2 can be used by the AS-i bus master (for example in a standard PLC) to transfer control signals. Because the factory set expected signals are normally not very useful in AS-i applications, the signal assigment of M1 (= D0), M2 (=D1) and M5 (=D2) has to be changed by SafetyLab. This can be:

- a muting signal at M5, when in the function package "Muting" the basic IO-configuration "2 sensor parallel muting (L1, M5) has been selected
- an additional muting enable signal
- a control signal for the muting timer
- an enable signal for blanking in the protective field (function package „blanking“)
- a Clear signal of a cycle control (single break / double break) (function package „cicle control“)

Warning!

None of these signals must be used for safety critical purposes.

The parameter port can only be operated by the bus master. The diagnostic information supplied to M3 and M4 by the receiver is available in P0 and P1. All parameter bits are inverted, that means, in order to read M3 and M4, the master must first write 1 in P0 and P1. COMPACT*plus* overwrites this value where necessary. If 1 is still in these bits after reading back by the master, then a 0-signal is present at M3 or M4. If 0 is in P0 and P1, then a logical “1” (=24VDC) is present in M3 or M4.

Note!

From firmware/hardware version V13 (see type plate) the AS-i profile must be changed to "S-7.B.1". If you replace a device from version V13 onwards with LEDs in the cap with an older device without LEDs in the cap, it will no longer be detected by the AS-i master and will not be automatically accepted by AS-i. To integrate such a device into an existing AS-i network you must:
-Set the AS-i address with the programming device manually.
-Set the AS-i master to the new slave profile.

You will find details on this in the manual of the respective master manufacturer; they are not part of this device documentation.

7.9.3 Initial operation of COMPACT*plus* /AS-i, interface for the AS-i master

Installation in AS interface/functions control

See also connecting and operating instructions of the AS-i safety monitor, Chapter 7 (function and initial operation).

Continue as follows:

1	**Address the AS-i slave** The addressing of the receiver is performed via the M12 device connection plug, with standard AS-i addressing devices. Each address may only be used once in an AS-i network (possible bus addresses: 1…31). The transmitter does not receive a bus address.
2	**Install the AS-i slave in the AS interface** Connection of the COMPACT*plus*/AS-i Transmitter is made via an M12 bus terminal; the COMPACT*plus*/AS-i Receiver is connected via the AS-i adapter for bus connection and 24V voltage supply, AC-PDA1/A.
3	**Check the voltage supply of the sensor via the AS interface** The 7-segment displays and the red LED1 light up on the COMPACT*plus*/AS-i Receiver and Transmitter.
4	**Check the protective field function between COMPACT*plus*/AS-i Transmitter and Receiver** The 7-segment displays on the transmitter and receiver light up and, where required, LED1 switches with free protective field after unlocking of the internal start/restart interlock of the COMPACT*plus* /A1, from red to green. ⓘ COMPACT*plus* /AS-i may not be interrupted for the system integration, that is, with the teaching-in of the code table of the AS-i slave by the AS-i safety monitor. The OSSDs must be in the ON state.
5	**The initial operation and configuration of the safe AS-i slave is now carried out with the "asimon configuration and diagnosis software" of the AS-i safety monitor (see the user manual for "asimon configuration and diagnosis software").**

Notes for error and fault clearance:

See Chapter 11, and connecting and operating instructions of the AS-i safety monitor, Chapter 9 (status report, error and fault clearance).

7.9.4 COMPACT*plus* /AS-i maintenance, interface for the AS-i master

Swopping out a safety-related AS-i slave:

If a safety-related AS-i slave is defective, its replacement is also possible without PC and re-configuration of the AS-i safety monitor using the SERVICE button on the AS-i safety monitor. See also connecting and operating instructions of the AS-i safety monitor, Chapter 9.4 (replacing a defective safety-related AS-i slave).

Continue as follows:

1	**Separate the defective AS-i slave from the AS-i line** The AS-i safety monitor stops the system.
2	**Press the SERVICE button on the AS-i safety monitor**
3	**Install the new AS-i slave** AS-i slaves have the bus address "0" in the factory setting status. With the swap-out, the AS-i master automatically programs the replacement device with the previous bus address of the defective device. A readdressing of this replacement device to the bus address of the defective device is therefore not necessary.
4	**Check the supply voltage of the sensor via the AS interface** The 7-segment displays and the red LED1 light up on the COMPACT*plus*/A1 receiver and transmitter.
5	**Check the protective field function between COMPACT*plus*/AS-i transmitter and receiver:** The 7-segment displays on the transmitter and receiver light up and, where required, LED1 switches with free protective field after unlocking of the internal start/restart interlock, from red to green. ⓘ COMPACT*plus*/AS-i may not be interrupted for the system integration, that is, with the teaching-in of the code table of the AS-i slave by the AS-i safety monitor. The OSSDs must be in the ON state.
6	**Press the SERVICE button on the AS-i safety monitor**
7	**Press the start signal to restart the AS-i system** The system restart is made according to the AS-i-side configuration of a restart interlock or an automatic restart in the AS-i safety monitor (see the manual for "asimon configuration and diagnosis software" for AS-i safety monitor).

It is determined with the first pressing of the SERVICE button if an AS-i slave is missing. This is noted in the error memory of the AS-i safety monitor. The AS-i safety monitor changes to configuration mode. With the second pressing of the SERVICE button, the code sequence of the new AS-i slave is saved and tested to assure correctness. If this is okay, the AS-i safety monitor changes back to the protective mode.

Warning!

After the swop-out of a defective safety-set AS-i slave, be sure to check the correct functioning of the new AS-i slave.

Checking for safe switching-off

The fault-free functioning of the safe AS-i system, that is, the safe switching-off of the AS-i safety monitor with activation of an assigned safety-related sensor (e.g. COMPACTplus/A1) must be checked by a specialist and authorized person on a yearly basis.
To facilitate this, the COMPACT/AS-i slave must be activated once a year and the switching behavior must be checked by observing the safety outputs of the AS-i safety monitor.

8 Parameterization

8.1 Factory settings

When delivered, the transmitter is ready for operation, set to

- Transmission channel 1

with switch S2 in the connection cap in the L (left) position.

The receiver is also ready for operation and its switches S1 to S6 are set on L (left) which means:

- No contactor monitoring (EDM)
- Transmission channel 1
- Without start/restart interlock
- Operating mode: protective
- Without cycle release requirement

You have the option of setting parameters for individual functions with the internal switches as described below.

8.2 Transmitter parameterization

To switch the transmission channel to channel 2

➢ Turn the device power off.

➢ Loosen the 4 screws and remove the transmitter's connection cap.

➢ Turn switch S 2 to the right setting R.

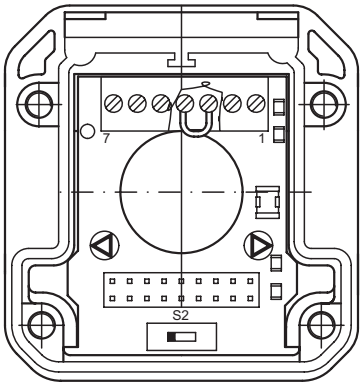


Fig. 8.2-1: Transmitter connection cap

Switch	Function	Pos.	Transmitter functions, can be set by switch	Factory setting
S2	Transmission channel	L	Transmission channel 1	L
		R	Transmission channel 2	

Table 8.2-1: Transmitter function depending on switch setting

➢ When replacing the connection cap, ensure that none of the plug pins extending out of the profile are bent.
➢ Check the transmitter display after the change has been made and it has been turned back on. After self-testing, it permanently displays the selected transmission channel.
ⓘ A change in the transmitter transmission channel also requires the transmission channel of the corresponding receiver to be changed.

8.3 Parameterization of the receiver

Five switches on the front and one switch on the back of the removable display and parameter module in the receiver are used for switching the receiver functions. To do this:
➢ Turn off the receiver power
➢ with devices with relay outputs, also separate the feed of the release circuit if required,
➢ Loosen the 4 screws on the connection cap and
➢ Pull the connection cap straight off.
The operating elements are now exposed.

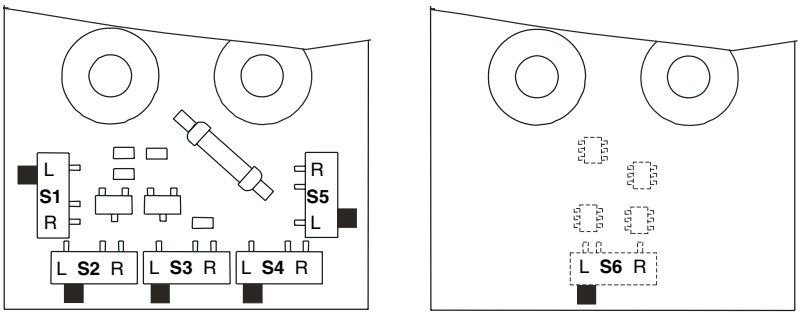


Fig. 8.3-1: Display and parameterization module, front and rear side (from the front)

The following table summarizes the functions of the receiver, which can be selected using switches S1 to S6. Plan the required settings carefully and always observe the **safety notes** for each of the individual functions in Chapters 2 and 4. The factory setting for all switches is position L. It is only in this position that the value written to the receiver by the SafetyLab Diagnostics an Parameterization Software becomes effective.

The module that has already been parameterized with SafetyLab can no longer be changed with switches. If one or more switches are changed to the switch setting R, the error indication E 17 appears after turning on the receiver. If, on the other hand, the switch is set back to the factory setting L, the value of this display and parameterization module set using SafetyLab is valid.

If switch setting of a module already parameterized with SafetyLab is required, the module must first be reset with SafetyLab and password to the basic setting. Only then can the switches S1 to S6 become effective again with their functions shown below.

ⓘ Please note that changes or additions to the purpose of the switches S1 to S6 described below, as well as changes to the factory-set parameters as part of a customer-specific parametering at the factory (see chapter 8.1 Factory settings) are documented as required in an accompanying datasheet or additional operating instructions.

Switch	Function	Pos.	"Initiation" function package, functions can be set by switch	Factory setting
S1	Contactor monitoring	L	SW: Default = No contactor monitoring EDM	L
		R	With dynamic contactor monitoring, feedback signal at M2	
S2	Transmission channel	L	SW: Default = Transmission channel 1	L
		R	Transmission channel 2	
S3	Start/restart interlock	L	SW:Default = automatic startup, (delay T_D= 100 ms)	L
		R	With start/restart interlock, start button required on L5 or M1	
S4/S5	Operating mode	L/L	SW: Default = Guard-only mode*	L/L
		R/L	Single-break operation with internal start/restart interlock	
		L/R	Double-break operation with internal start/restart interlock	
		R/R	Operating modes selection, external via selection switch at L3/L4: 0/0 guard-only*; 0/1 single-break; 1/0 double-break; 1/1 reserved;	
S6	Cycle release signal	L	SW: Default = No release signal required	L
		R	Release signal required for the last cycle at L2	

*) Guard-only mode with or without internal start/restart interlock depending on the switch setting S3

Table 8.3-1: Receiver functions depending on switch settings

Warning!

After every safety-relevant function change, check the optical protective device for proper effectiveness. Instructions can be found in Chapters 10 and 13.

The parameterization options of the receiver are described below, which are possible by changing switches S1 to S6 without the "SafetyLab" diagnostics and parameterization software.

The settings described below can also be made using SafetyLab, without any adjustment of the switches. For parameterization with PC, this is connected via the optical interface between connection cap and 7-segment display on the receiver. All switches S1 to S6 must be set in the factory setting to position L so that changes made with SafetyLab can be made effective. For other significant settings see the SafetyLab user manual.

8.3.1 S1 – Contactor monitoring (EDM)

Place switch S1 to the R setting to activate the dynamic contactor monitoring function. As illustrated in the wiring diagram examples in chapter 7, the receiver expects the reply from the positive-guided normally closed contacts within 300 ms (FS) after the OSSDs are turned on or off by a 24 V DC signal at M2.

If this reply is not received, the receiver/transceiver will show the E31 error message and go to the error locking state, from which it can only be returned to normal operation by switching the supply voltage off and back on again.

8.3.2 S2 – Transmission channel

In factory setting L, the receiver expects a transmitter set to transmission channel 1. After switch S2 has been changed to the R setting, the receiver expects signals from a transmitter that has also been changed to transmission channel 2.

8.3.3 S3 – Start/restart interlock

The receiver leaves the factory with the S3 switch in the L setting, therefore with automatic start/restart. You can select internal start/restart interlock by moving switch S3 to the R setting if no downstream machine interface takes over this function.

Internal start/restart interlock requires a start-/restart button to be connected against 24 V either on the machine interface input M1 or optionally on pin L5 of the local interface. Release can be achieved by pressing and releasing the start-/restart button within 100 ms <= t <= 4 s, which requires the active protective field to be free.

The start-/restart button can be alternatively connected on the local interface L5 or on the machine interface M1; it has the same effect in FS.

8.3.4 S4/S5 – Operating mode

Both switches S4 and S5 are used together for setting the operating mode. In the L/L setting (FS) the system works on the guard-only mode with or without internal start/restart interlock in accordance with S3.

With S4 in the R setting and S5 in L setting, the operating mode single-break operation is selected. After pushing and release of the start/restart button the system expects **one** intrusion and the release of the protective field to activate the movement to be controlled.

If on the other hand S4 is set to the L setting and S5 to the R setting, double-break operation is set. After pushing and release the start/restart button the system expects **two** intrusions and the release of the protective field to activate the movement to be controlled.

If both switches S4 and S5 are set to the right position R/R, the operating mode selection with an external two-level selection switch is possible. The connection example for the local interface, Fig. 7.1-2 shows the arrangement.

Warning!

When the operating mode is selected externally, you must take particular care to ensure that the startup/restart interlock is activated through S3. This makes certain that when the external selection switch is set to "pure protective mode", the OSSDs will remain locked until the start button is pressed. C norms generally insist that the switching of the operating mode selection switch on its own should not be enough to authorise release of the hazardous movement.

8.3.5 S6 – Cycle Start Control (CSC)

If switch S6 is set to position R, the cycle control modes require + 24 V DC at input L2 before release of the OSSDs. The release signal serves, for example, to indicate the correct workpiece position before release of the movement to be controlled. The signal prevents both the tool and workpiece from damage and therefore it serves for reliable operation.

9 Setting the device into service

Warning!

Before being put into operation for the first time on a power-driven production machine, an experienced and commissioned person with suitable training must check the entire setup and the integration of the opto-electronic protective device into the machine control system.

Before connecting the supply voltage for the first time and while the transmitters and receivers are being aligned, it must also be ensured that the outputs of the optical protective device do not have any effect on the machine. The switching elements that finally set the dangerous machine in motion must be safely switched off and secured from restarting.

The same precautionary measures apply after each change in parameter-based functions of the optical protective device, after repairs or during maintenance work.

Only after it has been determined that the optical protective device functions are correct can it be integrated into the machine's control circuit!

9.1 Switching on the device

Ensure that transmitter and receiver are protected against overcurrent (see Tab 12.1-3). There are special requirements for the supply voltage: The power supply unit must have a load current reserve of at least 2 A and, with use of receivers with safety-related transistor outputs, the ability to bridge a power outage for at least 20 ms, and it must guarantee secure supply isolation.

9.1.1 Display sequence with CPT transmitter

After the device is turned on, "8." appears for a few moments on the transmitter display followed by an "S" for about 1 second for the self test. The display then switches and permanently shows the selected transmission channel, "1" or "2".

ⓘ A "." next to the number indicates when the test input is open. As long as the test input is open, the transmitter diodes do not deliver any valid light pulses. With test signals longer than 3 seconds the receiver fails and shows „E18“.

Warning!

If an error is shown on the transmitter (permanent display of "8" or "F" for a fault code), then the 24V DC connection voltage and wiring should be checked. If the error remains after it is turned on again, abort the setup process immediately and send in the malfunctioning transmitter to be checked.

9.1.2 Display sequence for the CPR-i receiver

The following appears after the receiver is turned on or restarted:

- 88: = Self test
- 4y xx: 4 = "Initiation" function package; y. xx = Firmware version
- Hx: H = MultiScan factor; x = number of scans (FS = 1)
- tx xx: t = Response time of the AOPD; x xx = Value in milliseconds
- Cx: C = Transmission channel; x = Number of the channel (FS = 1)
- Px P = Parameter settings; 0 = guard-only mode, 1 = single-break operation, 2 = double-break operation (FS = 0)

Warning!

In case of an error or failure, the display will show "Ex xx" or "Fx xx". Using the error number, Chapter 11 "Troubleshooting" will provide information on whether it is an error (Ex xx) in external wiring or an internal fault (Fx xx). For internal faults, immediately interrupt the installation and send in the malfunctioning receiver to be checked.

However, if errors are found and cleared in the external wiring, the receiver will be restored to normal mode and startup can be continued.

If the **guard-only mode <u>without</u> internal start/restart interlock function** is activated, the receiver's LEDs display after startup (FS):

Warning!

The receiver switches to the ON state as soon as it receives all beams!

LED	**<u>Without</u> start/restart interlock, transmitter/receiver not aligned or protective field not free**		**<u>Without</u> start/restart interlock, transmitter/receiver aligned and protective field free**	
Red/ green	Red ON =	OFF state of the OSSDs	Green ON =	ON state of the OSSDs
Orange	OFF =	Protective field interrupted or transmitter/receiver alignment error	ON =	Weak beam indication with free active protective field
Yellow	OFF =	Start/restart interlock not locked	OFF =	Start/restart interlock not locked
Blue	OFF =	No special function active	OFF =	No special function active

Table 9.1-1: Display sequence receiver in guard-only mode without start/restart function

If the **guard-only mode with internal start/restart interlock function** is activated, the receiver's LEDs display after startup:

LED	With start/restart interlock, before unlocking with the start/ restart button		With start/restart interlock, after unlocking with the start/ restart button with free protective field	
Red/ green	Red ON =	OFF state of the OSSDs	Green ON =	ON state of the OSSDs
Orange	OFF =	Protective field interrupted or transmitter/receiver alignment error	ON =	Weak beam indication with free active protective field
	ON =	Active protective field free		
Yellow	ON =	Start/restart interlock locked	OFF =	Start/restart interlock unlocked
Blue	OFF =	No special function active	OFF =	No special function active

Table 9.1-2: Display sequence receiver in guard-only mode with internal start/restart function

If the **single-break operation** (with internal start/restart interlock function) is activated, the receiver's LEDs display after startup:

LED	Before unlocking with the start/restart button		After unlocking with the start/restart button with free protective field		After 1 x intrusion into the protective field	
Red/ green	Red ON =	OFF state of the OSSDs	Red ON =	OFF state of the OSSDs	Green ON = (until the clear signal is given)	ON state of the OSSDs
Orange	OFF =	Protective field interrupted or transmitter/receiver alignment error	ON =	Active protective field free	ON =	Weak beam
	ON =	Active protective field free			OFF =	No weak beam
Yellow	ON =	Start/restart interlock locked	1 x Blinking	Waiting on 1 x intrusion into the protective field	OFF =	Start/restart interlock unlocked
Blue	OFF =	No special function	OFF =	No special function	OFF =	No special function

Table 9.1-3: Display sequence receiver in single-break operation

If the **double-break operation** (with internal start/restart interlock function) is activated, the receiver's LEDs display after startup:

LED	**Before unlocking with the start/restart button**	**After unlocking with the start/restart button with free protective field**	**After 2 x intrusion into the protective field**
Red/ green	Red ON = OFF state of the OSSDs	Red ON = OFF state of the OSSDs	Green ON = ON state of the OSSDs (until the clear signal is given)
Orange	OFF = Protective field interrupted or transmitter/receiver alignment error ON = Active protective field free	ON = Active protective field free	ON = Weak beam OFF = No weak beam
Yellow	ON = Start/restart interlock locked	2 x Blinking Waiting on 2 x intrusion into the protective field	OFF = Start/restart interlock unlocked
Blue	OFF = No special function	OFF = No special function	OFF = No special function

Table 9.1-4: Display sequence receiver in double-break operation

9.2 Aligning transmitter and receiver

Transmitter and receiver must be at the same height or, if installed in a horizontal position, be at the same distance from the reference surface and slightly fastened at first. The small specified angle of beam spread of ± 2° requires increased precision in aligning the two components with each other before the devices are screwed firmly into place.

ⓘ If cascaded AOPDs are aligned with each other, it must always be in the order of host first, then guest.

9.2.1 Aligning with the 7-segment display of the receiver

If the SafetyKey is placed on the position in the display field reserved for this purpose, briefly removed and then replaced within approx. 2 seconds, the 7-segment display switches from the permanent display to alignment mode.

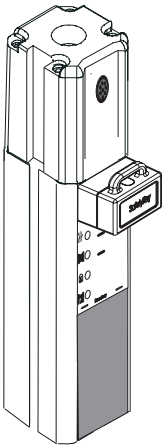


Fig. 9.2-1: Setting the SafetyKey on a light curtain's receiver

Individual device alignment	Switch the receiver display to service mode with SafetyKey  The first beam next the display (synchronization beam) meets the first receiver diode → the top horizontal beam in the left display lights up:  The last beam of the transmitter also hits the corresponding diode of the receiver → lower and upper horizontal beam of the left display light up: 
Align host/guest combination	First align the host as an individual device (see above):  The top and bottom horizontal beams of the right 7-segment display light up if both the guest transmitter and the guest receiver are aligned with one another. With two guest transmitters and receivers, the above right beam represents the first beam of the first guest and the bottom right beam represents the last beam of the second guest. 

Table 9.2-1: Aligning the receiver with the aid of the 7-segment displays

- With internal start/restart interlock: The orange LED2 of the receiver is lit constantly → Rotate transmitter and receiver to each other optimally and fix them in place.
- Without internal start/restart interlock: The LED1 of the receiver is constantly lit green → Rotate transmitter and receiver to each other optimally and fix them in place.

When the SafetyKey is removed, the 7-segment display of the receiver switches back into permanent display mode.

9.2.2 Optimizing the alignment by turning the transmitter and receiver

Using standard brackets for fastening requires level, precisely aligned mounting surfaces so that, for example, if mounted vertically using adjustable sliding nuts, then only the precise heights of the transmitter and receiver have to be set.

If this requirement is not met, swivelling mounting brackets (accessories) can be used as described in Chapter 6.3.2.

Alignment with internal start/restart interlock:

If the protective field is clear, the alignment can be optimized by observing the orange LED2 on the receiver (protective field free). Precondition here is that the pre-alignment work has been completed to such an extent that the orange LED2 is already constantly lit.

➢ Unscrew the locking screws on the transmitter's swivelling mounting brackets so that you can just move it. Move the transmitter until the orange LED2 switches off. Note this position. Move the transmitter back until the orange LED2 is constantly lit again and then continue until it goes off again. Now move the transmitter back to the center of the two positions found and fix the swivelling mounting brackets so that it cannot be moved.

➢ Now do exactly the same with the receiver and move it to the center between the two positions where LED2 goes off. Fix the receiver and secure it carefully against turning or shifting. The optimum setting is consequently achieved.

➢ For cascaded systems, the procedure can be performed for all transmitters and receivers one after the other, beginning with the host. A precise preliminary adjustment of all components is also required here.

Alignment without internal start/restart interlock

➢ The procedure is the same as described above. Instead of the orange LED2, observe LED1 of the receiver. The transition point is where LED1 switches from green to red. LED2 (weak beam indication) can briefly light up at the transition points during the set-up procedure.

10 Testing

10.1 Testing before putting the equipment in service the first time

Testing by an experienced technician before initial startup must ensure that the optical protective device and any other safety components that might be present have been selected in accordance with local regulations and if applicable the European Directives especially the European Machine and Machine Utilization Directive and that they provide the required protection when properly operated.

- ➢ Use the regulations listed above, where required, with the help of the checklists provided in the Appendix of these instructions, to check that the protective devices are properly installed, that they are properly wired into the controls and that they work in all operating modes.
- ➢ The same testing requirements apply if the machine in question has not been operated for a longer period of time and after major modifications or repairs if this could affect the safety of the machine.
- ➢ Observe the specifications regarding the instructing of operation personnel by experienced technicians before work is started. Instruction of personnel is the responsibility of the machine owner.

Leuze provides a specialist service in Germany, which undertakes the required testing and monitoring tasks (www.leuze.de**)** if commissioned to do so. The results of the test are documented for the machine owner in accordance with ISO 9000 ff.

10.2 Regular inspections

Regular inspections are also carried out in accordance with local regulations. They are designed to discover changes (e.g. in machine stopping times) or manipulations made on the machine or protective device.

- ➢ You must have the effectiveness of the protective device checked by an experienced technician at the required intervals, but at least once per year.
- ➢ The applicable checklist in the Appendix may also be used during regular testing.

Leuze also provides a specialist service for regular tests.

10.3 Daily testing with the test rod

COMPACT*plus* are self-monitoring safety light curtains. Nevertheless it is very important to check the protective field for its effectiveness daily to be sure that the protection also stays effective at every point after a parameter or tool change.

Warning!

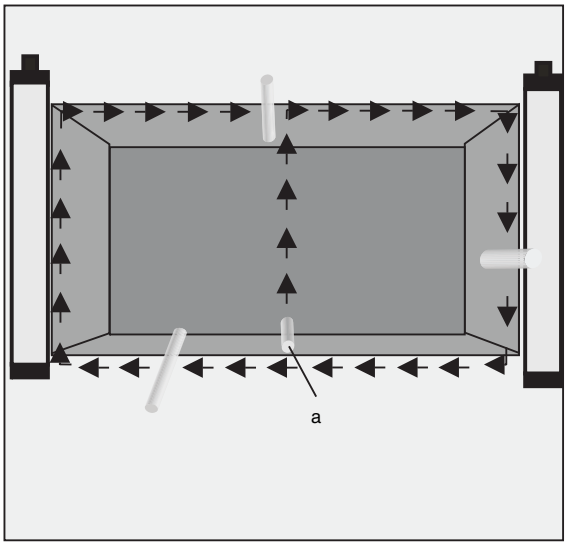
Work authorities in Germany require ***daily testing*** *with the test rod in accordance with ZH1/281 for presses with hand feed in metal industries.*

When using the safety light curtain for controlling it is very important that the requirements for this operating mode have not changed, e.g. that it is not possible to step behind the protective field or to pass around it in any other way. It is also essential to avoid reflections such as those. caused by tools. If the test rod is fed slowly into the middle of the protective field from above to below the protective field effect should be present at any point. The test rod should just extend beyond the protective field as shown in Fig. 10.3-1.

Warning!

Never use your fingers, hand or arm for checking the system!

- ➢ When selecting the test rod, use the nameplate on the receiver or on the additional nameplate indicating the effective resolution as a guideline.
- ➢ If internal start/restart interlock is selected and the AOPD is released, LED1 lights up green. When the test rod is inserted, LED1 switches to red and LED3 lights up yellow and therefore signals that the start/restart interlock is locked. During the testing procedure, LED2 must not light up orange at any point.
- ➢ If the AOPD is being operated without the internal start/restart interlock, it is sufficient to watch LED1 on the receiver during the testing procedure. When the test rod is inserted into the protective field, this LED1 must switch from "green" to "red" and must not switch back to "green" at any point during the test.



a = Beginning of test

Fig. 10.3-1: Testing the protective field with the test rod

Warning!

If the test does not yield the desired result, the cause could be a protective field height that is too low or reflections from reflective metals or tools brought into the area. In this case the installation of the safety light curtain must be checked by a specialist. If the cause cannot be clearly defined and remedied, the machine or system may not be used!

10.4 Cleaning the front screens

The front screens on the transmitters and receivers must be cleaned regularly depending on how dirty they are. An orange LED2 on the receiver with free and unlocked protective field (LED1 is green) indicates a "weak signal reception". The collective "malfunction/dirt" signal is provided on M4 in the factory setting. The dirt signal is generated with time filtering (10 min) from the internal weak beam signal. If this signal is activated (LOW signal on M4), then cleaning of the front screen may be required with free protective field and switched LED2. If cleaning the screens does not improve this, then the detection range and alignment must be checked. We recommend using a mild cleanser for cleaning the front screens. The screens are resistant to thinned acids or alkalis and resistant to organic solvents within limits.

11 Troubleshooting

The following information is used for rapid troubleshooting in the event of a malfunction.

11.1 What should I do if an error occurs?

If the AOPD shows an error on the display, the machine must be stopped immediately and checked by an experienced technician. If it is found that the error cannot be clearly defined and remedied, your local Leuze office and or the Leuze hotline can assist.

11.2 Quick diagnostic using the 7-segment displays

Operational malfunctions often have simple causes that you can remedy yourself. The following tables will help you do this.

11.2.1 Transmitter CPT diagnostics

Symptom	Measures to clear errors
7-Segment display does not light up	Check + 24V supply voltage (also check for polarity) Check the connection cable Replace the transmitter if required
8. is constantly lit	Hardware error, replace transmitter
F. is constantly lit and briefly interrupted by an error number	Internal error, replace transmitter
Decimal point in the 7-segment display is lit.	Jumper 3-4 is missing in the transmitter's connection cap or external circuit is not closed Insert jumper

Table 11.2-1: Transmitter diagnostics

11.2.2 Receiver diagnostics

The receiver distinguishes between error codes (Ex xx) and fault codes (Fx xx). Only error codes provide you with information about events or conditions that you can eliminate. If the receiver shows a fault code F, it must be replaced (see Chapter 11.4). For this reason, only error codes are listed below.

Code	Cause/Meaning	Measures to clear errors
	LEDS and 7-segment displays do not light up	Check +24 V supply voltage (also check for polarity), check connection cable and replace the receiver if necessary.
8:8	Is constantly lit $\rightarrow$ hardware fault	Replace receiver
F x(x)	Internal hardware fault	Replace receiver

Table 11.2-2: Receiver diagnostics

Code	Cause/Meaning	Measures to clear errors
E 1	Cross connection between OSSD1 and OSSD 2	Remove connection
E 2	Overload on OSSD1	Use correct load
E 3	Overload on OSSD2	Use correct load
E 4	Overvoltage on OSSD1	Use correct supply voltage
E 5	Overvoltage on OSSD2	Use correct supply voltage
E 6	Circuit against 0 V on OSSD1	Remove connection
E 7	Circuit against 24V on OSSD1	Remove connection
E 8	Circuit against 0 V on OSSD2	Remove connection
E 9	Circuit against 24V on OSSD2	Remove connection
E 10	Switch S1 - S6 not correctly positioned	Correct switch positions
E 11	Current and configured beam count differ	Correct beam parameters with PC and SafetyLab
E 12	Guest lit during operation, device too long	Connect correct guest(s)
E 13	Guest removed during operation, device too short	Connect correct guest(s)
E 14	Undervoltage on the power supply	Check/change power supply or load
E 15	Reflection errors at PC interface	Protect interface optically
E 16	Error at input/output	Switch signal line on correctly
E 17	Fault in the parameterization or wrong switch setting S1 to S6	- Reset to basic setting with PC and SafetyLab or - All switches S1 to S6 to position L
E 18	Transmitter test signal received for longer than 3 seconds	Close jumper between terminal 3 and 4 in the transmitter connection cap
E 20 E 21	Electromagnetic interference	Suppression of electromagnetic interference and/or signal lines
E 22	Overvoltage	Check/change power supply
E 30	Feedback contact of contactor monitoring not opening	Replace contactor, check wiring
E 31	Feedback contact of contactor monitoring not closing	Replace contactor, check wiring
E 32	Feedback contact of contactor monitoring is not closed	Replace contactor, check wiring

Table 11.2-2: Receiver diagnostics

Code	Cause/Meaning	Measures to clear errors
E 39	Start button pressed too long or short-circuited	Remove block or short against 24 V
E 40	Safety circuit on L3 / L4 has short cut to 0 V	Remove connection
E 41	Safety circuit on L3 / L4 has short cut to 24V	Remove connection
E 42	Safety circuit on L3 / L4: Simultaneity fault	Replace button
E 55	Time limit for cycle control exceeded	Unlock start interlock again
E 56	External operating mode selection switch or jumpers not connected correctly	Check connections
E 70	Display module incompatible with the receiver's hardware	Set original display and load correct parameter set
E 71	Display module incompatible with the receiver's hardware	Set original display and load correct parameter set
E 72	SafetyLab incompatible with the receiver's firmware version	Use current SafetyLab version
E 95	Fault in the beam parameterization	Correct beam parameterization with SafetyLab

Table 11.2-2: Receiver diagnostics

11.3 AutoReset

After an error or a fault has been detected and indicated, with the exception of the locking error/fault, a restart follows automatically in the

- transmitter after about 2 seconds and
- in the receiver after about 10 seconds

in the respective device. If an error is therefore no longer present, the machine/application can be restarted, but the temporary error code is then lost.

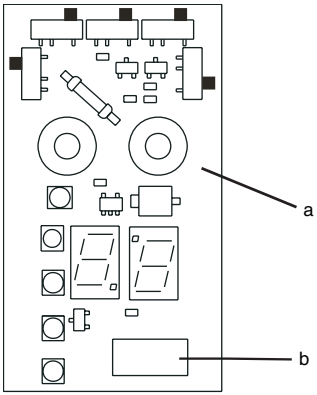
If these kinds of errors happen frequently and you want to find out the cause, keep the error signal until the reset is carried out by a maintenance technician. You can do this with the receiver by inversely setting the SafetyKey to the corresponding position of the receiver display (fig. 9.2-1), so that the "handle" points away from the connection cap.

The receiver will no longer reset automatically after approx. 10 seconds. It will now permanently display the last error code. Only after taking away the key and waiting another 10 seconds does the AutoReset procedure take place again.

The receiver is not automatically reset after 10 seconds with locking errors (e.g. E30 - E32 and E40 - E42). The receiver goes instead to the error locking state, which it can only leave by pressing the start/restart button or by switching the supply voltage off and back on again.

11.4 Maintaining the parameterization with receiver exchange

All setting values are stored on the display and parameterization module, where switches S1 to S6 are also located. When replacing a device, all parameter settings can be transferred by a specialist and authorized person into the new **same-model** receiver by transferring a correctly parameterized module.



a = Display and parameter module
b = Plug connection

Fig. 11.4-1: Display and parameter module

Warning!

*When replacing a device it must be assured that an **identical exchange device** is used. This is the only way that the correct functionality is reached for the **same installation point** if the correctly parameterized display and parameterization module is transferred into the exchange device.*

Even when exchanging the display and parameterization module, it is an unavoidable necessity to carefully recheck all safety-related functions of the optical protective device before placing it in service again. Non-observance can cause impairments of the protective function.

12 Technical data

12.1 General data

12.1.1 Beam/protective field data

Safety Light Curtain	Physical resolution	Detection range		Height of protective field	
		Min.	Max.	Min.	Max.
CP14-	14 mm	0 m	6 m	150 mm	1800 mm
CP30-	30 mm	0 m	18 m	150 mm	1800 mm

Table 12.1-1: Beam/protective field data

12.1.2 Safety-relevant technical data

Type in accordance with IEC/EN 61496	Type 4
SIL in accordance with IEC 61508	SIL 3
SILCL in accordance with IEC/EN 62061	SILCL 3
Performance Level (PL) in accordance with EN ISO 13849-1: 2008	PL e
Category in accordance with ISO 13849	Cat. 4
Average probability of a failure to danger per hour (PFH_d) For protective field heights up to 900 mm, all resolutions For protective field heights up to 1800 mm, all resolutions For protective field heights up to 3000 mm, all resolutions	 $2.26 \times 10^{-8}\ 1/h$ $2.67 \times 10^{-8}\ 1/h$ On request
Service life (T_M)	20 years
Number of cycles until 10 % of the components have a failure to danger (B_{10d}) Version /R with relay output, DC13 (5 A, 24 V, inductive load) Version /R with relay output, AC15 (3 A, 230 V, inductive load)	 630,000 1,480,000

Table 12.1-2: Safety-relevant technical data

12.1.3 System data

Safety category	Type 4 in accordance with IEC/EN 61496 SIL 3 in acc. with IEC/EN 61508
Supply voltage Uv Transmitter and receiver	+24 V DC, ± 20 %, external power supply with secure mains supply isolation and equalization with a 20 ms voltage dip where required (Chap. 7), current reserve of at least 2 A
Residual ripple of supply voltage	± 5 % within Uv limits
Transmitter power consumption	75 mA
Receiver power consumption	160 mA without external load and additional sensor equipment
Shared value for external fuse in the feed line for transmitter and receiver	4 A
Transmitter: Class: Wavelengths: Pulse duration Pulse pause Power:	Light-emitting diodes in accordance with EN 60825-1:1994+ A1:2002+A2:2001 1 880 nm 7 µs 3,12 ms 8,73 µW
Synchronization	Optical between transmitter and receiver
Safety class: Exception: Receiver with machine interface /R1 and separate cable for switching outputs. Safety class:	III PE connection to Z1-1 instead of FE to Z3-3 (see connection example, Fig. 7.6-5) I
Type of protection	IP65*)
Ambient temperature, operation	0 ... 50 °C
Ambient temperature, storage	-25 ... 70 °C
Relative humidity	15 ... 95 %
Vibration fatigue limit	5 g, 10 – 55 Hz according to EN IEC 60068-2-6
Resistance to shocks	10 g, 16 ms according to EN IEC 60068-2-29
Dimensions	See dimensional drawings and tables
Weight	See tables

*) Without additional measures the devices are not suited for outdoor use.

Table 12.1-3: System data

12.1.4 Receiver, local interface, status and control signals

Voltage output, only for command devices or safety sensor equipment	24 V DC ± 20 % max. 0.5 A	
L1: Signal input	Input:	Contact or transistor against +24 V DC current load: 20 mA max.
L2: Signal input/output	Input:	Contact or transistor against +24 V DC current load: 20 mA max.
	Output:	pnp, +24 V DC-switching, 60 mA max.
L3, L4: TriState signal input, e.g. for operating mode selection switch or for potential-free contact-based safety circuit	Input:	Contact or transistor against +24 V DC or against 0 V current load: 20 mA max.
L5: Signal input/output	Input:	Contact or transistor against 0 V (external pullup required) current load: 20 mA max.
	Output:	pnp, +24 V DC-switching, 500 mA max.

Table 12.1-4: Receiver, local interface, status and control signals

12.1.5 Receiver, machine interface, status and control signals

M1, M2: Signal input	Input:	Contact or transistor against +24 V DC current load: 20 mA max.
M3, M4: Signal input/output	Input:	Contact or transistor against +24 V DC current load: 20 mA max.
	Output:	pnp: +24 V DC-switching, 60 mA max.
M5: Signal input/output	Input:	Contact or transistor against +24 V DC current load: 20 mA max.
	Output:	npn: 0 V switching, 1 A max.

Table 12.1-5: Receiver, machine interface, status and control signals

12.1.6 Receiver, machine interface, safety related transistor outputs

OSSD **Transistor safety related switching outputs**	**2 Safety related pnp semiconductor outputs, cross circuit monitored, resistant to short circuits**		
	Min.	**Typical**	**Max.**
Switching voltage, high, active (Uv -1V) Switching voltage, low Switched current Leakage current Load capacity Load inductivity	+18.2 V 0 V 2 mA	+23 V 0 V 500 mA < 2 µA	+28.8 V +2.5 V 650 mA 200 µA *) 3.3 µF 2.2 H
Permissible wire resistance for load	-	-	< 1 kΩ **)
Permissible wire gauge	1 mm² with conductor sleeve		1,5 mm²
Permissible wire length between receiver and load (at 1 mm²)	-	-	100 m
Test pulse width	-	-	250 µs
Test pulse distance	-	-	22 ms
OSSD restart time after beam interruption	-	100 ms	-
OSSD response time	Dependent on number of beams and Multi-Scan factor H, see tables in Chapter 12.2		

*) In case of a failure (disconnection of 0 V wire) the outputs emulate a 120 kΩ resistor in line with Uv. A subsequent Safety PLC, must not recognize this as a logical "1".
**) Be aware of other restrictions due to cable length and load current

ⓘ The safety related transistor outputs carry out the spark extinction. With transistor outputs, it is therefore not necessary to use the spark extinction elements recommended by contactor/valve manufacturers etc. (RC modules, varistors or recovery diodes). These extend the delay times of inductive switching elements.

Table 12.1-6: Receiver, machine interface, safety related transistor outputs

12.1.7 Receiver machine interface, safety related relay outputs

OSSD Relay outputs		2 Potential-free relay outputs		
		Min.	Typical	Max.
/R1	Cable screw M25x1,5 when using only **one** connection cable:			
/R2 /R3	Hirschmann plug (typical 0.5 mm²) MIN-series plug (AWG 16 = 0.75 mm²)			
	⚠ The protective extra low voltage, 42V AC/DC may under no circumstances be exceeded.			
	With switching voltage 24 V DC	**15 V DC**	**24 V DC**	**30 V DC**
	Switching current inductive load*) [τ=L/R=40 ms]			1.5 A
	Assigned cable length, A = 0.75 mm² Fuse: max. 2 A slow			26 m
	Switching current inductive load*) [τ=L/R=40 ms]			1.5 A
	Assigned cable length, A = 0.5 mm² Fuse: max. 2 A slow			9 m
	Switching current ohmic load		up to 0.4 A	3.0 A
	Assigned cable length, A = 0.75 mm² Fuse: max. 3.15 A slow		100 m	13 m
	Switching current ohmic load		up to 0.4 A	2.0 A
	Assigned cable length, A = 0.5 mm² Fuse: max. 2.5 A slow		60 m	13 m

Table 12.1-7: Receiver machine interface, safety related relay outputs

OSSD Relay outputs		2 Potential-free relay outputs		
		Min.	Typical	Max.
/R1	MG 25 cable screw, 2 cables When using an **additional** cable for the OSSD switching contacts: 4 x 0.75 mm² + PE safety class I ⚠ Insulating plate is compulsory in the connection cap (see Fig. 7.6-3)			
	With switching voltage 115 V AC		**115 V AC**	**127 V AC**
	Switching current, inductive load*) (cosφ = 0.8) e.g. contactors, valves, etc. Assigned cable length, A = 0.75 mm² (AWG 16); fuse: max. 2.5 A slow		0.6 A 100 m	2.0 A 30 m
	Switching current, ohmic load Assigned cable length, A = 0.75 mm² (AWG 16); fuse: max. 3.15 A slow		0.5 A 100 m	3.0 A 16 m
/R1	MG 25 cable screw, 2 cables When using an **additional** cable for the OSSD switching contacts: 4 x 0.75 mm² + PE safety class I ⚠ Insulating plate is compulsory in the connection cap (see Fig. 7.6-3)			
	With switching voltage 230 V AC		**230 V AC**	**250 V AC**
	Switching current, inductive load*) (cosφ = 0.8) e.g. contactors, valves, etc. Assigned cable length, A = 0.75mm² Fuse: max. 2.5 A slow		1.2 A 100 m	2.0 A 60 m
	Switching current, ohmic load Assigned cable length, A = 0.75mm² Fuse: max. 3.15 A slow		1 A 100 m	3.0 A 32 m
Transmitter test input response time		18 ms	-	66 ms
Restart time after beam interruption		-	115 ms	-
OSSD response time		See tables in Chapter 12.2		

⚠ It applies with safety related relay outputs that: The cable or cables for machine control must generally be laid with protected installation in a cable duct or with armor in such a way that cross-connections of the cable wires can be safely ruled out.

*) With relay outputs, the spark extinction elements recommended by the manufacturers of contactors/valves etc. must be used (RC modules, varistors, etc.). With DC voltages, no recovery diodes should be used. These extend the delay times of inductive switching elements.

Table 12.1-7: Receiver machine interface, safety related relay outputs

12.1.8 Receiver machine interface, AS-i Safety at Work

OSSDs safety related switching outputs	4-Bit AS-i data		
	Min.	Typical	Max.
Permissible wire length	-	-	100 m
Restart time after beam interruption		140 ms	
Slave address range	1	-	31
Slave address (FS)	0 (ex-factory)		
Transmitter ID-code/IO-code	-		
ID-code receiver	B		
IO-code receiver	7		
AS-i profile	Safe slave		
Cycle time in accordance with AS-i specifications	5 ms		
OSSD response time	See tables in Chapter 12.2		
Current consumption	35 mA		
Additional response time of the AS-i system	40 ms		

Table 12.1-8: Receiver machine interface, AS-i Safety at Work

12.2 Dimensions, weights, response times

12.2.1 Safety light curtains, basic design/host, with transistor outputs, relay outputs or AS-i bus connection

Dim. A [mm]	Dim. B [mm]	Earth [kg]	tH1 = Response time of the AOPD in ms with MultiScan factor H=1 (FS) /T = Transistor outputs; /R = Relay outputs; /A = AS-i bus connection; n = Number of beams							
			CP14-xxxx				CP30-xxxx			
			n	/T	/R	/A	n	/T	/R	/A
				tH1 [ms]	tH1 [ms]	tH1 [ms]		tH1 [ms]	tH1 [ms]	tH1 [ms]
150	284	0.7	16	**5**	**20**	**10**	8	**5**	**20**	**10**
225	359	0.9	24	**7**	**22**	**12**	12	**7**	**22**	**12**
300	434	1.1	32	**9**	**24**	**14**	16	**5**	**20**	**10**
450	584	1.5	48	**12**	**27**	**17**	24	**7**	**22**	**12**
600	734	1.9	64	**15**	**30**	**20**	32	**9**	**24**	**14**
750	884	2.3	80	**18**	**33**	**23**	40	**10**	**25**	**15**
900	1034	2.7	96	**22**	**37**	**27**	48	**12**	**27**	**17**
1050	1184	3.1	112	**25**	**40**	**30**	56	**13**	**28**	**18**
1200	1334	3.5	128	**28**	**43**	**33**	64	**15**	**30**	**20**
1350	1484	3.9	144	**31**	**46**	**36**	72	**17**	**32**	**22**
1500	1634	4.3	160	**35**	**50**	**40**	80	**18**	**33**	**23**
1650	1784	4.7	176	**38**	**53**	**43**	88	**20**	**35**	**25**
1800	1934	5.1	192	**41**	**56**	**46**	96	**22**	**37**	**27**

An increase of the MultiScan factor H using PC and SafetyLab extends the response time! The recalculation and adjusting of the safety distance in accordance with Chapter 6.1.1 is compulsory.

Table 12.2-1: Safety light curtains, dimensions and response times

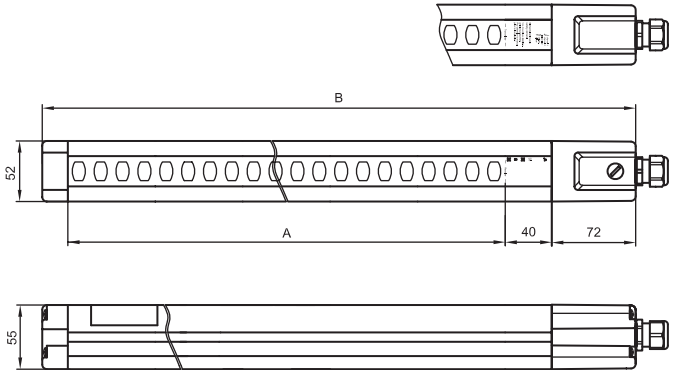


Fig. 12.2-1: Safety light curtain dimensions

12.2.2 COMPACT Guests series

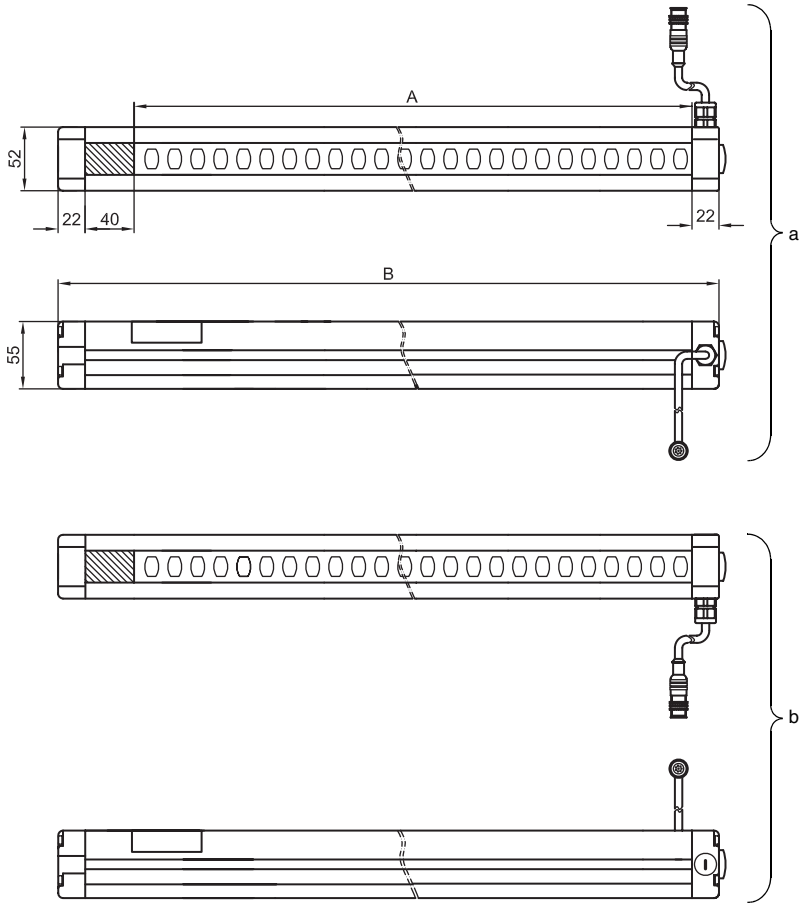
Dim. A [mm]	Dim. B [mm]	Weight CT-...S, CR-...S [kg]	tS = Guest response time; n = Number of beams							
			Example:		C14-300S with H = 1: tS = 13 ms					
			C14-xxxxS		C30-xxxxS		C50-xxxxS		C90-xxxxS	
			n	tS [ms] H = 1	n	tS [ms] H = 1	n	tS [ms] H = 1	n	tS [ms] H = 1
300	434	1,1	32	13	16	7				
450	584	1,5	48	10	24	10	12	10		
600	734	1,9	64	13	32	13	16	7		
750	884	2,3	80	17	40	9	20	9	10	9
900	1034	2,7	96	20	48	10	24	10	12	10
1050	1184	3,1	112	23	56	12	28	12	14	6
1200	1334	3,5	128	26	64	13	32	13	16	7
1350	1484	3,9	144	30	72	15	36	8	18	8
1500	1634	4,3	160	33	80	17	40	9	20	9
1650	1784	4,7	176	36	88	18	44	9	22	9
1800	1934	5,1	192	39	96	20	48	10	24	10
2100	2184	5,9					56	12	28	12
2400	2484	6,7					64	13	32	13
2700	2784	7,5					72	15	36	8
3000	3084	8,3					80	17	40	9

Table 12.2-2: COMPACT Guests series dimensions and response times

Warning!

An increase of the MultiScan factor H using PC and SafetyLab extends the response time! The recalculation and adjusting of the safety distance in accordance with Chapter 6.1.1 is compulsory.

The total response time of the protective device t_{AOPD} is calculated by adding the host response time to the guest response time.



a = Receiver, Guest
b = Transmitter, Guest

Fig. 12.2-2: Guest series dimensions

12.2.3 Standard mounting bracket dimensions

Dimensions in mm

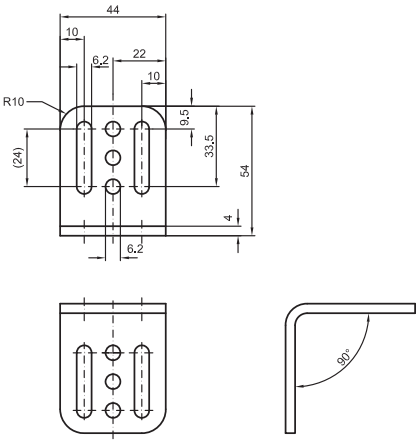
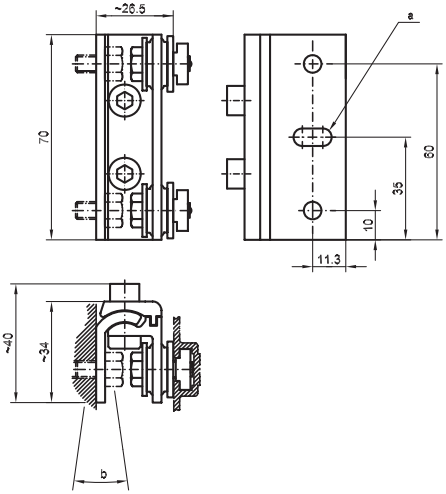


Fig. 12.2-3: Standard mounting bracket

12.2.4 Swivelling mounting bracket dimensions

Dimensions in mm



a = Slot 13 x 6
b = Swivelling angle ± 8°

Fig. 12.2-4: Option: Swivelling mounting bracket with shock absorber

13 Appendix

13.1 Delivery

Safety Light Curtains are delivered with:

- 1 Transmitter
- 1 Receiver
- 4 Sliding nuts with screws M6x10
- 4 Standard mounting brackets
- 1 SafetyKey
- 1 Connecting and operating instructions
- 1 Self-adhesive information plate

Additionally included in delivery for:

- Safety Light Curtains with 14 mm resolution:
  Test rod set consisting of test rods 14, 19, 24, 29, 33 mm
- Safety Light Curtains with 30 mm resolution
  Test rod set consisting of test rods 14/30 und 38 mm

13.2 Accessories

Art.-No.	Article	Description
560030	LA78UDC	External laser alignment aid for column mounting
150704	CB-M12-3000-8WM	Cable for local connection with angled M12x8 plug, 3 m
150699	CB-M12-10000-8WM	Cable for local connection with angled M12x8 plug, 10 m
426045	AC-LDH-12WF	Hirschmann cable socket, angled, incl. crimp contacts
426046	AC-LDH-12WF	Hirschmann cable socket, straight, incl. crimp contacts
426042	CB-8N-10000-12GW	Cable for /T2, /R2 – machine interface 10 m, straight socket
426044	CB-8N-25000-12GW	Cable for /T2, /R2 – machine interface 25 m, straight socket
426043	CB-8N-50000-12GW	Cable for /T2, /R2 – machine interface 50 m, straight socket
429071	CB-M12-5000S-5GF	Connection cable /T4 Transmitter, shielded with M12-coupling, 5-poles, 5 m, straight / open end
429073	CB-M12-10000S-5GF	Connection cable /T4 Transmitter, shielded with M12-coupling, 5-poles, 10 m, straight / open end

Table 13.2-1: COMPACT*plus*-i Accessories

Art.-No.	Article	Description
429075	CB-M12-15000S-5GF	Connection cable /T4 Transmitter, shielded with M12-coupling, 5-poles, 15 m, straight / open end
429081	CB-M12-5000S-8GF	Connection cable /T4 Transmitter, shielded with M12-coupling, 8-poles, 5 m, straight / open end
429083	CB-M12-10000S-8GF	Connection cable /T4 Transmitter, shielded with M12-coupling, 8-poles, 10 m, straight / open end
429085	CB-M12-15000S-8GF	Connection cable /T4 Transmitter, shielded with M12-coupling, 8-poles, 15 m, straight / open end
580004	AC-PDA1/A	AS-i, adapter for bus connection and 24V supply voltage (receiver)
50024346	AM 06	AS-i, M12 bus terminal for AS-i flat cable (transmitter)
50024750	AKB 01	AS-i, flat cable (unit per meter)
548361	CB-M12-1000-5G/MF	AS-i, M12 connection cable 1 m, 5-pin
548362	CB-M12-2000-5G/MF	AS-i, M12 connection cable 2 m, 5-pin
520065	AC-SCM1	Local connection box, external with 6 M12 connection sockets, cable 0.5 m
520068	AC-SCM1-BT	Local connection box with mounting plate
520066	AC-SCC2	Sensor cable splitter for PRK series … (Pin 2 active)
529603	UM 60-300	Deflecting Mirror, length 300 mm
529604	UM 60-450	Deflecting Mirror, length 450 mm
529606	UM 60-600	Deflecting Mirror, length 600 mm
529607	UM 60-750	Deflecting Mirror, length 750 mm
529609	UM 60-900	Deflecting Mirror, length 900 mm
529610	UM 60-1050	Deflecting Mirror, length 1050 mm
520073	SLAB-SWC	SafetyLab parameterization and diagnostic software incl. PC-cable, RS232 - IR
520072	CB-PCO-3000	PC-cable, RS232 - IR-adapter
346503	PS-C-CP-300	Protective screen 300 mm
346504	PS-C-CP-450	Protective screen 450 mm
346506	PS-C-CP-600	Protective screen 600 mm
346507	PS-C-CP-750	Protective screen 750 mm
346512	PS-C-CP-1200	Protective screen 1200 mm
346513	PS-C-CP-1350	Protective screen 1350 mm

Table 13.2-1: COMPACT*plus*-i Accessories

Art.-No.	Article	Description
346515	PS-C-CP-1500	Protective screen 1500 mm
346506	PS-C-CP-1650	Protective screen 1650 mm
346518	PS-C-CP-1800	Protective screen 1800 mm
560300	BT-SSD	Swivelling mounting bracket with shock absorber
549940	SITOP power	Power supply 115 V 50/60 Hz => 24V / 5 A
549908	LOGO! power	Power supply 230 V 50/60 Hz => 24V / 1.3 A

Table 13.2-1: COMPACT*plus*-i Accessories

13.3 Checklists

The inspection before the initial operation determines the safety related integration of the active opto-electronic protective device (AOPD) into the machine and its control. The results of the inspection must be written down and kept with the machine documents. They can then be used as a reference during the subsequent regular inspections.

13.3.1 Checklist for safeguarding danger points

Safety Light Curtain (resolution 14 or 30 mm), normal approach to the protective field

ⓘ This checklist represents a help tool. It supports but does not serve for the inspection before the initial operation or the regular inspections by an expert.

- Is the safety distance calculated accordingly to the valid formula for danger point protection, considering the resolution and the response time of the AOPD, the response time of a possibly used safety interface and the stopping time of the machine? Is this minimum distance between the protective field and danger point considered? yes no
- Is access to the danger point only possible through the protective field of the AOPD and are other possible accesses protected by suitable safety components? yes no
- Is the protective field effective at each position and checked in accordance with Chapter 10.3? yes no
- Is reaching-over, reaching-under or reaching-around the protective field effectively prevented, e.g. by mechanical measures (welded or screwed)? yes no
- Is the external condition of the protective device and the control devices in good condition with no faults? yes no
- Are transmitter and receiver fixed against displacement/turning after the alignment? yes no
- Is unprotected presence between the protective field and the danger point safely excluded, i.e. through a maximum distance of 75 mm between the protective field and the machining table at a height of 750 mm, e.g. by cascading the COMPACT*plus* yes no

• Are all connectors and connection cables in fault-free conditions?	yes	no
• Is the start/restart button for resetting the AOPD properly positioned outside the danger zone at a location from which the entire danger point is fully visible?	yes	no
• Are the safety outputs (OSSDs), linked into the downstream machine control in accordance with the required safety category?	yes	no
• Are the subsequent circuit elements controlled by the AOPD monitored by the feedback circuit (EDM), e.g. contactors with positive-guided contacts or safety valves?	yes	no
• Does the actual integration of the AOPD into the machine control unit match the circuit diagrams?	yes	no
• Is the AOPD effective during the entire dangerous movement of the machine?	yes	no
• Is a possibly connected Section Emergency STOP button effective and after its resetting, is pressing and releasing of the start/restart button required to start the machine again?	yes	no
• Is a possibly connected Safety Door Switch effective and after its unlocking, is pressing and releasing of the start/restart button required to start the machine again?	yes	no
• Is the dangerous movement stopped immediately if the power supply voltage of the AOPD is interrupted and is the start/restart button required to start the machine again after power returns?	yes	no
• Is the plate with information about the daily check of the AOPD provided so that it can be seen easily by operating personnel?	yes	no

13.3.2 Additional checklist for safeguarding danger points with cycle control

ⓘ This checklist represents a help tool. It supports but does not serve for the inspection before the initial operation or the regular inspections by an expert.

With cycle control it must be impossible for a person to walk through the protective field, as this would cause a machine stroke while the person is still inside the danger area. The standardization bodies have therefore formulated particularly strict requirements for the application of AOPD with control functions for mechanical or hydraulic presses. If no additional measures have been taken regarding the surveillance of the inner machine/press space, the following questions must all be answered with "yes":

- Has the checklist of Chapter 13.3.1 been used for safeguarding danger points? yes no
- Does the machining table have a minimum height of 750 mm? yes no
- Has the maximum depth for the inner machine/press space of 1000 mm been observed? yes no
- Has the maximum permissible stroke length of 600 mm been observed? yes no
- Is unprotected presence between the protective field and danger point safely excluded, i.e. through a maximum distance of 75 mm between the protective field and the machining table at a height of 750 mm? yes no
- Does the limit switch in the top end position effectively and safely stop the stroke and is the limit switch secured against shifting? yes no
- Is there only **one** start/restart button available for resetting the AOPD (L5 **or** M1) and is it possible to view the entire danger point from the installation position of the button? yes no
- Is the initiated cycle control switched off by the internal time monitoring function if the protective field is not interrupted and released within 30 seconds? yes no

ⓘ The requirements for mechanical and hydraulic presses can be applied according to the equivalence principle to all other machines that are operated cyclically with controlling protective devices.

13.4 EC Declaration of Conformity

Leuze electronic GmbH + Co. KG
In der Braike 1
73277 Owen - Teck / German

The signatory declares that the safety components of series **COMPACT*plus*** in the form in which they are marketed by us conform with the relevant, basic safety and health requirements of the EC directives*, and that the standards* were used in their design and construction.

Owen, 31.01.09

Dr. Harald Grübel
General Manager

* You can also download this EC Declaration of Conformity from the Internet under: http://www.leuze.com/compactplus