Leuze electronic

the sensor people

COMPACT*plus*-m

Safety Light Curtains, Multiple Light Beam Safety Devices and Muting Transceivers Function Package "Muting"

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Subject to change without prior notice

CONNECTING AND OPERATING INSTRUCTIONS
Original Instructions

About this Connecting and Operating Instructions Manual

This connecting and operating instructions manual contains information on the proper use and effective application of COMPACT*plus*-m Safety Light Curtains, Multiple Light Beam Safety Devices and Muting Transceivers.

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

This connecting and operating instructions manual must be stored carefully. It must be available for the entire operating time.

Notes regarding safety and warnings are marked by this symbol  .

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

Leuze electronic GmbH + Co. KG is not liable for damages caused by improper use. Knowledge of the connecting and operating instructions is an element of proper use.

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1 General

COMPACT*plus* Safety Light Curtains and Multiple Light Beam Protective Devices and Transceivers 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 with different ranges of functionality.

Overview of function packages:

COMPACT*plus*-m

Safety Light Curtains, 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 fixed and/or floating blanking of beams plus „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 has a certified quality assurance system in accordance with ISO 9001.

Products

COMPACT*plus* Safety Light Curtains, 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
Ridlerstraße 65
D-80339 Munich

1.2 Symbols and terms

Symbols used:

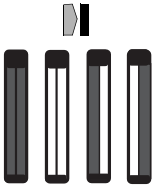
⚠	Warning sign – This symbol indicates possible dangers. Please pay especially close attention to these instructions!
i	Notes on important information.
➢	A note, which also refers to a course of action, provides information about special attributes or describes set-up procedures.
	Symbols of the COMPACT*plus* 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 • The receiver's active protective field is free, outputs in ON-state • The receiver's active protective field is not free, outputs still in ON-state (during muting procedure, for example) • The receiver's active protective field is free, outputs in OFF-state
	Symbol of the COMPACT*plus* CPRT Muting Transceiver General transceiver symbol
⇨ ⇦ ⇳	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 penetration in 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.

Table 1.2-2: Terms

Contactor monitoring (EDM)	The EDM function monitors the normally closed contacts of downstream positive-guided contactors and relays or valves
CP-m	COMPACT*plus* with “Muting” function package
CPR-m	COMPACT*plus* Receiver with “Muting” function package
CPT	COMPACT*plus* Transmitter
CPRT-m	COMPACT*plus* Transceiver with “Muting” function package
CPM500/2V	Passive deflecting mirror for transceivers
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 and/or SafetyLab)
Local connection box	Accessory that makes it easier to connect muting sensors, start button and muting lamp via the local connection sockets.
Local connection panel	Option for receiver/transceiver for direct connection of muting sensors and muting lamps on the device
MS	Muting sensor, e.g. light barriers, proximity switches or switches
MultiScan	Multiple evaluation: Beams must be interrupted in several consecutive scans, before the OSSDs switch OFF. MultiScan has a direct effect on the response time!
Muting	Regulations-correct, time-limited suppression of the protective field safety function
Muting restart	Muting restart is required when the muting lamp begins to blink (= Display: Muting error).
OSSD1, OSSD2	Safety related switching output **O**utput **S**ignal **S**witching **D**evice
Parallel muting	Muting is introduced if two defined muting sensors are activated within a specified time.
RES interlock	Start/restart interlock
SafetyKey	Additional components 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
Sequential muting	Muting is initiated if the muting sensors are activated one after another in a defined sequence.
Start/restart interlock	Prevents automatic start after supply voltage is switched on; after the protective field has been penetrated; or the external safety circuit has been activated

Table 1.2-2: Terms

1.3 Selecting COMPACT*plus*-m

1.3.1 CP-m Safety Light Curtains

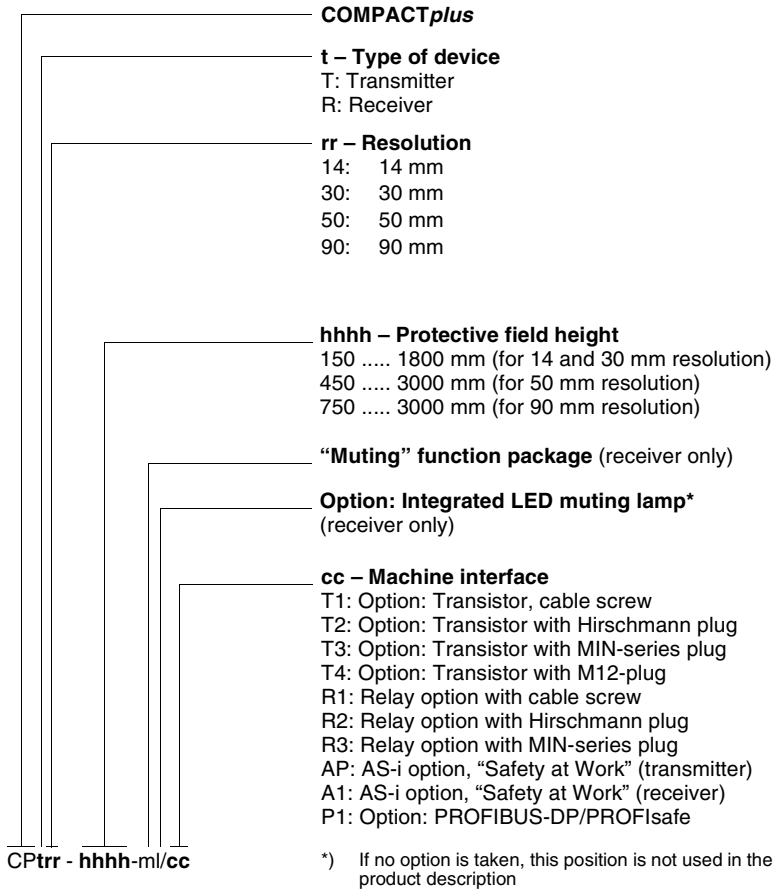


Fig. 1.3-1: Selecting COMPACT*plus*-m Safety Light Curtains

1.3.2 CP-m Multiple Light Beam Protective Devices

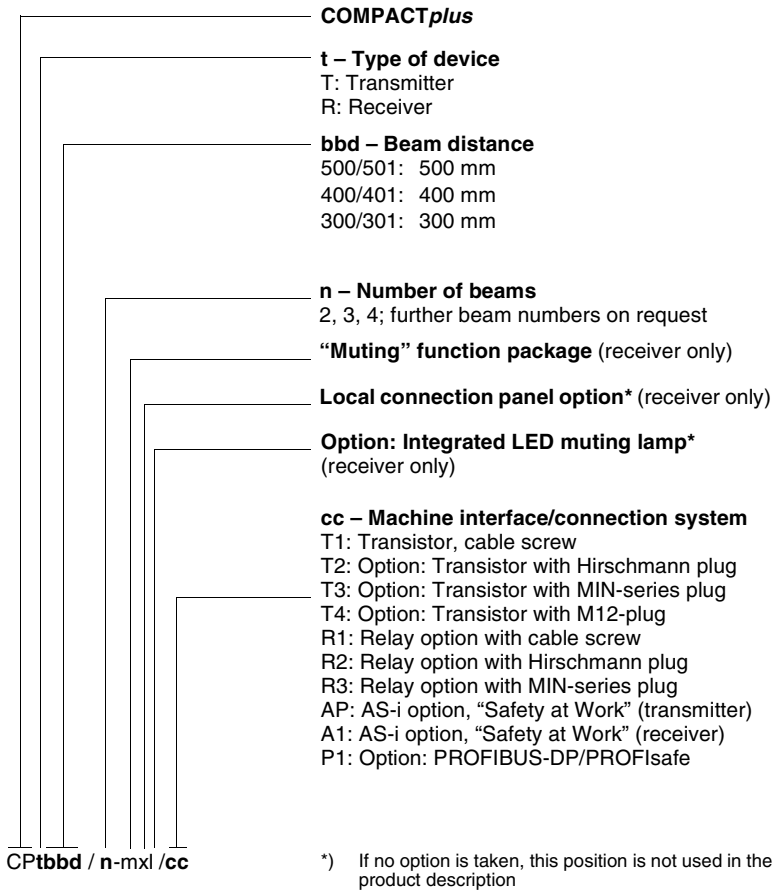


Fig. 1.3-2: Selecting COMPACT*plus*-m Multiple Light Beam Protective Devices

1.3.3 CPRT-m Muting Transceiver

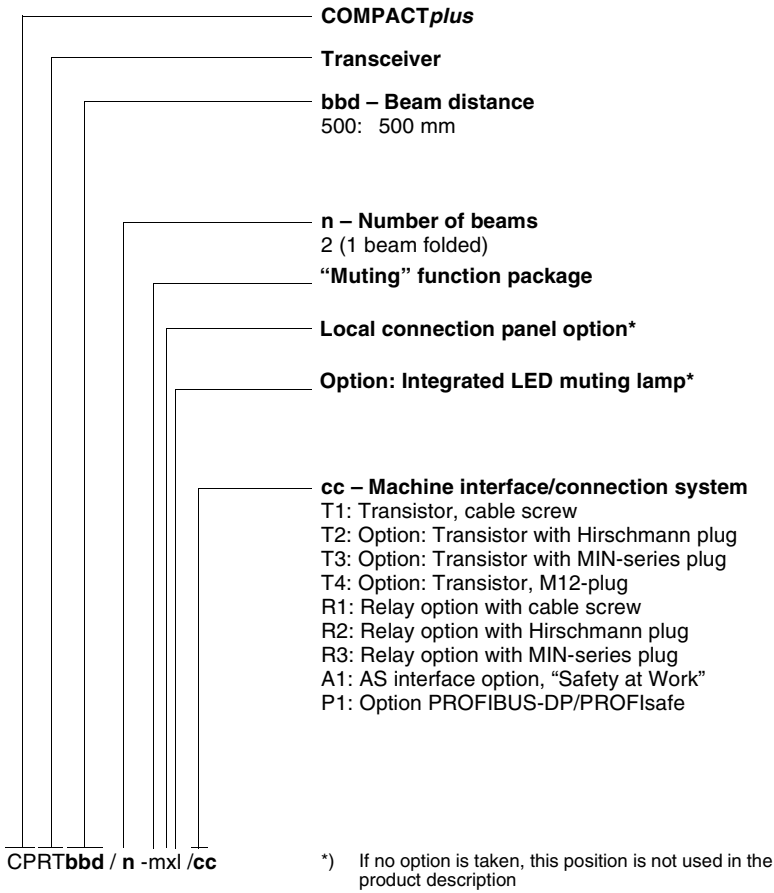


Fig. 1.3-3: Selecting COMPACT*plus*-m Muting Transceiver

ⓘ A passive deflecting mirror, CPM500/2V, is required for operating the muting transceiver!

1.3.4 Examples for selection

COMPACT*plus*-m Safety Light Curtain without options

CPT30-1500/T1		CPR30-1500-m/T1	
COMPACT*plus*	Safety Light Curtain	COMPACT*plus*-m	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:	1500 mm	Height of protective field:	1500 mm
		Function package:	Muting
		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-m Safety Light Curtain

COMPACT*plus*-m Safety Light Curtain with integrated LED muting lamp and AS-Interface options

CPT30-1200/AP		CPR30-1200-mI/A1	
COMPACT*plus*	Safety Light Curtain	COMPACT*plus*-m	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:	1200 mm	Height of protective field:	1200 mm
		Function package:	Muting
		Muting lamp option:	Integrated LED muting lamp
		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-m Safety Light Curtain

COMPACT*plus*-m Multiple Light Beam Protective Device without options

CPT400/3/T1		**CPR400/3-m/T1**	
COMPACT*plus*	Multiple Light Beam Protective Device	COMPACT*plus*-m	Multiple Light Beam Protective Device
Device type:	Transmitter	Device type:	Receiver
Beam distance:	400 mm	Beam distance:	400 mm
Detection range:	0 – 18 m	Detection range:	0 – 18 m
Number of beams:	3	Number of beams:	3
		Function package:	Muting
		Safety output:	2 OSSD transistor outputs
Transmitter interface connection system:	Cable screw	Machine interface connection system:	Cable screw

Table 1.3-3: Example 3, selecting CP-m Multiple Light Beam Protective Device

COMPACT*plus*-m Multiple Light Beam Protective Device with integrated LED muting lamp and PROFIBUS-DP/PROFIsafe options.

CPT400/3/T4		**CPR400/3-mxI/P1**	
COMPACT*plus*	Multiple Light Beam Protective Device	COMPACT*plus*-m	Multiple Light Beam Protective Device
Device type:	Transmitter	Device type:	Receiver
Beam distance:	400 mm	Beam distance:	400 mm
Detection range:	0 – 18 m	Detection range:	0 – 18 m
Number of beams:	3	Number of beams:	3
		Function package:	Muting
		Local-interface option:	Local connection panel
		Muting lamp option:	Integrated LED muting lamp
		Safety output option:	PROFIBUS-DP/ PROFIsafe
Transmitter interface connection system:	M12-plug, 5-pin	Machine interface connection system option:	3 cable tails with M12-plug

Table 1.3-4: Example 4, selecting CP-m Multiple Light Beam Protective Device

COMPACT*plus*-m Transceiver with local connection panel and integrated LED muting lamp options and M12-plug.

CPM500/2V		**CPRT-500/2-mxl/T4**	
Passive deflecting mirror	Passive Deflecting Mirror	COMPACT*plus*-m	Transceiver
Beam distance:	500 mm	Beam distance:	500 mm
		Detection range:	0 – 6.5 m
		Number of beams:	2 (1 beam folded)
		Function package:	Muting
		Local-interface option:	Local connection panel
		Muting lamp option:	Integrated LED muting lamp
		Safety output:	2 OSSD transistor outputs
Connection system:	No connection required	Machine interface connection system:	M12-plug, 8-pin

Table 1.3-5: Example 5, selecting CPRT-m Muting Transceiver

COMPACT*plus*-m Transceiver with options: Safety-related relay outputs with Hirschmann plug

CPM500/2V		**CPRT-500/2-m/R2**	
Passive Deflecting Mirror	Passive Deflecting Mirror	COMPACT*plus*-m	Transceiver
Beam distance:	500 mm	Beam distance:	500 mm
		Detection range:	0 – 6.5 m
		Number of beams:	2 (1 beam folded)
		Function package:	Muting
		Safety output option:	2 OSSD relay outputs
Connection system:	No connection required	Machine interface connection system:	Hirschmann plug

Table 1.3-6: Example 6, selecting CPRT-m Muting Transceiver

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*-m Safety Light Curtains, Multiple Light Beam Safety Devices and Muting Transceiver, Muting 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*-m Safety Light Curtain / Multiple Light Beam Safety Device.

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) 2, 3 and 4 beam 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	 $1.90 \times 10^{-8}\ 1/h$ $2.26 \times 10^{-8}\ 1/h$ $2.67 \times 10^{-8}\ 1/h$ 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*-m Safety Light Curtain / Multiple Light Beam Safety Device.

- The safety sensor protects persons at access points or at points of operation of machines and plants.
- The safety sensor as Safety Light Curtain with vertical mounting detects the penetration by fingers and hands at points of operation or by the body at access points.
- The safety sensor as Multiple Light Beam Safety Device 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 as Safety Light Curtain 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 “Muting” function package

COMPACT*plus*-m Safety Light Curtains and Multiple Light Beam Protective Devices and Muting transceivers are preferably used in a vertical position for access guarding of danger zones. Using additional sensor signals, they enable the protective field effect to be suppressed for a limited time, e.g. with material transport in or out of the danger zone.

Safety light curtains with 14 mm resolution detect finger, hand, arm or body; 30 mm resolution curtains detect hand, arm or body of a person that has entered the danger zone and can therefore be installed closer to the danger zone than 50 or 90 mm resolution curtains, multiple light beam protective devices and Muting transceivers, which, because of their wider beam distance, only detect a persons body (see Chapter 6). It applies for all versions that people are only detected during the access, their presence in the danger zone, however, is not detected! When one or more beams are interrupted by a person, the machine control unit must therefore go into safe interlock.

The start/restart interlock function is therefore obligatory for access guarding! The start button to release the start/restart interlock and the muting restart function must be positioned here outside the danger zone in such a way, that it cannot be reached from inside the danger zone, and a full overview of the complete danger zone must be possible from its location.

Before unlocking the start/restart interlock or the muting restart, the operator must be absolutely certain that nobody is inside the danger zone.

The muting sensors must be selected and arranged in such a way that their simultaneous activation cannot be triggered unintentionally by a person.

Muting may only be temporarily activated and only as long as the access to the danger zone is blocked by the transport material. If the distance between the transmitter and receiver or the transmitter and passive deflecting mirror is that much wider than the width of the transport material that a person can get by during the muting beside the transport material into the danger zone, then measures must be implemented that will detect the entry of the person and stop the dangerous movement. Step-on mats or swing doors monitored with safety switches have been tried, tested and proven here. Such measures prevent injuries being caused, for example, by squeezing in the access area.

Muting must be made automatically, it may not, however, be dependent on one single sensor signal nor may it be fully dependent on software signals.

The muting function must be released immediately after the transport material has passed through, so that anybody passing through behind the transport material will be detected by the protective device.

Warning!

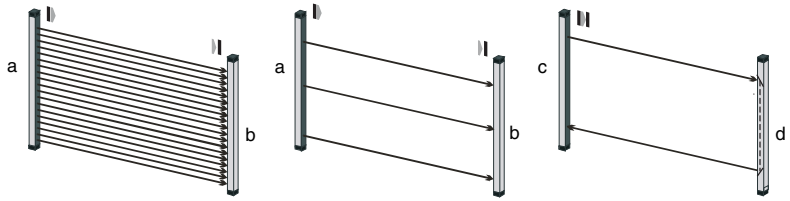
COMPACTplus-m Safety Light Curtains and Multiple Light Beam Protective Devices and Muting transceivers are ***not*** *suitable for danger point protection directly on machines (e.g. on presses). COMPACTplus-i Safety Light Curtain with selectable cycle control and muting function is the right choice for bridging the protective function during the part of a machine movement considered not dangerous (e.g. while lifting a tool).*

3 System design and possible uses

3.1 The opto-electronic protective device

Mode of operation

COMPACT*plus*-m is comprised of a transmitter and a receiver or a transceiver with passive deflecting mirror. Beginning with the first beam (the synchronizing beam) directly after the display panel, the transmitter pulses beam for beam in rapid succession. Synchronization between transmitter and receiver is performed optically.



a = Transmitter
b = Receiver
c = Transceiver
d = Passive deflecting mirror

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

The receiver/transceiver 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 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/transceiver response time.

If MultiScan mode is aktive, the functioning of the COMPACT*plus* safety light curtains will be scan-related. That is to say, irrespective of which of the beams is affected, the safety light curtain will switch to OFF as soon as a defined number (Hx) of successive scans has been interrupted.

With COMPACT*plus* multi-beam safety light barriers and transceivers, MultiScan’s operation is beam-related. That is to say, in MultiScan mode the same beam must be interrupted a number of times, depending on the selected MultiScan factor (Hx). When on having been switched on the system starts up, this MultiScan factor (Hx) will be displayed for a short time on the 7-segment display panel of the receiver/transceiver. The resulting response time is subsequently displayed with tx xx, whereby the response time x xx is displayed in milliseconds.

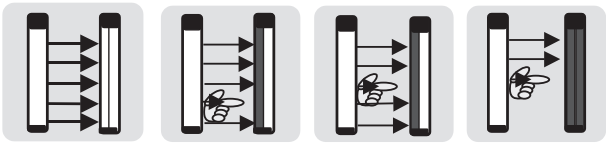


Fig. 3.1-2: Example: MultiScan, scan-related, MultiScan factor H = 3

Based on the factory settings, the following values for Hx will apply, depending on the beam number (AutoScan-Mode):

- Safety Light Curtains (8..240 beams): H = 1 (scan-related)
- Multiple Light Beam Safety Devices (2, 3 or 4 beams): H = 7 (beam-related)
- Muting transceiver (1 beam): H = 8 (beam-related)

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

Warning!

An increase of 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/transceiver so that there is generally no need for a downstream safety interface.

The Muting function package provides the option, by connecting 2 or 4 muting sensors, of limited bridging of the protective function of the safety light curtain, the multiple light beam protective device and the muting transceiver, e.g. if material has to be transported through the protective field.

3.2 Option: Integrated LED muting lamp

COMPACT*plus*-m Receivers/Transceivers can be delivered with optional integrated LED muting lamp (white). This sensor is mounted on an end cap designed especially for this purpose (opposite the connection cap).

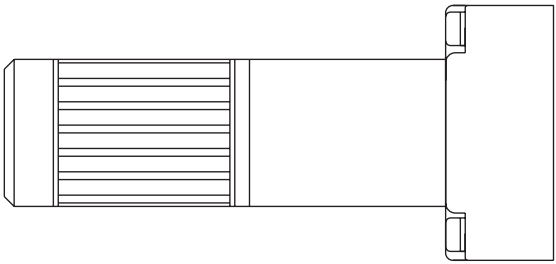


Fig. 3.2-1: Integrated LED muting lamp

3.3 Option: Local connection panel

The local connection panel option is an alternative to the local connection socket in the connection cap. The option exists for multiple light beam protective devices and muting transceivers of connecting the individual muting sensors and an external muting lamp to an own M12 connection socket directly on the front screen.

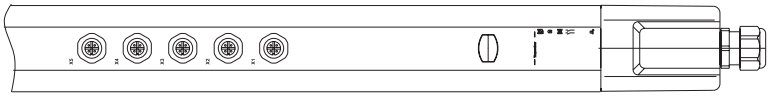


Fig. 3.3-1: Local connection panel

3.4 Application examples

3.4.1 Multiple Light Beam Protective Device, 4-sensor sequential muting

using four induction loops set into the floor, MS 1 to MS 4. Swing doors monitored by safety switches and separate safety interface (e.g. MSI from **Leuze**) prevent crushing between the transport vehicle/material and columns.

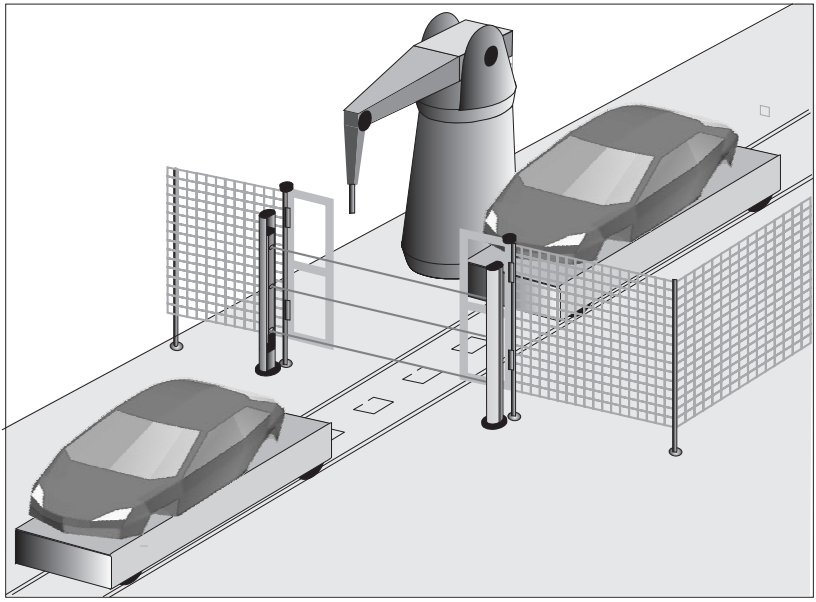


Fig. 3.4-1: Multiple Light Beam Protective Device, muting application at a robot station

3.4.2 Muting Transceiver, 2-sensor parallel-muting

with reto-reflective light barriers as muting sensors MS2 and MS3 with reflectors. As a result, connections are only required on one side.

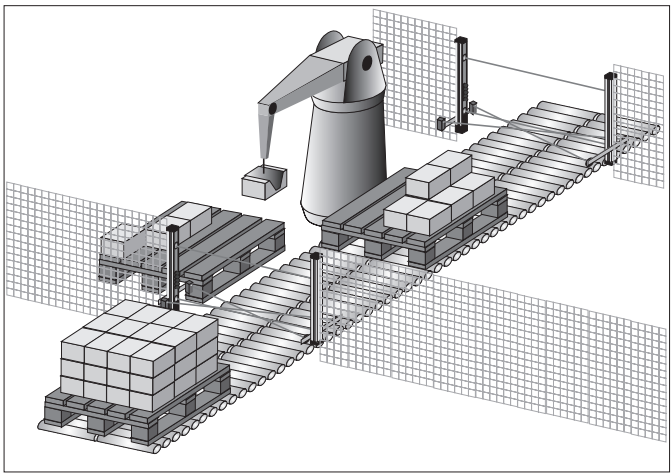


Fig. 3.4-2: Muting Transceiver, application on a palletizer

3.4.3 Safety Light Curtain, 4-sensor parallel-muting

enables space-saving arrangement, e.g. for loading and unloading areas of conveyor lines. In this example, light-switching diffuse reflection light scanners with background suppression serve as muting sensors.

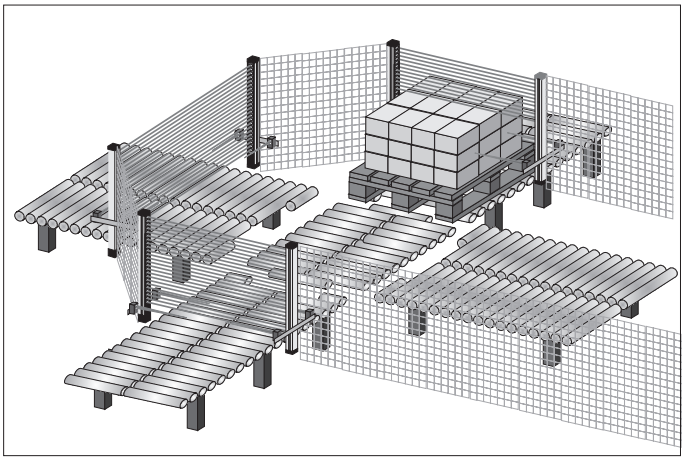


Fig. 3.4-3: Safety Light Curtain, muting application on a conveyor system

4 “Muting” function package

4.1 Parameterizable functions of the transmitter

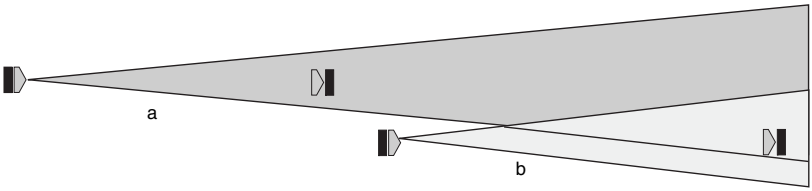
4.1.1 Transmission channel

The infrared beams are modulated with specially shaped pulse bundles so that they are distinct from ambient light and undisturbed operation is consequently ensured. Sparks from welding or warning lights from passing forklifts 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 (factory setting) to 2 must be made both on the transmitter and the receiver of the optical protective device in question. You find more detailed information in Chapter 8.

4.2 Parameterizable basic functions of the receiver/transceiver

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!*

If the start/restart interlock function is active, it prevents the automatic release of the safety circuits when the machine is turned on or the supply voltage is restored after a power outage. Only by pressing and releasing the start-/restart button within a time window is the receiver/transceiver switched to the ON-state.

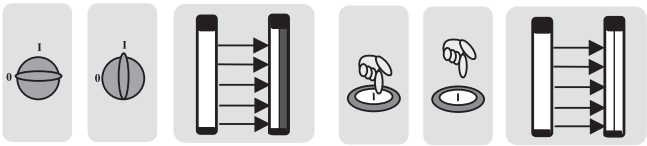


Fig. 4.2-1: Start/restart interlock function with supply voltage power-on

If the protective field is interrupted or an optional safety circuit is activated (can be activated via SafetyLab), the start/restart interlock function ensures that the receiver/transceiver also remains in the OFF-state even after the protective field has been freed. The receiver/transceiver 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).

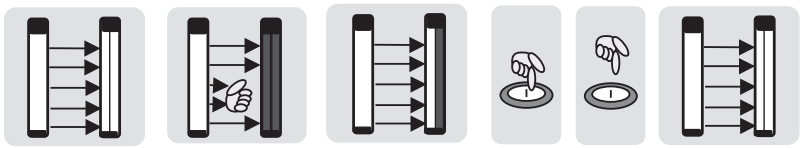


Fig. 4.2-2: Start/restart interlock function after interrupting the protected field

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.

In case of access guarding applications, the start/restart interlock function is obligatory due to the fact that only access to the danger zone, but not the area between the protective field and the danger points is monitored.

Warning!

Before unlocking the start/restart interlock of an access protection, the operator must be absoluteley certain that nobody is inside the danger zone.

How to activate the start/restart interlock:

➢ internally in the COMPACT*plus* receiver/transceiver (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/transceiver 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.

Exception:

In the muting error state, for example, activated by false sequence or exceeding of time limits, the start-/restart button also serves for the muting restart. In this case, after pressing, releasing and again pressing the start-/restart button within the prescribed time, the safety-related switching outputs (OSSDs) are released for as long as the button is pressed! If the system finds a valid signal pattern of the connected muting sensors, the system transfers to normal operation. With faulty configuration, the transport material can only be moved out of the access area in tip mode. The “Muting restart” function is described in more detail in Chapter 4.3.6.

Warning!

The operator must also be absolutely certain with the muting restart that nobody is inside the danger zone.

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

The connection of the start-/restart button is required to ensure the muting restart function, regardless of whether or not the internal start/restart interlock is activated or not. If the internal start/restart interlock is not activated, for example, because a subsequent control unit ensures this function, then the start-/restart button only performs the muting restart function.

4.2.3 Contactor Monitoring (EDM)

Warning!

*The contactor monitoring function is **not** activated at the factory!*

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

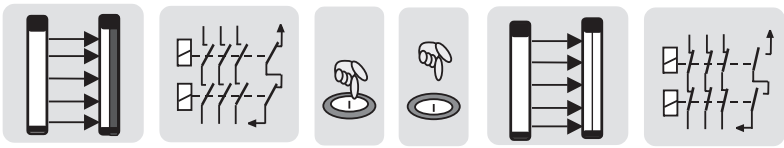


Fig. 4.2-3: Contactor monitoring function, combined in this example with start/restart interlock

Activate the contactor monitoring function via:

- ➢ the internal contactor monitoring in the receiver/transceiver (see Chapter 8.3.1),
- ➢ or the external contactor monitoring of a 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, and if it has closed again within 300 ms (FS) after the OSSD has been switched off. If this is not the case, the OSSDs return to the OFF-state again after being briefly switched on. An error code 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.

Further selection options emerge with SafetyLab and PC.

4.2.4 7-segment display turnaround

COMPACT*plus* can be mounted in any position. This allows transmitters/receivers to be operated overhead, e.g. if the cable entry is required from above. While the permanent displays of the transmitter for the transmission channel C1 with 1 or C2 with 2 are still clearly legible, it may become necessary with the receiver/transceiver with the double-7-segment display to turn the display around electronically and adapt to the new installation situation.

The display for the connection of the machine interface cable from below is set in the factory settings of the receiver/transceiver (FS).

- ➢ Where required, activate the display turn around function of the receiver/transceiver according to your application (see Chapter 8.3.5).
- ➢ When assembling, make sure that the cable connections of transmitter and receiver are always pointing in the same direction.

4.3 Muting

Muting is the intended, regulated and time-limited suppression of the protective field safety function. During the muting procedure, the OSSDs remain in the ON-state with the interruption of one or more beams. Special precautions must therefore be taken here to ensure safety. See the special safety notes in Chapter 2.5.

The muting operation is initiated by the muting sensor signals. On the basis of the number and sequence of the muting sensor signals, the factory-set receiver/transceiver automatically differentiates here between the muting mode “4-Sensor Sequential Muting” with the assignment of all muting signal inputs MS1 to MS4 and “2-Sensor Parallel Muting” with signals only from MS2 and MS3. Switching can be made to the muting mode “4-Sensor Parallel Muting” (see Chapter 8.3.4). The muting lamp must be connected in all muting modes.

Further muting modes are available using PC and SafetyLab software. The SafetyLab user manual provides information in this respect.

The following may be considered as examples of muting sensors:

- Light devices (transmitter/receiver or reto-reflective light barriers), the beam paths of which cross behind the protective field within the danger zone
- Light scanners, which scan the side of the transport material (observe correct scan range setting)
- Light device(s) and a feedback signal from the belt drive or a PLC signal, if both are activated within simultaneity or sequence conditions.
- Switching signals from induction loops, that, for example, are activated by a forklift.

Please consider that the switch-on filter time for sensor signal inputs is 40 ms.

Warning!

The muting sensors must be arranged a way that a person cannot be in a position to activate the muting function by a simple manipulation.

4.3.1 4-Sensor Sequential Muting

Sequential muting requires the connection of 4 muting sensors and their activation in a predefined sequence. This is preferably used when the transport material or the transport equipment always has the same dimensions and enough space is provided for entry and exit. Sequential muting is initiated after activation of the second muting sensor in both the sequences,

- MS1 .. MS2 .. MS3 .. MS4, and
- MS4 .. MS3 .. MS2 .. MS1.

Short-time drop-outs of muting sensor signals ≤ 100 ms (FS, can be changed with SafetyLab) are permitted.

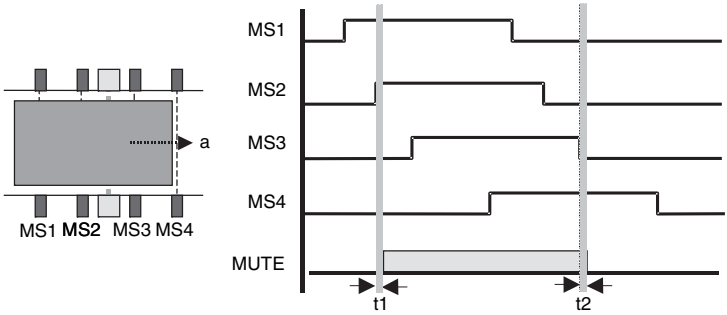
Note!

The advantage of sequential muting over parallel muting is that only the order of the sensor activation/deactivation is recorded. The time interval between the sensor signals is not important.

All 4 sensors must be briefly activated simultaneously for taking the muting over from the input area to the output area of the muting line. The transport material to be muted must therefore be sufficiently long.

Sequential muting is terminated correctly, that means that the OSSDs remain in the ON-state during the pass-through if the muting sensor activated third becomes free and is consequently switched to inactive. The 4-sensor sequential muting is not terminated correctly, which means that the OSSDs switch off, if

- a muting sensor > 100 ms (FS) is wrongly switched to inactive during a muting procedure
- the muting lamp fails
- the length of the object is shorter than the distance between MS1 and MS4
- the movement direction changes within the muting line
- a second object enters the muting line during the muting
- the muting time limit has expired



a = Danger zone

t1 < 40 ms
t2 = 100 ms (FS)

Fig. 4.3-1: 4-Sensor Sequential Muting

4-Sensor sequential muting works in both movement directions and is automatically detected when switch S4 is set to L (FS) and either MS1 or MS4 is activated as first muting sensor.

4.3.2 2-Sensor Parallel Muting

Switch the two signals MS2 and MS3 simultaneously (FS: within 2.5 s) without MS1 or MS4 being first or simultaneously activated or connected at all – this is how 2-sensor parallel muting is started up. Brief signal drop-outs of only one sensor < 2.5 s (FS) are tolerated. This type of muting is used frequently when the dimensions of the transport material in the transport direction are not consistent and/or not much space is available in front of the muting line. It is important that the crossover point of the two muting sensor light beams be behind the optical protective device, that is then, within the danger zone.

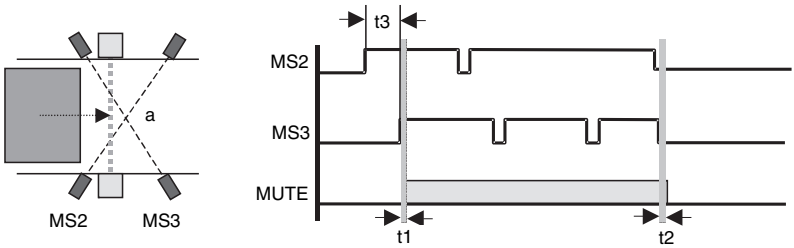
Advantages of 2-sensor parallel muting are:

- Low expense – only 2 sensors are required
- The option of moving forwards and backwards within the muting line

Once muting has been started, one of the two sensor signals may be briefly interrupted for not longer than 2.5 s (FS). 2-Sensor parallel muting is terminated correctly, which means that the OSSDs remain in the ON-state during the pass-through of the transport material if the signals of both muting sensors become inactive simultaneously (FS: within 2.5 s).

2-Sensor parallel muting is not terminated correctly (OSSDs switch OFF), if

- one muting sensor signal is interrupted over 2.5 s (FS), but the other muting sensor continues to be active,
- the muting time limit has expired,
- the muting lamp fails.



a = Danger zone

t1 < 40 ms
t2 = 100 ms (FS)
t3 < 2.5 s (FS)

Fig. 4.3-2: 2-Sensor parallel muting

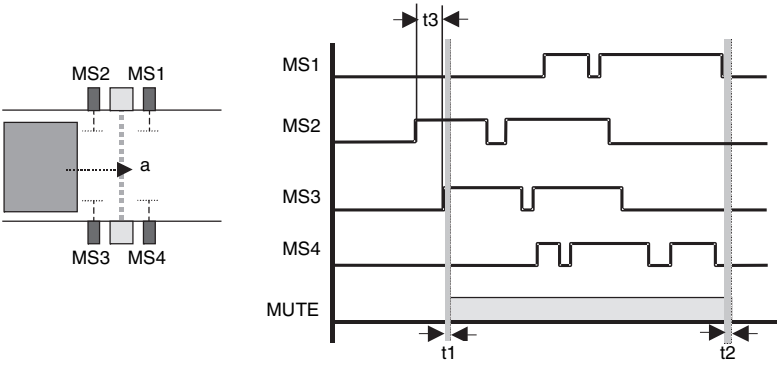
2-Sensor parallel muting is automatically detected when switch S4 is set to L (FS) and either MS2 or MS3 is active as first muting sensor.

4.3.3 4-Sensor Parallel Muting

4-Sensor parallel muting can be used with advantages everywhere where

- the transport material is too small to be registered by 4 sequentially arranged sensors simultaneously;
- the spatial conditions are too confined, even for the two crossed light beams of the 2-sensor parallel muting.

4-Sensor parallel muting corresponds as regards functions with the 2-sensor parallel muting with the added feature that the muting activation signal is gained from two sensor pairs respectively. Muting is started up when (FS: within 2.5 s) MS2 is activated with MS3 or MS1 is activated with MS4 simultaneously. Brief signal drop-outs of only one sensor < 2.5 s (FS) are tolerated. In comparison with electrical parallel connection of MS1 with MS2 and MS3 with MS4, which is difficult to implement constructively on-site anyway, here the simultaneity of the activation is checked in pairs for both MS2 and MS3 and for MS1 and MS4.



a = Danger zone

t1 < 40 ms
t2 = 100 ms (FS)
t3 < 2.5 s (FS)

Fig. 4.3-3: 4-Sensor Parallel Muting

Chapter 8.3.4 describes how to change to 4-sensor parallel muting using switch S4.

4.3.4 Muting time limit

If the muting function is activated longer than 10 minutes (FS), then it is terminated with the E50 error signal regardless of the selected muting mode. The receiver resets automatically after approx. 10 s. A renewed muting is only started after an applicable muting sequence has been initiated. The muting time limit is obligatory.

The muting time limit may only be switched off in cases with good reason, e.g. with normally uninterrupted flow of goods on the muting line and when no person is endangered thereby.

Warning!

The user assumes responsibility for switching off the muting time monitoring!

4.3.5 Muting lamp monitoring

Warning!

*The muting lamp indicates the operating staff by constant lighting that muting has been correctly initiated and the protective function of COMPACT*plus*-*m *has been bridged. The muting lamp is current-monitored during the muting procedure.*

Muting is not permitted with a defective lamp. If it is determined that the current deviates from the required value (FS: 15...500 mA), then the OSSDs switch to the OFF-state. E51 or E52 appears on the 7-segment display and the collective error indication output, M4, displays the error by switching to 0 V. The receiver/transceiver automatically resets after approx. 10 s (FS) and attempts again with detection of the next correct muting sequence to control the lamp.

The device designs -ml and -mxl have an LED lamp integrated in the end cap opposite the connection cap. The switching of further external muting lamps is, nonetheless, still possible, as long as the overall current does not exceed 500 mA (FS).

4.3.6 Muting restart

An applicable muting sequence can be interrupted in line with the operating conditions, e.g. with failure of the supply voltage while a permissible object is just passing the muting line. With the recovery of the supply voltage, the muting procedure does not continue automatically, because the expected sequence is not supplied from the already activated muting sensors. The muting line may have to go to free-move mode if the palette's load is distributed so badly that only one muting sensor is activated when the protective field is interrupted and the muting isn't even activated by this. The muting lamp blinks to indicate this state. In order to prevent a manual removal of the object from the muting line, COMPACT*plus*-m provides an integrated free-move mode via the start-/restart button. The OSSDs are switched on here, provided at least one muting sensor is activated, and within 4 seconds (FS), for at least 0.3 seconds each:

➢ the start-/restart button is pressed,

➢ released again and

➢ pressed again.

The second time the start/restart button is released the receiver checks the muting sensors for an n effective assignment. If an effective muting combination is determined, the OSSDs remain in the ON state; the system returns to its normal operation; the muting lamp lights constantly until the transported goods have left the muting line.

If, however, an ineffective muting combination is determined, the release of the OSSDs is only maintained while the button is pressed. If it is released, the system stops again. This happens, for example, with dealignment, dirty or damaged muting sensors, and also when palettes are loaded wrongly.

In this case as well, the free-movement in tip mode is therefore possible under the condition that a responsible person observes the procedure and can interrupt the dangerous movement at any time by releasing the start/restart button. The error must be checked by a qualified specialist.

The free-movement is limited to 60 s. Thereafter the abovementioned sequence must be pressed on the start/restart button again in order to continue the process.

Warning!

It must be ensured that the entire danger area is fully visible from the start/restart button's installation point.

When the protective device is switched on again the following scenarios can be differentiated:

1. Normal start

   The protective field is free and none of the muting sensors is seized. Pressing and releasing the start button once switches the safety outputs (OSSDs) of the protective device on.

2. Muting restart 1

   After releasing the start button the second time the protective device remains switched on; the muting lamp lights constantly. This is the case,
   - with a failure and power supply switch on again during a correct muting sequence.
   - with activation of the first muting sensor with parallel muting, subsequent stopping of the palette transport for longer than 2.5 seconds and continuing the movement; as no muting has been activated the OSSDs switch off when the protective field is interrupted.
   - with activation of the muting for longer than the set muting time limit of 10 minutes. After protective device re-start this can be overridden.

3. Muting restart 2

   After releasing the start button the second time the protective device switches off again; the muting lamp flashes again. This happens as examples when with parallel muting only one muting sensor has been activated, e.g. because,

   - the second muting sensor has failed
   - the second muting sensor was not activated during transport through the muting line because the load is badly distributed.

4.4 Additional functions can 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 E17, 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 by SafetyLab and the password 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
- Further muting types
- MultiScan factor change
- Partial muting of light curtains, i.e. not just selected but any beams are muted
- Muting extension, muting release signal
- Change and control of muting time limit
- Premature muting termination with free protective field

Further details on diagnostics and parameterization can be found in the user manual of the Diagnostics an Parametrization software SafetyLab.

5 Display elements

5.1 Transmitter status displays

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

Fig. 5.1-1: Transmitter status displays

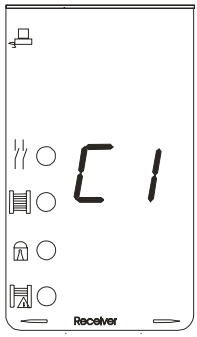
Current status of the transmitter:

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”

Table 5.1-1: Transmitter 7-segment display

5.2 Receiver/transceiver status displays

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



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

Fig. 5.2-1: Receiver/transceiver status displays

5.2.1 7-Segment displays

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

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
3y **xx**	Function package display (3 = muting) y xx = Firmware version
Hx	MultiScan factor display x = Number of scans per evaluation cycle (FS: see tables in Chapter 12.2)
tx **xx**	Response time of the AOPD after interruption of the active protective field x xx = response time in ms
	Permanent parameter display after startup
Cx	Transmission channel display x = Transmission channel set (1 or 2, FS = 1)

Table 5.2-1: 7-Segment displays for receiver/transceiver

	Temporary event displays in alignment mode
1  **n**	Alignment display: One horizontal bar represents one beam: 1: first beam n: last beam 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 correct signal from contactor monitoring, see Chapter 11)
Fx **xx**	Display of locking status, “device fault”, receiver/transceiver must be replaced

Table 5.2-1: 7-Segment displays for receiver/transceiver

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 start/restart interlock in OFF-state (LED1 red):** ON = Protective field free
		Operating mode with/without internal start/restart interlock in ON-state (LED1 green): ON = Weak beam indication with free protective field
LED3	Yellow	ON = Internal restart interlock locked OFF = Restart interlock unlocked/not activated
LED4	Blue	OFF = No special function ON ⚠ = Muting or Muting-Restart ON, AOPD without protective function!

Table 5.2-2: LED displays, receiver/transceiver

6 Installation

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

6.1 Minimum distances and component positions

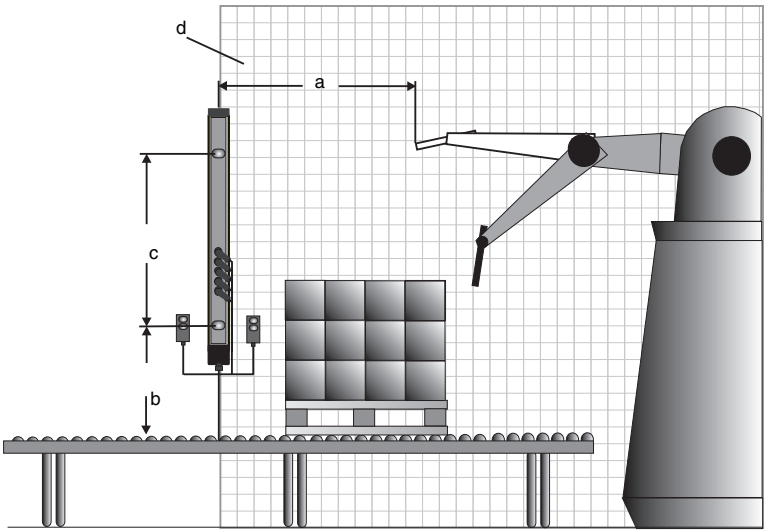
Optical protective devices can only fulfill their protective requirements if they are installed with a sufficient safety distance.

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 reflecting surfaces are determined in accordance with the European standard for “Active Opto-electronic Protective Devices (AOPD)” prEN IEC 61496-2.

6.1.1 Beam heights and safety distance for multiple light beam protective devices, transceivers and safety light curtains with 50 mm or 90 mm resolution

Determination of beam heights above reference level and calculation of the safety distance for COMPACT*plus* Multiple Light Beam Protective Devices, Transceivers or Safety Light Curtains with 50 mm or 90 mm resolution.



a = Safety distance (protective field/danger point)
b = Height of the lowest beam above the reference level
c = Beam distance
d = Measures against approach from the sides

Fig. 6.1-1: Access guarding with muting transceiver

Beam heights for access guarding in accordance with EN 999:

Version	Number of beams	Beam distance in mm	Beam heights above reference level in mm
CP50-900-m (50 mm resolution)	24	37.5	300 to 1200
CP90-900-m (90 mm resolution)	12	75	300 to 1200
CP300/4-m, CP301/4-m	4	300	300, 600, 900, 1200
CP400/3-m, CP401/3-m	3	400	300, 700, 1100
CP500/2-m, CP501/2-m and CPRT500/2-m	2	500	400, 900
CP600/2-m	2	600	300, 900

Table 6.1-1: Beam heights above reference level for access guarding

Calculation formula for safety distance S in accordance with EN 999:

The safety distance S for access guarding 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

K: = Approach speed 1600 mm/s.

T: = Total time delay in s
Sum of:
protective device response time t_{AOPD}, see tables in Chapter 12.2
the protective interface, if any $t_{Interface}$, Technical data interface
and the machine's stopping time $t_{Machine}$. Technical data of the machine or stopping time measurement

C = 850 mm (arm length)

$$S\ [mm] = 1600\ [mm/s] \times (t_{AOPD} + t_{Interface} + t_{Machine})\ [s] + 850\ [mm]$$

Calculation example: Access guarding with transceiver

A robot with a stopping time of 250 ms should be protected with a CPRT500/2-m/T1 Transceiver. The beam heights are determined at 400 and 900 mm.

The response time for CPRT500/2-m/T1 in accordance with Table 12.2-3, is: tH8T = 20 ms (FS). An additional interface can de dispensed with since CPRT500/2-m/T1 is already equipped with internal start/restart interlock and EDM functions.

T = 20 + 250 = 270 ms

C = 850 mm = 850 mm

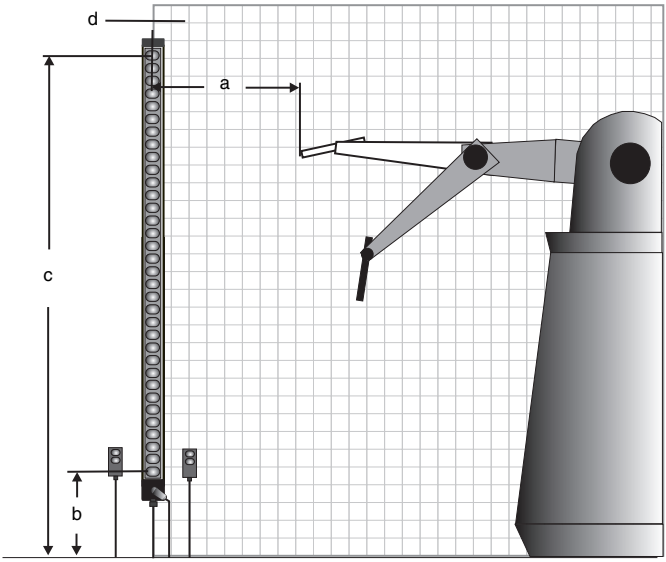
S = 1600 x 0.270 + 850 = 1282 mm

Warning!

Using access guarding, it must be ensured that the start/restart interlock function is active and that unlocking from inside the danger zone is not possible.

6.1.2 Safety distance and protective field heights for safety light curtains with 14 mm or 30 mm resolution

Determination of protective field height and calculation of the safety distance of safety light curtains with 14 or 30 mm resolution with use as access guarding



a = Safety distance (protective field/danger point)
b = Height of the lowest beam above the reference level = 300 mm
c = Height of the highest beam (in accordance with EN 294)
d = Measures against approach from the sides

Fig. 6.1-2: Access guarding with safety light curtain, 14 or 30 mm resolution

Protective field height with use of a safety light curtain as access guarding in accordance with EN 999:

Version	Resolution	Lowest beam above the reference level	Highest beam above the reference level
CP14-xxxx	14 mm	300 mm	In accordance with EN 294
CP30-xxxx	30 mm	300 mm	In accordance with EN 294

Table 6.1-2: Beam heights above the reference level for CP14-m and CP30-m as access guarding

Calculation formula for safety distance S in accordance with EN 999:

Calculation of the safety distance for a safety light curtain with a resolution of up to 40 mm as access guarding. The safety distance S is calculated in accordance with EN 999 using the formula:

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

S = Safety distance in mm

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 can be used. However, in this case a minimum safety distance of 500 mm is applied.

T: = Total time delay in s
Sum of:

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

C = 8 x (d-14) in mm
Allowance depending on the depth of penetration into the protective field before turning on the AOPD

d = AOPD resolution up to maximum 40 mm

$$S\ [mm] = 2000\ [mm/s] \times (t_{AOPD} + t_{Interface} + t_{Machine})\ [s] + 8\ (d-14)\ [mm]$$

Calculation example: Access guarding with safety light curtain, 30 mm resolution

A robot with a stopping time of 300 ms should be protected with a, Safety Light Curtain CP30-1800-m/T1. The lowest beam is determined at 300 mm and highest beam is consequently at 2100 mm.

The response time for CP30-1800-m/T1 in accordance with Table 12.2-1, is: tH1T = 22 ms (FS). An additional interface can be dispensed with since CP30-1800-m/T1 is already equipped with internal start/restart interlock and EDM functions.

T = 22 + 300 = 322 ms

C = 8*(d-14) mm= 8*(30-14) = 128 mm

S = 2000 x 0.322 +128 = 772 mm

As the value for S is over 500 mm, calculation can be made with an approach speed of 1600 mm/s (if the result here is less than 500 mm, at least 500 mm must be used):

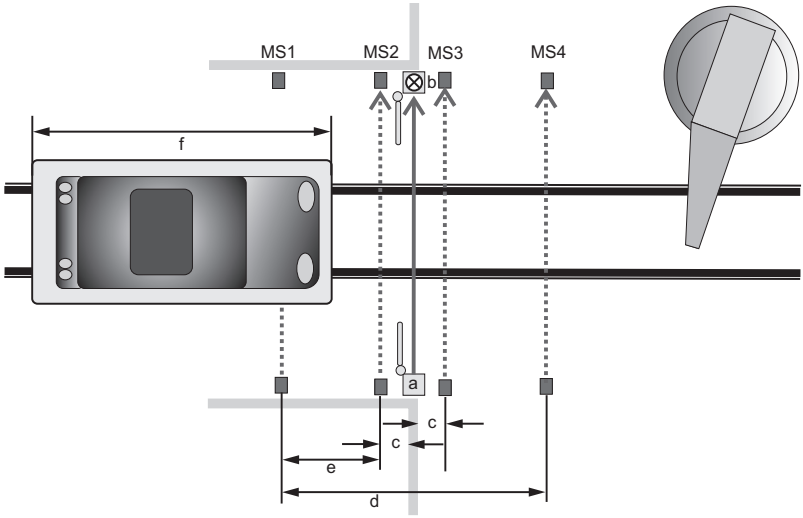
S = 1600 x 0.322 +128 = 644 mm

In accordance with the table for high risk from EN 294, a distance of at least 600 mm is required between the danger point and the hard guard/protective field. The height of the protective device must, in accordance with this table, be at least 2000 mm so that the danger point cannot be reached with the upper limbs (fingers, hands, arms). This condition is met with the 2100 mm height for the highest beam!

Warning!

Using access guarding, it must be ensured that the start/restart interlock function is active and that unlocking from inside the danger zone is not possible.

6.1.3 Sensor positions with 4-sensor sequential muting



a = Transmitter
b = Receiver
c = Distance between MS and protective field must be less than 200 mm
Distance between MS2 and MS3 must be symmetric to protective field, but not so small that MS2 and MS3 can be triggered simultaneously, e.g. by a shoe (see fig. 6.1-4), >250 mm; the MS filter time of 160 ms and max. protective-field response time of 40 ms at a normative approach speed of v = 1.6 m/s yield a minimum distance of 80 mm between MS2 and the protective field
d = Distance between MS1 and MS4:
Symmetrical to the protective field, as big as possible, however < e, so that all sensors are assigned before the first activated sensor is released again.
e = Distance between two muting sensors, >250 mm
f = Consistent length of the transport vehicle

Fig. 6.1-3: Arrangement of the muting sensors, 4-sensor sequential muting

The example shows four dark-switching throughbeam photo electric sensors as muting sensors, the receivers of which switch actively high with assignment, that is, delivers +24V to the assigned muting inputs of the CPR-m/CPRT-m. However, proximity switches or mechanical switches can also be used. If there is a danger of crushing between the transport vehicle and the protective device, swing doors, for example, with a width of approx. 500 mm are recommended. The swing doors must be monitored by safety switches integrated into the release circuit via a separate safety interfaces.

The connected muting lamp indicates the muting procedure. If the muting lamp blinks, then the muting restart described in Chapter 4.3.6 is required.

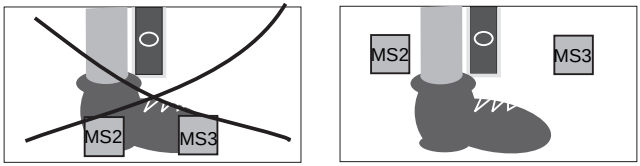
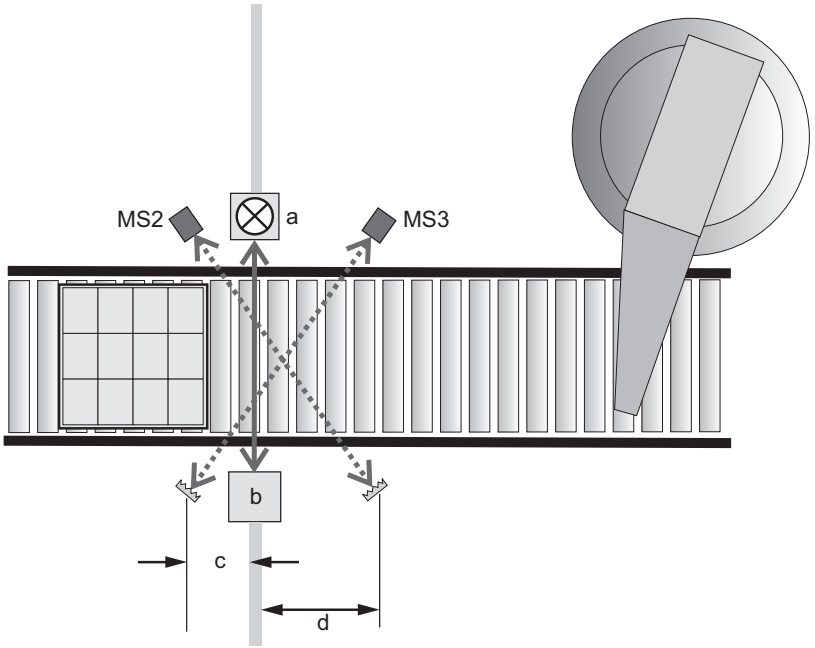


Fig. 6.1-4: Arrangement of the muting sensors MS2 and MS3

Warning!

*Applicable for all muting types: It may **not** be possible to activate two muting sensors simultaneously with, for example, a shoe!*

6.1.4 Sensor positions with 2-sensor parallel muting



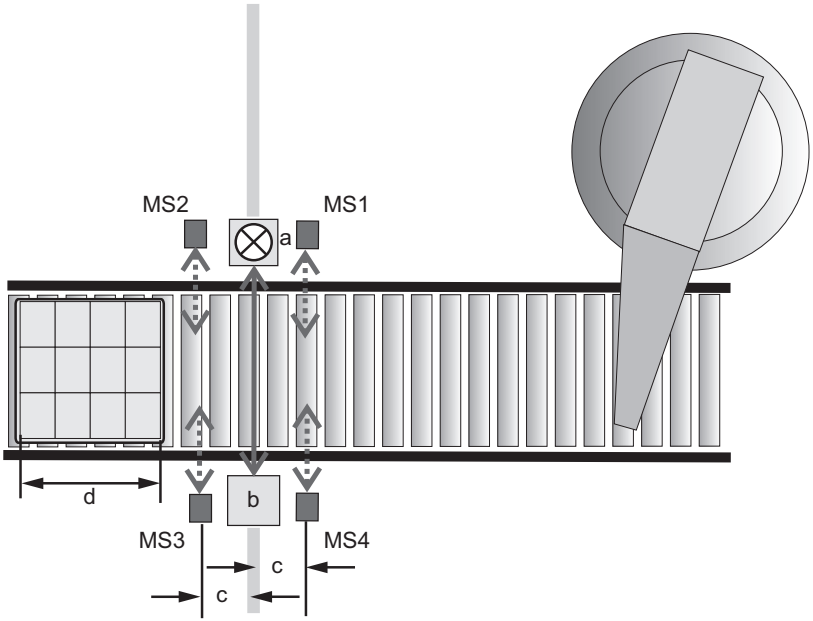
a = Muting transceiver
b = Passive deflecting mirror
c = Distance between reflector and ESPE, <200 mm
d > c, Asymmetric arrangement, so that the intersection point of the beam path of muting sensors MS2 and MS3 lies within the danger zone and a distance of 200 mm between protective field and intersection point is not exceeded.

Fig. 6.1-5: Arrangement of the muting sensors, 2-sensor parallel muting

Consequently a person entering would first interrupt the protective field and only then the two light beams of the muting sensors at the same time. The example above allows for two dark-switching reto-reflective light barriers that deliver +24V to the assigned muting inputs on interruption. If this is possible on-site, then MS2 and MS3 should be positioned at different heights so that no point-shaped crossover of the beam paths occurs.

CPRT-m has been selected in the example so that the connections of the optical protective device and the muting sensors are only necessary on one side of the transport path.

6.1.5 Sensor positions with 4-sensor parallel muting



a = Muting transceiver
b = Passive deflecting mirror
c = Distance between muting sensor and ESPE, <200 mm
d > c, so that the muting sensors MS1 and MS4 can maintain the muting signals from MS2 and MS3 during the pass through. Only when both MS1 and MS4 are freed does the muting procedure end.

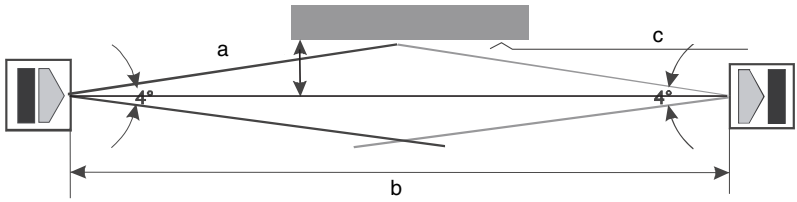
Fig. 6.1-6: Arrangement of the muting sensors, 4-sensor parallel muting

Four light-switching diffuse reflection light scanners with limited detection range are shown as muting sensors in the example, which deliver +24V to the AOPD when they are activated by the transport material. The scanning range is to be adjusted by the start-up engineer at each optical scanner in such a way that it is not possible for a single person to simultaneously activate MS2 and MS3 or MS1 and MS4. The width of the muting object must be correspondingly large. Switches or mechanical switches can also be used.

6.1.6 Minimum distance from reflecting surfaces

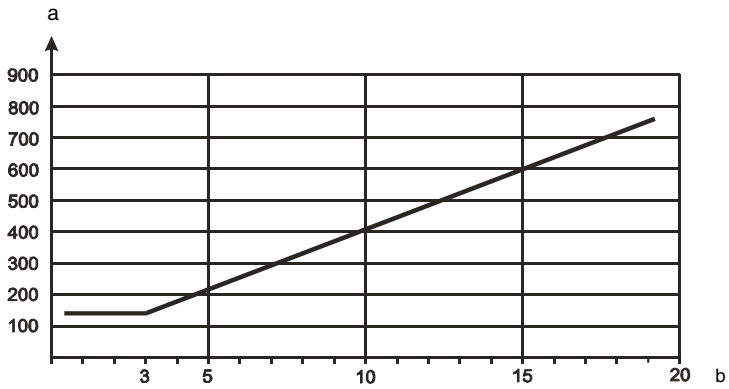
Warning!

Reflecting 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" depends on the distance "b" between the transmitter and the receiver/transceiver and the passive deflecting mirror.



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

Fig. 6.1-7: Minimum distances to reflecting surfaces



a = Required minimum distance from reflective surfaces [mm]
b = Protective field width [m]

Fig. 6.1-8: Minimum distance from reflecting surfaces depending on protective field width

6.2 Mounting notes

Special notes for mounting safety light curtains, multiple light beam protective devices and transceivers as **access guarding**:

➢ Calculate the safety distance according to the formula in Chapter 6.1.1 and 6.1.2.

➢ Consider the beam heights as set out in Table 6.1-1. In the case of 2-beam safety light devices and transceivers, the lowest beam is 400 mm above the reference level; with 3 and 4-beam multiple light beam protective devices and safety light curtains, 300 mm above the reference level.

➢ Calculate the safety distance for safety light curtains with 50 mm or 90 mm resolution, multiple light beam protective devices or transceivers according to Chapter 6.1.1 and for safety light curtains with 14 mm or 30 mm resolution according to Chapter 6.1.2.

➢ The highest light beam and consequently the protective field height is determined for safety light curtains with 14 mm or 30 mm resolution by the requirements in accordance with EN 294.

➢ Ensure that the access to the danger zone is only possible through the protective field. Additional access points must be secured separately (e.g. by hard guards, additional safety light curtains or doors with interlocking devices).

➢ Access guarding must only be operated with start/restart interlock function. Activate the internal start/restart interlock function or the start/restart interlock function of a downstream safety interface and check the effectiveness.

➢ Consider while installing the start-/restart button, that it must be impossible to press this button from inside the danger zone. Every part of the danger zone must be fully visible from the installation position of the button.

6.3 Mechanical mounting

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

What should generally be taken into consideration during installation?

➢ Ensure that transmitter and receiver/transceiver and passive deflecting mirror are mounted on an even surface.

➢ Transmitter and receiver must be mounted at the same height. Their connections must point in the same direction. The assignment of transceiver and passive deflecting mirror is described in Chapter 9.3.

➢ When mounting, use screws that can only be loosened by a tool.

➢ Fix and secure the transmitter and receiver or the transceiver and passive deflecting mirror in position so that they cannot be turned or shifted. Securing against turning is particularly important in the close range of less than 0.8 m 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, swivelling brackets with shock absorbers must be used.

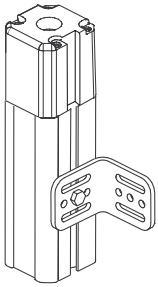


Fig. 6.3-1: Standard mounting bracket

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°.

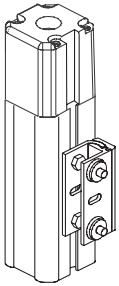


Fig. 6.3-2: Swivelling support with shock absorber

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 protected externally in order to prevent the contacts from welding together (Technical Data, Chapter 12.1.6).
- Signal outputs must not be used for switching downstream safety circuits.
- The start-/restart button for unlocking the 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 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 receivers/transceivers have a local interface and a machine interface. Local control elements and/or sensors can be optionally connected to the local interface. The cables required for this are listed as accessories in Chapter 13.2 and are not included in the delivery.

The local interface is available in the following design types.

Design type	Local interface
-m, -ml	Local connection socket M12, 8-pin, in the receiver/transceiver connection cap (standard)
-mx, -mxl	Local connection panel with 5 connection sockets M12, 5-pin, in the front screen (optional)

Table 7.0-1: Local interface selection table

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

Design type	Transmitter interface	Machine interface Receiver/transceiver	
	Connection system	OSSD 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, M20x1.5
/R2	With transmitter /T2	Relay	Hirschmann plug, 11-pin+FE
/R3	With transmitter /T3	Relay	MIN-series plug, 12-pin
/A1	M12 plug, 5-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 7.0-2: 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/transceiver, local interface

One of the characteristics of all receivers/transceivers is the local interface, which, depending on the design type is layed out as 8-pin M12 local connection socket in the connection cap or as local connection panel with 5-pin M12 connection sockets in the front screen. This makes it possible to have short cables leading to components in the immediate vicinity of the optical protective device, regardless of the selected machine interface. Included here are, for example, the start-/restart button, muting sensors and/or an external muting lamp.
Based on the factory settings, a muting sensor signal will be recognised as activated when 24 V DC are applied. With SafetyLab any signal can be inverted separately, if the application or the available sensor technology calls for this.

7.1.1 Local connection socket

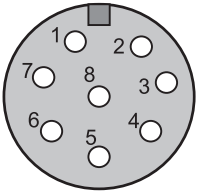


Fig. 7.1-1: Receiver/transceiver – local connection socket M12, 8-pin

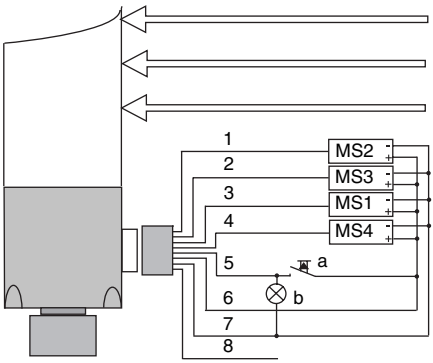
Receivers/transceivers of design type –m and –ml have an 8-pin M12 connection socket in their connection caps with the following signal assignment:

Pin	Cable color*	Assignment		Inputs/outputs (FS) can be differently arranged via SafetyLab
1	White	⇐	L1, local input	MS2: Muting sensor 2
2	Brown	⇔	L2, local input/output	MS3: Muting sensor 3
3	Green	⇐	L3, local input	MS1: Muting sensor 1
4	Yellow	⇐	L4, local input	MS4: Muting sensor 4
5	Gray	⇔	L5, local input/output	Input: RES_L: Local start-/restart button Output: ML: Muting lamp
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

Warning!
Cross connection safe laying of the cable to the local input is absolutely necessary!

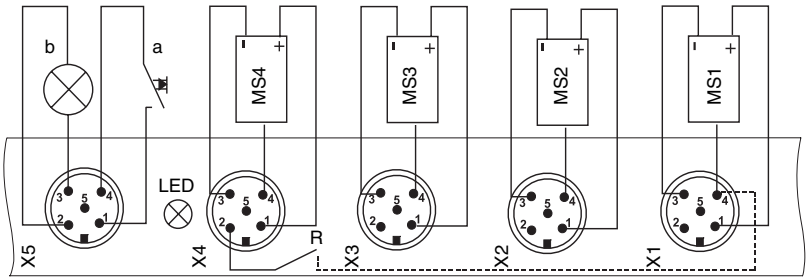


1 to 8 =PIN number of the local connection socket
a = Start/muting restart button
b = External muting lamp

Fig. 7.1-2: Connection example local connection socket

7.1.2 Option: Local connection panel

Receivers/transceivers with the local connection panel option, consisting of five 5-pin M12 connection sockets in the part of the front screen not assigned with optics, have the following signal assignment:



1 to 5 =PIN number of the inputs of the connection panel
a = Start/muting restart button
b = External muting lamp
R = Relay contact, which is only closed when TriState tests are activated.
LED=Indicates switching status of relay R, when weak: relay is open; when strong: relay is closed

Fig. 7.1-3: Connection example local connection panel

Pin	Cable Color*	Connection socket				
		X5	X4	X3	X2	X1
1	Brown	24 V DC	24 V DC	24 V DC	24 V DC	24 V DC
2	White	L5 (ML/ RES_L)	L3 (MS1)**	n.c.	n.c.	n.c.
3	Blue	0 V	0 V	0 V	0 V	0 V
4	Black	L5 (ML/ RES_L)	L4 (MS4)	L2 (MS3)	L1 (MS2)	L3 (MS1)
5	Gray	FE	FE	FE	FE	FE

*) Cables are not included in the delivery, see Table 13.2-1 for accessories
**) Only connected when the Tristate tests are activated with SafetyLab

Table 7.1-2: Local connection panel, assignment of the 5-pin cable plug of the muting sensors

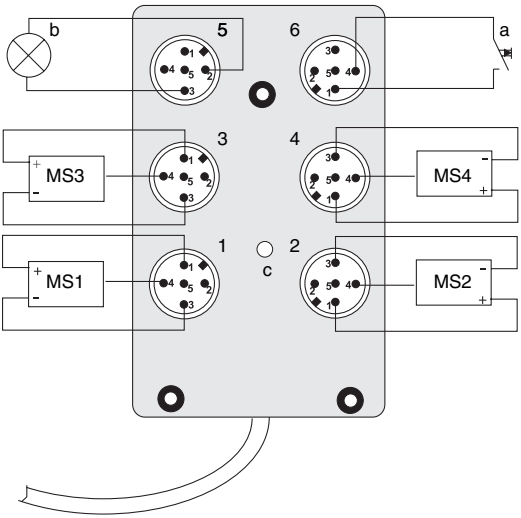
The connection cable with 5-pin M12 plugs for muting sensors, start-/restart button or muting lamp are available as accessories in varying lengths.

Pin2 and Pin4 of connection socket X5 are connected and correspond with the input/output L5 of the local connection socket. As long as the locally connected start-/restart button is pressed, the muting lamp lights up regardless of the operating status of the optical protective device.

It is possible with SafetyLab to change the assignment of the connection sockets X1 to X5, so that, for example, with restricted muting operation, an additional safety circuit can be connected. In such cases, a red-lit additional LED between the connection sockets X4 and X5 of the local connection panel shows the changed operating mode and connection assignment.

7.1.3 Accessories: Local connection box

A local connection box is available as an accessory for -m and -ml type receivers/ transceivers. The approx. 50 cm long connection cable with 8-pin M12 plug must be connected to the local connection socket. The assignment of connection sockets 1 to 5 corresponds here with the assignment of connection sockets X1 to X5 of the local connection panel. Pin2 and Pin4 of connection socket 5 and Pin2 and Pin4 of connection socket 6 are connected and correspond with the input/output L5 of the local connection socket. As long as the locally connected start-/restart button is pressed, the connected muting lamp lights up regardless of the operating status of the optical protective device.



a = Start/muting restart button
b = Muting lamp
c = LED display: Supply voltage ON

Fig. 7.1-4: Connection example local connection box

Warning!

The 8-pin connection cable must 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.
Please note that the muting sensors should be connected with 3-wire cable with connection at pins 1 (+24V DC), 3 (0V) and 4 (switching signal). You will find the appropriate cables in the table in chapter 13.2. The L3 signal input (MS1) is connected with both connection socket 1 / pin 4 and connection socket 4 / pin 2; L2 input/output (MS2) with connection socket 3 / pin 2 and pin 4. If 4-wire standard cable are used, this can cause faults in the muting function, as in addition to the switching signal on pin 4, a number of sensors also actuate pin 2, e.g. with a warning signal or the inverse switching signal from pin 4.

Pin	Buchse				
	6/5	4	3	2	1
1	24 V DC	24 V DC	24 V DC	24 V DC	24 V DC
2	L5 (ML/RES_L)	L3 (MS1)	L2 (MS3)	n.c	n.c
3	0 V	0 V	0 V	0 V	0 V
4	L5 (ML/RES_L)	L4 (MS4)	L2 (MS3)	L1 (MS2)	L3 (MS1)
5	FE	FE	FE	FE	FE

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

Table 7.1-3: Local connection panel, assignment of connection sockets

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

Transmitter, receiver and transceiver are delivered as standard with machine interface /T1. The connection cap of the devices are equipped here with a cable screw, with which the user connects the power cable they have selected to the screw terminals inside the connection cap. While the transmitter is only fed the supply voltage, receiver and transceiver have both of the safety outputs OSSD1 and OSSD2 with transistors, plus additional signal inputs/outputs.

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 as straight a direction as possible. Use insulated conductor sleeves.

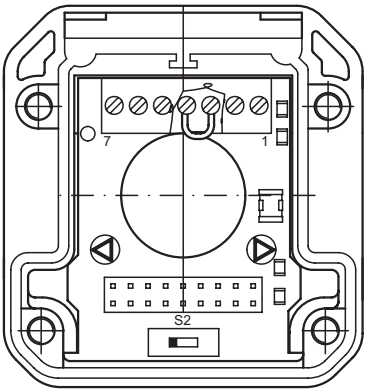


Fig. 7.2-1: Transmitter connection cap /T1 removed, inside view/terminal field

Terminal	Assignment		Inputs/outputs	
1	⇐	Supply voltage	+24 V DC	
2	⇐	Supply voltage	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	

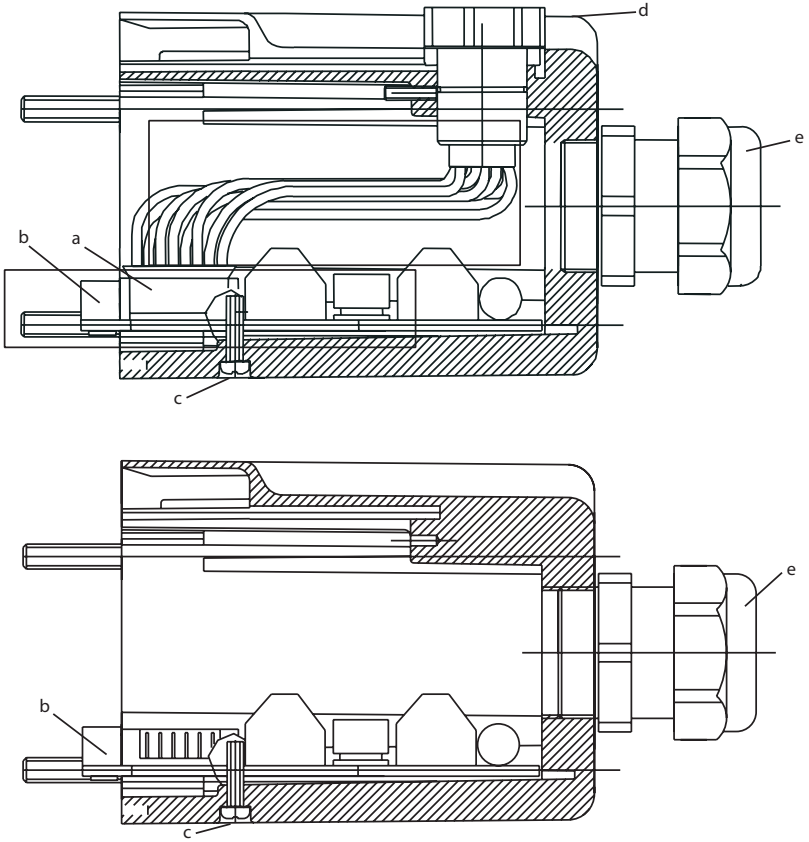
Table 7.2-1: Transmitter interface /T1 – terminal field connection assignment

7.2.2 Receiver/transceiver, machine interface /T1

The receiver/transceiver has safety-related transistor outputs. 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 as straight a direction as possible.

➢ 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 cables to the local connection socket with design types -m and -ml.
b = Connecting circuit board
c = Fixing screw
d = Local connection socket with design types -m and -ml.
e = Cable screw M20x1.5

Fig. 7.2-2: Receiver/transceiver cap /T1 removed, with and without local-connection socket

➢ If required, loosen the plug connection for the cable to the local connection socket.
➢ Pull the terminal field out completely, the connecting terminals are free.
➢ Use insulated conductor sleeves.

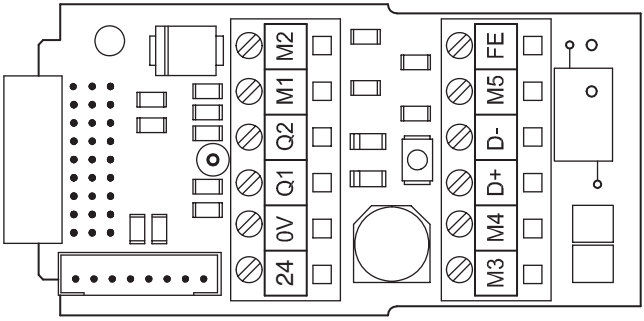
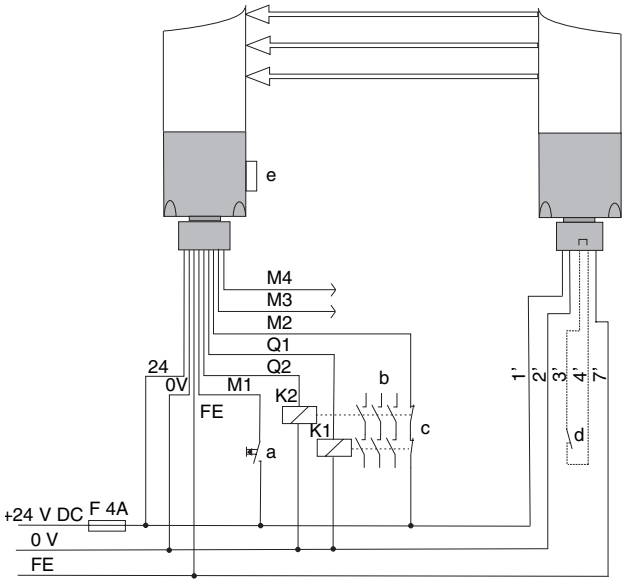


Fig. 7.2-3: Receiver/transceiver machine interface /T1, terminal field

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-/restart button*
M2	⇐	M2 input	EDM, contactor monitoring against +24 V DC
M3	⇔	M3 input/output	Active protective field free
M4	⇔	M4 input/output	Fault, dirt or muting muting lamp failure
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/transceiver machine interface /T1, terminal field connection assignment



a = Start/muting restart button
b = Release circuits
c = EDM, feedback contacts contactor monitoring
d = Optional: External test, if factory-set jumper is removed
e = Local connection socket with design types -m and -ml
1‘ to 4‘,7‘ = Transmitter terminal field numbers

ⓘ The transceiver connection is identical to the receiver connection. A passive deflecting mirror CPM500/2-V (without electrical connection) is required in place of the transmitter.
Shielded connection cables are recommended for extreme electromagnetic interference. The shield should be connected with FE on a large surface.
The safety-related transistor outputs carry out the spark extinction. 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 time 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 design type is equipped to connect the transmitter and receiver/transceiver 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.

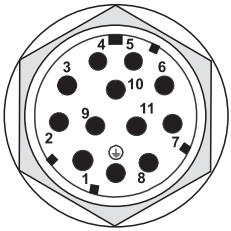


Fig. 7.3-1: Transmitter and receiver/transceiver, machine interface /T1 (view of the pins)

7.3.1 Transmitter interface /T2

Pin	Wire colors CB-8N-xxxxx-12GF	Assignment		Inputs/outputs	
1	Brown	⇐	Supply voltage	+24 V DC	
2	Pink	⇐	Supply voltage	0 V	
3	Blue	⇒	Test out	Ext. jumper to 4	Factory setting: **No** internal jumper set
4	Gray	⇐	Test in	Ext. 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

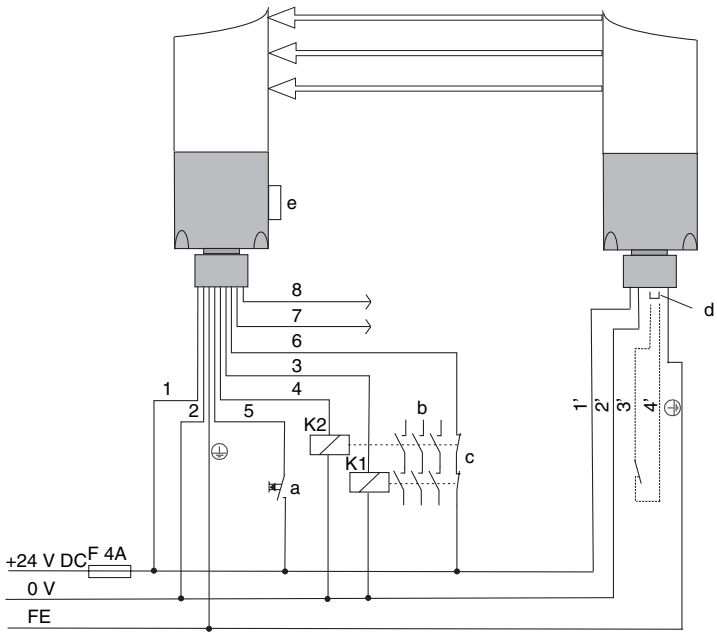
7.3.2 Receiver/transceiver, machine interface /T2

The receiver/transceiver 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, machine interface start-/re-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	Fault, dirt or muting lamp failure
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 on the machine interface (M1). In FS same effect as via L5.

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



a = Start/muting restart button
b = Release circuits
c = EDM, feedback contacts contactor monitoring
d = Optional: External test, if factory-set jumper is removed
e = Local connection socket with design types -m and -ml, see Chapter 7.1.
1‘ to 4‘, ⏚
= Pin numbers, Hirschmann plug, transmitter
1 to 8, ⏚
= Pin numbers, Hirschmann plug, receiver/transceiver

ⓘ The transceiver connection is identical to the receiver connection. A passive deflecting mirror CPM500/2V without electrical connection is required in place of the transmitter.
Shielded connection cables are recommended for extreme electromagnetic interference. The shield should be connected with FE on a large surface.
The safety-related transistor outputs carry out the spark extinction. 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 time 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-s*/T3 design type is equipped to connect the transmitter with a 3-pin and the receiver/transceiver 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

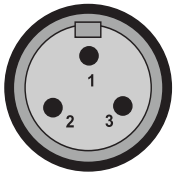


Fig. 7.4-1: Transmitter interface /T3, MIN-series (view of the pins)

Pin	Wire colors	Assignment		Inputs
1	Green	⇐	Functional earth, shield	FE
2	Black	⇐	Supply voltage	0 V
3	White	⇐	Supply voltage	+24 V DC
Internal jumper factory-set				

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

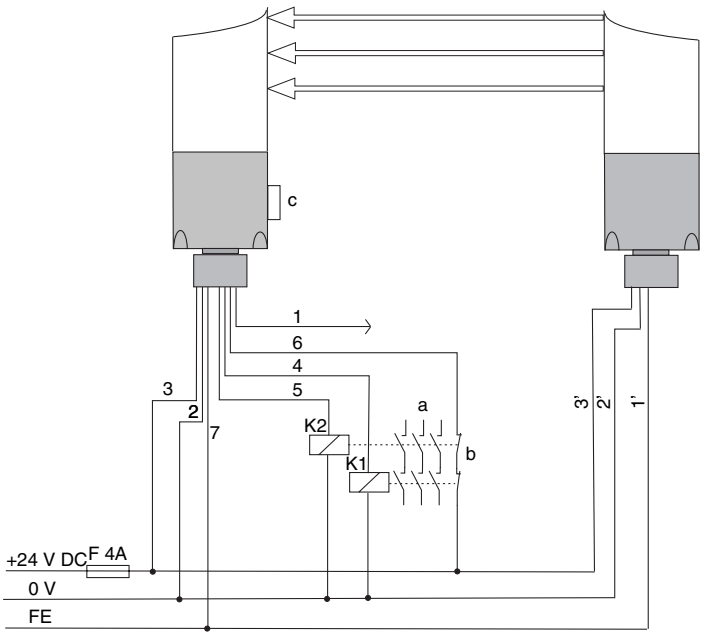
7.4.2 Receiver/transceiver, machine interface /T3

The receiver/transceiver has safety-related transistor outputs.

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

Pin	Wire colors	Assignment		**In-/outputs** M2, M3 (FS), can be differently arranged via SafetyLab
1	White/black	⇔	M3 input/output	Active protective field free
2	Black	⇐	Supply voltage	0 V
3	White	⇐	Supply voltage	+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	⇐	FE Functional earth, shield	

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



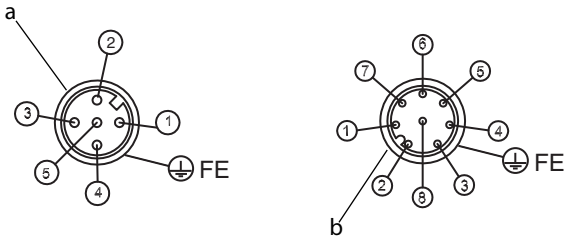
a = Release circuit
b = EDM, feedback contacts contactor monitoring
c = Local connection socket with design types -m and -ml
1‘ to 3‘,
= Pin numbers, MIN-series plug 3-pin, transmitter
1 to 7
= Pin numbers, MIN-series plug 7-pin, receiver/transceiver

ⓘ The transceiver connection is identical to the receiver connection. A passive deflecting mirror CPM500/2V (without electrical connection) is required in place of the transmitter.
Shielded connection cables are recommended for extreme electromagnetic interference. 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 safety/valve manufacturers etc. (RC modules, varistors or recovery diodes). These extend the delay time 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/transceiver machine interface with an 8-pin M12 plug. Connection cables in different lengths are available.



a = Transmitter encoding
b = Receiver/transceiver encoding

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

7.5.1 Transmitter interface /T4

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

Table 7.5-1:

7.5.2 Receiver/transceiver machine interface /T4

The receiver/transceiver has safety-related transistor outputs.

Pin	Wire colors, CB-M12-xxxxxS-8GF	Assignment		Inputs/outputs M2, M4, M5 (FS), 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/transceiver 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/transceiver. 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 safety-related relay outputs that: The cable for the release circuit must generally be laid with protected installation in a cable duct or with armor in such a way that cross-connections between the cable cores can be safely ruled out.

7.6.1 Transmitter interface /T1

A separate transmitter for devices with safety-related 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/transceiver, machine interface /R1

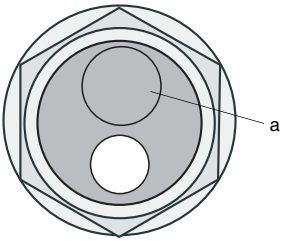
The design type COMPACT*plus*/R1 has 2 relay outputs (2 potential-free N/O contacts) and is equipped with a cable screw connection for connecting to the machine interface. The seal in the cable screw has an ex-factory lead-in opening. If protective extra low voltages of up to 42 V are switched, then **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 described in Table 12.1-7.

Warning!

*For higher switching 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.*

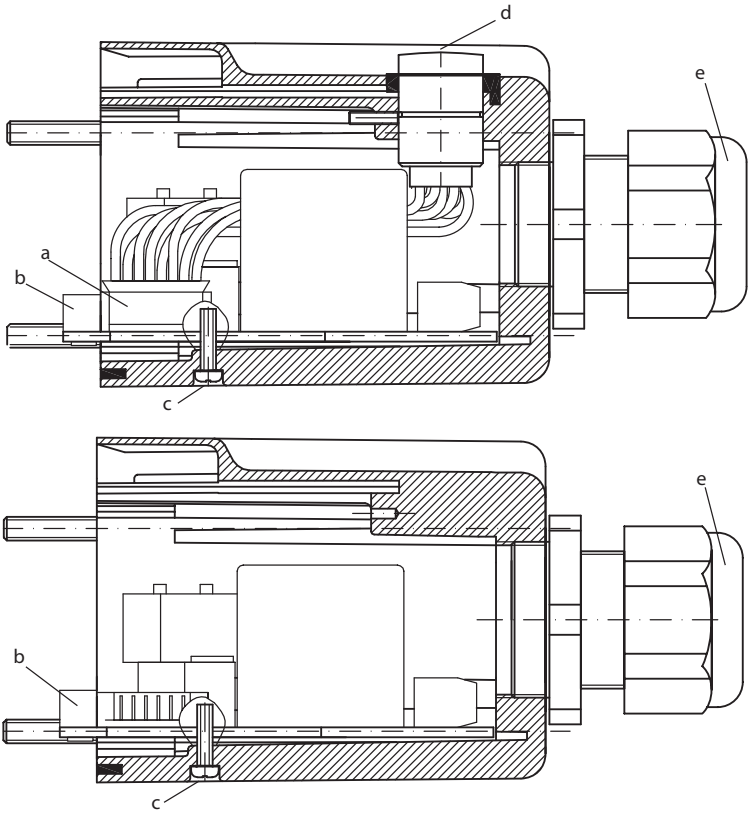


a = Just push opening through when a separate connection cable for the load circuit is to be connected.

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 as straight a direction as possible.
➢ 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 local sockets.
➢ Pull the terminal field out completely, the connecting terminals are free.
➢ Use insulated conductor sleeves.



a = Plug connection for the cables to local connection socket with design types -m and -ml
b = Connecting circuit board
c = Fixing screw
d = Local connection socket with design types -m and -ml.
e = Cable screw M25x1.5

Fig. 7.6-2: Receiver/transceiver cap /R1 removed, with and without local connection socket

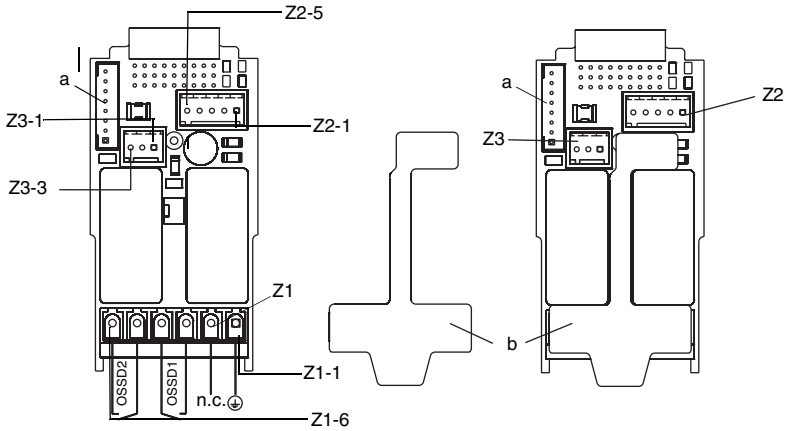
Regardless of whether the receiver/transceiver has been delivered with a local connection socket or a local connection socket or a local connection panel, a relay circuit board, to which the load lines (Z1-1 to 6), signal lines (Z2-1 to 5) and power supply lines (Z3-1 to 3) must be connected, are located in the connection cap.

➢ If required, pull plug d, 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 Z3-3.

➢ 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/transceiver machine interface /R1, terminal fields (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 linked up, a **separate cable** must be routed through the second opening of the MG screw intended for this purpose. Instead of the FE connection to Z3-1, PE connection to 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

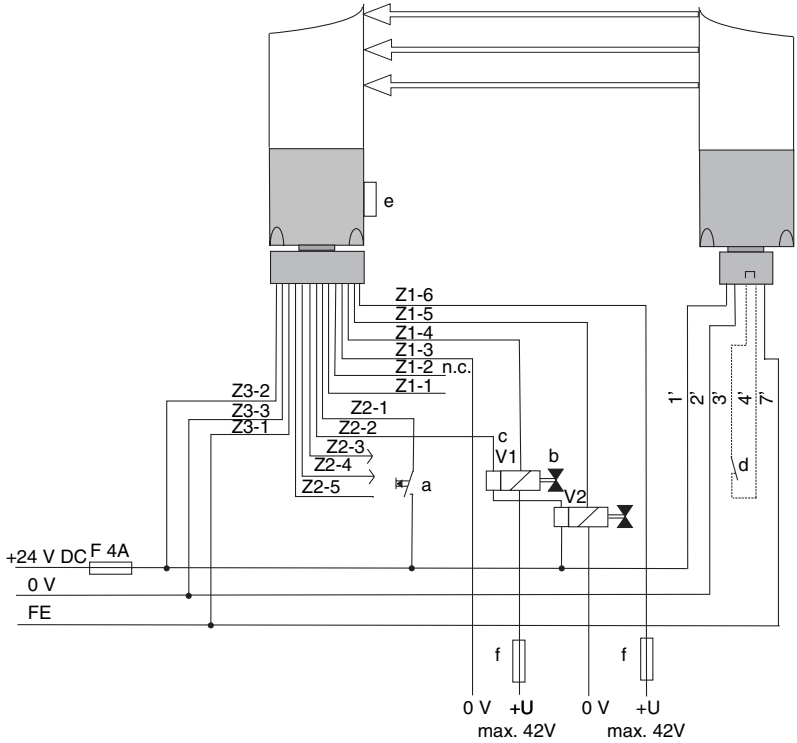
Pin	Assignment		Inputs/Outputs M1 to M5 (FS), can be differently arranged via SafetyLab
Z2-1	⇐	M1 input	RES_M, machine interface start-/restart button*
Z2-2	⇐	M2 input	EDM, contactor monitoring against +24 V DC
Z2-3	⇔	M3 input/output	Active protective field free/Ready for unlocking
Z2-4	⇔	M4 input/output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

*) Alternative to L5 of the local interface: Start button on the machine interface M1 has the same effect in FS

Z3: Supply voltage connection

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

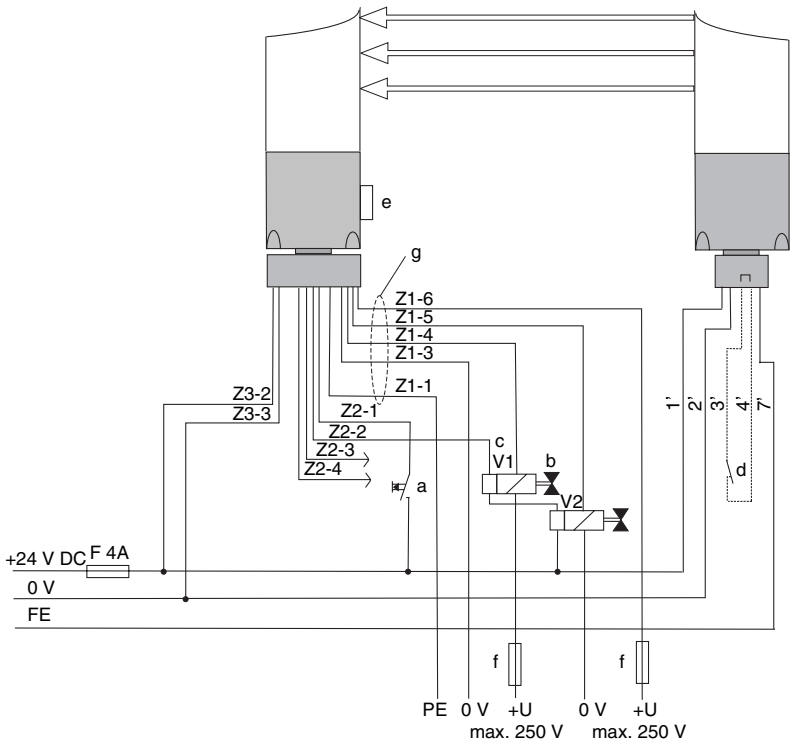
Table 7.6-1: Receiver/transceiver machine interface /R1, terminal fields connection assignment Z1 to Z3



a = Start/muting 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 with design types -m and -ml
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 transceiver connection is identical to the receiver connection. A passive deflecting mirror CPM500/2V (without electrical connection) is required in place of the transmitter.
The connection cables must be routed in a strong conduit so that mechanical damage is prevented.
Shielded connection cables are recommended for extreme electromagnetic interference. 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/muting 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 with design types -m and -ml
f = Fuse for protecting the normally open contacts, for sizes see technical data, Chapter 12.1.7
g = Separate cable, required with switching voltages > 42 V AC/DC
Z1, Z2 and Z3
= Terminal numbers of the blocks Z1, Z2 and Z3
1' to 4', 7'
= Transmitter terminal numbers

ⓘ The transceiver connection is identical to the receiver connection. A passive deflecting mirror CPM500/2V (without electrical connection) is required in place of the transmitter.
The connection cable, connected to Z1, must be routed in a strong conduit so that mechanical damage is prevented.
Shielded connection cables are recommended for extreme electromagnetic interference. 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 42 V 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 complete connection cable in varying lengths are available as accessories.

Warning!

It applies with safety-related 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 between the cable cores can be safely ruled out.

7.7.1 Transmitter interface /T2

A separate transmitter for devices with safety-related relay 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/transceiver, machine interface /R2

The receiver/transceiver has safety-related relay outputs.

Warning!

The machine interface /R2 is suitable for switching U max. = 42V. 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. It is provided in The Technical Data,Table 12.1-7.

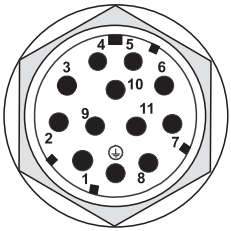


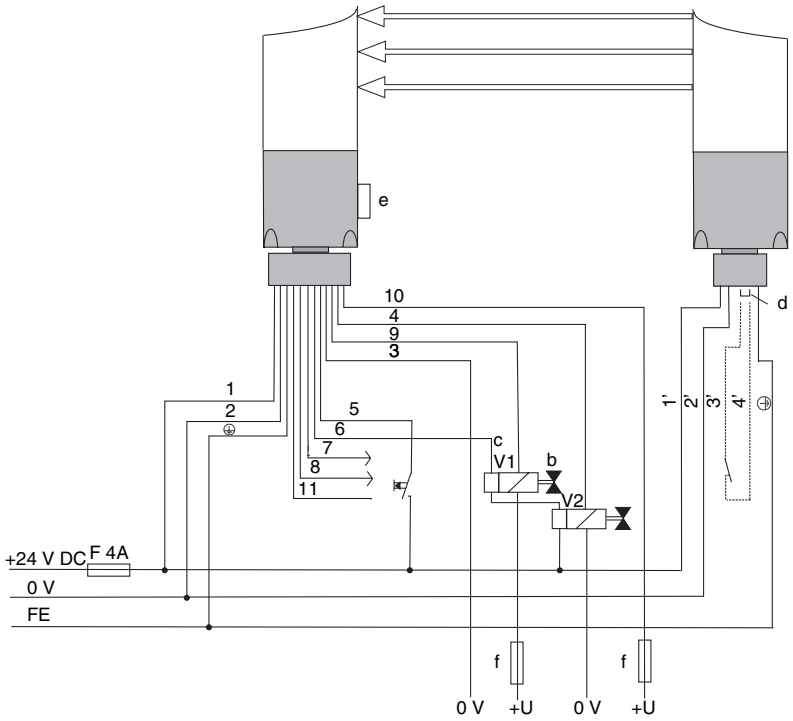
Fig. 7.7-1: Receiver/transceiver machine interface /R2, Hirschmann plug (view of the pins)

The plug is assigned as follows:

Pin	Wire colors CB-M12-xxxxxS-8GF	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	⇐	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-/restart 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	Fault, dirt or muting lamp failure
9	White	⇒	Relay 1, terminal B	OSSD1B
10	Beige	⇒	Relay 2, terminal B	OSSD2B
11	Clear	⇔	M5 input/output	free
⏚	Green/yellow	⇐	FE, functional earth, shield	

*) Alternative to L5 of the local interface: Start-/restart button on the machine interface M1 has the same effect in FS

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



a = Start/muting 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!
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 with design types -m and -ml
f = Fuse for protecting the normally open contacts, for sizes see technical data, Chapter 12.1.7
1‘ to 4‘, ⏚
= Pin numbers, Hirschmann plug, transmitter
1 to 8, ⏚
= Pin numbers, Hirschmann plug, receiver/transceiver

ⓘ The transceiver connection is identical to the receiver connection. A passive deflecting mirror CPM500/2V (without electrical connection) is required in place of the transmitter.
The connection cables must be routed in a strong conduit so that mechanical damage is prevented.
Shielded connection cables are recommended for extreme electromagnetic interference. The shield should be connected with FE on a large surface.

Fig. 7.7-2: Connection example 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 safety-related 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 relay outputs is not available. The corresponding transmitter /T3 with 3-pin MIN-series plug is used (see 7.4.1)

7.8.2 Receiver/transceiver, machine interface /R3

The receiver/transceiver has safety-related relay outputs.

Warning!

The machine interface /R3 is suitable for switching U max. = 42V. 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, table 12.1-7.

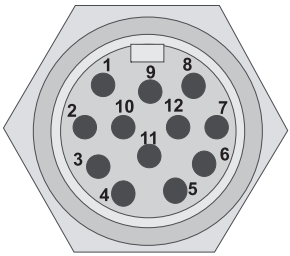


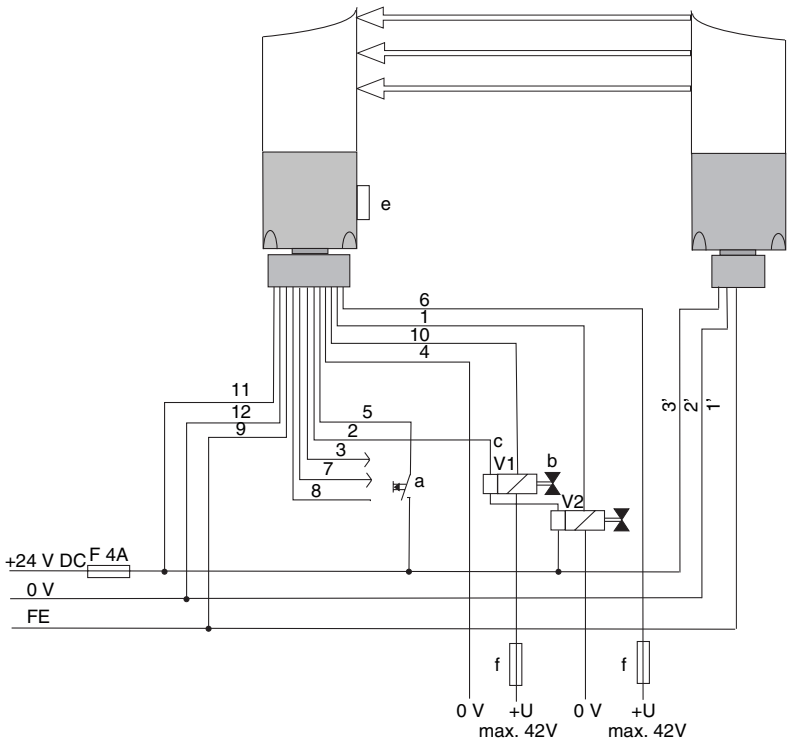
Fig. 7.8-1: Receiver/transceiver machine interface /R3, MIN-series (view of the pins)

The plug is assigned as follows:

Pin	Wire colors	Assignment		Inputs/outputs M1…M5 (FS), can be differently arranged via SafetyLab
1	Orange	⇐	Relay 2, terminal A Max. switching voltage 42V	OSSD2
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	OSSD1
5	Green/black	⇐	M1 input	RES_M, machine interface start-/restart button*
6	Orange/black	⇒	Relay 2, terminal B	OSSD2
7	Blue/black	⇔	M4 input/output	Fault, dirt or muting lamp failure
8	Black/white	⇔	M5 input/output	Free
9	Green/yellow	⇐	Functional earth, shield	FE
10	Red	⇐	Relay 1, terminal A	OSSD1
11	White	⇐	Supply voltage	+24 V DC
12	Black	⇐	Supply voltage	0 V

*) Alternative to L5 of the local interface: Start-/restart button on the machine interface M1 has the same effect in FS

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



a = Start/muting 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 with design types -m and -ml
f = Fuse for protecting the normally open contacts, for sizes see technical data, Chapter 12.1.7
1‘ to 3',
= Pin numbers, 3-pin MIN-series plug, transmitter
1 to 12
= Pin numbers, 12-pin MIN-series plug, receiver/transceiver

ⓘ The transceiver connection is identical to the receiver connection. A passive deflecting mirror CPM500/2V (without electrical connection) is required in place of the transmitter.
Shielded connection cables are recommended for extreme electromagnetic interference. 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

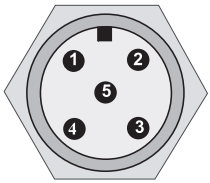
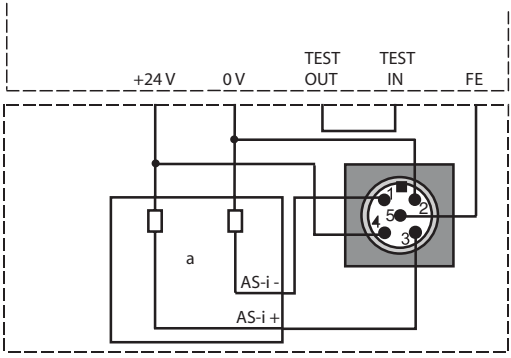


Fig. 7.9-1: Transmitter interface /AP, device plug M12 5-pin (view of the pins)

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

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/transceiver, machine interface /A1

It must be ensured that the supply voltage for the receiver/transceiver cannot be taken from the standard AS-i line. 24 V DC must be fed via pins 2 and 4 for the receiver/transceiver. 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 socket so that the receiver/transceiver can be connected via a standard M12 extension cable with 1:1 connection.

Fig. 7.9-3: Receiver/transceiver machine interface /A1, 5-pin M12 plug signal assignment

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: Receiver/transceiver machine interface /A1, 5-pin cable socket connection assignment

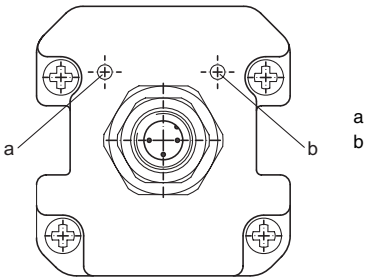


Fig. 7.9-4: Receiver/Transceiver connection cap with LEDs

LED green „PWR“	LED red „Fault“	Meaning	Activity
On	Off	AS-i communication without faults	None
Flashing	On	Receiver/transceiver 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: Maschinen-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 muting lamp failure

Table 7.9-4: Receiver/transceiver 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.

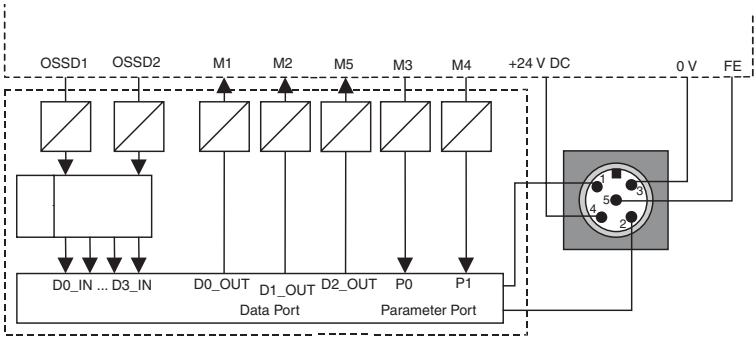


Fig. 7.9-5: Machine interface /A1, schematic structure

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/transceiver 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/transceiver 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/transceiver is connected via the AS-i adapter for bus connection and 24V voltage supply, AC-PDA1/A.
3	**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*/AS-i
4	**Check the protective field function between COMPACT*plus*/AS-i transmitter and receiver and of the transceiver.** The 7-segment displays on the transmitter and receiver or on the transceiver light up and, where required, LED1 switches with free protective field after unlocking of the internal start/restart interlock of the COMPACT*plus*/AS-i, from red to green. ⓘ COMPACT*plus*/AS-i may not be interrupted for the system integration, that is, with the saving 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")**

Note 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 AS-i master

Swopping out a safety-set AS-i slave:

If a safety-set AS-i slave is defective, its replacement is also possible without PC and reconfiguration 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-set 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 swop-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
5	**Check the protective field function between COMPACT*plus*/AS-i transmitter and receiver and of the transceiver:** The 7-segment displays on the transmitter and receiver or on the transceiver light up and, where required, LED1 switches with free protective field after unlocking of the start/restart interlock, from red to green. ⓘ COMPACT*plus*/AS-i may not be interrupted for the system integration, that is, with the saving 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 user 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-set sensor (e.g. COMPACTplus/AS-i) must be checked by a specialist and authorized person on a yearly basis.

To facilitate this, the COMPACT*plus*/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/transceiver 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
- Muting type: Automatic muting, 4-sensor sequential muting or 2-sensor parallel muting
- Direction for display: connection cap down
- Muting time limit, 10 minutes

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.

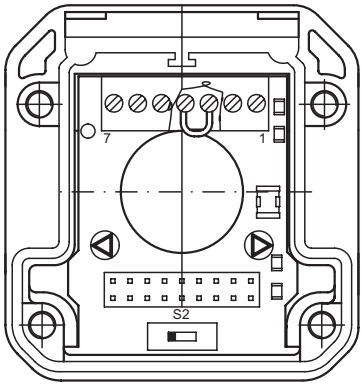


Fig. 8.2-1: Transmitter connection cap

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, make certain 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 Receiver/transceiver parameterization

Five switches on the front and one switch on the back of the removable display and parameter module in the receiver/transceiver are used for switching the receiver functions. To do this:

➢ Turn off the receiver/transceiver 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.

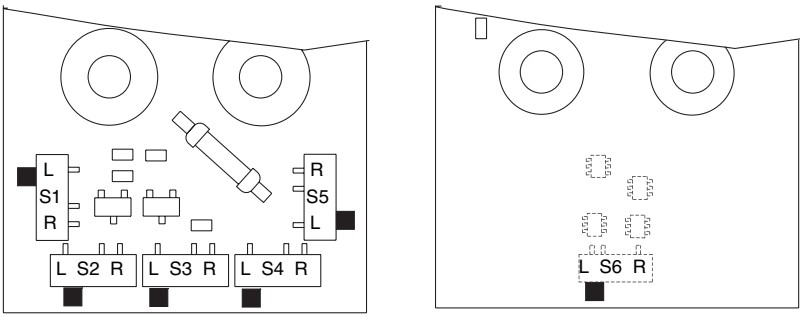


Fig. 8.3-1: Display and parameterization module, front and rear side (from the front)

The following table summarizes the functions of the receiver/transceiver, 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/transceiver. If, on the other hand, the switches are set back to the factory setting L, the values of this display and parameterization module set with SafetyLab are once again valid.

If the setting of a module with switches 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.	"Muting" 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 to M2, response time max. 300 ms	
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-/restart button required on L5 or M1	
S4	Muting type:	L	SW: Default = AM (automatic muting, 4-sensor sequential muting or 2-sensor parallel muting)	L
		R	4-Sensor parallel muting	
S5	Display direction	L	SW: Default = Display down	L
		R	Display up	
S6	Muting time limit	L	SW: Default = 10 minutes	L
		R	Indefinite, i.e. no time limit	

Table 8.3-1: Receiver/transceiver 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 Chapter 10 and 13.

The parameterization options of the receiver/transceiver are described below, which are possible by changing switches S1 to S6 without the SafetyLab 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 to the receiver/transceiver. All switches S1 to S6 must be set in the factory setting to position L so that changes made with SafetyLab can 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.

The transceiver may also be switched to transmission channel 2. Due to the fact that the transceiver generates the transmitted signals on its own, the R setting from S2 is considered accordingly.

8.3.3 S3 – Start/restart interlock

The receiver/transceiver leaves the factory with the S3 switch in the L setting, that is, 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 button to be connected against +24V 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 for 100 ms <= t <= 4s (FS). Precondition here is that the active protective field is free.

Even without selecting the internal start/restart interlock function, the start-/restart button is required to execute the muting restart function.

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 – Muting type

Auto mode muting is active in the factory setting L of the switch S4. In the auto mode muting, the muting type depends on which muting sensors are activated first. If MS1 or MS4 are activated first, 4-sensor sequential muting is initiated. If MS2 and MS3 are activated first within the requested time, then 2-sensor parallel muting begins. If switch S4 is set to position R, switching is made to 4-sensor parallel muting.

8.3.5 S5 – Display turn-around

The 7-segment display of the receiver/transceiver is factory-set so that it can be read if cable entry is required from below. With the changeover of S5 to position R, the figures on the 7-segment display turn around by 180°.

Warning!

The cable connections of transmitter and receiver must always point in the same direction, i.e. either both down or both up!

8.3.6 S6 – Muting time limit

In factory setting L, a muting error indicates when the 10-minute muting time has been exceeded, regardless of the selected muting mode of the receiver/transceiver.

Only in cases with good reason and when no person is endangered thereby can the time limit be turned off by switching from S6 to setting R. Notes on safety can be found in Chapter 4.3.4.

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, receivers/transceivers and passive deflecting mirrors 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 it can be integrated into the machine's control circuit!

9.1 Switching on the device

Make sure that transmitter and receiver/transceiver are protected against overcurrent (see Chapter 12.1-3 for fuse size). 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/transceivers 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 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 display of “F” for a fault code), then the 24 V 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 with receiver/transceiver

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

- 88: = Self test
- 3y xx: 3 = "Muting" function package; y.xx = Firmware version
- Hx: H = MultiScan factor; x = number of scans
- tx xx: t = Response time of the AOPD; x xx = Value in milliseconds
- Cx: C = Transmission channel; x = Number of the channel (FS = 1)

Warning!

In case of an error or failure, the display of the receiver/transceiver 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/transceiver in to be checked.

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

If the internal **start/restart interlock function is not used** (FS), because, for example this function is executed by a downstream safety interface, the receiver's LEDs display after startup:

Warning!

The receiver/transceiver switches to the ON-state as soon as the aligned protective field is free.

LED	**No internal start/restart interlock, protective field not free or transmitter/receiver not aligned**		**No internal 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: Receiver/transceiver – LED display sequence without internal start/restart interlock

If the **internal start/restart interlock function** is activated (activation, see Chapters 4.2.2 and 8.3.3), after startup the LEDs of the receivers display:

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: Receiver/Transceiver – LED display sequence with internal start/restart interlock

9.2 Aligning transmitter and receiver

Transmitter and receiver must be at the same height and lightly 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.

9.2.1 Aligning with the 7-segment displays of the receiver

If the SafetyKey of a light curtain 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.

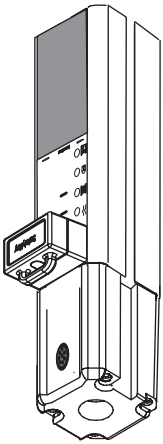


Fig. 9.2-1: Setting the SafetyKey on a light curtain's receiver

Alignment procedure	Switch the receiver display to service mode with SafetyKey:  The first beam above the display (synchronization beam) meets the first receiver diode ✐ the bottom 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: 

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 alignment by turning the transmitter and receiver

Using standard mounting 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.

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 or vice versa. LED2 can be lit at the transition points during the set-up procedure (weak beam indication).

9.3 Aligning transceiver and passive deflecting mirror

The type labels (plates) of the transceiver and passive deflecting mirror must be pointing in the same direction. The internal V-mirror is therefore located opposite the transceiver's transmission module, on the side of the end cap or the optional muting lamp. Ensure that the entry and exit windows are at the same height across from one another. 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.

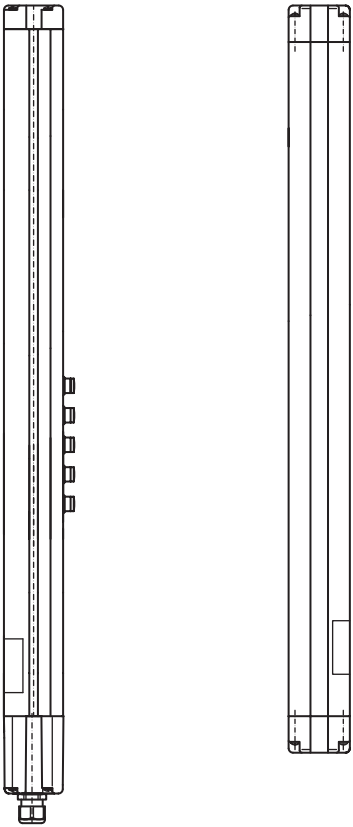


Fig. 9.3-1: Arranging transceiver and passive deflecting mirror

Optimizing alignment by turning the transmitter and passive deflecting mirror

Using standard mounting 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 transceiver and the passive deflecting mirror 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 transceiver's swivelling mounting brackets so that you can just move it. Move the transceiver 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 transceiver 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 passive deflecting mirror and move it to the center between the two positions where LED2 of the transceiver goes off. Fix the receiver and secure it carefully against turning or shifting. The optimum setting is consequently achieved.

Alignment without internal start/restart interlock

➢ The procedure is the same as described above. Instead of the orange LED2 observe LED1 of the transceiver. The transition point is where LED1 switches from green to red or vice versa. LED2 can be lit at the transition points during the set-up procedure (weak beam indication).

10 Testing

10.1 Testing before setting 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 machine 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.

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

10.3 Cleaning the front screens

The front screens of transmitter and receiver, and transceiver and passive deflecting mirror must be cleaned regularly depending on how dirty they are. An orange LED2 on the receiver/transceiver with free 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 diagnostic

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, terminal 3-4 is missing in the transmitter connection cap or external circuit is not closed Insert jumper

Table 11.2-1: Transmitter diagnostic

11.2.2 Receiver/transceiver diagnostic

The receiver/transceiver distinguishes between error/perturbation codes (Ex xx) and fault/failure codes (Fx xx). Only error codes provide you with information about events or conditions that you can eliminate. If the receiver/transceiver 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 display do not light up	Check + 24V supply voltage (also check for polarity) and connection cable. Replace the receiver or transceiver if necessary.
8:8	Is constantly lit → hardware fault	Replace receiver/transceiver
F x(x)	Internal hardware fault	Replace receiver/transceiver
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 power supply
E 5	Overvoltage on OSSD2	Use correct power supply
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 to S6 not correctly positioned	Correct switch positions
E 11	Actual and configurated beam count differ	Correct beam parameters by PC and SafetyLab
E 14	Undervoltage on the power supply	Check/change power supply
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 – S6	Reset to basic setting with PC and SafetyLab or All switches S1 to S6 are switched to setting 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

Table 11.2-2: Receiver/transceiver diagnostic

Code	Cause/Meaning	Measures to clear errors
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
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 error	Exchange button
E 50	Initiate muting exceeded	Initiate muting restart, Chapter 4.3.5
E 51	Undercurrent on muting lamp (L5)	Connect correct lamp, check wiring
E 52	Overcurrent on muting lamp (L5)	Connect correct lamp, check wiring
E 53	Short circuit on the control input for the muting timer release signal	Remove connection
E 54	Override time limit exceeded	After AutoReset system switches back to normal operation
E 57	Muting sequence error	Check the function, alignment and wiring of the muting sensors
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/transceiver diagnostic

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
- receiver/transceiver after approx. 10 seconds

of the respective device. Therefore, if a temporary error is no longer present, the application can be restarted, but the temporary error code is then lost.

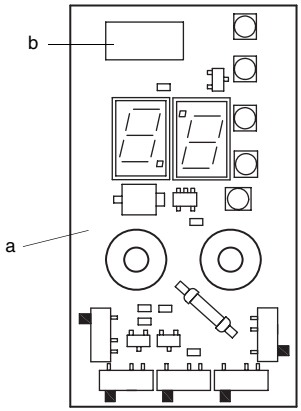
If these kinds of errors happen frequently and you want to find out the cause, keep the error signal until the reset is carried out by a maintenance technician. You can do this with the receiver/transceiver by inversely setting the SafetyKey to the corresponding position of the receiver/transceiver display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

The receiver/transceiver 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 auto reset procedure take place again.

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

11.4 Maintaining the parameterization with receiver/transceiver 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/ transceiver 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. Only in this way 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
CP50-	50 mm	0 m	18 m	450 mm	1800 mm
CP90-	90 mm	0 m	18 m	750 mm	3000 mm

Multiple light beam protective device	Beam distance in mm	Detection range		Number of beams	Heights of beams above reference level in mm (EN 999)
		Min.	Max.		
CP500/2	500	0 m	18 m	2	400, 900
CP501/2	500	6 m	70 m	2	400, 900
CP400/3	400	0 m	18 m	3	300, 700, 1100
CP401/3	400	6 m	70 m	3	300, 700, 1100
CP300/4	300	0 m	18 m	3	300, 600, 900. 1200
CP301/4	300	6 m	70 m	4	300, 600, 900, 1200

Muting transceiver	Beam distance in mm	Detection range		Number of beams	Heights of beams above reference level in mm (EN 999)
		Min.	Max.		
CPRT500/2-	500	0 m	6.5 m	2	400, 900
CPRT600/2	600	0 m	6,5 m	2	300, 900

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) 2, 3 and 4 beam 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	 1.90×10^{-8} $^1/_h$ 2.26×10^{-8} $^1/_h$ 2.67×10^{-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

Supply voltage Uv Transmitter and receiver, transceiver	+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/transceiver power consumption	160 mA without external load, muting sensors and muting lamps
Shared value for external fuse in the feed line for transmitter and receiver/transceiver	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

Table 12.1-3: System data

Safety class: Exception: Receiver/transceiver with machine interface /R1 and separate cable for switch 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 table

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

Table 12.1-3: System data

12.1.4 Receiver/transceiver, 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 for potential-free safety circuit	Input:	Contact or transistor against +24 V DC current load: 20 mA max.
L5: Signal input/output	Input:	Contact or transistor against +24 V DC or against 0 V current load: 20 mA max.
	Output:	pnp, +24 V DC-switching, 500 mA max.

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

12.1.5 Receiver/transceiver, 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: 20c mA max.
	Output:	pnp: +24 V DC-switching, 60 mA max.
M5: Signal input/output	Input:	Contact or transistor against +24 V current load: 20 mA max.
	Output:	npn: 0 V switching, 1 A max.

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

12.1.6 Receiver/transceiver, machine interface, safety-related transistor outputs

OSSD Transistor outputs	**2 safety-related pnp transistor outputs, cross connection monitored, resistant to short circuits**		
	Minimum	**Typical**	**Maximum**
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 k **)
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 MultiScan 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 time of inductive switching elements.

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

12.1.7 Receiver/transceiver, 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*			1.5 A
	[τ=L/R=40 ms] Assigned cable length, A = 0.75 mm² Fuse: max. 2 A slow			26 m
	Switching current inductive load*			1.5 A
	[τ=L/R=40 ms] Assigned cable length, A = 0.5 mm² Fuse: max. 2 A slow			9 m
	Switching current ohmic load Assigned cable length, A = 0.75 mm² Fuse: max. 3.15 A slow		up to 0.4 A 100 m	3.0 A 13 m
	Switching current ohmic load Assigned cable length, A = 0.5 mm² Fuse: max. 2.5 A slow		up to 0.4 A 60 m	2.0 A 13 m
/R1	Cable screw M25x1,5, 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* ($\cos\varphi$ = 0.8) e.g. contactors, valves, etc.		0,6 A	2.0 A
	Assigned cable length, A = 0.75 mm² (AWG 16); fuse: max. 2.5 A slow		100 m	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

Table 12.1-7: Receiver/transceiver, 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 230 V AC		**230 V AC**	**250 V AC**
	Switching current, inductive load* ($\cos\varphi$ = 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		Depends on number of beams and MultiScan factor H, 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/transceiver, machine interface, safety-related relay outputs

12.1.8 Receiver/transceiver 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)		
ID-code/transmitter IO-code	-		
Receiver/transceiver ID-code	B		
Receiver/transceiver IO-code	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 from AS-i circuit	35 mA		
Additional response time of the AS-i system	40 ms		

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

12.2 Dimensions, weights, response times

12.2.1 Safety light curtains 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				CP50-xxxx				CP90-xxxx			
			n	/T	/R	/A	n	/T	/R	/A	n	/T	/R	/A	n	/T	/R	/A
				tH1 [ms]	tH1 [ms]	tH1 [ms]		tH1 [ms]	tH1 [ms]	tH1 [ms]		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**	12	**7**	**22**	**12**				
600	734	1.9	64	**15**	**30**	**20**	32	**9**	**24**	**14**	16	**5**	**20**	**10**				
750	884	2.3	80	**18**	**33**	**23**	40	**10**	**25**	**15**	20	**6**	**21**	**11**	10	**6**	**21**	**11**
900	1034	2.7	96	**22**	**37**	**27**	48	**12**	**27**	**17**	24	**7**	**22**	**12**	12	**7**	**22**	**12**
1050	1184	3.1	112	**25**	**40**	**30**	56	**13**	**28**	**18**	28	**8**	**23**	**13**	14	**5**	**20**	**10**
1200	1334	3.5	128	**28**	**43**	**33**	64	**15**	**30**	**20**	32	**9**	**24**	**14**	16	**5**	**20**	**10**
1350	1484	3.9	144	**31**	**46**	**36**	72	**17**	**32**	**22**	36	**9**	**24**	**14**	18	**6**	**21**	**11**
1500	1634	4.3	160	**35**	**50**	**40**	80	**18**	**33**	**23**	40	**10**	**25**	**15**	20	**6**	**21**	**11**
1650	1784	4.7	176	**38**	**53**	**43**	88	**20**	**35**	**25**	44	**11**	**26**	**16**	22	**7**	**22**	**12**
1800	1934	5.1	192	**41**	**56**	**46**	96	**22**	**37**	**27**	48	**12**	**27**	**17**	24	**7**	**22**	**12**
2100	2234	5.9									56	**13**	**28**	**18**	28	**8**	**23**	**13**
2400	2534	6.7									64	**15**	**30**	**20**	32	**9**	**24**	**14**
2700	2834	7.5									72	**17**	**32**	**22**	36	**9**	**24**	**14**
3000	3134	8.3									80	**18**	**33**	**23**	40	**10**	**25**	**15**

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 or 6.1.2 is compulsory.

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

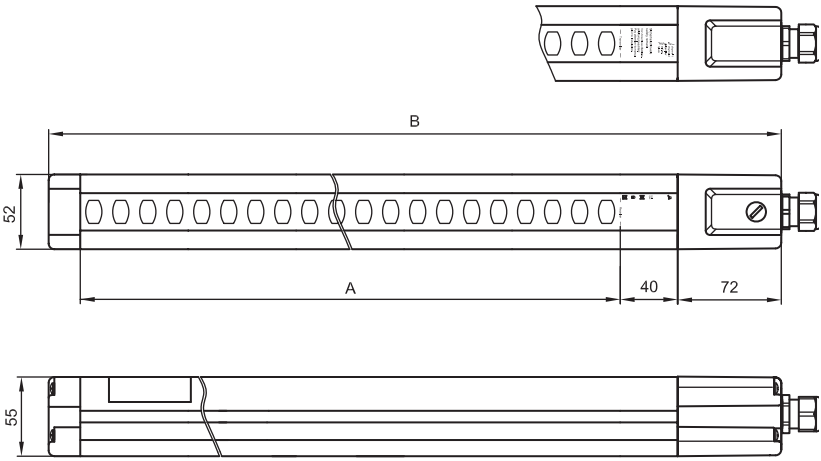


Fig. 12.2-1: Safety light curtain dimensions

12.2.2 Multiple light beam protective devices with transistor outputs, relay outputs or AS-i bus connection

Dim. A [mm]	Dim. B [mm]	Earth [kg]	tH7 = Response time of the AOPD with MultiScan factor H=7 (FS) /T = Transistor outputs; /R = Relay outputs; /A = AS-i bus connection; n = Number of beams											
			CP50x/2-...				CP40x/3-...				CP30x/4-...			
			n	/T	/R	/A	n	/T	/R	/A	n	/T	/R	/A
				tH7 [ms]	tH7 [ms]	tH7 [ms]		tH7 [ms]	tH7 [ms]	tH7 [ms]		tH7 [ms]	tH7 [ms]	tH7 [ms]
500	734	1.9	2	**19**	**34**	**24**								
400	1034	2.7					3	**19**	**34**	**24**				
300	1184	3.1									4	**19**	**34**	**24**

An increase of the MultiScan factor 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 12.2-2: Multiple light beam protective devices, dimensions and response times

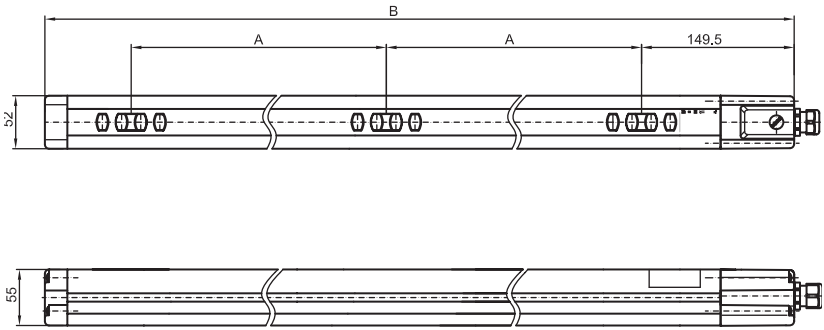


Fig. 12.2-2: Multiple light beam protective device dimensions

12.2.3 Muting transceiver with transistor outputs, relay outputs or AS-i bus connection

Dim. A [mm]	Dim. B [mm]	Dim C [mm]	Earth [kg]	tH8 = Response time of the AOPD with MultiScan factor H=8 (FS) /T = Transistor outputs; /R = Relay outputs; /A = AS-i bus connection; n = Number of beams				
				CPRT x00/2-m...				
						/T	/R	/A
				n	H	tH8T [ms]	tH8R [ms]	tH8A [ms]
500	734	662	1.9	2 (1 beam folded)	8	20	35	25
600	884	812	1,9	2 (1 beam folded)	8	20	35	25

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

Table 12.2-3: Muting transceiver: dimensions and response times

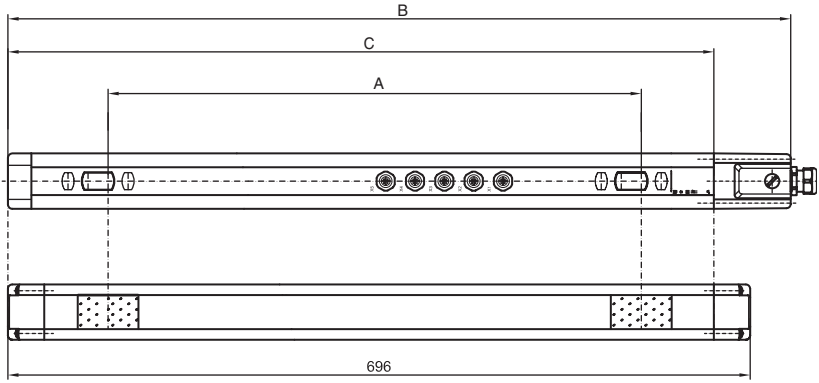


Fig. 12.2-3: Muting transceiver dimensions

12.2.4 Mounting bracket dimensions

Dimensions in mm

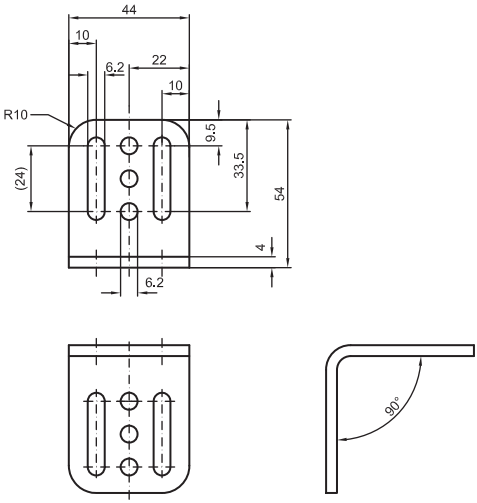
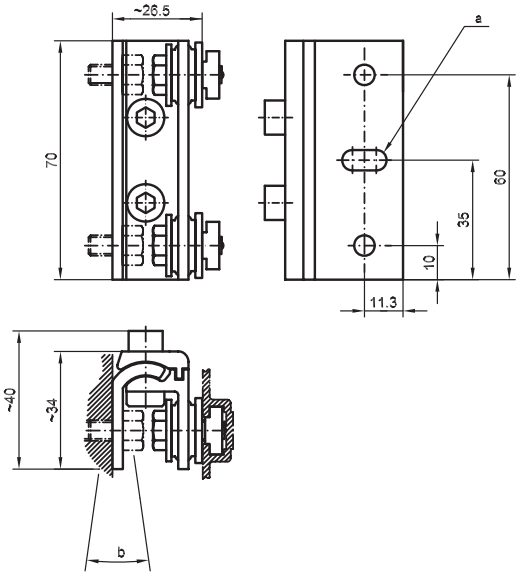


Fig. 12.2-4: Standard mounting bracket

12.2.5 Swivelling mounting bracket dimensions

Dimensions in mm



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

Fig. 12.2-5: Option: Swivelling mounting bracket with shock absorber

12.2.6 Integrated LED muting lamp dimensions

Dimensions in mm

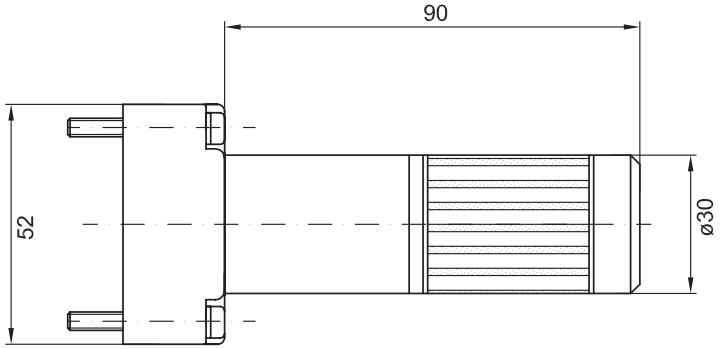


Fig. 12.2-6: Option: Integrated LED muting lamp

13 Appendix

13.1 COMPACT*plus*-m 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 manual
- 1 Self-adhesive information plate

Additionally supplied for safety light curtains with 14 mm or 30 mm resolution:
- Test rod set consisting of test rods 14, 24, 33 mm

Multiple Light Beam Safety Devices are delivered with:
- 1 Transmitter
- 1 Receiver
- 4 Sliding nuts with screws M6x10
- 4 Standard mounting brackets
- 1 Connecting and operating instructions manual
- 1 Self-adhesive information plate

Muting Transceivers are delivered with:
- 1 Transceiver
- 2 Sliding nuts with screws M6x10
- 2 Standard mounting brackets
- 1 Connecting and operating instructions manual
- 1 Self-adhesive information plate

ⓘ Passive Deflecting Mirror must be ordered separately.

13.2 Accessories

Art.-No	Item	Description
909606	CPM500/2V	Passive deflecting mirror for transceiver
909607	CPM500/2V-SO	Passive deflecting without mounting bracket for installation in UDC
560030	LA78UDC	External laser alignment aid for column mounting
560020	LA-78U	For slot mounting
150704	CB-M12-3000-8WM	Cable for local connection with M12, 8-pin angled plug, 3 m
150699	CB-M12-10000-8WM	Cable for local connection with M12, 8-pin angled plug, 10 m
426045	AC-LDH-12WF	Hirschmann cable socket, angled, incl. crimp contacts
426046	AC-LDH-12GF	Hirschmann cable socket, straight, incl. crimp contacts
426042	CB-8N-10000-12GF	Cable for machine interface /T2, /R2 10 m, straight socket
426043	CB-8N-50000-12GF	Cable for machine interface /T2, /R2 50 m, straight socket
426044	CB-8N-25000-12GF	Cable for machine interface /T2, /R2 25 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
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/transceiver)
50024346	AM 06	AS-i, M12 bus terminal for AS-i flat cable (transmitter)
50024750	AKB 01	AS-i, flat cable (unit per meter)

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

Art.-No	Item	Description
548361	CB-M12-1000-5GF/GM	AS-i, M12 connection cable 1 m, 5-pin
548362	CB-M12-2000-5GF/GM	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)
548000	MS 851	Muting single lamp
660600	MS 70/2	Muting lamp with two lights
660620	MS70/LED.01	LED muting indicator yellow complete with base
660621	MS70/LED.02	LED muting indicator yellow complete with support bracket
548050	CB-M12-1500X-3GF/ 3WM	Muting sensor cable 1.5 m, crossed, connection socket straight, pin2 on plug, angled, pin4
548051	CB-M12-1500X-3GF/GM	Muting sensor cable, 1.5 metres crossed, pin 2 straight socket on pin 4 straight plug
150717	CB-M12-2000-5G/M	Sensor cable, 2 m, 4-poles, M12 plug straight / open end
150718	CB-M12-5000-5G/M	Sensor cable,5 m, 4-poles, M12 plug straight / open end
150680	CB-M12-1500-3GF/GM	Muting sensor cable, 1.5 metres, 3 poles, coupling straight, M12 plug straight
150681	CB-M12-1500-3GF/WM	Muting sensor cable, 1.5 metres, 3 poles, coupling straight, M12 plug angled
150682	CB-M12-5000-3GF/GM	Muting sensor cable, 5 metres, 3 poles, coupling straight, M12 plug straight
150683	CB-M12-5000-3GF/WM	Muting sensor cable, 5 metres, 3 poles, coupling straight, M12 plug angled
150684	CB-M12-15000-3GF/GM	Muting sensor cable, 15 metres, 3 poles, coupling straight, M12 plug straight
150685	CB-M12-15000-3GF/WM	Muting sensor cable, 15 metres, 3 poles, coupling straight, M12 plug angled
549810	UDC-1000	Universal device mounting column, height = 1000 mm
549813	UDC-1300	Universal device mounting column, height = 1300 mm

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

Art.-No	Item	Description
549816	UDC-1600	Universal device mounting column, height = 1600 mm
549819	UDC-1900	Universal device mounting column, height = 1900 mm
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
346509	PS-C-CP-900	Protective screen 900 mm
346510	PS-C-CP-1050	Protective screen 1050 mm
346512	PS-C-CP-1200	Protective screen 1200 mm
346513	PS-C-CP-1350	Protective screen 1350 mm
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
429044	AC-PS-MB-C-CP-1	2 screen clamps up to 900 mm protective field height
429045	AC-PS-MB-C-CP-2	3 screen clamps from 900 mm protective field height
560300	BT-SSD	Swivelling mounting bracket with shock absorber
549940	SITOP power	Power supply, 115 - 230 V 50/60 Hz $\rightarrow$ 24V / 5 A
549908	LOGO! power	Power supply, 115 - 230 V 50/60 Hz $\rightarrow$ 24V / 1.3 A

Table 13.2-1: COMPACT*plus*-m 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. It can then be used as a reference during the subsequent regular inspections.

13.3.1 Checklist for access guarding

ⓘ 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.

• Has the safety distance been calculated in accordance with the valid formula for access guarding, and has this minimum distance between protective field and the danger point been considered?	yes	no
• Has care been taken to ensure that the lower light beam of a 2-beam AOPD is located 400 mm above the reference level, and that of a 3- or more beam AOPD is located 300 mm above the reference level?	yes	no
• Was it considered during risk assessment that 2-beam AOPDs mounted above ground level are regarded as being capable of being crawled under (EN-999)?	yes	no
• Is the approach to the danger area only possible through the protective field of the AOPD and are other approach possibilities protected by suitable hard guards or other means?	yes	no
• Is the protective field effective at each position and positively checked according to Chapter 10.2?		
• Are the AOPDs and their control devices fault-free conditions?	yes	no
• Are transmitter and receiver/transceiver and also, where applicable, the passive deflecting mirror, fastened sufficiently against displacement/turning after the alignment?	yes	no
• Are all connectors and connection cables in fault-free conditions?	yes	no
• Is the start/restart button for resetting the AOPD positioned outside of the danger zone in line with specifications so that it cannot be reached from inside? Is there a complete overview of the danger area from the start/restart button position?	yes	no
• Are the safety outputs (OSSDs), linked into the subsequent machine control unit in accordance with the required safety category?	yes	no
• Are the subsequent switching elements controlled by the AOPD, e.g. contactors with positive-guided contacts or safety valves monitored via the feedback circuit (EDM)?	yes	no
• Does the actual integration of the AOPD into the machine control unit match the circuit diagrams?	yes	no

- Is the AOPD effective with interruption of any beam* and does the system lock (inevitable with activated start/restart interlock as only the access and not the presence in the danger zone is registered)? yes no
- Does the dangerous movement stop immediately if the power supply voltage of the AOPD is interrupted and is the start/restart button needed to start the machine again after supply voltage returns? yes no

*) Special feature with safety light curtains:

With safety light curtains with 14 or 30 mm resolution, the test rod included in the delivery (with the side that corresponds with the resolution) must be fed slowly into the middle of the protective field from above to below. If the internal start/restart interlock is activated, the orange LED2 switches off when the test rod is inserted into the protective field and it must not light up again during the test procedure at any point as long as the test rod moves through the protective field. If no internal start/restart interlock function is selected because it, for example, is taken over by the downstream control, LED1 must be observed. LED1 must display “red” during the test and must not light up “green” at any point.

13.3.2 Additional checklist for muting operation

ⓘ 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.

- Has the checklist been used in accordance with Chapter 13.3.1 for access guarding for arranging the protective device and the start/ restart button? yes no
- Have the muting sensors MS2 and MS3 been mounted so close to the protective field that it is not possible with an activated muting function for a person to pass undetected in front of or behind the transport material through the muted protective field into the danger zone? yes no

With 4-sensor sequential and 2-sensor parallel muting

- Is it impossible for a person without an aid of any kind to simultaneously activate MS2 and MS3 with, for example, their shoe or in some other similar way, and as a result, activate the muting function? yes no

With 4-sensor sequential muting

- Are the muting sensors MS1 and MS4 / MS2 and MS3 arranged symmetrically and is the MS1 and MS4 distance less than the length of the “consistently the same” transport vehicle length? yes no

With 2-sensor parallel muting

- When light barriers are used, is the crossover point of the two beams from MS2 and MS3 behind the protective field on the danger side so that persons entering will interrupt the protective field first before they reach the crossover point? yes no

With 4-sensor parallel muting

- Is it impossible for persons without an aid of any kind to simultaneously activate MS2 and MS3 or MS1 and MS4 with, for example, their shoes or in some other similar way, and as a result, activate the muting function? yes no
- Is it impossible for a person to pass into the danger zone beside the vehicle during the muting procedure without the dangerous movement being interrupted? yes no
- Is it impossible for a person to be squeezed between the vehicle and the opening by using, for example, monitored swing doors or safety mats beside the vehicle route. yes no
- Is the muting lamp visibly mounted on the entrance/exit line and have employees working on the system been informed that the protective function is removed during the muting procedure? yes no
- Has a warning sign showing that the protective function is removed when the muting lamp is lit been mounted in a clearly visible position? yes no
- Is the time limit for muting active (10 minutes after muting starts)? yes no

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